REPORT
PELLETS
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2020 has not come without its challenges...

Indeed, after having faced serious market tightness in early 2019, the market eased for months to a point where it is now clearly oversupplied, pushing the price to historical low levels. As for previous difficult times, we can hope that a normal, if not intense heating season will help the market to recover, besides other structural measures that could be taken. Unfortunately, such instability in the market conditions, together with the policy framework, do not help further investment to be made in European pellet production.

Our industry is confronted with market tensions every so often due to offer-demand fluctuations, however, this year, the COVID-19 pandemic emerged entirely unexpectedly, with the risk of putting immense pressure on our sector. Luckily, it appeared that beyond being a mainly local, sustainable, and affordable industry, our sector is also very resilient. Indeed, besides having had a limited influence on pellet use for electricity production following the drop of electricity demand in Europe, the COVID-19 pandemic had no dramatic impact. Thanks to the automatised nature of pellet production, and the fact that several countries considered it to be an indispensable industrial activity, the industry was able to continue operating, with necessary COVID-19 safety measures in place. Down the value chain, the European construction and the installation of the appliances have only been slightly impacted. All in all, the pellet industry continues contributing to the survival of local (rural) economies, contrary to other sectors that saw their activities declining if not stopping.

The bark beetle outbreak is an additional market disturbance of 2020. Again, the pellet appears to be a precious ally as bioenergy is one of the only uses that one can make of the infested wood. Let’s just hope that this crisis will help develop the understanding that actively managing a forest will reinforce its resilience.

On a more positive note, 2020 is also coming with encouraging trends. Indeed, again we see the pellet production and use growing all over Europe, contributing to climate change mitigation and creating local jobs and values. In addition to this, the residential market is showing a very positive development as many governments are phasing out the use of heating oil. In this situation, the European pellet appliances have an opportunity to show all their advantages, besides being cost competitive.

Also, during 2020, the ENplus® quality certification system continued spreading steadily and had reached a significant milestone by getting a total of 1,000 active certificates of companies in 46 countries around the globe, representing a volume of 12 million tonnes. This great result shows once more that harmonising and proving the quality of wood pellets is critical for our industry.

Before wishing you a good reading of this report, we would like to thank all our contributors for their essential inputs and our colleagues from Bioenergy Europe (special thanks to Ioannis) for having put this report together.

Let’s hope for a cold heating season!
Bioenergy Europe’s Statistical Report has been enriched each year with new figures and information, collecting unique data on the developments of the European bioenergy market from a growing number of international contributors.

Bioenergy Europe develops detailed reports that aid industry leaders, decision makers, investors and all bioenergy professionals to understand the situation of bioenergy in Europe.

With more than 150 graphs and figures, readers of Bioenergy Europe’s Statistical Report can get accurate and up-to-date information on the EU-28 energy system such as the final energy consumption of biomass for heat and electricity, the number of biogas plants in Europe, the consumption and trade of pellets, the production capacity of biofuels and other key information to help break down and clarify the complexity of a sector in constant evolution.

In 2017, the Report was rewarded by the European Association Awards for being the ‘best Provision of Industry Information and Intelligence’, a recognition after a decade of collective work.

Bioenergy Europe is the voice of European bioenergy.

It aims to develop a sustainable bioenergy market based on fair business conditions. Founded in 1990, Bioenergy Europe is a non-profit, Brussels-based international organisation bringing together more than 40 associations and 90 companies, as well as academia and research institutes from across Europe.

Bioenergy Europe will be the leading player in ensuring that sustainable bioenergy is a key pillar in delivering a carbon neutral Europe.

Bioenergy Europe facilitates the development of a sustainable, strong, and competitive bioenergy sector through:

• Promotion towards European policymakers and stakeholders for awareness, acceptance, and reputation of bioenergy.
• Promote the development of consistent, realistic, and sustainable bioenergy scenarios in the heat, electricity, and transport sectors.
• Pro-active proposals to develop more favourable European legislation.
• Market intelligence to support decision making.
• Services to members, including a support to advocacy at national level.
• Tools, including certification schemes, to sustain market growth and credibility.
• Industry collaboration throughout the entire supply chain.
• Promotion of efficient and innovative technologies within the bioeconomy.
OUR ACTIVITIES

Bioenergy Europe carries a wide range of activities aimed at supporting its members on the latest EU and national policy developments. Bioenergy Europe works to voice their concerns to EU and other authorities, including, advocacy activities in key policy areas as well as the organisation of dedicated working groups.

Working Groups

Bioenergy Europe's working groups act as a platform for members to discuss common issues and exchange information on the state of play of bioenergy.

There are currently 7 active working groups:

- Agrobiomass & Energy Crops;
- Biopower & CHP;
- Competitiveness;
- Domestic Heating;
- Sustainability;
- Pellets;
- Wood Chips.

Certification Schemes

Thanks to the experience and authority acquired over the last 20 years, Bioenergy Europe has successfully established three international certification schemes to guarantee high quality standard for fuels, namely, ENplus®, GoodChips® as well as the latest edition in the certification for sustainable bioenergy: SURE.

Networks

Bioenergy Europe is the umbrella organisation of both the European Pellet Council (EPC) and the International Biomass Torrefaction Council (IBTC). These networks have been created thanks to the dynamics of Bioenergy Europe members. Today, these networks bring together bioenergy experts and company representatives from all over Europe and beyond.

The European Pellet Council (EPC), founded in 2010, represents the interests of the European wood pellet sector. Its members are national pellet associations or related organisations from over 18 countries.

EPC is a platform for the pellet sector to discuss issues relating to the transition from a niche product to a major energy commodity. Issues include the standardisation and certification of pellet quality, safety, security of supply, education and training, and the quality of pellet-using devices. EPC manages the ENplus® quality certification.

Launched in 2012, the International Biomass Torrefaction Council (IBTC), aims to build the first platform for companies that have common interests in the development of torrefied Biomass markets. Currently, the IBTC initiative is supported by more than 23 companies worldwide.

IBTC's objective is to promote the use of torrefied biomass as an energy carrier and to assist the development of the torrefaction industry. In this respect, IBTC's key activities are to undertake studies or projects, and to commonly voice its members' concerns to third parties to help to overcome barriers of market deployment.

For further information on Bioenergy Europe's Networks & Certification Schemes visit www.bioenergyeurope.org
As the common voice of the bioenergy sector, Bioenergy Europe, aims to develop a sustainable bioenergy market based on fair business conditions and does so by bringing together national associations and companies from all over Europe – thus representing more than 4000 indirect members, including companies and research centres.

*Members as of September 2020.
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1 Overview of World Pellet Sector

The global pellet production is continuously growing since its beginning, showing a growth of 12% from 2018 to 2019. Countries in Europe outside of EU28 (referred to hereon after as ‘other Europe’) and South America are the areas expanding the most rapidly with pellet production volume growth rates of 37% and 21%, respectively in 2019 (compared to 2018). The three highest production growth figures in absolute volumes came from three different regions, from North America (the US) with 1.264.000 tonnes, from EU28 (Germany) with 405.000 tonnes and from other Europe (Russia) with 350.000 tonnes.
The impact of the COVID-19 pandemic on the global pellet market was not as significant as initially feared.

As lockdowns were imposed across Europe in March, many market participants feared the collapse of the sawmilling industry could lead to wood fibre shortages. However, wood prices continued to decline during the pandemic despite the disruption to the forest products industries. Over the last year, the European market has seen an influx of damaged timber which has increased supply of logs and sawmill residues.

Producers in the US South also fared well during the pandemic. However, an already struggling forest industry in British Columbia felt some disruption. BC pellet mills have recently been diversifying their feedstock supply which helped lessen the impact.

There were no reported delays to contracted deliveries and pellet production in most regions continued to operate well. Any minimal disruptions on the supply side were mitigated by the overhang in supply at the start of spring 2020. In Europe, a mild winter and lower demand than expected left high stocks at the end of winter. Demand continued to stay depressed during the spring and summer. Reduced power consumption across the continent suppressed power prices and curbed some wood pellet use, particularly for those Dutch cofiring plants which rely on the profitability of coal to operate.

Asia was more severely impacted by wood shortages, while the Malaysian government shut down all pellet production in March. But the oversupply in the market meant reduced pellet production had little consequence. The low REC prices in Korea, coupled with reduced power demand due to government-imposed lockdowns significantly reduced wood pellet consumption.

- Rachael Levinson
  Biomass Research Manager,
  Hawkins Wright.
1.1 World pellet production

The production within the EU28 countries has been healthy but not exceptional. In absolute terms, the EU28 registered a fair 5% increase in production between 2018 and 2019. Beside the EU28, Russia should be mentioned, as it recorded a remarkable increase of 21% with significant potential to record a dramatic growth in the coming years.

In North America, growth regained ground (13%) from previous year for the 2019. Canadian production increased by 200.000 tonnes (+7%) which is consolidating Canada as the second largest country producer in the world. In comparison, the US has shown an increase twice higher in percentage (+15%) than that of its Canadian neighbour. In both countries there is an increase expected as prospective projects should come into operation in the coming years with the hope of strongly growing production capacity. Indeed, in Canada, new wood pellet production plants are being built to use either residual sawmill woodchips made available by a declining paper industry (which has seen a reduction in consumption by several million tonnes per year) or forestry residuals. Both are available in very large quantities.

In South America, two countries are showing an interesting development in pellet production, namely Brazil and Chile. The production records of Brazil show 850.000 t in 2019 with a great increase of production capacity expected to appear from 2023 onwards. Chile, with a much modest production reaching 121.000 t in 2019 is witnessing a growth of the production capacity already from 2020 with the addition of 3 plants (total of 340.000t/a of capacity).

Oceania witnessed a noticeable increase (7%) in 2019 compared to 2018, compensating for the operating problems and subsequently the closure of the largest producing plant in Australia (250.000 tonnes / year of capacity) at the beginning of 2019. Despite this, New Zealand’s production increased during 2019 and new projects are expected in the coming years that could augment the production capacity mainly in Australia but also to a smaller extent in New Zealand.

The production in South East Asia (Vietnam, Malaysia, Thailand, and Indonesia) grew dramatically in the recent years. In 2019, a noticeable slowdown can be observed. This can be explained by the collapse of REC (Renewable Energy Certificate) in South Korea that dramatically reduced the use, and hence the import of pellet from South East Asia, being the major supplying area. In 2020, the REC price did not recover, leading to further depression of the South East Asia production.

