Bioenergy – Distributed power generation

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18 March 2016

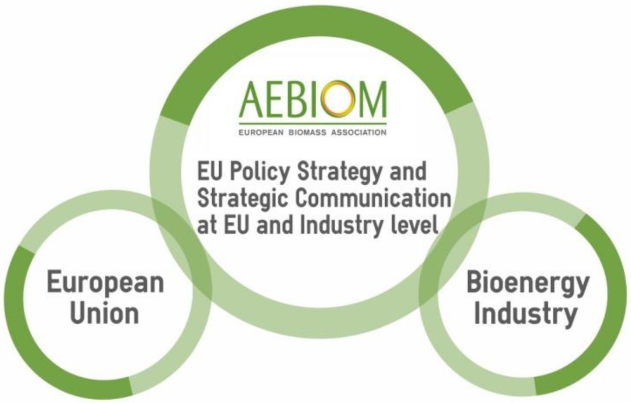
AEBIOM

EUROPEAN BIOMASS ASSOCIATION

common voice of the European bioenergy sector for the past 25 years

non-profit, Brussels based association founded in 1990

How it works



30 Full Members
90 Associate Members
from all over the world

Umbrella of 3 Networks

EUROPEAN PELLET COUNCIL — EPC is an umbrella organisation representing the interests of the European wood pellet sector.

EUROPEAN INDUSTRY OF PELLET SUPPLIERS — EIPS is a platform of European companies focused on the wood pellet business.

INTERNATIONAL BIOMASS TORREFACTION COUNCIL — IBTC is a platform of international companies promoting the use of torrefied biomass as energy carrier.

How to stay informed and connected

AEBIOM Statistical Report

AEBIOM EUROPEAN BIOENERGY CONFERENCE 4 - 6 May 2015 Brussels, Begium www.aebiom.org/conference

AEBIOM Bioenergy Conference

BIOMASS COUNTS

Biomass Counts Campaign

AEBIOM MEMBERS

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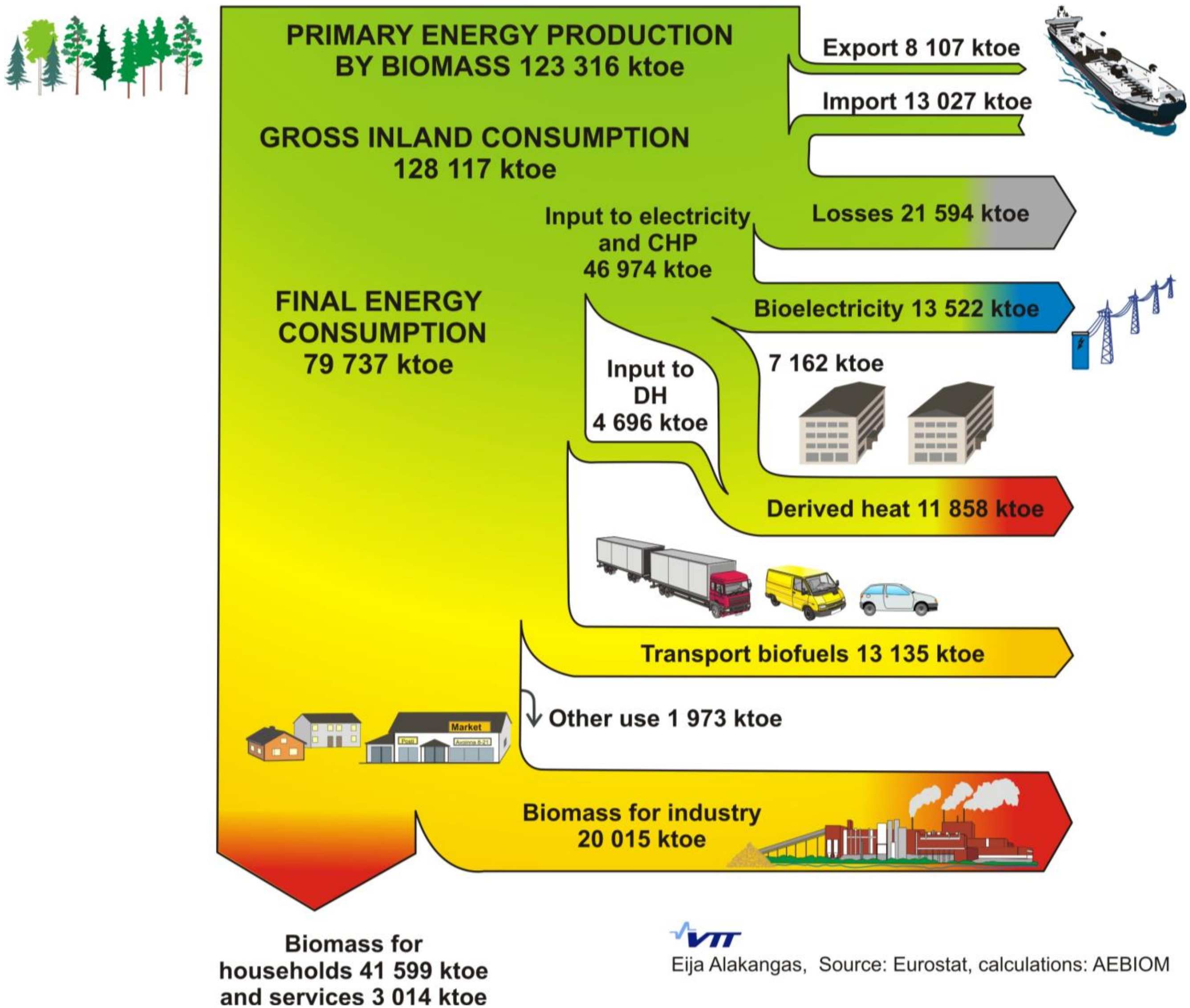
Full Members

- Österreichischer Biomasse-Verband
- CEBio
- HellaBiom Hellenic Biomass Association
- C.A.R.M.E.N.
- CZ Biom Czech Biomass Association
- DI Bioenergy
- AEOB
- France Biomasse FBE Energie
- BBE Bundesverband BioEnergie e.V.
- Irbea
- AIEL Associazione Italiana Energie Agroforestali
- ITABIA Italian Biomass Association
- LATbio Perpetuum Mobile
- LITBIOMA
- ValBiom
- ARBIO
- Udruženje Biomasa u BiH
- Südtiroler Energieverband
- AVEBIOM
- APPA
- SVEBIO
- Bioenergia
- EBÜ Eesti Biokütuste Ühing
- Platform bioenergie
- nobio Norsk Bioenergiforening

