

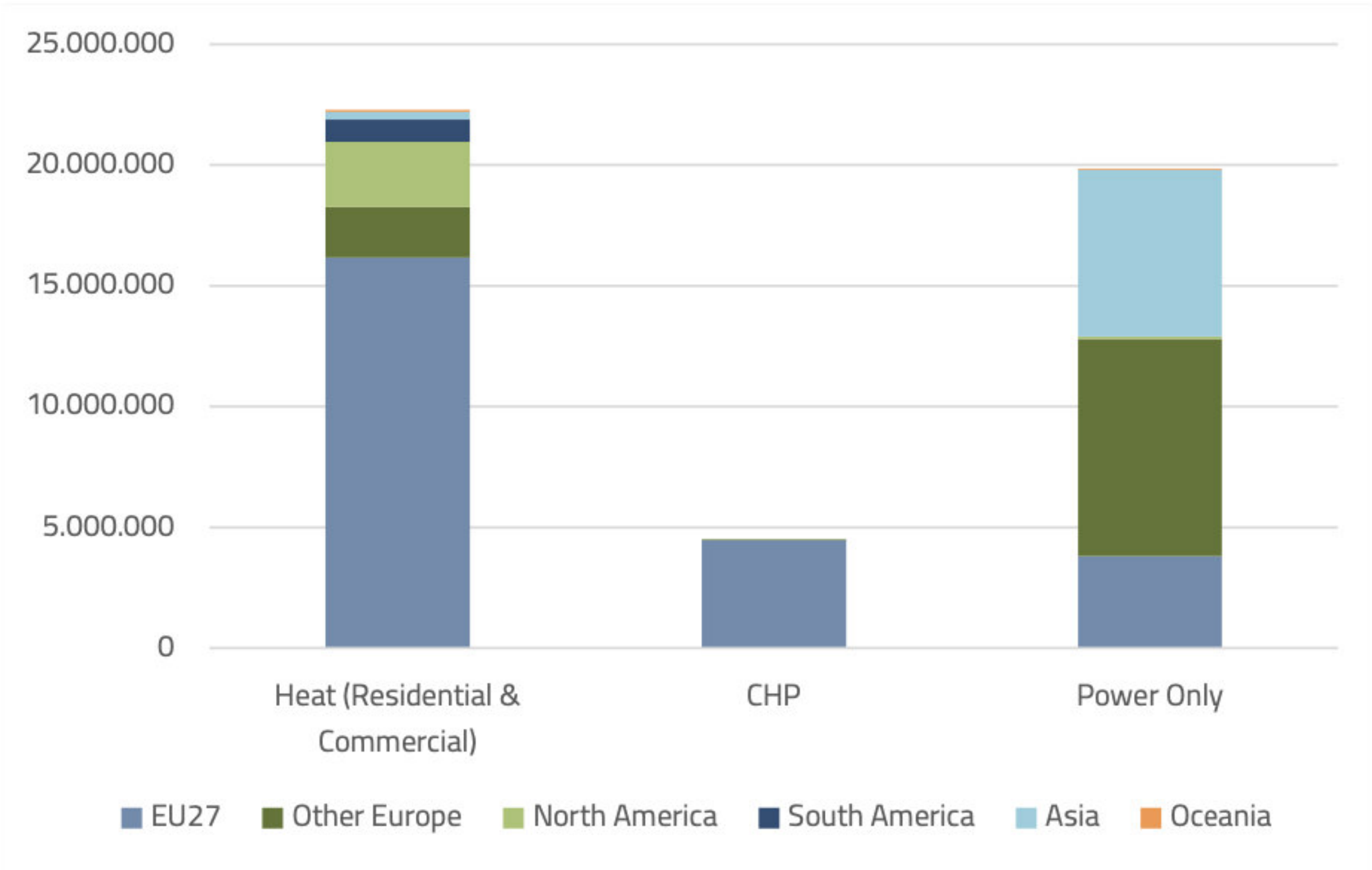


BIOENERGY EUROPE
**STATISTICAL
REPORT**
2022

REPORT **PELLETS**



Figure 5 World pellet consumption in 2021 by type of end-use (tonnes)



Note: LV, PT, US, CL, JP, KR, AU, NZ residential consumption is from 2020. FR, LV, PT, SI, SK, US, CL, NZ commercial consumption is from 2020. BE, PL, SI, CA CHP consumption is from 2020. PT, CA, NZ. Power Only consumption is from 2020.
Source: EPC survey 2022; Hawkins Wright

Figure 6 Distribution of world pellet consumption in 2021 (tonnes and %)