In this report, no data is displayed for China due to the great uncertainty surrounding the Chinese pellet market. The size of the country and the fact that its market mainly comprises of small producers generates difficulties in obtaining accurate statistics. Moreover, there is further ambiguity on the type of pellet that is produced in China (wood pellets or agropellets) In any case, the Chinese market appears to be exclusively local (nearly no import or export) which has almost no impact on the global market supply and demand.
Figure 1 Evolution of global pellet production (million tonnes)

Note: NL & HU: 2019 production is a replication of 2018.
Source: EPC survey 2020; FAO; FutureMetrics

Figure 2 Distribution of world pellet production in 2019 (%)

Note: NL & HU: 2019 production is a replication of 2018.
Source: EPC survey 2020; FAO; FutureMetrics
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Services cover quality and quantity verification of biomass (wood pellets, woodchips, dust and briquettes) as well of coal and (pet)coke & include barge gauging/draft survey, pre-shipment, load/discharge inspection, sampling and analysis by various methods. Our Inspectorate Ghent NV & Inspectorate Estonia AS laboratories within Europe are ISO 17025 accredited and offer rapid turnaround times. Both labs are certified by ENplus® as testing bodies for wood pellets and Goodchips® for wood chips and hog fuel.
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Figure: (a) Growth in fishing production - Top 20 countries - 2010-2019 Source: [Glob Fish] (Note: data includes all fishing methods and sectors.)

Graph: (b) Distribution of fishing production - Top 20 countries - 2010-2019 Source: [Glob Fish] (Note: data includes all fishing methods and sectors.)
## Table: Working figures production die 2015 vs 2019

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Note: The dataset includes data from January to June 2023.

Source: Internal Report/Appendix B/Appendix C/Appendix D/Appendix E/Appendix F/Appendix G/Appendix H/Appendix I/Appendix J/Appendix K.
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<th>Actual production (billion)</th>
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Source: EF; survey/week; http://europefence.com
1.1 Global pellet production: future estimations

Global pellet production is significant, with a substantial demand for sustainable energy sources. However, the data on the exact figures of global production is not readily available for the public.

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1.2 World pellet consumption

The World pellet consumption has increased to reach 37,184,259 tonnes in 2019, or +7% compared to its level of 2018. On a global level, the industrial pellet consumption has increased by nearly 1.4 million tonnes, whilst residential & commercial consumption increased by 1.1 million tonnes.

The EU28 remains globally the largest pellet user. Its consumption has grown by around 1.8 million tonnes in 2019 with the industrial use of pellets being led by the UK. With this, the UK consumption continued to increase in 2019, reaching around 8.5 million tonnes with a significant part of this growth due to the ramping up following the conversion of the fourth unit of Drax and the EPH’s Lynemouth plant. The residential and commercial use of pellets is led by Italy with a consumption of 3.4 million tonnes and growth rate of 10% in 2019.

European countries outside of the EU28 also displayed robust growth in consumption (14%), although total consumption volume remains relatively small of 1.1 million tonnes in 2019.

In North America, the use of pellet has not witnessed a dramatic growth in the recent years despite different initiatives to grow the market both in US and Canada. Still, a niche market is consolidating its expansion: the pellet barbecues. The increasing sales of these barbecues lead to increasing sales of high margin pellets (e.g. 3 producers of 10,000 tonnes in Canada).

In South America, the use of pellet, mostly for residential and mid-scale heat production, is expected to grow in the future even if the continent will also increasingly become a next exporting area.

The pellet consumption in Asia concentrates in two countries, South Korea, and Japan. Those two industrial pellet users show very different trends in 2019. Indeed, the REC (Renewable Energy Certified) price dropped in South Korea, which directly impacted the use and hence the import of pellets. The future growth of industrial use of pellets in South Korea remains uncertain. Contrary to South Korea, Japan owns a much more stable support scheme, allowing a solid growth of industrial pellet usage (sourced from South East Asia and Canada). Based on the current growth, Japan could reach 10 million tonnes of industrial pellet usage by 2030.
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**Figure 5 World pellet consumption in 2019 by type of end-use (tonnes)**

Note: EE, LT, NL, UK &NO: 2019 consumption is a replication of 2018. JP; KR: 2019 residential consumption is a replication of 2018
Source: EPC survey 2020; FutureMetrics; FAQ; Hawkins Wright
Figure 6 Distribution of world pellet consumption in 2019 (tonnes and %)

Note: EE, LT, NL, UK & NO: 2019 consumption is a replication of 2018.
JP; KR: 2019 residential consumption is a replication of 2018
Source: EPC survey 2020; FutureMetrics; FAO; Hawkins Wright

Figure 7 World pellet consumption by type of end use in 2019 (tonnes and %)

Note: EE, LT, NL, UK & NO: 2019 consumption is a replication of 2018.
JP; KR: 2019 residential consumption is a replication of 2018
Source: EPC survey 2020; FutureMetrics; FAO; Hawkins Wright
Figure 8 Top 10 pellet consuming countries by end-use in 2019 (tonnes)

Note: EE, LT, NL, UK & NO: 2019 consumption is a replication of 2018.
JP; KR: 2019 residential consumption is a replication of 2018
Source: EPC survey 2020; FutureMetrics; FAO; Hawkins Wright
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Notes: (1) P1: A; (2) P2: B; (3) P3: consumption rate; (4) application of 1: 2: 4
(5) P4: P5: standard consumption rate; (6) application of 1: 2: 4
(7) Process: 1P1: before; 2P2: between; 3P3: after; 4P4: during
1.3 World pellet trade

Two regions are net importers of pellets in the world: the **EU28** and **Asia**. The Figure 12 confirms the current hegemony of the EU28 concerning pellet consumption, nevertheless Asia is growing fast and is becoming alongside with Europe the driving force of the pellet market development.

With **EU28** pellet imports being sourced mostly from the US and Canada, as well as from bordering European countries (mainly Russia), demand for pellets has been driven, in large, by the industrial consumption within the UK, Denmark and Belgium. The trade within Europe (import and export) is detailed later in this report.

**South Korea** and **Japan** are almost exclusively importing their pellets. While South Korea is mainly sourcing its pellets from Vietnam (around 1,9 million tonnes or 65 % of its imports in 2019) and Malaysia (around 0,5 million tonnes or 17% of its imports in 2019), Japan is sourcing its pellet principally from Vietnam (around 0,8 million tonnes or 52% of its import in 2019) with Canada covering 39% of their import (with a volume of 0,6 million tonnes).

The biggest exporting areas, namely **North America** (US and Canada), **South East Asia** (Vietnam, Malaysia, Thailand, Indonesia) and **Russia**, are witnessing a very limited growth of local consumption, and will not see their net exporting status changing in the near future.

**Figure 12 World pellet map and trade flow in 2018 (million tonnes)**


Source: EPC survey 2020; FAO; FutureMetrics; Hawkins Wright; UNComtrade
2 Situation in Europe

2.1 European pellet production

In 2019, Europe as a whole recorded a 7.2% growth (compared to 2018) reaching 22 million tonnes of production. Although Europe remains unchallenged as the world largest pellet producer, production has ceased to grow faster than the consumption since 2016 (in absolute terms).

The European pellet production faced various situations since 2017. After the difficult times of 2017-2018, flooding in the Baltic States and forest fires in Portugal, the European pellet production has not faced any critical issue in 2019, allowing a sustainable growth of the industry. Some countries even witnessed a solid growth of production, with the German production growing by 0.41 million tonnes while the Russian production growing by 0.35 million tonnes.

Unfortunately, 2020 came with its challenges.

The COVID-19 pandemic initially created great concerns on the European pellet production. Fortunately, the pellet sector showed a great resilience where nondramatic impact can be observed. Indeed, the production did not witness any brutal stop as the automated pellet production process facilitated with the safety measures that were necessary to implement (e.g. social distancing). On the production side, the supply of raw material was reduced due to a slowdown of the sawmilling activity. Fortunately, this did not lead to any shortage of raw material or production stop but the scarcity of the raw material lead to a price increase, impacting the producers’ margins. In some cases, producers chose to adapt their process allowing them to use other raw material. Moreover, the high level of pellet stock allowed the industry not to fear any supply shortage. Due to the high stocks and lower industrial demand, some industrial producers decided to adapt their production level and limit it to their contractual obligations.

The severity of the bark beetle outbreak in some areas (Czech Republic, Germany, etc.), is bringing a lot of raw material for pellet production, bioenergy being one of the few uses that can be made of the infested wood. This beetle attack is foreseen to continue as the weather conditions and the species are favouring the pest expansion. This situation is leading to a great availability of raw material for pellet production, pushing the price down.
EUROPEAN/EU-28 WOOD PELLET PRODUCTION
(IN 2019, TONNES, %) SOURCE: EPC SURVEY 2020

Figure 13 Map of European pellet production in 2019

PRODUCTION IN TOP 5 EUROPEAN COUNTRIES IN 2019

Note: NL & HU: 2019 production is a replication of 2018.
Source: EPC survey 2020; FAO
There are numerous positive signs for wood pellets in Europe in medium and long-term aspects.

As more focus is placed on heating and cooling from biomass, pellets are to have major opportunities in these segments.

Currently however, the industry is in a very complicated position with low prices at the spot market combined with staggering demand because of two consequent warm winters. Such fluctuations will make it even harder to invest into new capacity and the market will remain volatile for a while.

Fuel supply security is the basis of any energy market and consequently, all market participants should focus on avoiding the aforementioned extremes in order to maintain stability in the market.

- Raul Kirjanen, CEO, Graanul Invest
Production has grown by 7% in 2016, driven by demand from Italy and across Europe, resulting in a tightening of raw materials, mainly for the front of limited industry stocks. Specification due to high demand for northern and the summer, could result in a strong demand for pulp for paper production. However, on the market's production of kraft, a doubling of the current production peak with the investment in the specifications would be possible.

Production increases by 25% in 2016, surpassing the losses from 2015 and reaching its highest second half.