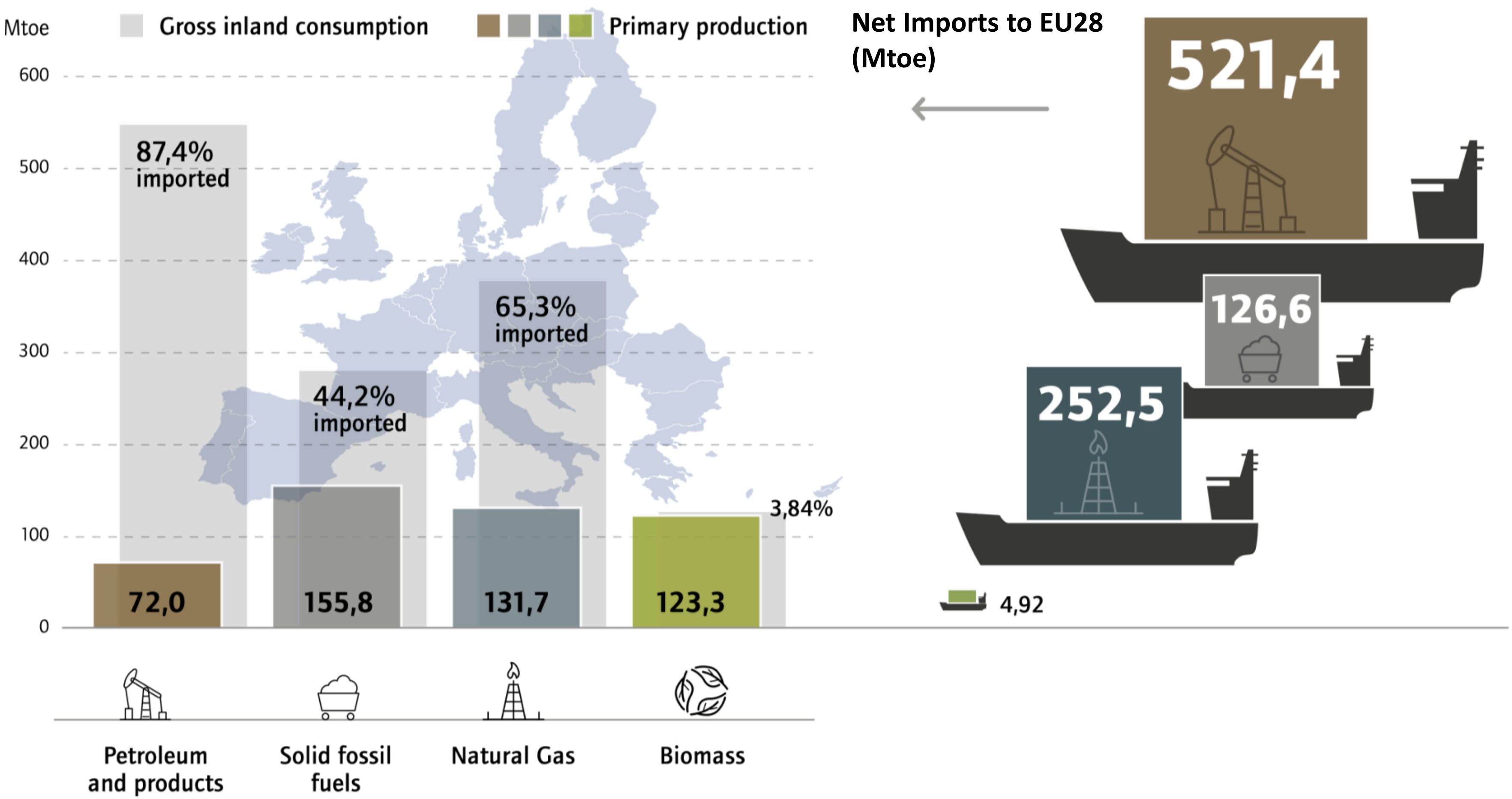
Associate Members

- APREN
- AIREX Energy
- KAHL Group
- AR-TU Kimya
- Arigna Fuels
- BENET
- Biobrændsels foreningen
- BioEndev
- CEG
- bio.wanze
- Bord na Móna
- Charmont Investments
- cmi
- CPL Industries
- CPM Europe
- Croatian Chamber of Economy
- česká peleta
- DNV·GL
- Drax
- edora
- Ekman
- ECN
- enviva
- ETA
- ifp Energies nouvelles
- EIFER
- Holzenergie Schweiz
- cra-w
- froling
- german pellets
- Asociația Producătorilor de Peleți și Brichete din România
- Göteborg Energi
- GreenWatt
- HARGASSNER
- Hawkins Wright
- Blackwood Technology
- Jeferco
- HYGEA
- heig-vd
- JENZ
- KOMPTECH
- KWB
- KG Kurzemes Granulas
- GDF SUEZ
- LATGRAN
- Marquard & Bahls
- MHG systems
- MIKTECH
- PALAZZETTI
- EURONEXT
- PETERSON
- POLYTECHNIK Biomass Energy
- ANPEB
- 2ZK
- PROPELLET
- pro pellets Austria
- Renergy UK Ltd.
- River Basin Energy
- Jeferco
- SBE Latvia
- SCHIEDEL
- River Basin Energy
- SEEGER Engineering
- SEKAB
- pro pellets Austria
- Söderenergi
- Solvay Biomass Energy
- Statkraft
- SVEASKOG
- Svenska Trädbränsleföreningen
- tsi
- Total
- VAPO
- RFT
- Torr Coal
- UK Pellet Council
- Valmet
- VICTAM
- Vision Energy Group
- windhager
- Wood Pellet Association of Canada
- Forest and Biomass Services Belgium sa
- DONG energy
- Fortum
- W&P

Bioenergy balance in 2013 (ktoe)