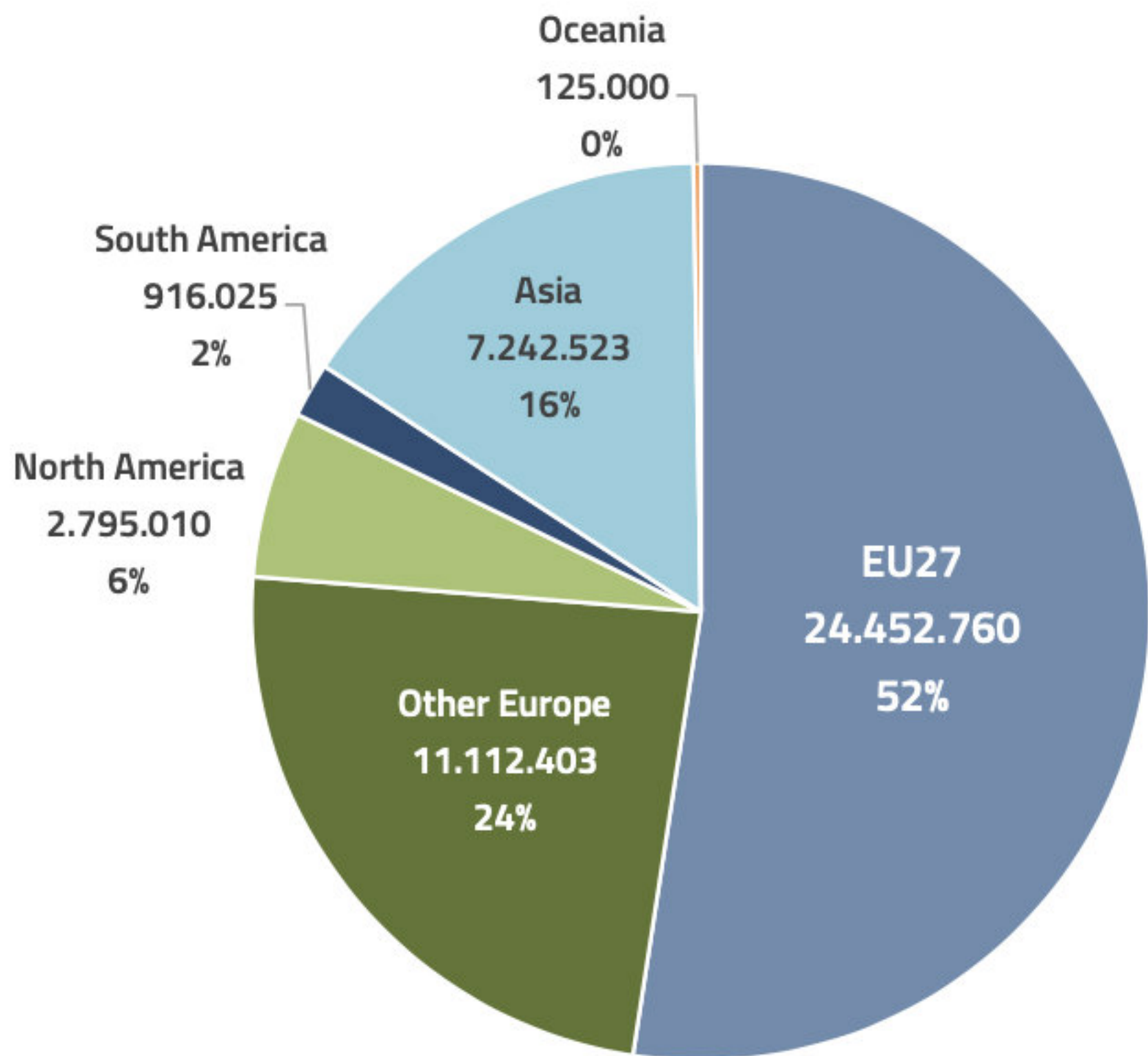
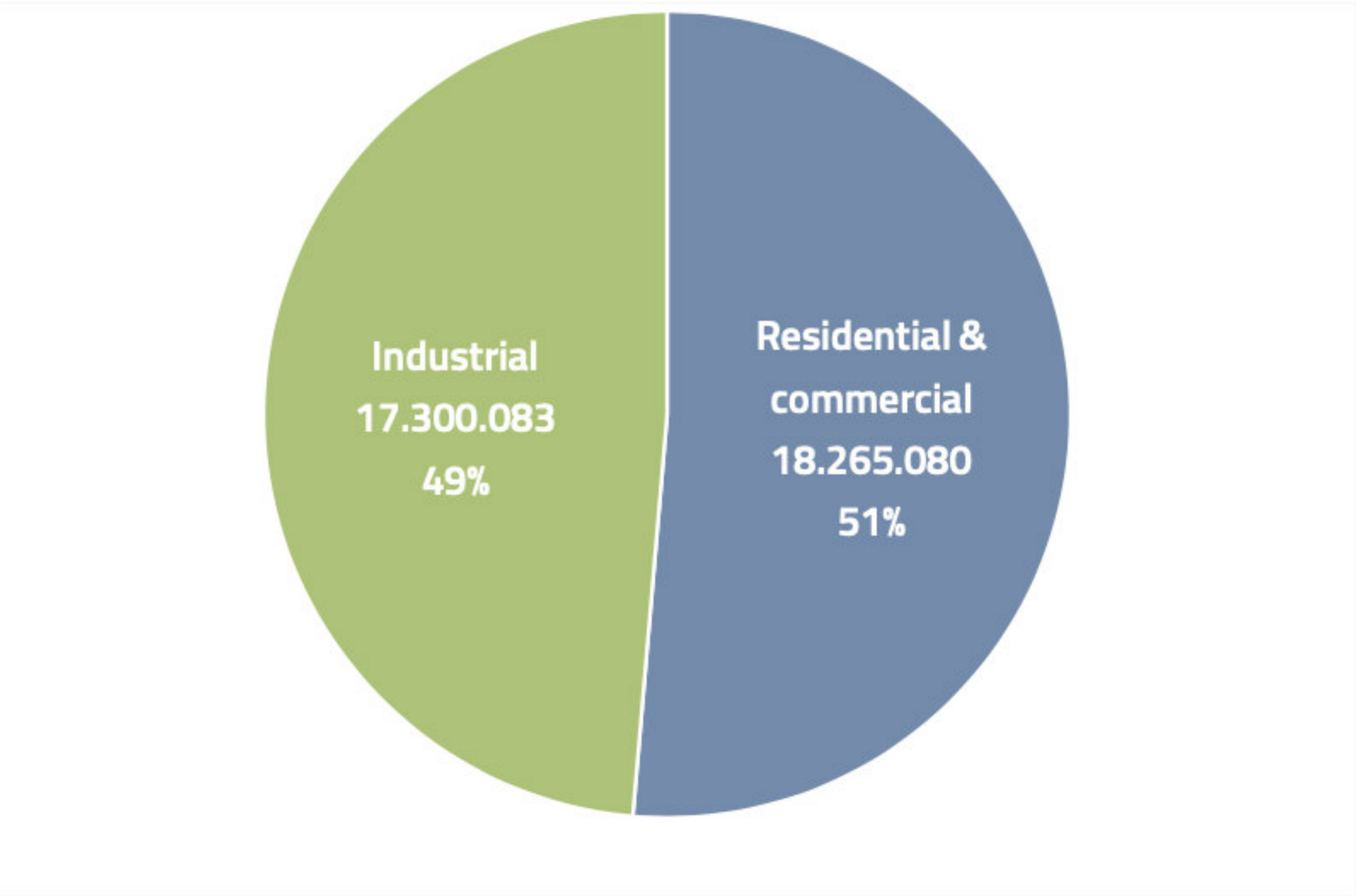
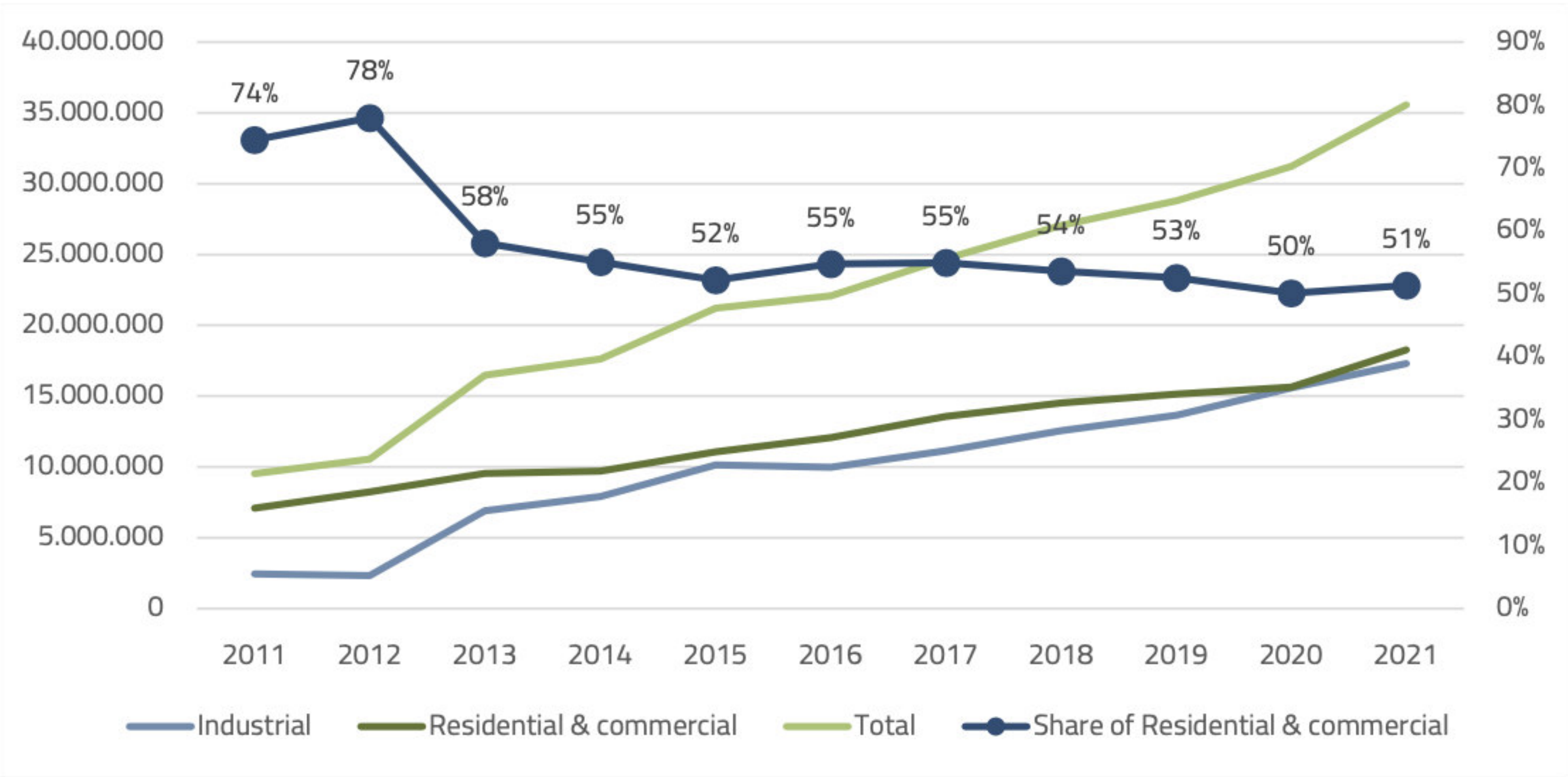


Figure 24 European pellet consumption by type of end use in 2021 (tonnes and %)