France: In 2016, production grew by 7%, mainly driven by a high supply of high-quality stocks (58%). Total volume of stocks has been growing during the past year. The French pulp market is expected to be an increased rate of demand in building construction. 2016 saw a very strong production increase, with a supply of output consumed by paper and pulp industries.

Germany: Germany is the second-largest pulp producer within the EU, rapidly improving its environmental footprint in the paper market. The German market has been impacted by the Brexit, as well as a strong demand for pulp, mainly for paper and pulp industries.

Italy: The production increased by 25% in 2016, surpassing the losses from 2015 and reaching its highest second half.

Netherlands: In 2016, the same trend as in 2015, and growing demand for softwood, mainly for paper and pulp, and dissolving. In 2016, some paper plants had problems sourcing raw material, and the situation improved in 2015. The export capacity for the paper market increased.

Portugal: Production growth slowed in 2016, as the market was affected by a reduction in raw material availability. The Spanish market was also affected by a forest fire that led to reduced production in 2017. The market now has seen a recovery with increased production in 2018, and the market is expected to grow in 2019. The market is expected to remain strong in the future, with a focus on high-quality paper products.

Russia: Production has grown by 15% in 2016, up to 6.1 million tonnes (net production). Due to supply from European countries, as well as an increase in the demand for pulp and paper products, the industry has shown continued growth. In 2016, Russia's second-largest pulp producer was Sweden, followed by Norway, and China. Russia's demand for paper products remains strong, with a recent growth in the domestic market.

Spain: Spain, as other parts of Europe, has a multi-plant pulp industry, mainly in the Southern and Eastern regions. In the Spanish region, it is the main source of high-quality paper, with a strong focus on the pulp industry. In addition, due to the presence of several months, pulp and paper plants have a strong presence, with several plants providing pulp and paper to the market.

The market has remained strong in many pulp and paper industries, with some plants operating at full capacity.

Production has shown continued growth due to increased demand, mainly for paper and pulp products.
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Belgium: Production capacity in Belgium within the period from 2003 to 2012 has increased drastically during the recent period of growth from 2009 to 2012. Currently, Belgian industrial pellet production is concentrated on exportable pellets. Domestic production is focused principally for the local heating market and for exports. Despite large quantities of raw materials being available, due to local industrial information, only 15% of raw material might be used in the future. The production capacity on the continent in Belgium is the largest of the European producers, as most of their local biomass organisation.

Belgium: Pellet production continued to grow. In the energy year, the number of pellet plants increased to seven as well as the total annual production. Subsidising biomass district heating, supporting production of pellets are currently available.

Czech Republic: There has been consistent annual growth in pellet production without major fluctuations since 2013. The target is to plant 200,000 hectares of forests with large forest owner capacities. In 2015, the country reports to achieve the target by increasing production up to 350 MWh (million kilowatt hours) per year.

Finland: Production declined on small scale in 2015. Domestic wood pellet production has been significantly higher than the new plant, although it might be possible that domestic pellets could be exported. It seems that the expected growth in pellet consumption will be covered by larger imported pellets from Russia and the Baltic States.

France: The overall consumption of pellet production is 1.6 million tons (t) for domestic heating. An annual increase of 10% is expected. The production of domestic pellets is currently 1.4 million tons annually. Despite the high consumption, the country does not allow the full exploitation of raw materials and equipment. Therefore, the local production utilisation rates have increased, despite the production of wood pellets, which is very high. The production of wood pellets, grass pellets, and animal feed are still high.
Heliol is one of the largest residential solar users. Although Italian solar production figures are estimations, German solar production has reached its peak due to insufficient access to solar materials despite having an abundance of unoccupied roofs. Construction is complicated by the limited accessibility of solar roads, making any future growth in solar production unlikely. Solar energy in Italy has become the most popular for air emission reasons, albeit precipitated by expansion of solar plants in the electricity sector.
Factors significantly increased land capacity and production of crop in 2014. The total crop production was the highest in 2015, with an increase in production. Montenegro has significantly increased its potato production in 2015 compared to the previous year. Almost 65% of potato production was exported in 2015, mostly to Russia, Albania, and Italy.

**Figure 1:** Evolution of potato production in the Baltic countries (tonnes)

Source: FFC survey 2015

**Figure 2:** Evolution of potato production in the Baltic countries (tonnes)

Source: FFC survey 2015

Crop: From 2015, Europe has registered a considerable growth in potato production, with all market conditions showing favorable times for national availability and foreign demand, allowing the production to increase. This growing trend is expected to continue in the coming years.
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<td>15</td>
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<td>1000</td>
</tr>
</tbody>
</table>

Note: The data reflects the production capacity of various counties. Further information is available at [data source].
CENER (National Renewable Energy Centre of Spain) operates the Pre-treatment Unit integrated in its Biorefinery and Bioenergy Centre (BIO2C) for production of batches of pre-treated biomass. It consists on a pilot plant with a production capacity of 150-350 kg/h including chipping, chopping, drying, torrefaction, and pelletization. The Torrefaction Unit consists of an indirectly heated cylindrical reactor using thermal uid at temperatures between 220 and 300 °C to convert raw biomass into thermally treated product. The pilot plant is very flexible regarding bulk density and particle size, being able to process difficult fuels with very low bulk density and very high fines content.

www.bio2c.es

An R&D and innovation company, Européenne de Biomasse aims at substituting fossil energy with a renewable and competitive solid biofuel.

It licenses edb-HPCI®, its patented technology that uses continuous vapocracking of lignocellulosic biomass to produce wood pellets with advanced characteristics as well as a variety of value-added biomolecules. Standardised, and energy-dense, the HPCI® pellet uses any biomasses, is highly stable, water-resistant, and reduces both health and industrial risks, as well as supply chain and conversion costs. A world-first, Européenne de Biomasse’s FICA-HPCI factory (125 000 tons) proves its concept.

www.ebiomass.eu

Woodtech France is a start-up in the field of bioenergy. The company’s goal is to contribute to the energy transition through the development of renewable heat. Woodtech specialises in B2B supply of sustainable quality wood-fuel.

www.swisswarme.com

CPM Europe is a globally trusted supplier of premium biomass grinding, pelleting and briquetting systems and solutions.

CPM is a preferred supplier of equipment to a continuously growing number of customers in Europe, America and Asia. When matched together with a global sales and service network there is no better partner for your biomass grinding, pelleting and briquetting needs worldwide.

www.cpmeurope.nl

Stora Enso develops and produces solutions based on wood and biomass for a range of industries and applications worldwide, leading in the bioeconomy and supporting our customers in meeting demand for renewable eco-friendly products.

Stora Enso’s high-quality wood pellets - made from wood shavings, dry chips and sawdust by-products from our own sawmills – offer a reliable, renewable source of energy for residential, commercial or industrial heating. From forest to front door, we are responsible for the entire production and supply chain. We integrate our wood pellet production directly after the sawing line, reducing any unnecessary transport.

www.storaenso.com
3.1.1 European pellet production: future opportunities

On the European level, there is with significant room for further expansion of sustainable pellet production provided that some current constraints (e.g., transportation, logistics, etc.) are overcome. Additionally, if water is sufficiently available from rivers stream it can be inferred that the pellet production could be enhanced by additional biomass, such as the youth reserve, cofired, subsequently, depending on the raw material supply.

Austria: Pellet production could reach 260,000 tonnes.

Austria: The total usable pellet production could be 2 million tonnes per year or the availability of aquatic resources. Some further increase could stem from the aquaculture sector relying on fish waste as a feedstock.

Brazil: The country is projected to be a major potential for pellet production in the near future, given the number of pellets plants expected to increase. Meanwhile, National and national funding schemes supporting pellet production.

Canary Islands: In the short term, the use of raw materials allows a total production of 150 million tonnes. If aquatic organic waste is not utilized, almost all existing technologies, (e.g., Bali-based) with their use, raw material to produce it, million tonnes of aquatic pellets.

France: France's current production could reach 650 million tonnes of pellets using raw material available like algae and other aquatic plants. This amount could be increased significantly as more resources are utilized for pellet production, thereby reducing the need for aquatic by-products, especially fish residues.

Germany: In Germany, there are 460,000 tonnes of raw material per year that could potentially be used for pellet production. With an estimated market of 155 million tonnes, the potential exists to produce 1.5 million tonnes of aquatic pellets instead of 1.0 million tonnes, which are currently produced. This potential could be reached from the aquaculture sector relying on fish waste as a feedstock.

Montenegro: Pellet production could reach 500,000 tonnes.

Russia: The current extent of aquatic processing exceeds that of raw materials. Russia has reached 50 million tonnes which could be used as a feedstock for aquatic pellets production.

Sweden: The use of aquatic biomass for aquatic pellets production is approximately 1 million tonnes per year.

Spain: Pellet production could reach 800,000 tonnes.

Spain: The potential use of aquatic biomass for aquatic pellets production could reach 50 million tonnes (50% of annual tonnage for aquatic) in future.

Sweden: Pellet production could reach 500,000 tonnes.
21.2  Baseline analysis for European aspen pellet production

Within the data collection process, it has been identified that raw material used for pellet production in change.

Three categories have been defined:

- Primary/Residual = Roundwood and processing residues (i.e., wood ash and wood for pellet production)
- Secondary/Residual = any by-products from sawmill industry, e.g., sawdust, shavings, etc.
- Tertiary/Residual = any ash and residual wood, waste wood

Figure 2: Estimates of the share of raw materials used in local pellet production in Europe 2010-2016.

Source: EF:ercise 2010

For further data collection on the use of Roundwood and off-Residues in the chosen material file for local pellet production.

Figure 3: Estimates of the share of Roundwood and off-Residues as raw material for local pellet production in Romania 2018.

Source: EF:ercise 2018
In consultation with experts, the main markets for peatlands produced in each European country have been identified. Two main categories have been identified: namely, countries that mainly produce peatlands for the heating market (residential and commercial) and countries that mainly produce peatlands for industrial use.

Figure 3: Distribution of European peatland production by market category over years (2010-15).


For more information, visit: [link to resources].
In 2018, European pallet production grew to 1.5 billion pallets while consumption increased to 1.2 billion pallets. This is offset by a decrease in the number of pallets used for pallet production, all of which occurred due to a decrease in demand. Availability and pricing of raw materials are now of major interest.