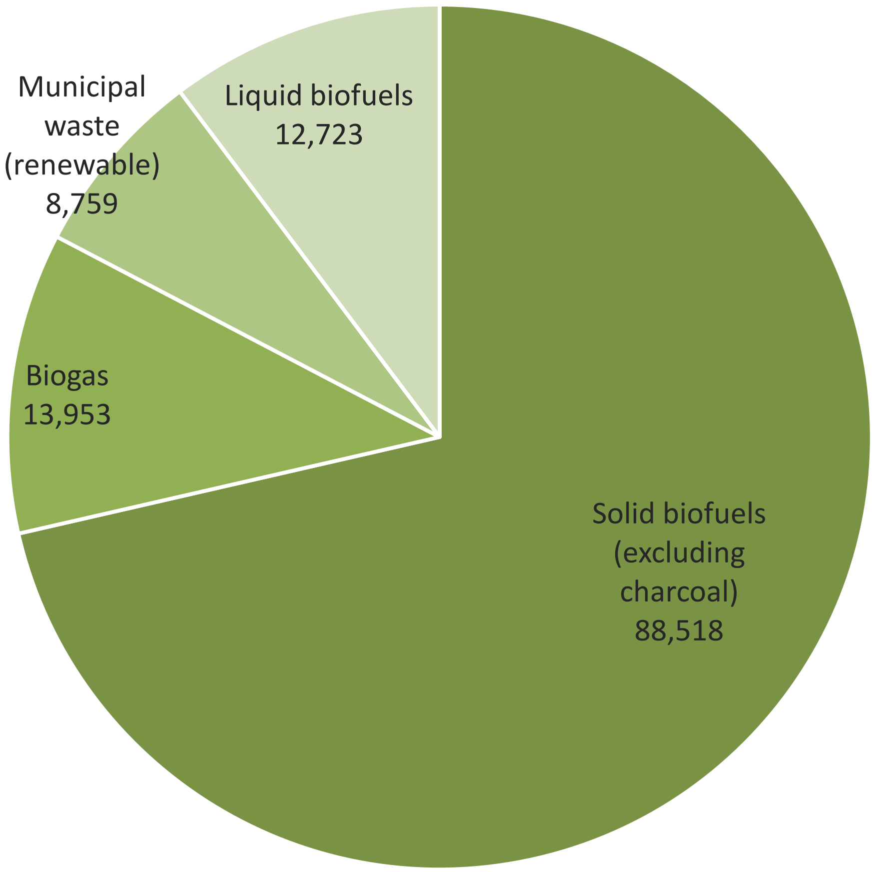


European Energy Dependency, 2013

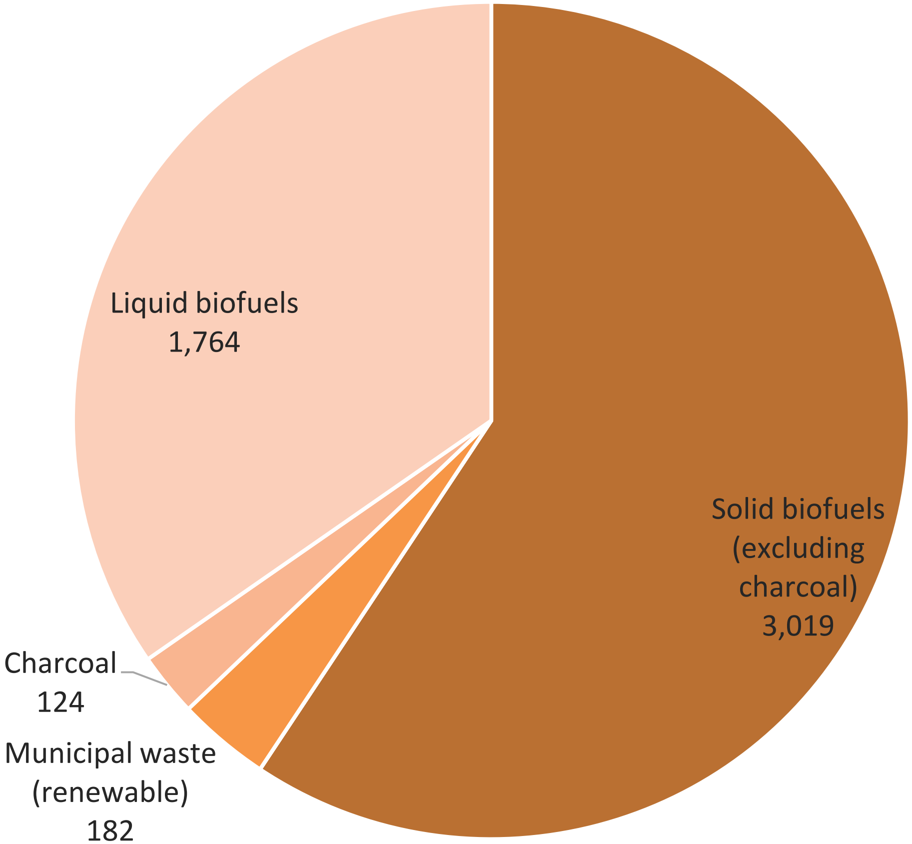


Source: AEBIOM based on Eurostat data

Primary production 2013 (ktoe)

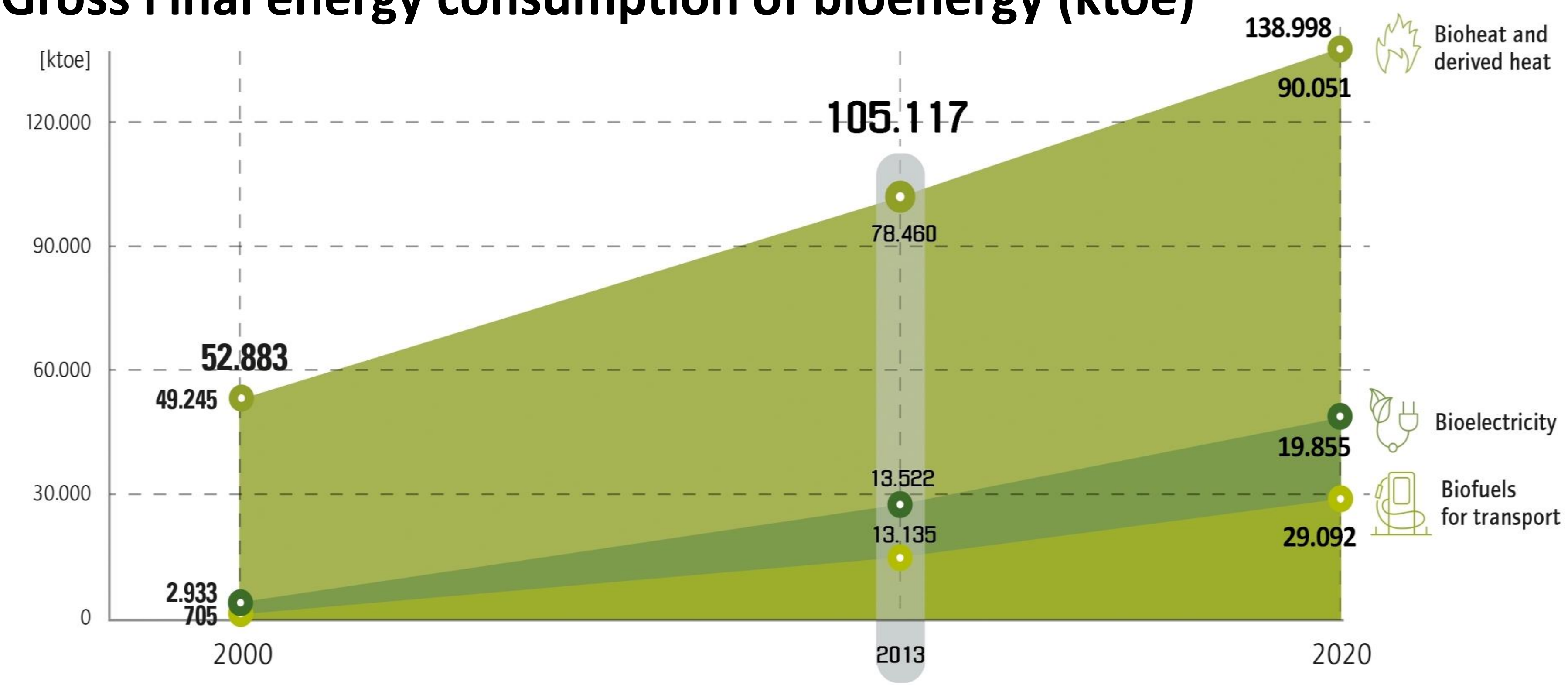


Net Imports 2013 (ktoe)