Note: LV, PT residential consumption is from 2020. FR, LV, PT, SI, SK commercial consumption is from 2020. BE, PL, SI CHP consumption is from 2020. PT Power Only consumption is from 2020.
Source: EPC survey 2022; Bioenergy International, Hawkins Wright

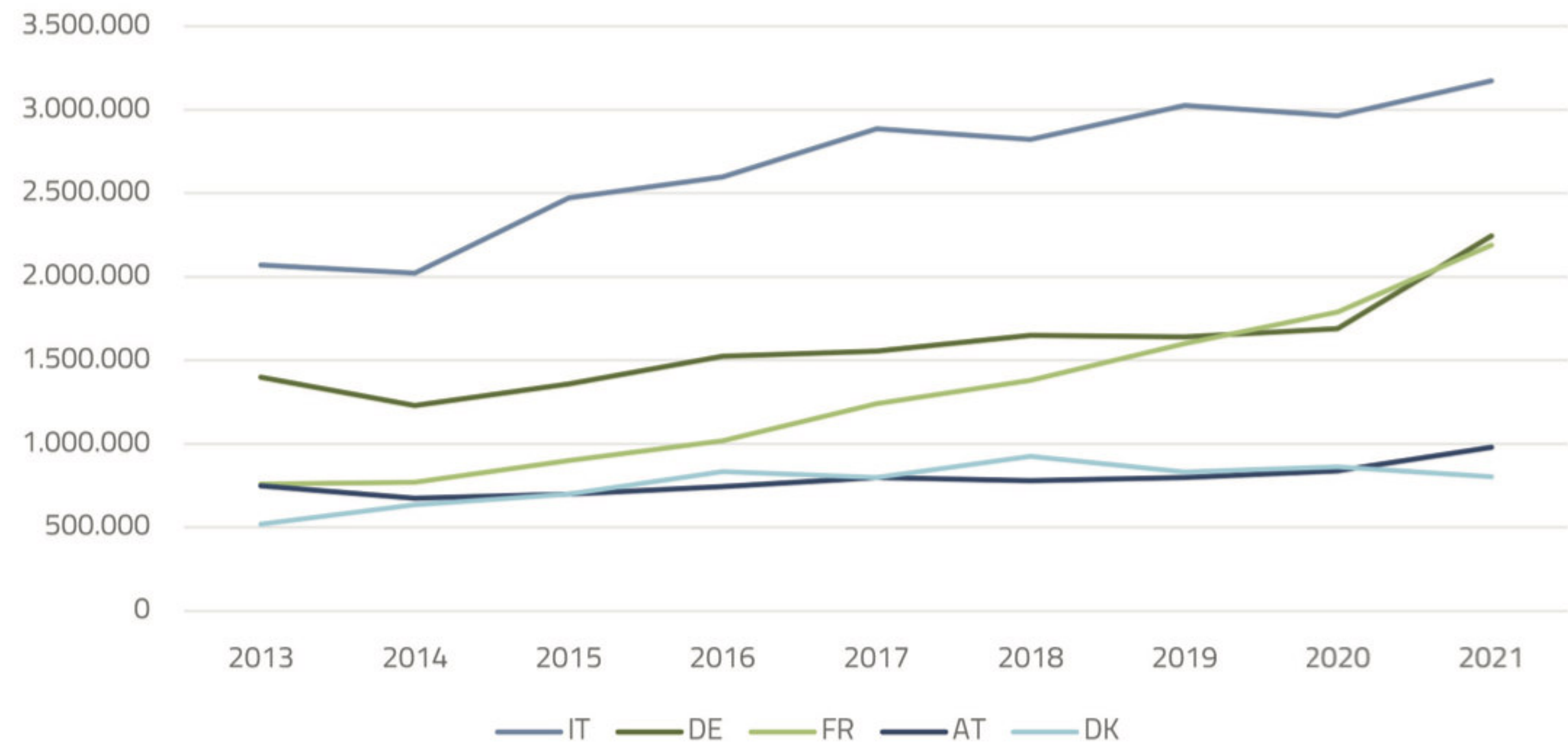
Figure 25 Evolution of pellet consumption in Europe by type (tonnes and %)



Note: LV, PT residential consumption is from 2020. FR, LV, PT, SI, SK commercial consumption is from 2020. BE, PL, SI CHP consumption is from 2020. PT Power Only consumption is from 2020.
Source: EPC survey 2022; Bioenergy International, Hawkins Wright

3.2.2.1 RESIDENTIAL PELLET CONSUMPTION

Figure 32 Evolution of Europe's top 5 countries for residential (<50kW) pellet consumption in Europe (tonnes)



ProPellets Switzerland

EXPERT COMMENT



Pellets Market in Switzerland 2021

In the year 2021 a great increase in pellets use was registered. ProPellets.ch estimates a sale of 418.000 tonnes, an increase of 22% compared to 2020. 198.000 tonnes were ENplus certified, an increase of 20% compared to the previous year. ProPellets.ch estimates the total production in Switzerland at 324.000 tons (+20%) of which 271.000 tonne (+16%) were ENplus certified. Import remains at the same low level as in 2020, with 80.000 tonnes there was only a minor increase of 2% compared to 2020. With 43.500 tonnes, more than half of the imported pellets were ENplus certified, an increase of 0.8% compared to 2020. Overall, the production, trade and import of ENplus certified pellets did not increase in the same volume as the total volume.

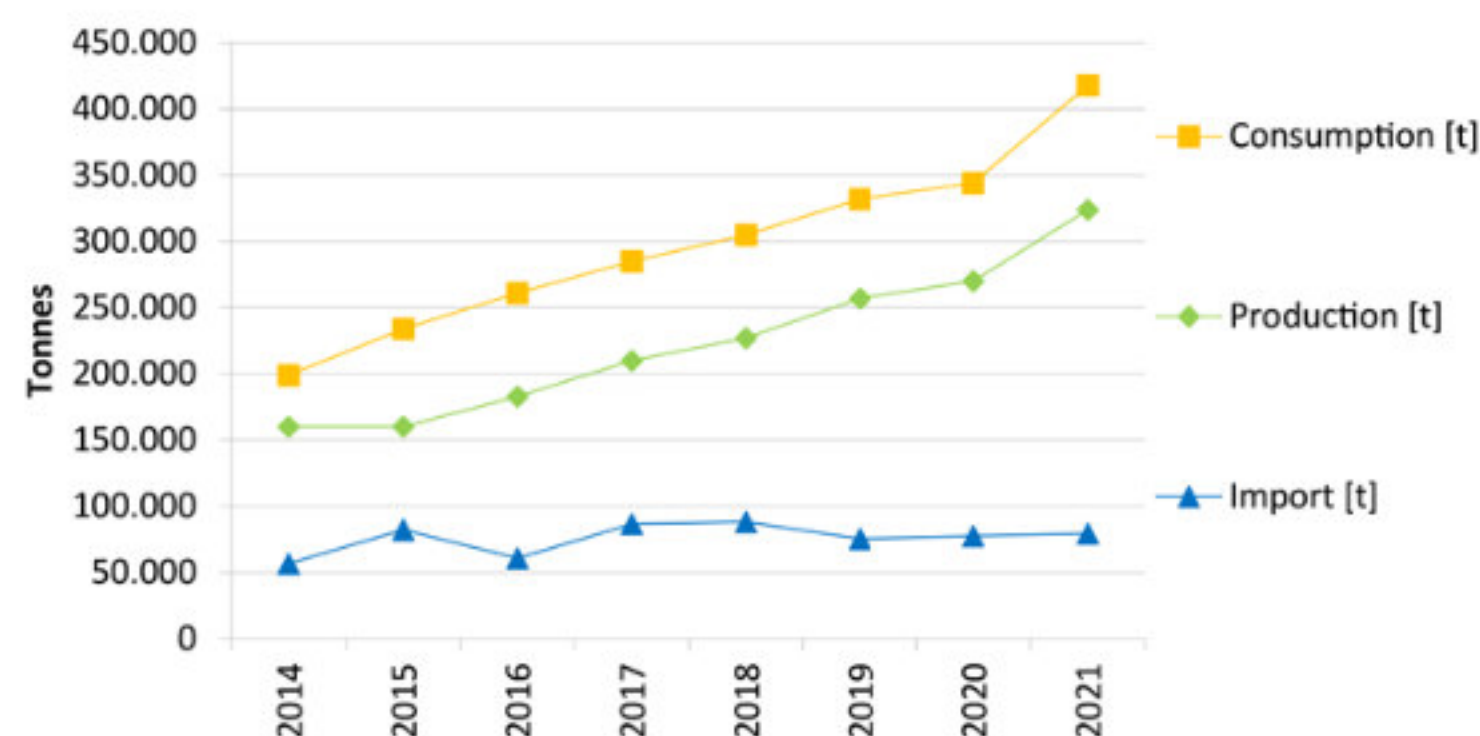
These figures are collected by ProPellets.ch during the monthly production and trade survey and the customs statistics of the Swiss federation. The production of about 10 small producers of pellets which do not participate in the surveys of ProPellets.ch are estimated at 35.000 tonnes and are included in the statistics.