Table: European pallet production: perception of the main difficulties in 2018 (1: least concerning; 5: most concerning)

<table>
<thead>
<tr>
<th>Source</th>
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Note: Diff difficult
2.2 European pellet consumption

2.2.1 Total European pellet consumption

In 2019, European pellet demand experienced an increase of 1.8 million tonnes in comparison to 2018, representing a growth of 7%, below the 8% growth that was observed in 2018.

The industrial growth was responsible for 53% of the total pellet consumption increase (from 2018 to 2019) in Europe, while actually the total pellet consumption increase for the same period for United Kingdom (UK) and Netherlands was due to a consumption increase for power only (9% increase for UK, 129% increase for Netherlands).

The residential/commercial market realised modest growth in most European countries in 2019 compared to 2018. This can be explained by two main (correlated) factors. Firstly, the 2018-2019 heating season showed a rather similar energy demand as for 2017-2018 in most European climate zones. Additionally, the 2019-2020 heating season has, however, witnessed a low energy demand. Secondly, the heating appliance sales in Europe did not show a dramatic increase during that period. However, despite this, Italy and France are highlighted as growing examples, as they have both registered the biggest increase (in absolute terms) in residential/commercial pellet consumption.

More recently, the COVID-19 which was initially seen as a great risk for the pellet demand, finally appeared to have very limited impact, much less than the low 2019-2020 heating season.
Figure 25 European pellet consumption by type of end use in 2019 (tonnes and %)

Note: EE, LT, NL, UK & NO: 2019 consumption is a replication of 2018.
Source: EPC survey 2020, Hawkins Wright

Figure 26 Evolution of pellet consumption in Europe by type (tonne and %)

Note: EE, LT, NL, UK & NO: 2019 consumption is a replication of 2018.
Source: EPC survey 2020, Hawkins Wright
2.2.2 European pellet consumption for heating

Figure 27 Map of pellet consumption for heating in Europe in 2019

The annual increase of the pellet demand in the residential/commercial sector was smaller in 2019 than in 2018: +3.8% in 2019 (vs 2018) and +5% in 2018 (vs 2017). It can be explained by the fact that 2018 has benefited from fairly good heating seasons while 2019 was deeply impacted by the low 2019-2020 heating season. Furthermore, the not so strong increase in sales of heating appliances also did not compensate for this low demand. Despite this, Italy and France are highlighted as growing examples, as they have both registered the biggest increase (in absolute terms) in residential/commercial pellet consumption.

Still, in 2019, the residential and commercial consumption increased together by 682,453 tonnes. Commercial pellet demand stagnated for 2019 (+0.1%) while the residential showed a weak growth (+3.8%) and in absolute terms: +676,977 tonnes for residential use and only, 5,476 tonnes for commercial use.

The most recent times brought some surprises and challenges in the market. Indeed, after a very tight pellet availability (especially in the industrial market) in Q1 and Q2 2019, the European pellet demand appeared to be rather low in the rest of 2019 and during the 2019-2020 heating season, ended up with a complete turning point where most of the players should show extremely high inventories at the end of 2020.

The pellet industry showed a noticeable resilience as the COVID-19 did not dramatically impact the demand of pellets for heating. The low 2019-2020 heating season impacted much more the demand than the COVID-19. The only noticeable direct COVID-19 impact is to be seen on the industrial pellet use. For example, even though the installations of new heating appliances have been impacted by the lockdown, no noticeable decline could be observed. Even the pellet delivery, being large or small scale, did not suffer extensively from the COVID-19 crisis, with only some private individuals having to find alternatives to obtain pellets during the closure of the hardware shops. The COVID-19 pandemic has even brought opportunities in the sector. Indeed, the (wood) construction sector is currently dramatically growing in several areas, generating an increasing amount of wood residues, to be used in pellet production. On the demand side, the generalisation of homeworking did increase the use of residential consumption in some parts of Europe.
Heating Degree Days (HDD)\(^3\) per heating season (from September to April) for different years for the three climatic zones considered* (in HDD)

Source: Eurostat

Figure 28 shows the fluctuation of energy demand for heating between heating seasons since 2000. Indeed, HDD is used as a proxy to estimate the heating energy needs - the higher the HDD for a season, the higher the need for heating. Therefore, we can see that the heating season of 2012-2013 was generally characterised by colder temperatures (i.e. higher HDD), creating some disruption on the pellet market that was not fully prepared, leading to market tensions and even small shortages. For this reason, pellet market players then tried to organise themselves to prevent this situation from repeating itself by increasing their production and stock. Unfortunately, from 2013 to 2016, Europe experienced three consecutive mild winters, leading to a rather disappointing growth of pellet consumption in the heat market inducing the accumulation of pellet stock in some regions. Thankfully, the following heating seasons were colder, resulting in better pellet use for heat showing a growth of around 12% over the 2016-2017 period. This sudden rise in consumption generated again some tensions in the supply leading to shortage in some areas and generating a price increase in 2018. The heating season of 2018-2019 was slightly milder than the previous ones but only marginally colder than the ones from 2013 to 2016, leading to a modest growth of the pellet consumption for heating. The 2019-2020 season appeared to be milder than the previous season (data not available).

\[\text{HDD} = \begin{cases} \sum_i (18 - T_{i,m}) & \text{if } T_{i,m} \leq 15 \degree C \\ 0 & \text{otherwise} \end{cases}\]

Heating Degree Days (HDD) depict the severity of the cold in a specific time period taking into consideration outdoor temperature and average room temperature (in other words the need for heating). The calculation of HDD relies on the base temperature, defined as the lowest daily mean air temperature not leading to indoor heating. The value of the base temperature depends in principle on several factors associated with the building and the surrounding environment. By using a general climatological approach, the base temperature is set to a constant value of 15\degree C in the HDD calculation.

If \(T_{i,m} \leq 15 \degree C\) then \(\text{HDD} = \sum_i (18 - T_{i,m})\) Else \(\text{HDD} = 0\) where \(T_{i,m}\) is the mean air temperature of day \(i\).

Examples: If the daily mean air temperature is 12\degree C, for that day the value of the HDD index is 6 (18\degree C-12\degree C). If the daily mean air temperature is 16\degree C, for that day the HDD index is 0. Definition and explanations from Eurostat.
Figure 29 Heating Degree Days for different heating seasons per months for three main EU climatic regions since 2013 (in HDD)*

(a) HDD for Spain – Low heating needs region

(b) HDD for Belgium – Medium heating needs region

(c) HDD for Austria – High heating needs region


Source: Eurostat
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Note: Data for 2015-2024: 2019 consumption is a cumulative sum of 2019.
Figure 30 Evolution of European pellet consumption for residential (<50kW) and commercial (>50kW) heat excluding CHP (tonnes)

Note: EE, LT, NL, UK & NO: 2019 consumption is a replication of 2018.
Source: EPC survey 2020

Figure 31 Growth of European pellet consumption for residential (<50kW) and commercial (>50kW) heat excluding CHP by countries between 2018-2019 (tonnes & %)

(a) Top 3 countries of absolute growth in pellet consumption
2.2.2.1 RESIDENTIAL PELLET CONSUMPTION

Figure 33 Evolution of Europe’s top 5 countries for residential (<50kW) pellet consumption in Europe (tonnes)

Source: EPC survey 2020
Noted: pellet consumption in small-scale heating plants as well as in small-scale heating will be assessed on the same scale as today, but it may be possible that the consumption will increase in large-scale heating, such as industrial, institutional uses, district heating, etc.


Notes:
- Consumption of pellets in Petron has grown since 2011. Government subsidies have increased in recent years, which also shows increased air pollution, which is a result of increased use resulting in higher consumption. The effect of these subsidies should continue to be monitored for years to come.

Spain: The consumption of small-scale heating has increased significantly in recent years due to the cold weather. The consumption rate is expected to increase in the near future and reach new heights as a result of rising costs.

Notes: From 2009, the market size is estimated to be around 1.75% of the total market in 2010. The share of small-scale heating has increased by 4% in the residential market, 3% in the medium-sized market, and 2% in the large-scale customer market, which is expected to remain at 4% in the next few years. The share of the small-scale market has increased by 1.5%.
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Figure 1: Shares of European residents' online food consumption (kg, courtesy of WF Wilkerson)
2.2.2 COMMERCIAL PELLET CONSUMPTION

Figure 38 Evolution of Europe’s top 5 countries commercial (>50kW) pellet consumption in EU (tonnes)

Source: EPC survey 2020
Figure: Distribution of energy consumption in EU countries: commercial (kWh) per consumption in EU (kWh)

Source: IEA, 2021

**Roads**
- Electric vehicles have been important recently, but usage in commercial heating/appliances.

**Railways**
- Most passenger transportation is done on a professional and industrial level, generating more carbon.

**Ships**
- High-quality transport by maritime vessels.

**Airports**
- Air travel is a significant contributor to greenhouse gas emissions.

**Offices**
- Buildings have adopted their self-heating systems. Based on coal and heating oil, self-heating units and efficient heating appliances using wind, solar, and waste heat.
(Figure showing European commercial and residential consumption by country in 2019 with percentages)

Note: (Data on consumption by country in 2019)
Source: (Source details)

### Qualitative Analysis

European statistics indicate that different countries use a variety of fuels for residential and commercial heating. In 2019, European countries showed significant differences in fuel consumption, with some countries using higher-quality fuels for both residential and commercial purposes, while others used lower-quality fuels. This variation highlights the need for energy efficiency and sustainable practices across the European market.

(Figure showing breakdown of fuel quality by European countries in 2019)

This analysis was conducted to identify trends and areas for improvement in fuel consumption and energy efficiency. Further research is needed to explore strategies for reducing carbon emissions and improving the sustainability of energy use in European countries.

(Data on fuel consumption by country in 2019)
Source: (Source details)
Another consultation case was conducted to identify how patients can be allocated to users within the residential heat markets of eight European countries.

Germany, Austria, and France have heat market systems where consumers operate buildings with high energy demand capacity. The approach in Italy/France markets was mainly conducted through auctions. In contrast, Austrian consumers purchase heat in multi-metered apartments, with gas consumers purchasing gas separately. In Denmark, the heat market was initially based on a high-capacity energy system, and it was later decentralized that high/low users either community-owned comes, etc.
2.2.3 European industrial pellet consumption

Q1-Q2 2019 showed great tensions on the industrial pellet market. Indeed, the supply was very tight, leading to spot price records, increased use of coal (for the co-firing plants) but enhanced interest and use of agropellets.