Source: AEBIOM based on Eurostat data

Gross Final energy consumption of bioenergy (ktoe)



Source: AEBIOM based on Eurostat data and NREAPs

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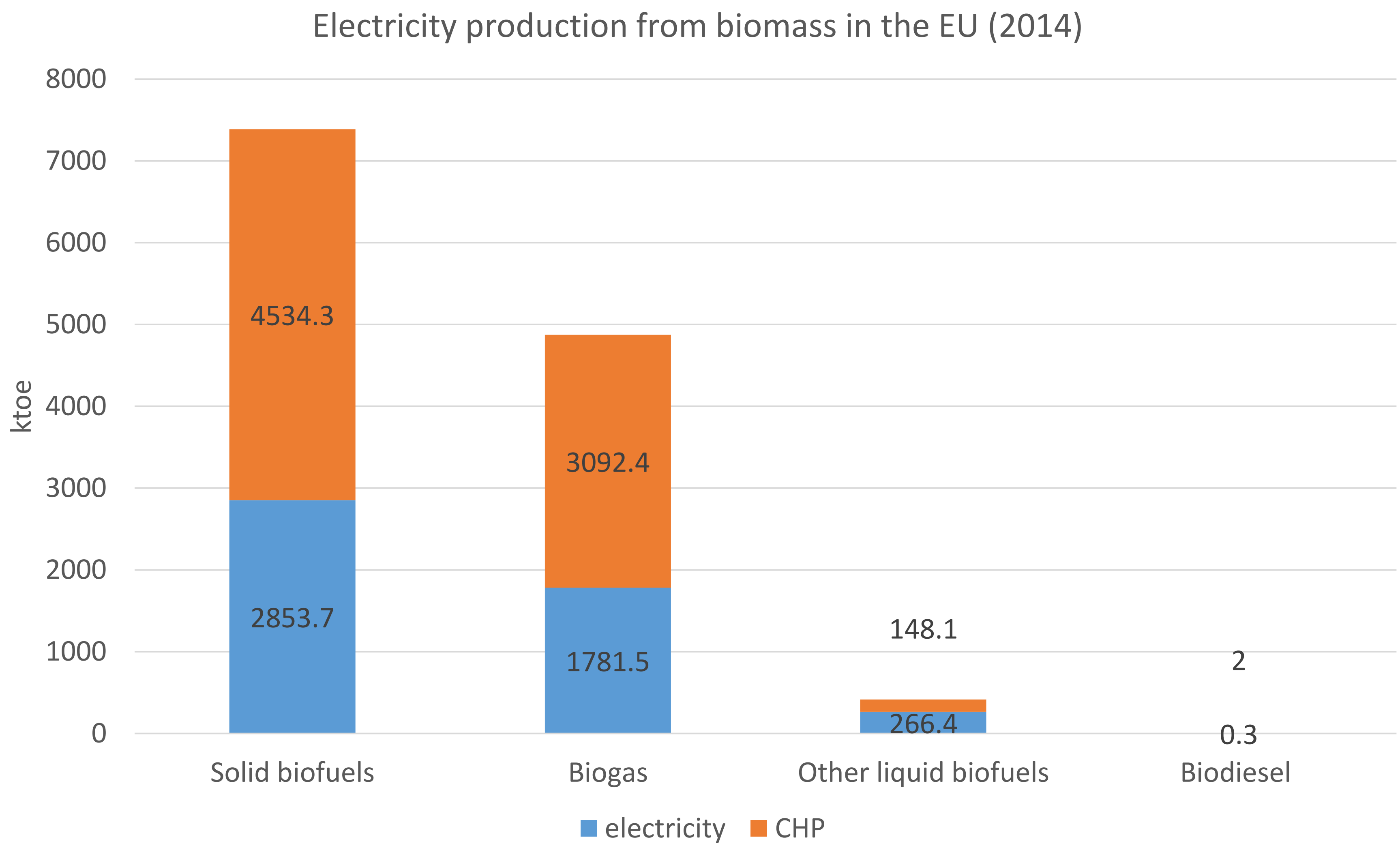
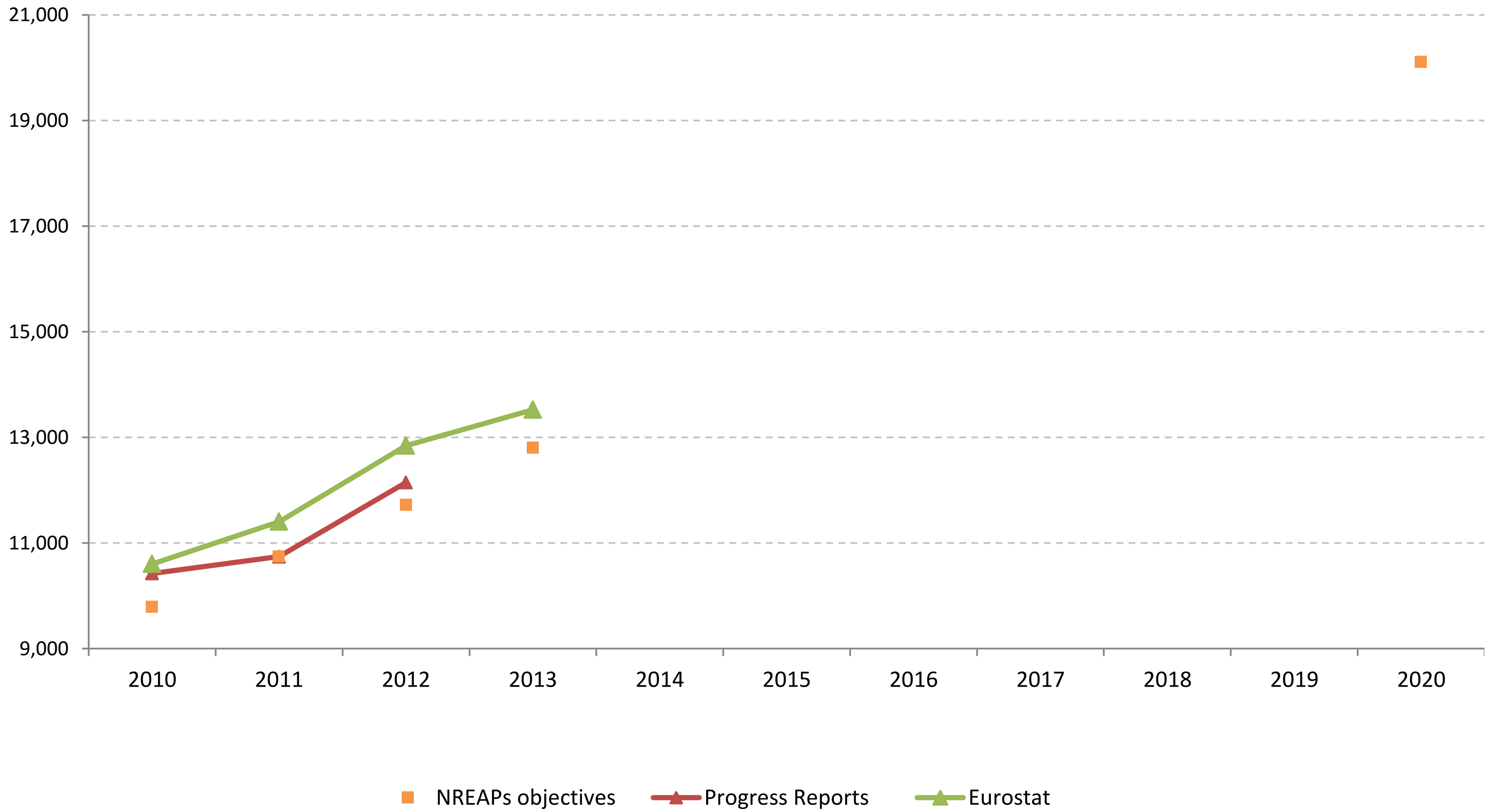
Electricity production from biomass in EU