The whole market around pellets registered in 2021 a much larger increase than the previous years. Pellet boiler sales increased by 46% compared to 2020 and many producers invested in expanding their production. Still, the higher demand could be covered by the increased production, even if it was a close call. To minimize the risk of a pellet shortage and ensure supplies in short and long term, ProPellets.ch increased the market analysis and is in close contact with the federal office for national economic supply.

2021 was a tense year and we expect the next few years to be at least as demanding.

Sabine L'Eplattenier-Burri
Managing Director
ProPellets.ch

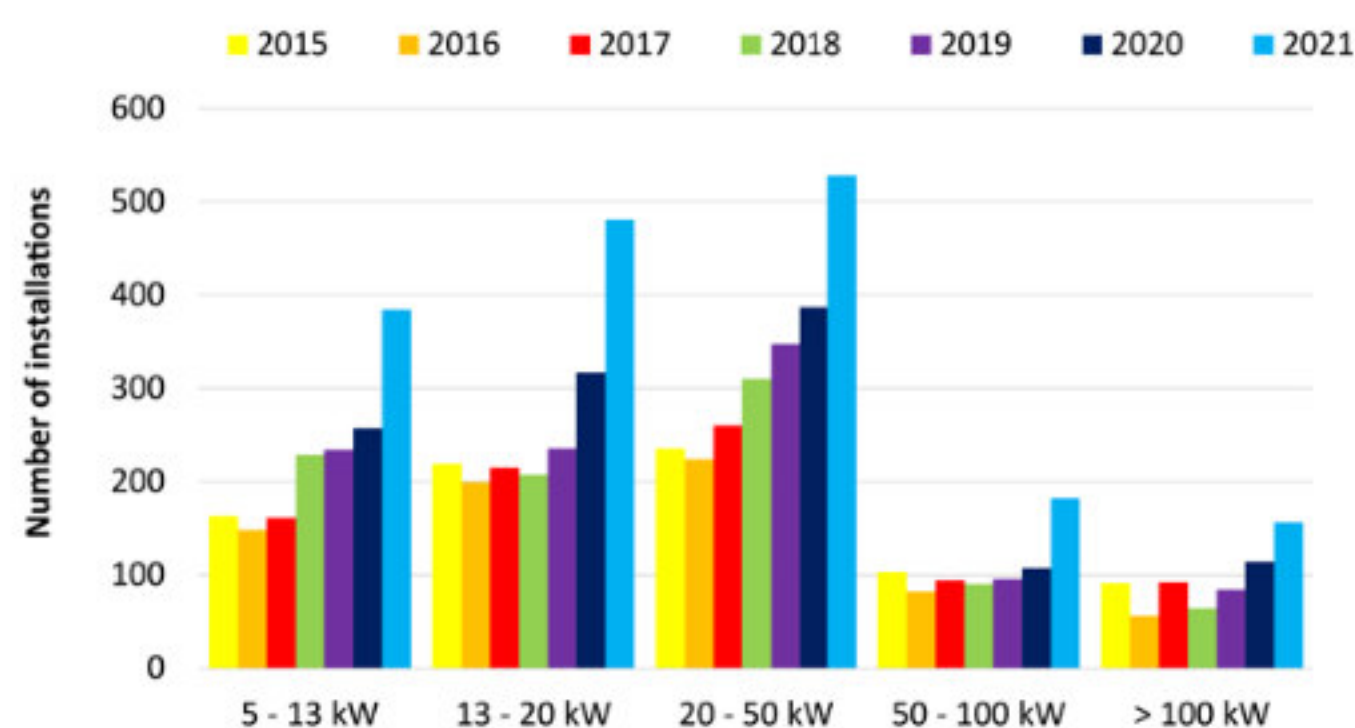
Development of the pellet market in Switzerland