Following great supply tightness that occurred in Q1-Q2 2019, the rest of 2019 and 2020 completely reversed the trend. To avoid the 2019 hurdle, the utilities took strong positions and entered the 2019-2020 very well stocked while the demand actually slowed down. Indeed, the 2019-2020 heating season has been rather low, impacting the need of industrial pellets. In March 2020, the COVID-19 pandemic did reduce the electricity demand, which impacted the industrial pellet users having their costs exposed. On top of that, the supply is strong, and some utilities did plan outages or even faced technical problems, beside ENGIE Les Awirs closure.

**Belgium:** The industrial pellet consumption has not witnessed any dramatic change as there is no recent plant conversion since ENGIE les Awirs and Rodenhuize. In the future, a decrease of industrial pellet consumption of about 350.000 tonnes per year is expected in Belgium following the decision of ENGIE to close Les Awirs (80 MW) in 2020.

**Denmark:** The industrial pellet consumption in Denmark witnesses a drop for two consecutive periods with a decrease of -5% in 2019, following a drop of 3% in 2018 compared to the previous year. The retrofitting success of coal plants to biomass, that initially focused on wood pellets, indeed resulted in a peak consumption of pellets in 2017. However, the recent retrofitting programmes have been diverted from pellets to wood chips. On top of that, since straw is being cofired with pellets and due to the warm winter, the pellet consumption has been rather suppressed in 2019.

**Sweden:** No additional capacity has been recently added in Sweden. The consumption fluctuations are only due to the energy demand variation.
The Netherlands: Most of the expectations for the (nearby) future increase of industrial pellet use in Europe concentrates on the Netherlands. After RWE Amers 9 and Uniper MPP3, RWE Eemshaven plant was expected to bring additional demand, but a storage fire has deeply impacted the 2020 consumption.

United Kingdom: The industrial pellet consumption increased again in 2019 to reach its record. This is mainly due to 2019 having been the first full year of operation both for the 4 units of Drax (the 4th unit conversion was finalized in Q3 2018) and the fully biomass converted EP Lynemouth plant. More use is expected from the end of 2020 as the MGT Teesside unit should be put online after having experienced some delay in the plant commissioning.
European Heating Apparatus Market

Generally, the European heating apparatus market shows a great development year after year.需求 of the commodities among the different countries. The overall initiatives of European countries to phase out the use of heating oil greatly helped the open further market opportunities despite fierce competition with heat pumps that is allowing this growth.

More recently, the EU/EHG (European Heat Emission Graph) on the heating apparatus market is showing the market activities. But the impact finally appeared to be rather limited.

Figure 6 presents the breakdown of energy sources by fuel type in the heating and cooling residential sector within the European countries. The purpose of the graph is to understand the market share of fuel of the heating technology, within the residential sector. The graph can help in identifying the potential European markets for the most promising technologies. The replacement of heating oil with renewable heat appliances represents a significant potential of growth for the European pellet market.

Figure 6: Breakdown of energy source by fuel type in the heating and cooling residential sector within the European countries (2010-15)

Methods: Substantial budgets for activities will be available for the purposes of managing the existing non-renewable heating systems and renewable ones. Additionally, various countries are expected to prohibit the replacement of old fossil fuel heating systems with new heat pump systems. Among these, the need to replace heat pumps is not expected with alternative approaches.

Regulations: Until 2050, there are two significant EU regulations for heating devices. Heating appliances must be more efficient in household heating devices. Heating opportunities for alternative renewable heat sources are increased with associated savings.
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2.3.1 European stove market

In 2014, 2015 and early 2016, sales of stoves were slow through most EU28 countries. This was mainly due to mild winters and the low heating oil price. However, at the benefit of the stove market, the customer perceives the purchase of a stove as much less of an investment in comparison to a boiler, thanks to the ability to pay it off rapidly, in comparison to a boiler. For this reason, the better heating season of 2016-2017, allowed for the market to recover in many countries. 2019 was again a good year for the pellet stoves sector.

Table 10 Average percentage of households with pellet stoves in 2019 in some European countries (%)  

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<th>Percentage</th>
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<td>SK</td>
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Note: considering maximum one appliance per household  
Source: Eurostat and EPC survey 2020
Germany: Heating prices for heating oil have improved substantially for many pellet installations. However, this trend is not generally evident on a national level, although, despite recent policy frameworks, considerable lead difficulties political support.

Italy: The development of the pellet appliances market depends to a greater degree on available incentives by individual programmes in the sector of renewable energy. Italy will continue to invest in the sector of renewable energy and will start implementing the European programme "Sustainable Energy." (SEALEXH) 2010.

Europe: Domestic demand for heating appliances for stoves is still a matter of concern in the European market. The market has been closing down since 2010, and a decrease is seen in 2015 with the demand for pellets falling from 400,000 to 150,000 units per year. Despite the fall in sales, Italy remains the country with the highest number of installed pellet stoves in Europe. Heating (-2%) million pellet stoves installations, almost 1.5 times as many appliances as the next largest market, France.

Italy: Heating oil appliances market is expected to increase due to the expansion of "Sustainable Heat" programmes in the beginning of 2015. This program is expected to be associated with new requirements for fuel (biofuel).

Scandinavia: The installation of pellet boilers and stoves reached a peak in the number of 2015-2017. The growth is expected to continue in the coming years. The number of installations still be steady until mid-2025 due to the competition with other heating.

Scotch: A huge increase of pellet boilers on the market is the result of a huge number of schools, homes, and other public and commercial buildings that have switched from coal and heating oil. During 2015, the government of Scotch has supported the use of pellet boilers in replacing heating oil with coal with savings on energy costs. These activities continued 2015 until 2025, as costs are expected to rise due to consumption.

Spain: 2015: A significant increase in number of appliances sold (88%) since 2014. An increase in the number of stoves sold (88%) to 2014. The number of installations has a slight decrease from last year, although. The trend is expected to continue until 2025. On the other hand, employment figures show a decline, and the growth of renewables is expected to continue at nominal figures. The capital increase and population in 2015 for the appliance category. It is expected to remain between 2015 and 2025. The increase in consumption (88%) is the largest increase for the individual heating systems. Overall, the number of installations for stoves is expected to increase and to nominal figures. 2015 to 2025 the number of stoves will increase with the same percentage as the number of installations for stoves. The capital increase and population in 2015 for the appliance category. It is expected to remain between 2015 and 2025. The increase in consumption (88%) is the largest increase for the individual heating systems. Overall, the number of installations for stoves is expected to increase and to nominal figures. 2015 to 2025 the number of stoves will increase with the same percentage as the number of installations for stoves.
### 2.3.2 European residential boiler market

**Table 11 Average percentage of households with pellet boilers in 2019 in some European countries (%)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
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<tbody>
<tr>
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<tr>
<td>HR</td>
<td>0.06%</td>
</tr>
<tr>
<td>UK</td>
<td>0.04%</td>
</tr>
</tbody>
</table>

Note: considering maximum one appliance per household  
Source: Eurostat and EPC survey 2020
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The next ten years will define the life of many future generations.

The effects of climate change do not proceed along a straight line; a slight increase in CO₂ emissions will lead to much worse circumstances. Thus, every year counts and therefore we should expect dynamic times ahead of us in energy policies.

In the sector of heating, which is a very important sector in Europe, sustainable biomass is one of the low hanging fruits we need to roll out now on a much bigger scale. Switching from oil heating to pellets, made from recycled saw dust, is technically easy and does bring many positive effects to the homeowner, whilst allowing to annually save as much CO₂ as getting three average cars off the road. Plus, it strengthens the local economy and creates jobs in local communities. For these reasons, many markets for pellet boilers grew strongly in 2019 and the trend continues in 2020, despite the pandemic.

It is no coincidence that with France, Germany and Austria, the countries that have a clear deadline for the ban of oil heating, are the most promising countries for the development of biomass heating in the immediate future.

If we, as an industry, do a good job in addressing public misinformation about air quality and the sustainability of biomass, many countries will follow and become growing markets for the use of wood pellets in the heating industry.

- Stefan Ortner, CEO, ÖkoFEN
AIEL, Italian Agroforestry Energy Association, represents Italian companies operating in the wood-energy sector and includes producers of wood biofuels, builders of technologies that transform biofuels into heat energy (stoves, replace inserts, boilers, cogeneration groups), heating system installers and maintainers.

For the past 18 years, the association has promoted the correct and sustainable growth of agro-forestry biomass and wood biofuels production, by accompanying the entire supply chain from the forest to the fireplace.

To drive the market to quality, AIEL manages three certification schemes in Italy: ENplus® for pellet, Biomassplus® for rewood, woodchips and briquettes, and ariaPulita® for stoves, replace inserts, and domestic boilers.

www.aiel.cia.it

There are numerous positive signs for wood pellets in Europe in medium and long-term aspects. As more focus is placed on heating and cooling from biomass, pellets are to have major opportunities in these segments.

ENplus® is the world-leading certification scheme for wood pellets.

From production to delivery, ENplus® guarantees quality and combats fraud along the entire supply chain. Through national partners or local trainings, the scheme reaches unique levels of proximity and dialogue with its certified companies. With a projected 13 million tonnes of certified pellets to be produced in 2020, ENplus® today is the prominent certification scheme for wood pellet quality - produced and traded by over 1000 companies from over 45 countries.

www.enplus-pellets.eu

Froling: The big name in heating with wood and pellets, providing innovative solutions (with an output range) from 7 to 1,500 kW.

Froling is a pioneer in modern wood heating systems. The Froling signature is on many products from the groundbreaking invention of the firewood boiler with high-temperature combustion more than 20 years ago to the wood chip burner with Lambda technology or the development of the internationally acclaimed pellet boiler. A wide variety of well-known international quality awards underscores the ongoing success of this Austrian family company.

www.froeling.com

SGS is the world’s leading inspection, verification, testing and certification company.

SGS is recognised as the global benchmark for quality and integrity. With more than 94,000 employees, SGS operates a network of over 2,600 offices and laboratories around the world. SGS services help ensure the integrity of solid biofuel supply chains from forest to fuel and trade inspection at export or import.

www.sgs.com

Leading pan-European stock exchange, Euronext, offers a futures contract on wood pellets, allowing pellet industry participants to manage risk from production all the way through to purchase and sales.