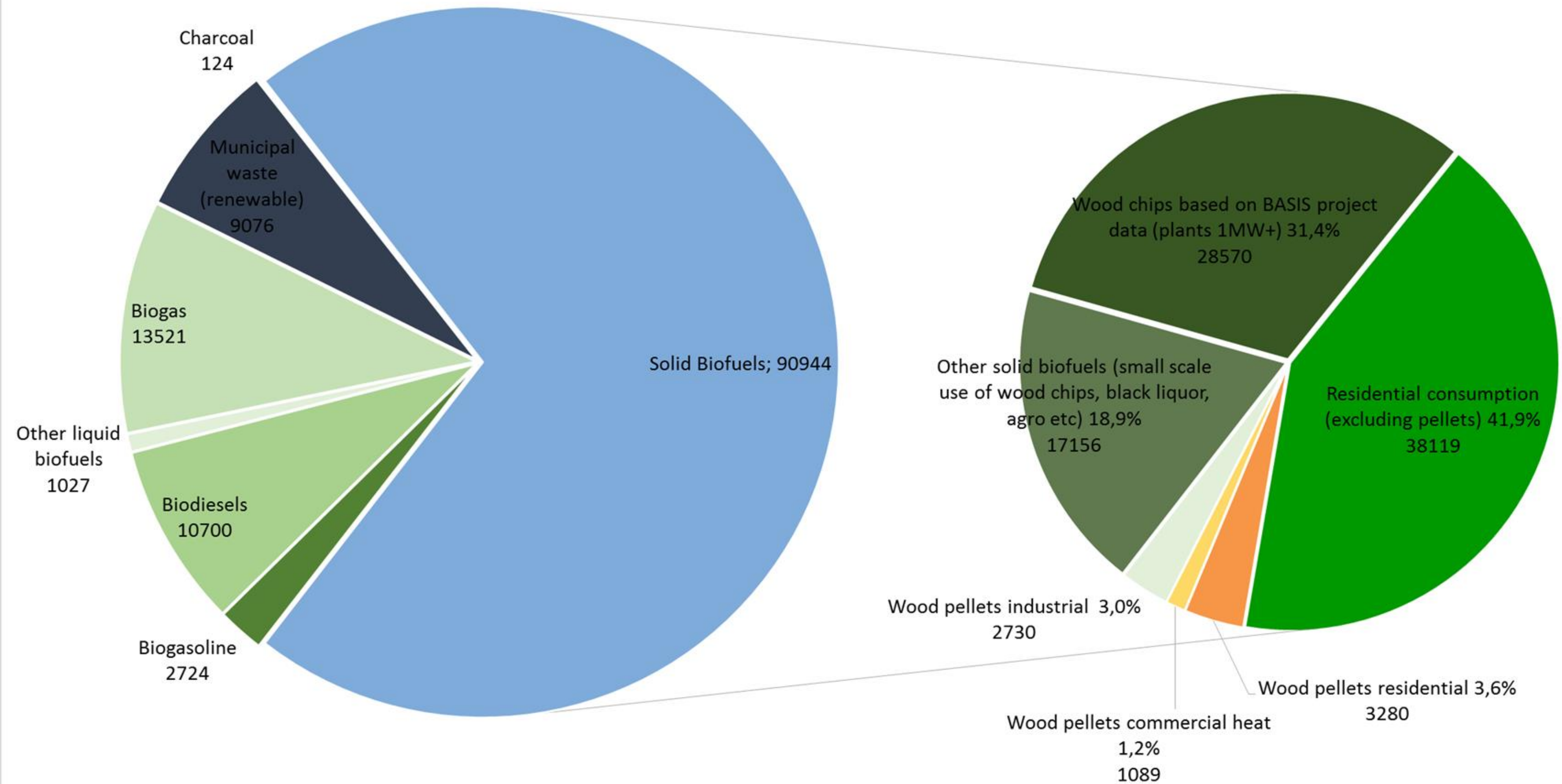


Bioelectricity



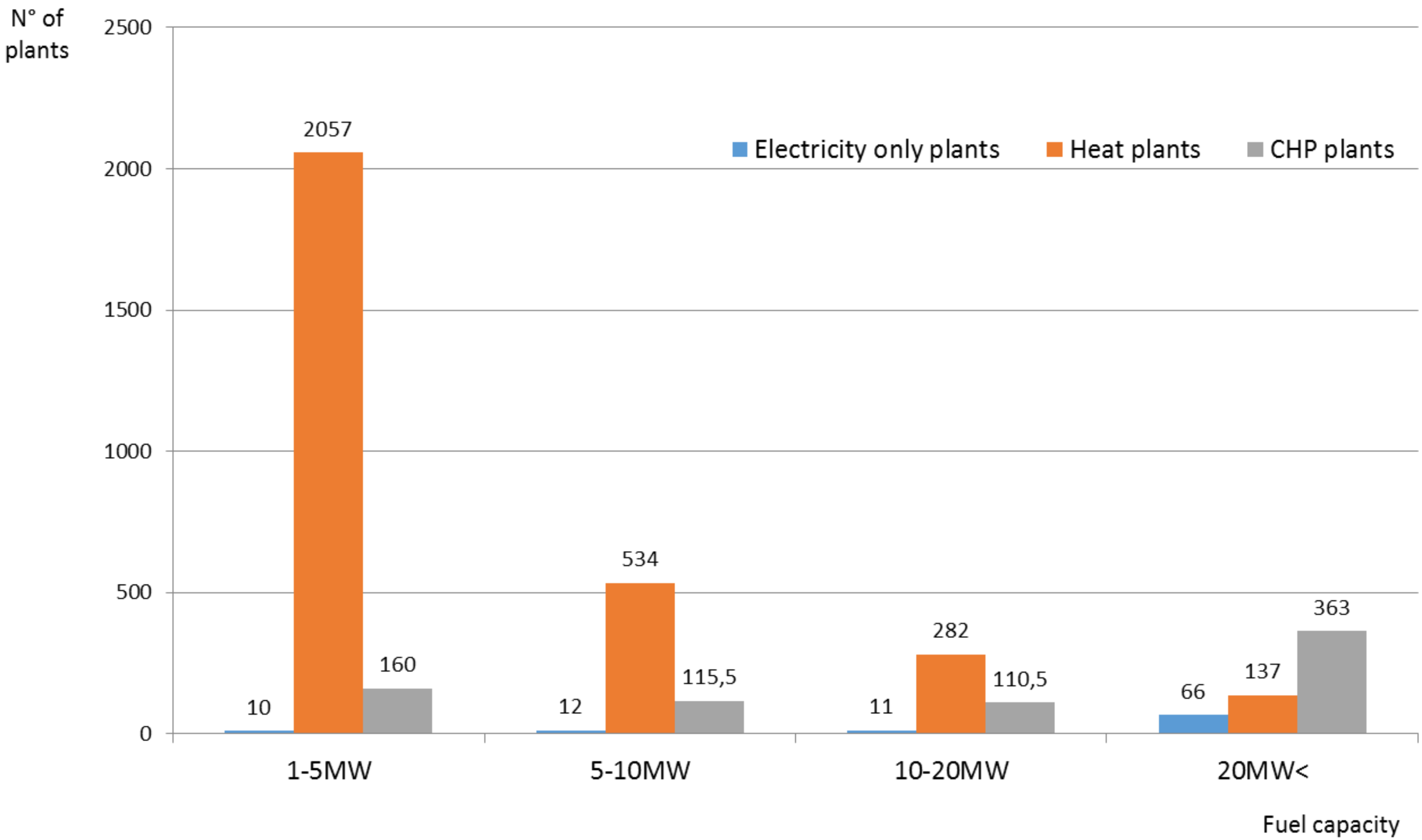
Source: Eurostat, 2nd Progress Reports and NREAPs targets