Source: proPellets.ch, Swiss federal statistical office 2021



Pellet boilers sold in Switzerland



Source: Holzfeuerungen Schweiz 2021

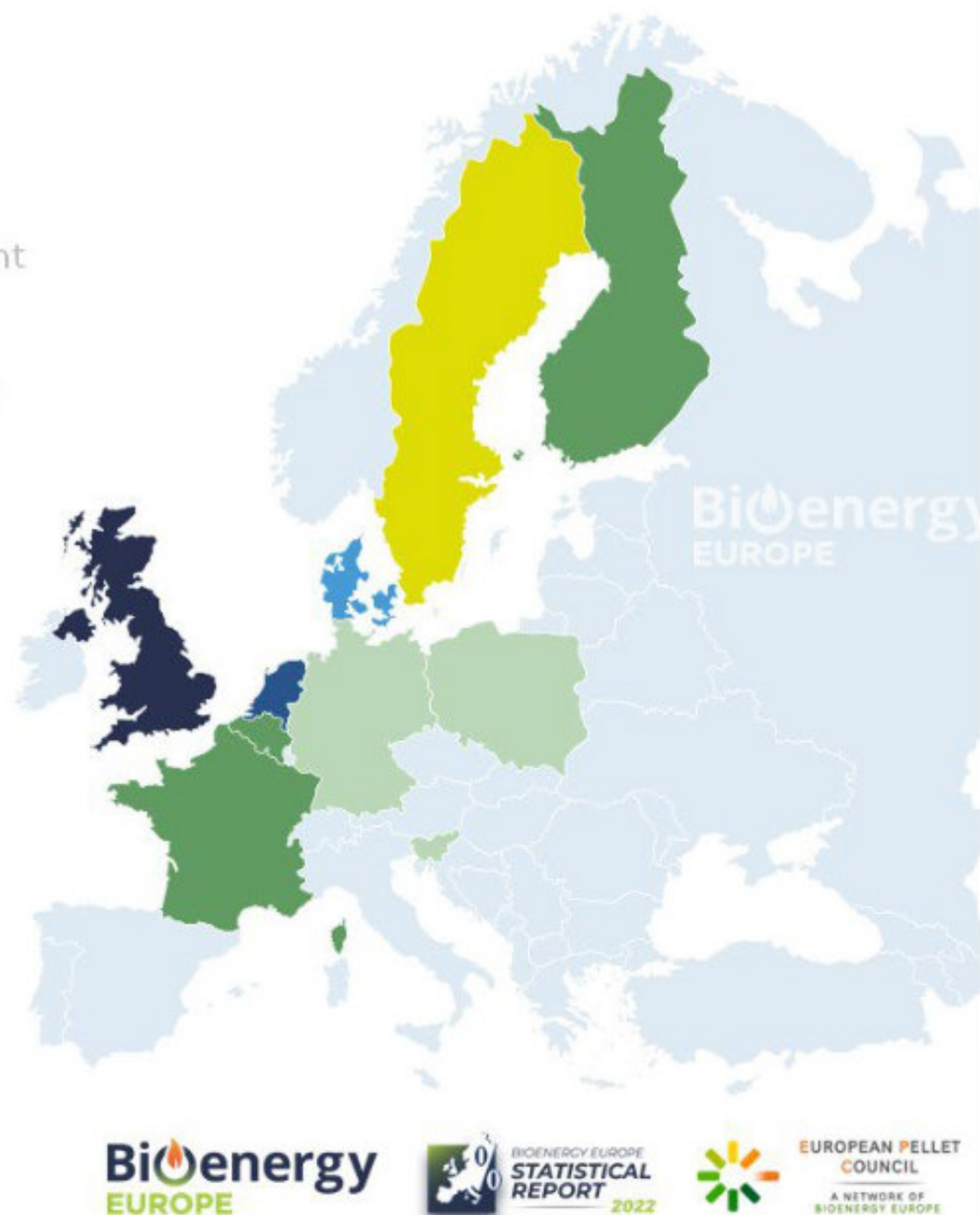
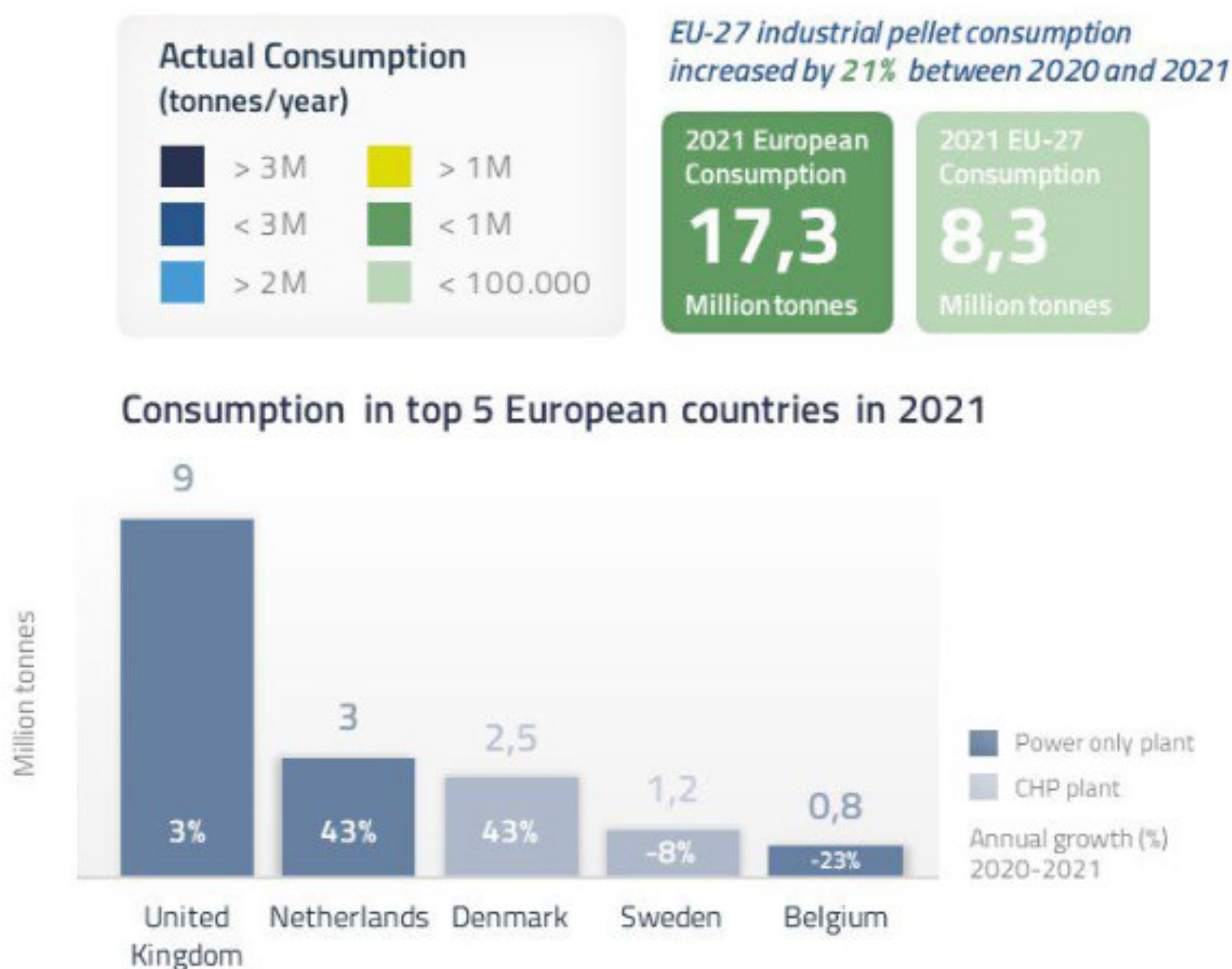


3.2.3 European industrial pellet consumption

Figure 43 European map of industrial pellet consumption in 2021

European Industrial Wood Pellet Consumption

(in 2021, tonnes, %) Source: EPC Survey 2022, Hawkins Wright



Source: EPC survey 2022, Hawkins Wright

Percent of homes with pellet stoves. The top five are Italy, France, Spain, Austria, and Germany.

IT	7,11%
FR	4,62%
ES	2,31%
AT	1,44%
DE	0,57%
SE	0,47%
EL	0,38%
HR	0,26%
LV	0,26%
CZ	0,20%
SK	0,04%

3.3.2 European residential boiler market

Table 11 Average percentage of households with pellet boilers in 2021 in select European countries (%)

AT	3,89%
LV	1,61%
SE	1,28%
PL	0,82%
DE	0,81%
CZ	0,81%
IT	0,53%
FR	0,41%
SK	0,35%
ES	0,32%
EL	0,15%
HR	0,06%

Extraordinary times for the residential pellet boiler market

In 2021, the momentum of recent years continued. Pellet heating is now considered an established solution in most regions of Europe. To follow the demand, all manufacturers of boilers have greatly expanded their production capacities. In our case, the production volume was even tripled within two years.

Until now, the main target group was clearly the 18 million oil-fired heating systems still in operation in Europe.

Since the war in Ukraine, however, the target group of gas heaters is gaining strongly in importance. Many customers are extremely insecure and also want to get away from gas for moral reasons. Above all, however, the prices for gas have risen sharply in many countries and heating is often no longer affordable for homeowners.

This customer segment is more difficult for the pellet heating market because these customers are not used to needing space for fuel storage, but on the other hand the market is several dimensions larger and even a few percent shift has a big impact. In Germany, Austria and France alone, 1.4 million gas heating systems were sold last year. That is 69% of all heating systems sold! By comparison, pellet boilers were sold 101,000 units in these countries in 2021.

Unfortunately, however, the market for pellets has not been spared the effects of the war and the associated energy crisis in Europe. Sharply increased prices and, in some cases, poor availability cost us a lot of confidence among end customers.



Trust is also being lost with the discussion about REDIII. It is completely incomprehensible how EU politicians, in the midst of the biggest energy crisis in post-war history, question the only year-round renewable energy source, sustainable forest products. Even more so when pellets for the heating market are predominantly produced from sawmill residues and are therefore a prime example of circular economy.

Despite the negative headlines surrounding these issues, however, more and more people want to switch to green heat from pellets. Technologically, a lot has happened in recent years. Today, there are devices that are ultra-clean and highly efficient. And the most important thing: the switch can be made NOW and immediately brings independence and climate protection.

Therefore, we are still firmly convinced that pellets will play a major role in the heating market of the future. In addition to good and affordable products, this requires above all reliability in the supply and prices of pellets. We are all hopeful to get this back in the course of the next months.

Stefan Ortner
CEO
ÖkoFEN

3.5 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. Moreover, the high unpredictability of today's market makes it difficult to provide any kind of forecast on its development.