Trading in a transparent, secure and regulated environment, the contract allows users to protect their margins and hedge against fluctuations in the prices of pellets. Changes often caused by economic supply and demand, availability of raw materials as well as winter seasonality patterns. The Euronext Wood Pellets Futures contract is based on the European Pellet Council ENplus® A1 certification and was developed in close co-operation with the biomass community to support portfolio diversification and price hedging.

www.euronext.com

www.sgs.com
European commercial sector market

Notes: The commercial sector, defined as dedicated commercial space at least 50% below of overall cost in residential buildings, public buildings, services, retail, etc. remains quite resilient in most of Europe, but has been identified by some researchers as a niche http://www.establishinggarden.com/#!long-term/

Figure: Evolution of the total number of commercial properties between 1995 and 2009 in some European countries (Source: CEPREMAP, 2009)

Note: Commercial properties in green indicate a high ratio of buildings.

Sources: CEPREMAP, 2009

Analysis: The increase in commercial properties is associated due to political pressures on fiber optic network building.

Spanish Data on Spanish commercial spaces include retail, food outlets, cafes, other stores, plus car-shops and auto-stores. They are capable of consuming retail-electricity if other energy sources are not available. The ratio-marks some position is 2009 for the three application categories. It is expected a fall between 20% - 30% due to Commerce being the biggest decrease for the retail-electric network-systems. Nevertheless, it is expected to come back to normal Figures n 2012 and a bigger increase in 2015 due to all the Renewable energy supports the recovery. Source: Ministerio de Fomento 2009 year. 2009 - 2010 objectives for Spain that are among higher in EU Spanish government plans to decarbonize domestically, 2009)
The price of natural gas in residential, public, and industrial sectors has recently dropped, leading to a rise in the growth of heating and cooling installations in these sectors.

France: Despite over 30% of runs for three in the data available, no matter if heated, there is no uptake-threshold correlation/heat pump uptake in this country.

Scrooge: Further development of asset-related heating, market and hot water generation appliances, together in the commercial sector also depend on the availability of capital, otherwise, the quality return on assets is greater in funding for the businesses. As the main conclusion of heating appliances have been modest in the early stages, users of the residential sector are the commercial sector is also expected to grow or enter into the coming years, especially in low-temperature or renewable generation network assets, or specific solutions for existing Heating systems displayed.

Scheme: The big issue of the number of installed heating blankets is the result of a large number of schools building 2000. Considering energy costs and climate, public and commercial buildings, which have been funded or equipped instead of cost and heating. In 2014, the Swedish government supported a vast number of public buildings to replace heating systems and this holds is that people are using.

Another Brighton: As with the residential sector, the sustainable heat has been (UK) has helped commercial heating blankets to appreciate in this 20% to nearly 2/3. In short, the heating sector in the same reason heat pump installations have been increasing in the following years, heating around 30% in 2016. Since then, heat generation awareness...
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#bepartofbioenergy
Table 15: Selected tables of fatalities and rescues in Europe in 2019 and 2018 (all fatalities).

<table>
<thead>
<tr>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
<th>Year</th>
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<tr>
<td>1001</td>
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<td>1500</td>
<td>1501</td>
<td>1500</td>
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</tbody>
</table>

Table 16: Selected tables of fatalities and rescues in Europe in 2019 and 2018 (all fatalities).

<table>
<thead>
<tr>
<th>Year</th>
<th>Year</th>
<th>Year</th>
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<td>1500</td>
<td>1501</td>
<td>1500</td>
<td>1501</td>
<td>1500</td>
</tr>
</tbody>
</table>

Note: Columns indicate location: 1 = Europe, 2 = Italy, 3 = Spain, 4 = France.
Reference: [source] (2019/2020)
2.4 European Trade of Coffee

The data provided in this section has been provided by Eurostat. Unfortunately, for some countries, the data does not present the same level of accuracy as the report that the report creating some inaccuracies. However, these numbers still reflect the big trends within import/export across Europe.

Figure: 2020 Coffee Balance (production, consumption, exports, imports)

Source: Eurostat, Yearbook: World Coffee Report

Note: PP: survey, WW: Weather, WW+Year: Wing Weather, WW
Figure 59 Share of total EU28 pellet exports in 2019 (%)

Source: Eurostat
<table>
<thead>
<tr>
<th>Source</th>
<th>Table 1: Splitting countries in source and destination countries between 2015 and 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td>Source</td>
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</tbody>
</table>

**Source:** European Commission
11.2 **EU28 reporting countries**

**Hegem:*****Polish have been imported from Romania, Austria, Germany, Belgium, and France in 2019.***

**Hegem:** The import of industrial pellets has been relatively constant over the years due to a relatively low consumption for electricity production.

**Hegem:** Germany is the second largest pellet importer, mainly sourcing pellets from Poland, Estonia, and France in 2018. The importation volume decreased by 19% in 2019 mainly due to the decrease of 2018-2019 heating season.

**Hegem:** Italy is the report’s second-largest importer (38%) after Austria, followed by Poland (10%) and Germany (9%). The total consumption was 1.1 million tonnes of pellets, the total is for domestic use. The price of pellets has increased in the recent years; challenges in the operation of heating appliances.

**Hegem:** Italy is the third largest importer of pellets, with a production of 0.5 million tonnes and a consumption of 0.6 million tonnes. The number of tonnes imported in Italy in 2019 was 1.1 million tonnes. The price increase was likely due to the increased production costs in 2019.

**Hegem:** Germany imported the largest volume of pellets, with a production of 1.9 million tonnes, mainly from France and Russia, reflecting a significant increase in demand and production during 2019.

**Hegem:** Poland exported 1.5 million tonnes of pellets, mainly from France and Russia, reflecting the recovery of domestic pellet use.

**Hegem:** The EU is the largest pellet exporter in the EU, with most of its pellets being sourced from Northern Europe, due to the continuing increase of pellets in the power plants coupled with limited decarbonisation.

**Hegem:** The top five countries (United Kingdom, Germany, Italy, Netherlands, and Belgium) represent 70% of European imports. The number of pellets imported in the EU has increased in recent years.

---

**Figure:** Distribution of the imports of pellets in the EU, by top EU28 importing countries (tonnes, 2020 and 2021).

---

*Source: Renon*
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Table 1b: Top 5 Emission sources in the top 5 supplying countries between 2012 and 2019 (Kg)

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<td>(5)</td>
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</table>

Source: Econdata
2.5 European pellets price

Limitation of liability - Under no circumstance shall EPC and its contributors be liable for the exactitude or the use made of the price information available in this section.

Note: Red values indicate that VAT rates have changed from the previous year.

Table 16 VAT rate for pellets compared with general VAT rate applied in European countries in 2019 (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>VAT rate for wood pellets (in %)</th>
<th>General VAT rate (in %)</th>
</tr>
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<tbody>
<tr>
<td>AL</td>
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<td>AT</td>
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<td>BG</td>
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<tr>
<td>CH</td>
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<td>25</td>
</tr>
<tr>
<td>SK</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: EPC survey 2020
United Kingdom

Wood Fuel

In the UK, wood fuel consists of various types of wood, wood waste, and other biomass sources. The government has set standards for the quality and sustainability of wood fuel to ensure that it meets environmental and safety requirements. These regulations are enforced by the Department for Environment, Food & Rural Affairs (DEFRA).
25.1 European price development of residential pellets

25.1.1 MANNERI/PELLET PRICES

https://www/Statutory/gathered/prices/in/European/countries/with/highest/prices/within/January/2019/and
http://www/statutory/prices/in/pellet/countries/within/January/2019/and

Source: EPC survey 2019
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Figure 11: Estimation of market price for European countries with highest prices between January 1994 and May 1997. Source: FAO/World Bank.
2.5.2 European price development of industrial pellets

The industrial pellet price has faced serious turbulences in 2019 and 2020. The industrial wood pellet cif northwest Europe (NWE) index entered 2019 at a record high, as North American and European wood pellet deliveries struggled to keep pace with increased utility demand. Europe’s installed industrial wood-fired power capacity was significantly higher in winter 2018/19, since Drax’s fourth unit and EPH’s Lynemouth plant began firing wood pellets in 2019 and in the Netherlands, RWE commenced co-firing at its Amer 9 plant. Meanwhile, on either side of the Atlantic, a torrid combination of hurricanes, forest fires, floods and new project delays limited the production and delivery of wood pellets. The coalescence left Europe’s biomass market short on supply and lifted the Argus cif NWE wood pellet spot price to a record high of $210.36/t in mid-February. But supply tightness eased throughout the second quarter. Utility wood pellet demand lowered as some turned to co-firing with coal or agriresidues, and others extended or brought maintenance periods forward, furthermore warmer spring weather softened heating demand. Furthermore, previous production troubles eased and there was no longer a wood pellet supply shortage.

Keen to avoid the shortages of the previous winter, utilities took strong positions in the run up to the 2019-2020 winter season, building plentiful stocks. But European temperatures were mild throughout the heating season, and utilities had little need to purchase additional spot volumes. Several utilities approached the second quarter of 2020 with plentiful stocks left-over from winter. As Europe entered Spring, the COVID-19 pandemic weighed on electricity demand and pellet demand fell further as a result of a fire of RWE’s co-fired Eemhaven plant in the Netherlands. In Belgium, Engie’s Les Awirs permanently closed at the end of August 2020, while in the UK a delay at MGT’s 299MW dedicated Teesside plant in the UK, further curbed wood pellet demand. The combination of these elements flattened European spot demand, leading to a long-term decline in spot pricing throughout 2020. The Argus cif northwest Europe (NWE) spot index has moved close to historical lows, and floundered below break-even production costs for several months.
3 ENplus® pellet production

The ENplus® certification scheme ensures wood pellet quality for the customer by guaranteeing the quality of the pellets over the entire supply chain (i.e. from production to end-user delivery). This certification is governed and managed by the European Pellet Council (network of Bioenergy Europe) with the support of National Associations, managing the certification on a national level. Since its introduction, the number of countries with certified ENplus® producers has rapidly grown, reaching 45 countries with a total volume over 13 million tonnes of certified pellets produced in 2020 (projection).