Gross inland consumption of biomass in 2013 (ktoe)



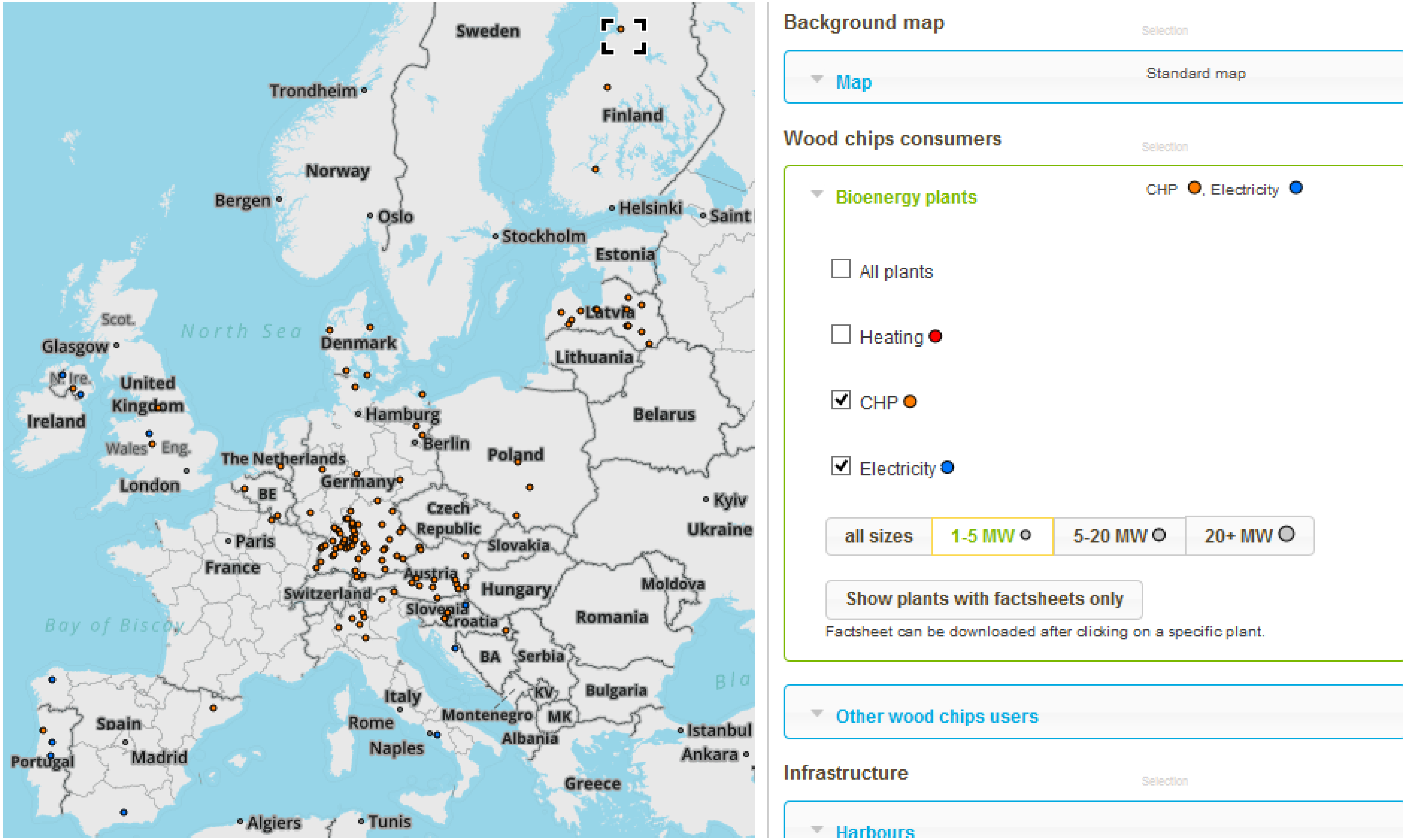
Source: Eurostat, BASIS project, EPC Survey, Hawkins Wright and FAO