Table 17 VAT rate for pellets compared with general VAT rate applied in select European countries in 2021 (%)

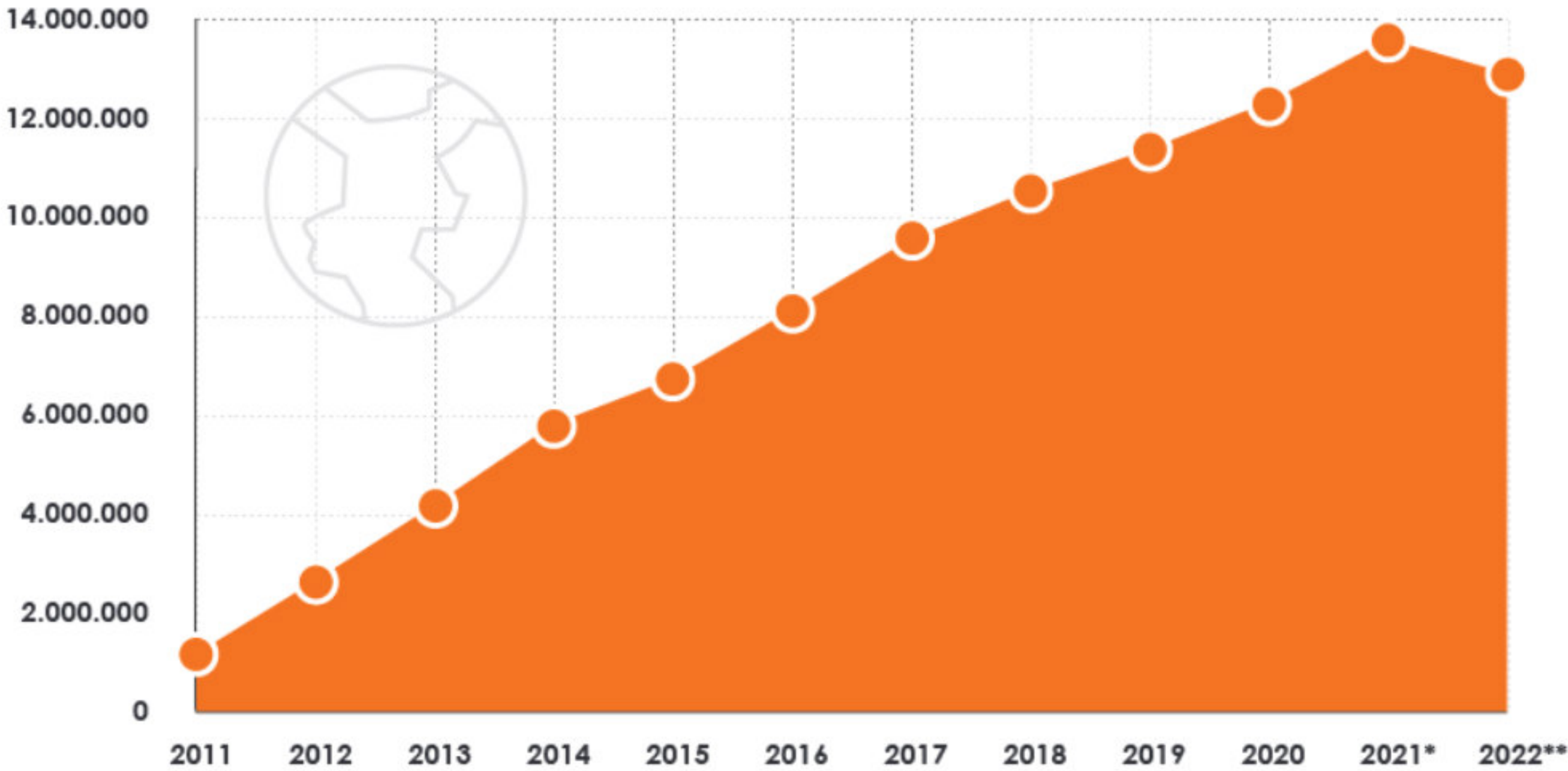
	2021 VAT rate for wood pellets (in %)	2021 General VAT rate (in %)
AL	20	20
AT	13	20
BA	17	17
CZ	15	21
DE	7	19
EL	24	24
ES	21	21
IT	22	22
LV	12	21
ME	21	21
PT	23	23
RO	19	19
RS	10	20
SK	20	20

4 Focus on ENplus®

Figure 67 Worldwide ENplus® certified production from 2011 to 2022 (tonnes)

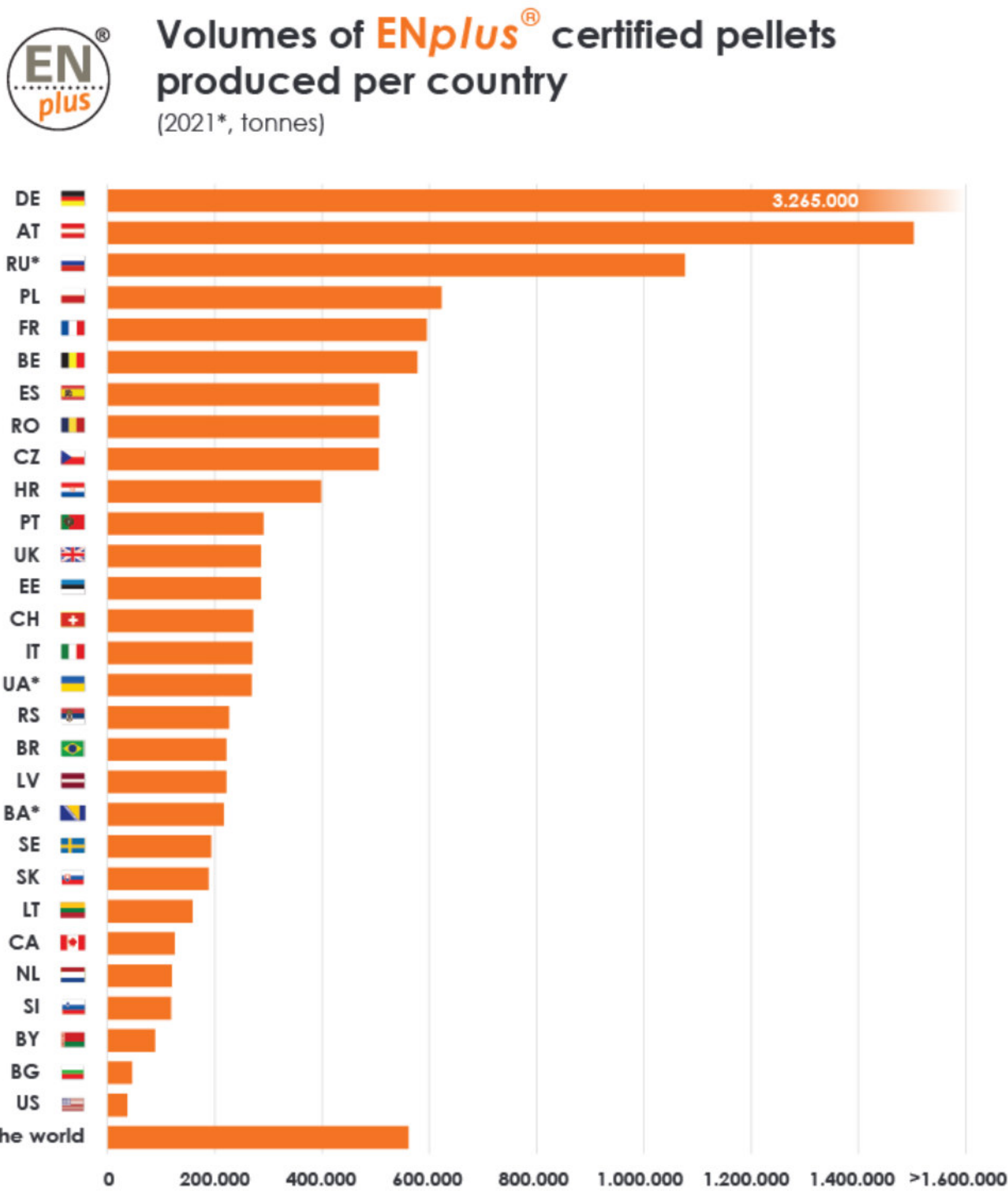


Worldwide ENplus® certified pellet production
(from 2011 to 2022**, tonnes)



*Estimated. Due to the war situation numbers for Ukraine, Russia and Belarus could not be confirmed.
**Estimated. The numbers do not include Russian and Belarussian estimates.

Figure 73 Volumes of ENplus® certified pellets produced by the top 20 countries in 2021 (tonnes)



*Due to the war situation numbers for Ukraine, Russia



ENplus® Communication

Statistical Report

OCTOBER 2022

Fraud updates – General overview

Since mid-2022, the ENplus® Management has witnessed a sharp increase in the number of counterfeit certificates reported by both certified companies, scheme partners, and end-users, to its fraud management team, now representing 53% of all trademark fraud investigated and managed by ENplus®. The sudden rise in certificate falsifications could be explained by the growing demand for pellets, leading to a surge in such fraudulent practices. This wave of new reported fraud is particularly noticeable in Poland (15% share of all fraud cases received in 2022), Ukraine (9%), Germany (8%) and the Netherlands (6%). Additionally, 25% of new fraud has an unknown origin.