The number of ENplus® certified producers worldwide shows once again a sizeable growth, reaching 531 producers and 449 traders in 2020. With these results, ENplus® is well on its way to reach its aim of harmonised pellet quality at a global level.
Figure 71 Worldwide ENplus® certified pellet production plants in 2019

Figure 72 Amount of countries with ENplus® certified producers
Figure 73 Total number of ENplus® certified producers/traders in 2019

531 ENplus® certified Producers
449 ENplus® certified Traders

Figure 74 Volumes of ENplus® certified pellet produced by the top 5 countries from 2014 to 2020 (tonnes)

Volumes of ENplus® certified pellets produced by the top 5 countries
(from 2014 to 2020, tonnes)

Source: ENplus®
Figure 75 Volumes of ENplus® certified pellets produced by the top 20 countries in 2019 (tonnes)

Figure 76 ENplus® certified pellets producers per quality class (September 2020)
Figure 77 Type of raw material used for ENplus® certified pellets (September 2020)

Type of raw material used for ENplus® certified pellets (September 2020)

Source: ENplus®
Is the bumpy road for torrefaction getting smoother? Finally, it seems so!

Aside from the demonstration plants scattered around the globe, first industrial scale plants have started operation or are in final stage of construction. Advantages of product quality, supply chain efficiency and the business profitability have been proven for a while now. However, project developers have not translated these advantages sufficiently within their marketing schemes. Moreover, bringing technical innovation, and its uncertainties, in the current wood pellets market that is primarily looking to mature and reach a commodity status, appears to be very challenging.

In any case, the uptake of torrefied biomass has been improving recently. Indeed, it is gaining popularity among those looking to switch from conventional coal or oil derived carbon to bio-carbon, that are now subject to increasing GHG reduction requirements, as well as among new consumers searching for a specific product for their bio-refineries processes.

- Michael Wild,
IBTC President

ABOUT INTERNATIONAL BIOMASS TORREFACTION COUNCIL

The International Biomass Torrefaction Council (IBTC) is a Brussels based international platform founded in 2012, which brings together more than 20 companies from all over the world.

IBTC was founded by Bioenergy Europe (former AEBIOM) and resulted from the joint efforts of major torrefied biomass stakeholders who decided to create a discussion platform of companies with similar interests. IBTC was also initiated in collaboration with the Dutch Torrefaction Association (DTA).

IBTC is a unique network connecting all companies with a shared interest in torrefaction and solid biofuels, connecting industry players and academia for undertaking actions to drive forward torrefied biomass.

www.ibtc.bioenergyeurope.org
### Overview of advanced/biomass pellet sector

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<thead>
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<th>Location</th>
<th>Status</th>
<th>Transaction Type</th>
<th>Annual Capacity</th>
<th>Biomass/Heat</th>
<th>Waste/Heat (Note)</th>
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</thead>
<tbody>
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<td>Norway</td>
<td>Project</td>
<td>Negotiation</td>
<td>200,000 t/year</td>
<td>0.5% biomass</td>
<td>0.5% waste</td>
</tr>
<tr>
<td>Spain</td>
<td>Project</td>
<td>Negotiation</td>
<td>150,000 t/year</td>
<td>0.75% biomass</td>
<td>0.75% waste</td>
</tr>
<tr>
<td>Italy</td>
<td>Project</td>
<td>Negotiation</td>
<td>100,000 t/year</td>
<td>0.3% biomass</td>
<td>0.3% waste</td>
</tr>
<tr>
<td>France</td>
<td>Project</td>
<td>Negotiation</td>
<td>80,000 t/year</td>
<td>0.6% biomass</td>
<td>0.6% waste</td>
</tr>
<tr>
<td>Germany</td>
<td>Project</td>
<td>Negotiation</td>
<td>60,000 t/year</td>
<td>0.8% biomass</td>
<td>0.8% waste</td>
</tr>
<tr>
<td>Russia</td>
<td>Project</td>
<td>Negotiation</td>
<td>40,000 t/year</td>
<td>0.4% biomass</td>
<td>0.4% waste</td>
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<tr>
<td>China</td>
<td>Project</td>
<td>Negotiation</td>
<td>30,000 t/year</td>
<td>0.2% biomass</td>
<td>0.2% waste</td>
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<tr>
<td>India</td>
<td>Project</td>
<td>Negotiation</td>
<td>20,000 t/year</td>
<td>0.1% biomass</td>
<td>0.1% waste</td>
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<td>Name</td>
<td>Position/Role</td>
<td>Year</td>
<td>Location</td>
<td>Event</td>
<td>Notes</td>
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<td>Project Manager, Development</td>
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<td>New York</td>
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<tr>
<td>Sarah</td>
<td>Director of Marketing</td>
<td>2019</td>
<td>Chicago</td>
<td>Event 3</td>
<td>Notes 3</td>
</tr>
</tbody>
</table>
5 Overview of agropellets market

The agropellets market is rather unknown. Indeed, it appears to be very difficult to collect any precise statistics about this sector. This market is also rather fragile, as there is only a great interest for these products when the wood pellet market is scarce (as in early 2019). Even with that, this market deserves the industry attention as the raw material potential is extremely important but also because it might become a solution for several (industrial) market players in having their operational costs reach a sustainable level.

In this current section, the few elements that could be collected will be aggregated.

The below data was collected in 2017, while the verbal comments were collected in 2020.

Figure 78 European pellet production by raw material in 2016 (%)

![Pie chart showing 90% wood pellets and 10% non-wood pellets.](source: EPC survey, 2017)

Figure 79 Evolution of the production of non-wood pellets in Europe (million tonnes)

![Bar chart showing production in 2014, 2015, and 2016.](source: EPC surveys, 2017)
**Greece:** Should the sustainable forestry management practices, harvesting and logistics methods for agricultural residues improve in the future, then there might be serious opportunities to feed local factories from local agricultural by-products (agropellets) or mixed bio-pellets (woody and agro-based). Especially tree pruning (e.g. resulting from olive trees or vineyards) is expected to be a biomass source increasingly entering the feedstock mix with promising chances of becoming a suitable fuel both for commercial and industrial.

**Poland:** Before 2018, the green certificates in Poland were driving an important use of agropellets in power plants, mainly sourced from Ukraine and Poland. In 2016, the imported volume of sunflower husk pellets exceeded 300,000 tonnes. In 2018, the green certificates’ price crashed, leading to a drastic reduction of agropellets use in Poland. Since then, most of the Polish agropellets producers have reduced their production, looked for other markets (e.g. animal bedding) or switched to wood pellet production.

**Spain:** The main agropellets in Spain are olive cake pellet (50,000 tonnes in 2019) and some undetermined quantities of straw (about 25,000 tonnes). A pellet plant for wood pellet has recently invested in a straw pelletizer.

**Slovakia:** The recent increase of straw price (30-80 €/t) has deeply impacted the production of straw pellet in Slovakia.

**Switzerland:** The production of agropellets is not expected to develop in Switzerland for two reasons. First, this fuel requires a suitable burning equipment and second, the straw cannot be exported from the fuel.

**Ukraine:** Ukraine shows enormous potential for agropellets production (straw, sunflower husks, etc.). The sunflower husk is gaining popularity in the metal and cement production.

**Brazil:** There are three plants using sugarcane bagasse for pellets production, one very small plant that uses coffee husks, and that uses peanuts shell. There are no more significant projects for pellets from agriculture residues. The main reasons for this is the competition with 2nd generation ethanol, the seasonality of the raw material and the difficulties to find a stable place in the market.

**US:** There is currently some interest in bagasse pellet production to be used in European power plants.
**Greece:** Should the sustainable forestry management practices, harvesting and logistics methods for agricultural residues improve in the future, then there might be serious opportunities to feed local factories from local agricultural by-products (agropellets) or mixed bio-pellets (woody and agro-based). Especially tree pruning (e.g. resulting from olive trees or vineyards) is expected to be a biomass source increasingly entering the feedstock mix with promising chances of becoming a suitable fuel both for commercial and industrial.

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This enhanced visibility opportunity is limited and interested members are required to contact the team via info@bioenergyeurope.org

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Bioenergy Europe offers two sponsorship opportunities to further enhance organisation profiles to not only Bioenergy Europe members but to the wider European and global bioenergy sector. New to 2020, organisation's get the chance to feature in two major deliverables for Bioenergy Europe namely, the Statistical Report 2020, as well as the leading bi-annual event, **European Bioenergy Future (EBF20).** *

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For both sponsorship opportunities, you can find out more information in regards to sponsorship on the Bioenergy Europe website.

*Bioenergy Europe Members receive a 50% discount on this sponsorship package
# Annexes

## COUNTRY ABBREVIATIONS

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<th>European Union (28 members)</th>
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<tr>
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<td>United states of America</td>
</tr>
<tr>
<td>VN</td>
<td>Vietnam</td>
</tr>
</tbody>
</table>

**Conventions to geographic regions:**

**EU28**: European Union member states. In the case when a new country has joined the EU, the country will be added also to previous years as a member of EU.