Number of plants in Europe consuming wood chips



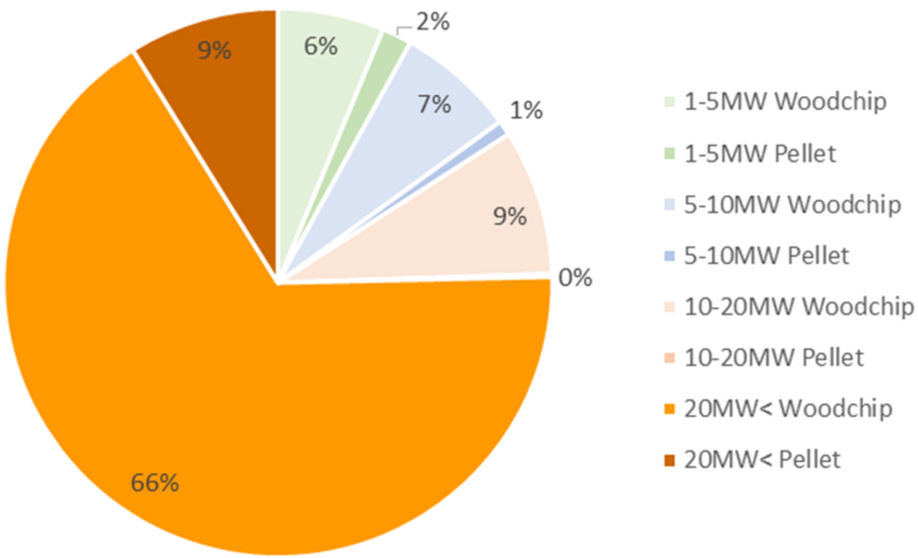
Source: AEBIOM - Basis Bioenergy project – non-final

Project results shown in a GIS

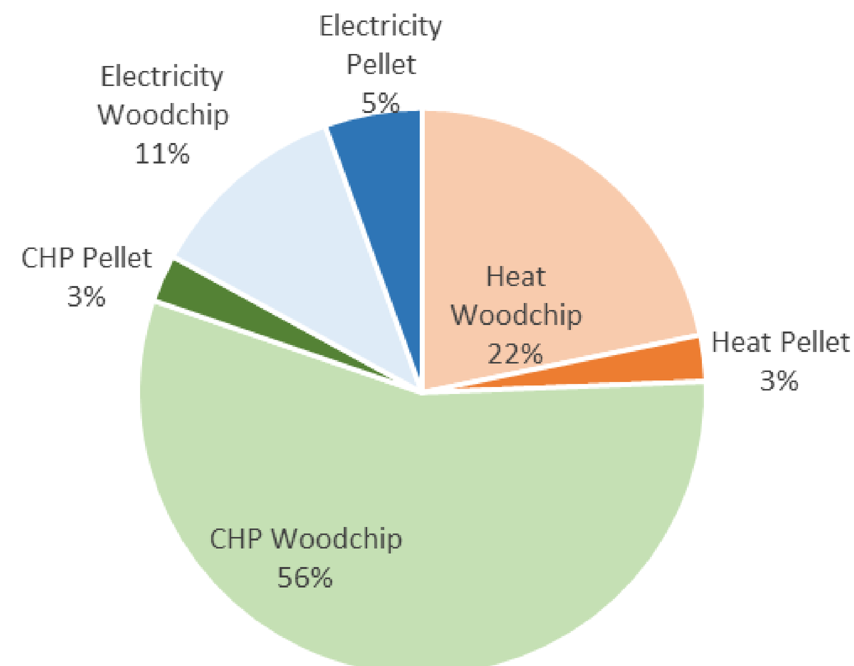


http://www.basisbioenergy.eu/basis-gis.html

Wood biomass consumption by plant size class



Wood biomass consumption by energy use



Source: AEBIOM - Basis Bioenergy project

Micro and small scale CHP

	Micro scale CHP <5 kWel	Micro scale CHP 5-50 kWel	Small scale CHP 50-250 kWel
Applications	Residential market	Small industries, services, micro grids etc.	Industry, services, DHC etc.
Main products	Heat, by-product electricity	Heat, electricity	Heat, electricity
Main feedstock	High quality solid biomass (woody sources), biogas, bio-oil[21], preferably standardised quality fuel	Solid biomass (mostly woody sources), syngas, biomethane, biogas, bio-oil	Solid biomass (wood chips), biogas, syngas, bio-oil tolerating a wider quality range. Applicable fuels range from wood pellets to lower grade wood chips or even locally available non-wood or pre-treated biomass fuels derived from waste streams
Technologies covered	Thermoelectrics, Stirling engine, steam cycles, organic Rankine cycle (ORC), internal combustion engine (IC), micro gas turbine (MGT), fuel cell (FC)	Stirling engine, steam cycles, ORC, gasification + IC, IC, externally fired micro gas turbine (EF-MGT)	Stirling engine, steam cycles, ORC, gasification + IC, IC, EF-MGT

Micro and small scale CHP

Key Performance Indicators

	2013	2020
Electricity production costs		Reduction of 50%
Minimum lifetime suitable components for bio-oil engines and turbines		2,000 operational hours
Proven lifetime	No data	20.000 h (<5 kWel) / 35.000 h / 50.000 h (>50 kWel)
Electric system efficiencies based on solid state technologies	1%	2%
Electric system efficiencies based on thermodynamic cycles	No data	7% (<5 kWel) <10% -12% (5 - 50 kWel) 12-15 (<250 kWel)
Investment costs solid state technologies	20-30 EUR/W (depending on materials and suppliers)	10 EUR/W
Investment costs thermodynamic cycle technologies	4-25 EUR/W (depending on technology and fuel)	3.5 EUR/W
Reduction of emissions	In compliance with EN303-5	1/10 of the specifications in EN303-5 (except for NOx)

Micro and small scale CHP

Main technological challenges (from 2013)

- Cost reduction by technical optimization with consideration of serial production
- Reduction of maintenance costs
- Development of high temperature- and high corrosion-resistant heat exchanger
- Material development (seals, heat exchanger, ...)
- Integration in smart houses and smart grid
- Development of efficient storage systems (electricity, heat) to avoid grid losses

Biogas

Key Performance Indicators

	2013	2020
Diversification of raw material for biogas production	Biogas yield per ha of alternative energy crops is significantly lower than yield for maize[18]	Increase of biogas yield of alternative energy crops by 20-30%
Increase of efficiency of biogas up-grading	Up-grading power consumption: Ø 0.25 kWh/Nm^3	Up-grading power consumption: Ø 0.15 kWh/Nm^3
Cost reduction of biogas upgrading	A 500 Nm3/h upgrading plant costs about 7.500 €/Nm^3 h	Cost reduction by 10-20%
Improvement of load flexibility of biogas CHP systems	Part load operability of biogas CHP units > 60%	Part load operability of biogas CHP units > 40%
Increase of efficiency of biogas CHP systems	Electrical efficiency of biogas systems is 33-45%	Efficiency improvements by 10-20%
GHG emission reduction by the use of waste heat of biogas CHP units	About 50% of European biogas plants have implemented appropriate use of "waste heat".	80% of all European biogas plants have implemented the use of "waste heat" from their CHP units with GHG savings almost 14 million tons.