Bioenergy Europe and the National Licensors of ENplus® continue to place significant effort and resources into combating fraud. Practically, 130 fraud cases have been or are currently being handled by this network of partners since the beginning of 2022, of which more than a third (or 35%) is already solved, for a total of 832 fraud cases solved by ENplus® since 2014 (63% of all cases handled). Moreover, an additional 22 infringing companies were included this year on the ENplus® Blacklist, available on the ENplus® website (173 in total since 2014), making their actions known to the wider public, and thus safeguarding the pellet market as a whole.

The recent figures give an overview of the positive results of fraud fighting and highlight once again the importance of this activity. Last year, the total number of cases processed since 2014 reached the symbolic mark of 1000, and as of October 2022, more than 1300 cases have or are being dealt with, an all-time high. In 2022, marketing fraud (the unauthorised use of ENplus® in communication material) is the type of fraud with the second highest percentage (29%), followed by product misuses (the fraudulent use of the ENplus® seal on pellet bags) as the third most common type of fraud handled (13%). Finally, a small number of cases (5%) do not fit into any of those categories.

Eoin Stuckens

ENplus® Fraud Officer
Bioenergy Europe



Figure 76 ENplus® fraud cases per type of fraud from January 2022 until September 2022

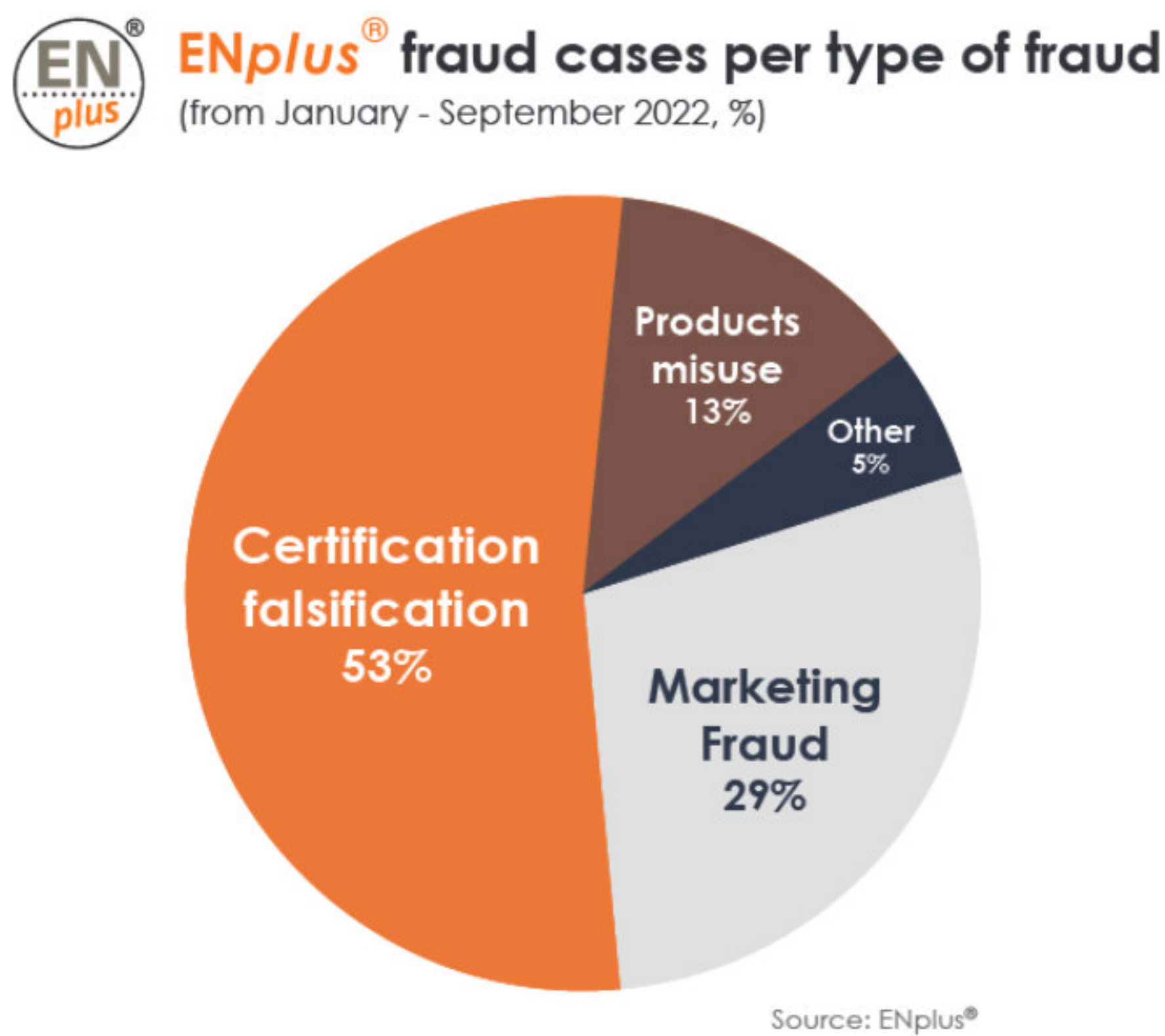
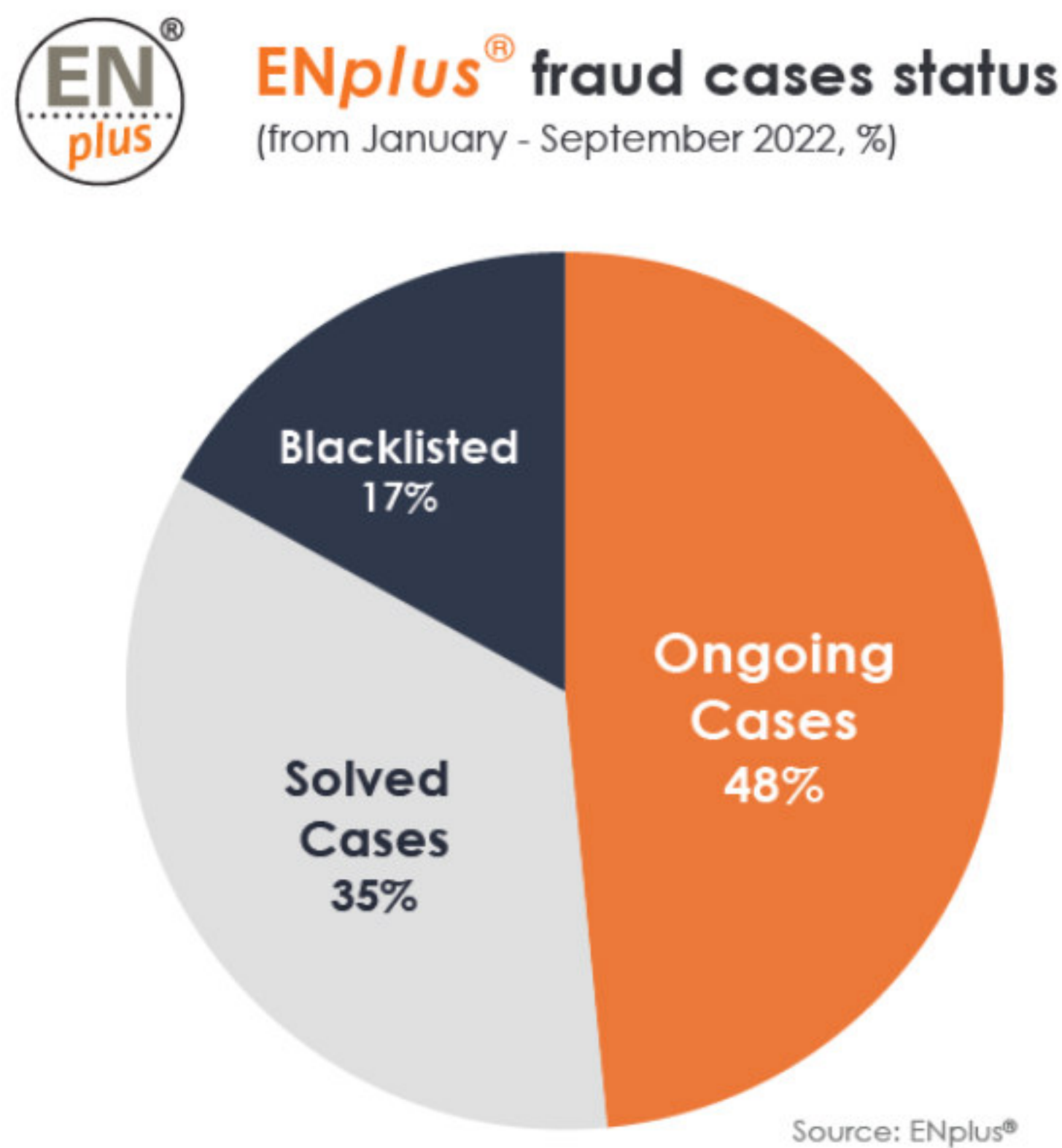