**Other Europe**: Albania, Bosnia Herzegovina, Belarus, Switzerland, Montenegro, Norway, Serbia, Ukraine, Russia

**Europe**: EU28+other European countries

**Balkan countries**: Bosnia Herzegovina, Croatia, Serbia, Slovenia, Montenegro, Albania

**Baltic countries**: Lithuania, Latvia, Estonia
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
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<tr>
<td>,</td>
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<td>/ n.a.</td>
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GENERAL CONVERSION FACTORS FOR ENERGY

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<tr>
<th>from</th>
<th>1 MJ</th>
<th>1 kWh</th>
<th>1 kg oe</th>
<th>Mcal</th>
</tr>
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<tr>
<td>1 MJ</td>
<td>1</td>
<td>0.278</td>
<td>0.024</td>
<td>0.239</td>
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<tr>
<td>1 kWh</td>
<td>3.6</td>
<td>1</td>
<td>0.086</td>
<td>0.86</td>
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<tr>
<td>1 kg oe</td>
<td>41.868</td>
<td>11.63</td>
<td>1</td>
<td>10</td>
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<tr>
<td>1 Mcal</td>
<td>4.187</td>
<td>1.163</td>
<td>0.1</td>
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FUEL PROPERTIES OF SELECTED BIOMASS FUELS

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Net calorific value, dry content (kWh/kg) (moisture content 0%) (q(_{p,net,d}))</th>
<th>Moisture content w-% (ar)</th>
<th>Net calorific value, as received=actual value (kWh/kg) (q(_{p,net,ar}))</th>
<th>Bulk density (kg/loose m(^3))</th>
<th>Energy density (MWh/loose m(^3))</th>
<th>Ash content, dry (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawdust</td>
<td>5.28-5.33</td>
<td>45-60</td>
<td>0.60-2.77</td>
<td>250-350</td>
<td>0.45-0.70</td>
<td>0.4-0.5</td>
</tr>
<tr>
<td>Bark, birch</td>
<td>5.83-6.39</td>
<td>45-55</td>
<td>2.22-3.06</td>
<td>300-400</td>
<td>0.60-0.90</td>
<td>1-3</td>
</tr>
<tr>
<td>Bark, coniferous</td>
<td>5.14-5.56</td>
<td>50-65</td>
<td>1.38-2.50</td>
<td>250-350</td>
<td>0.50-0.70</td>
<td>1-3</td>
</tr>
<tr>
<td>Plywood chips</td>
<td>5.28-5.33</td>
<td>5-15</td>
<td>4.44-5.00</td>
<td>200-300</td>
<td>0.9-1.1</td>
<td>0.4-0.8</td>
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<tr>
<td>Wood pellets</td>
<td>5.26-5.42</td>
<td>7-8</td>
<td>4.60-4.90</td>
<td>550-650</td>
<td>2.6-3.3</td>
<td>0.2-0.5</td>
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<tr>
<td>Steam wood chips</td>
<td>5.14-5.56</td>
<td>40-55</td>
<td>1.94-3.06</td>
<td>250-350</td>
<td>0.7-0.9</td>
<td>0.5-2.0</td>
</tr>
<tr>
<td>Lof wood (oven-ready)</td>
<td>5.14-5.28</td>
<td>20-25</td>
<td>3.72-4.03</td>
<td>240-320</td>
<td>1.35-1.95</td>
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<tr>
<td>Logging residue chips</td>
<td>5.14-5.56</td>
<td>50-60</td>
<td>1.67-2.50</td>
<td>250-400</td>
<td>0.7-0.9</td>
<td>1.0-3.0</td>
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<tr>
<td>Whole tree chips</td>
<td>5.14-5.56</td>
<td>45-55</td>
<td>1.94-2.78</td>
<td>250-350</td>
<td>0.7-0.9</td>
<td>1.0-2.0</td>
</tr>
<tr>
<td>Reed canary grass (spring harvested)</td>
<td>4.78-5.17</td>
<td>8-20</td>
<td>3.70-4.70</td>
<td>70</td>
<td>0.3-0.4</td>
<td>1.0-10.0</td>
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<tr>
<td>Reed canary grass (autumn harvested)</td>
<td>4.64-4.92</td>
<td>20-30</td>
<td>3.06-3.81</td>
<td>80</td>
<td>0.2-0.3</td>
<td>5.1-7.1</td>
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<tr>
<td>Grain</td>
<td>4.8</td>
<td>11</td>
<td>4.30</td>
<td>600</td>
<td>2.6</td>
<td>2</td>
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<tr>
<td>Straw, chopped</td>
<td>4.83</td>
<td>12-20</td>
<td>3.80-4.20</td>
<td>80</td>
<td>0.3-0.4</td>
<td>5</td>
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<tr>
<td>Miscanthus, chopped</td>
<td>5.0</td>
<td>8-20</td>
<td>3.86-4.06</td>
<td>110-140</td>
<td>1.72-2.19</td>
<td>2.0-3.5</td>
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<tr>
<td>Straw pellets</td>
<td>4.83</td>
<td>8-10</td>
<td>4.30-4.40</td>
<td>550-650</td>
<td>2.4-2.8</td>
<td>5</td>
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<td>Olive cake (olive pomace)</td>
<td>4.9-5.3</td>
<td>55-70</td>
<td>1.00-3.10</td>
<td>800-900</td>
<td>1.46-1.64</td>
<td>2.7</td>
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<tr>
<td>Olive cake (olive marc)</td>
<td>4.9-5.3</td>
<td>&lt;10</td>
<td>4.30-4.70</td>
<td>600-650</td>
<td>2.6-2.9</td>
<td>2.7</td>
</tr>
</tbody>
</table>

1kWh/kg = 1 MWh/tonne = 3,6 GJ/tonne

Source: EUBIONET “Biomass fuel supply chains for solid biofuels”
## REQUIREMENTS FOR WOOD PELLETS

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>ENplus® A1</th>
<th>ENplus® A2</th>
<th>ENplus® B</th>
<th>Testing standard</th>
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<tbody>
<tr>
<td>Diameter</td>
<td>mm</td>
<td>6 ± 1 or 8 ± 1</td>
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<td></td>
<td>ISO 17829</td>
</tr>
<tr>
<td>Length</td>
<td>mm</td>
<td>3,15 &lt; L ≤ 40</td>
<td></td>
<td></td>
<td>ISO 17829</td>
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<tr>
<td>Moisture</td>
<td>w-% 2)</td>
<td>≤ 10</td>
<td></td>
<td></td>
<td>ISO 18134</td>
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<tr>
<td>Ash</td>
<td>w-% 3)</td>
<td>≤ 0,7</td>
<td>≤ 1,2</td>
<td>≤ 2,0</td>
<td>ISO 18122</td>
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<tr>
<td>Mechanical Durability</td>
<td>w-% 2)</td>
<td>≥ 98,0 5)</td>
<td>≥ 97,5 5)</td>
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<tr>
<td>Fines (&lt; 3,15 mm)</td>
<td>w-% 2)</td>
<td>≤ 1,0 6) (≤ 0,5 7))</td>
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<td>ISO 18846</td>
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<tr>
<td>Temperature of pellets</td>
<td>°C</td>
<td>≤ 40 8)</td>
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<tr>
<td>Net Calorific Value</td>
<td>kWh/kg 2)</td>
<td>≥ 4,6 9)</td>
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<td>ISO 18125</td>
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<td>Bulk Density</td>
<td>kg/m³ 2)</td>
<td>600 ≤ BD ≤ 750</td>
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<td>Additives</td>
<td>w-% 2)</td>
<td>≤ 2 10)</td>
<td></td>
<td></td>
<td>-</td>
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<tr>
<td>Nitrogen</td>
<td>w-% 3)</td>
<td>≤ 0,3</td>
<td>≤ 0,5</td>
<td>≤ 1,0</td>
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<td>Sulfur</td>
<td>w-% 3)</td>
<td>≤ 0,04</td>
<td>≤ 0,05</td>
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<td>Chlorine</td>
<td>w-% 3)</td>
<td>≤ 0,02</td>
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<td>Ash Deformation Temperature</td>
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<td>≥ 1200</td>
<td>≥ 1100</td>
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<td>Arsenic</td>
<td>mg/kg 3)</td>
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<td>Cadmium</td>
<td>mg/kg 3)</td>
<td>≤ 0,5</td>
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<td>Chromium</td>
<td>mg/kg 3)</td>
<td>≤10</td>
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<td>Copper</td>
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<td>Lead</td>
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<td>≤10</td>
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<td>mg/kg 3)</td>
<td>≤10</td>
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<tr>
<td>Zinc</td>
<td>mg/kg 3)</td>
<td>≤100</td>
<td></td>
<td></td>
<td>ISO 16968</td>
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</table>

1) ash is produced at 815 °C  
2) as received  
3) dry basis  
4) a maximum of 1% of the pellets may be longer than 40mm, no pellets longer than 45mm are allowed.  
5) at the loading point of the transport unit (truck, vessel) at the production site.  
6) at factory gate or when loading truck for deliveries to end-users (Part Load Delivery and Full Load Delivery)  
7) at factory gate, when filling pellet bags or sealed Big Bags.  
8) at the last loading point for truck deliveries to end-users (Part Load Delivery and Full Load Delivery)  
9) equal ≥ 16.5 MJ/kg as received  
10) the amount of additives in production shall be limited to 1,8 w-%, the amount of post-production additives (e.g. coating oils) shall be limited to 0,2 w-% of the pellets.  
11) As long as the mentioned ISO standards are not published, analyses shall be performed according to related CEN standards  

Source: ENplus® Handbook
### GLOSSARY

**Pellet**

In this report, the word ‘pellet’ is always in reference to ‘wood pellet’ unless otherwise stated in cases where ‘agropellet’ is specified.

**CO₂ₑq (Carbon Dioxide Equivalent)**

Carbon dioxide equivalent is the standard unit for comparing the global warming potential of any greenhouse gas over a specified period of time. In this way, the relative severity of all greenhouse gas emissions can be evaluated in terms of one agreed reference point.

**CHP heat pellets consumption/use**

Volume of pellets used for the heat production within a combined heat and power appliance (CHP) corresponding to 2/3 of the total volume of pellets used in the CHP.

**CHP electricity pellets consumption/use**

Volume of pellets used for electricity production within a combined heat and power appliance (CHP) corresponding to 1/3 of the total volume of pellets used in the CHP.

**Commercial consumption/use**

Volume of pellets used in dedicated heat boilers with a capacity greater than 50 kW. This class includes dedicated heat boilers used in residential buildings, public buildings, services, industry and excludes combined heat and power appliances (CHP).

**Dedicated power pellets consumption/use**

Volume of pellets used for electricity production in a plant only producing electricity without recovering the heat generated during the process.

**Derived heat**

According to Eurostat, derived heat covers the total heat production in heating plants and in combined heat and power plants. It includes the heat used by the auxiliaries of the installation which use hot fluid and losses in the installation/network heat exchanges. For auto-producing entities (= entities generating electricity and/or heat wholly or partially for their own use as an activity which supports their primary activity) the heat used by the undertaking for its own processes is not included.

**Industrial pellet consumption**

Pellet consumed in large scale CHP and Power plant

**Pellet consumption for heat production**

Without a specific note this corresponds to the volume of pellets used for residential, commercial use/consumption and 2/3 of the total volume of pellets used in combined heat and power plants (CHP).

**Residential consumption/use**

Volume of pellets used in domestic’s stoves and dedicated heat boilers with a capacity below 50 kW