Lymberopoulos, 2004, Microturbines and their application in bio-energy

Strengths	Weaknesses
➢ Microturbines suitable to utilize fuels of varying calorific value ➢ low maintenance requirements, compact size, low noise ➢ high grade waste heat ➢ suitable as a DG technology for stand alone or grid connected operation ➢ minimal installation time, low installation cost ➢ lowest emissions of commercially available CHP technologies ➢ size of plants suitable to disperse nature of biomass ➢ biomass cogeneration is CO2 neutral ➢ limited emissions are restricted to sites that are far away from urban centres ➢ reduce impacts from waste disposal, providing solutions for waste streams ➢ installation producing close to load ➢ exploitation of indigenous fuels ➢ create rural revenue streams and local jobs ➢ help to improve land management practices such as forestry thinning and clearing ➢ dispatchable biomass based plants ➢ biomass combustion, production of landfill or sewage gas well proven	➢ low efficiency in basic configuration, that reduces even further under part load ➢ high capital cost ➢ suitable power conditioning equipment required for stand alone operation ➢ installation costs can be high for some cases of retrofits ➢ auxiliary systems required to operate with biomass derived fuels ➢ existing power grids unsuitable for accommodating large number of small power plants ➢ high cost of kWh produced ➢ external costs of fossil fueled power plants are not cared for in today's energy system ➢ the establishment of biomass fuel supplies is novel and risky in some countries ➢ chicken and egg problem to invest in biomass cogeneration until fuel supply chains are in place and vice versa ➢ biomass can be transported but has relatively low calorific value to make transport viable. ➢ biomass gasification and pyrolysis unproven at microturbine scale ➢ many biomass applications have a low heat demand or operate seasonally (agro-industries) ➢ occasional mismatch between biomass cogeneration site and site of heat demand

Opportunities	Threats
➢ capital costs of microturbine-based CHP systems to drop when series production levels are achieved ➢ trigeneration becoming commercially proven ➢ local job opportunities ➢ initial microturbine pilot applications utilizing biofuels running successfully and accumulating valuable experiences ➢ possible development of a Directive for renewable energy heat ➢ increased taxation of fossil fuels, from which biomass would be exempt ➢ current EU and national financing schemes for innovative RES applications ➢ diversification of energy companies ➢ some biomass fuels are available for free (mostly applies to wastes)	➢ microturbines could be sidelined by the Hydrogen "hype" and leapfrogged by fuel cells running on bio-ethanol or biogas ➢ trigeneration even more difficult to achieve locally ➢ few pure commercial applications running on biomass, most still pilot ➢ competing technologies (ICEs) performing perfectly adequately, specially in CHP mode ➢ Current CHP market static, having negative impact on R&D of biomass based CHP ➢ In increasingly liberalized energy markets, direct subsidies become less available ➢ Uncertain economic conditions for investors ➢ Current electricity prices are very low ➢ Third party accept to electricity networks complex ➢ potential end users have no experience ➢ renewable energy incentives focus on electricity and exclude heat

SWOT of MGTs in bioenergy – situation in 2016

Focusing on the bioenergy related issues:

Strengths
Applicable still today

Weaknesses
Still applicable – though biomass availability has increased

Opportunity
Changes as biomass logistics have improved and cost has increased

Threats
Mostly still valid – subsidies still exist

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Case 1: Ökofen pellet boiler and Microgen stirling engine

Pellematic Smart_e

Experince from Kuurne Office of Ökofen

-Installation : October 2014
-Connected on the wall heating system
-8kWth
-650We
-Parallel with a buffertank of 800 liter

-Running hours : 1173h in 103 days
-Running hours Stirling : 1157h (98,6%)
-Total energy production : 710 kWh
-Mean poweroutput : 613Watt

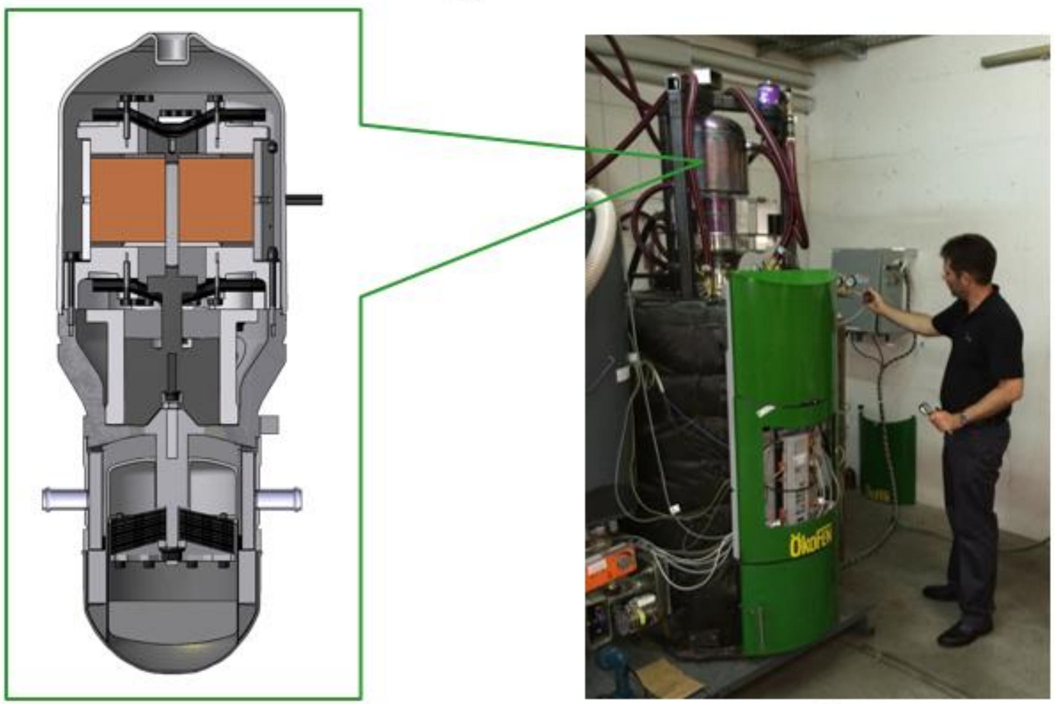
Source: Ökofen presentation in Biomass Counts event 20.10.2015

Case 2: ÖkoFEN_5.0e

ÖkoFEN PELLETSHEIZUNG + Qnergy Renewable. Reliable. Resilient.

Pellematic 50e

Stirling 5 kWe + **Pellematic 50 kWth**



- New designed ÖkoFEN Pellets boiler including

  Qnergy-Stirling-Engine
- Goal of the project:
  - 50-60 kW thermal capacity
  - 5 kW electric capacity
  - Target customer group: large buildings, company commecial building, hotels etc. which have a thermal base load of at least 50 KW therm.
- 2013: beginning of cooperation with Qnergy
- August 2014: Start of first prototype at the test lab in Lembach
- 2015: Type testing and certification & Field test installations