Figure 77 ENplus® fraud cases status from January 2022 until September 2022



COUNTRY ABBREVIATIONS

EU27	European Union (27 members)
AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovak Republic

AL	Albania
AU	Australia
BA	Bosnia Herzegovina
BR	Brazil
BY	Belarus
CA	Canada
CH	Switzerland
CL	Chile
CN	China
ID	Indonesia
JP	Japan
KR	South Korea
ME	Montenegro
MY	Malaysia
NO	Norway
NZ	New Zealand
RS	Republic of Serbia
RU	Russia
TH	Thailand
UA	Ukraine
UK	United Kingdom
US	United states of America
VN	Vietnam

Conventions to geographic regions:

EU27: 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, Belarus, Bosnia Herzegovina, Montenegro, Norway, Russia, Serbia, Switzerland Ukraine, United Kingdom

Europe: EU27+other European countries

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

Baltic countries: Estonia, Latvia, Lithuania

FUEL PROPERTIES OF SELECTED BIOMASS FUELS

Fuel	Net calorific value, dry content (kWh/kg) (moisture content 0%) ($q_{p,net,d}$)	Moisture content w-% (ar)	Net calorific value, as received=actual value (kWh/kg) ($q_{p,net,ar}$)	Bulk density (kg/loose m ³)	Energy density (MWh/loose m ³)	Ash content, dry (%)
Sawdust	5,28-5,33	45-60	0,60-2,77	250-350	0,45-0,70	0,4-0,5
Bark, birch	5,83-6,39	45-55	2,22-3,06	300-400	0,60-0,90	1-3
Bark, coniferous	5,14-5,56	50-65	1,38-2,50	250-350	0,50-0,70	1-3
Plywood chips	5,28-5,33	5-15	4,44-5,00	200-300	0,9-1,1	0,4-0,8
Wood pellets	5,26-5,42	7-8	4,60-4,90	550-650	2,6-3,3	0,2-0,5
Steam wood chips	5,14-5,56	40-55	1,94-3,06	250-350	0,7-0,9	0,5-2,0
Log wood (oven-ready)	5,14-5,28	20-25	3,72-4,03	240-320	1,35-1,95	
Logging residue chips	5,14-5,56	50-60	1,67-2,50	250-400	0,7-0,9	1,0-3,0
Whole tree chips	5,14-5,56	45-55	1,94-2,78	250-350	0,7-0,9	1,0-2,0
Reed canary grass (spring harvested)	4,78-5,17	8-20	3,70-4,70	70	0,3-0,4	1,0-10,0
Reed canary grass (autumn harvested)	4,64-4,92	20-30	3,06-3,81	80	0,2-0,3	5,1-7,1
Grain	4,8	11	4,30	600	2,6	2
Straw, chopped	4,83	12-20	3,80-4,20	80	0,3-0,4	5
Miscanthus, chopped	5,0	8-20	3,86-4,06	110-140	1,72-2,19	2,0-3,5
Straw pellets	4,83	8-10	4,30-4,40	550-650	2,4-2,8	5
Olive cake (olive pomace)	4,9-5,3	55-70	1,00-3,10	800-900	1,46-1,64	2-7
Olive cake (olive marc)	4,9-5,3	<10	4,30-4,70	600-650	2,6-2,9	2-7

ENplus® REQUIREMENTS FOR WOOD PELLETS

Quality class	ENplus® A1	ENplus® A2	ENplus® B	Unit	Testing standard
Diameter (as received)	$6 \pm 1, 8 \pm 1$	$6 \pm 1, 8 \pm 1$	$6 \pm 1, 8 \pm 1$	mm	ISO 17829
Length (as received)	$3,15 \leq L \leq 40$ (a)	$3,15 \leq L \leq 40$ (a)	$3,15 \leq L \leq 40$ (a)	mm	ISO 17829
Share of pellets with a length < 10 mm (as received)	value & category to be stated	value & category to be stated	value & category to be stated	w-%	ENplus® Guidance Document (b)
- Category L < 20%, $20\% \leq M \leq 30\%$, $S > 30\%$					
Moisture (as received)	$\leq 10,0$	$\leq 10,0$	$\leq 10,0$	w-%	ISO 18134
Ash (dry basis)	$\leq 0,70$	$\leq 1,20$	$\leq 2,00$	w-%	ISO 18122
Mechanical durability (as received) (c)	$\geq 98,0$	$\geq 97,5$	$\geq 97,5$	w-%	ISO 17831-1
Bulk density (as received)	$600 \leq BD \leq 750$	$600 \leq BD \leq 750$	$600 \leq BD \leq 750$	kg/m³	ISO 17828
Particle density (as received)	value to be stated	value to be stated	value to be stated	g/cm³	ISO 18847
Coarse fines ($3,15 \text{ mm} \leq FP < 5,6 \text{ mm}$) (as received)	value to be stated	value to be stated	value to be stated	w-%	analysis based on ISO 18846 (d, e, f, g)
Fines (< 3,15 mm) (bulk) (as received)	$\leq 1,0$	$\leq 1,0$	$\leq 1,0$	w-%	ISO 18846 (d, f, g)
Fines (< 3,15 mm) (bags) (as received)	$\leq 0,5$	$\leq 0,5$		w-%	ISO 18846 (e, f, g)
Net calorific value (as received)	$\geq 4,6$ (h)	$\geq 4,6$ (h)	$\geq 4,6$ (h)	kWh/kg	ISO 18125
Additives (as received)	$\leq 2,0$ (i)	$\leq 2,0$ (i)	$\leq 2,0$ (i)	w-%	
Nitrogen (dry basis)	$\leq 0,3$	$\leq 0,5$	$\leq 1,0$	w-%	ISO 16948
Sulfur (dry basis)	$\leq 0,04$	$\leq 0,04$	$\leq 0,04$	w-%	ISO 16994
Chlorine (dry basis)	$\leq 0,02$	$\leq 0,02$	$\leq 0,03$	w-%	ISO 16994
Arsenic (dry basis)	≤ 1	≤ 1	≤ 1	mg/kg	ISO 16968
Cadmium (dry basis)	$\leq 0,5$	$\leq 0,5$	$\leq 0,5$	mg/kg	ISO 16968
Chromium (dry basis)	≤ 10	≤ 10	≤ 10	mg/kg	ISO 16968
Copper (dry basis)	≤ 10	≤ 10	≤ 10	mg/kg	ISO 16968
Lead (dry basis)	≤ 10	≤ 10	≤ 10	mg/kg	ISO 16968
Mercury (dry basis)	$\leq 0,1$	$\leq 0,1$	$\leq 0,1$	mg/kg	ISO 16968
Nickel (dry basis)	≤ 10	≤ 10	≤ 10	mg/kg	ISO 16968
Zinc (dry basis)	≤ 100	≤ 100	≤ 100	mg/kg	ISO 16968
Ash deformation temperature	≥ 1200	≥ 1100	≥ 1100	°C	ISO 21404 (j)