

The strategic role of forest and agro-forestry biomass in the production of heat and power

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Power production from biomass:
Technological progress, perspective of development

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<http://www.blazeproject.eu/>



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- **ITABIA** - Italian Biomass Association, is a not for profit Association founded in 1985 with the aim of promoting the diffusion of efficient and environmentally-sound biomass production and conversion systems for energy and industrial purposes
- **ITABIA** activities concern mainly the transfer of knowledge to public and private bodies, research centers, manufactures, agro-forestry entrepreneurs etc.
- **ITABIA** has established an efficient net of key persons and bodies (more than one hundred specialists coming from scientific institution, public bodies and industries with special interest in the biomass sector) able to support actions and giving help for implementing the bioenergy industry in Italy

For more information: itabia@mclink.it



The importance of Bioenergy

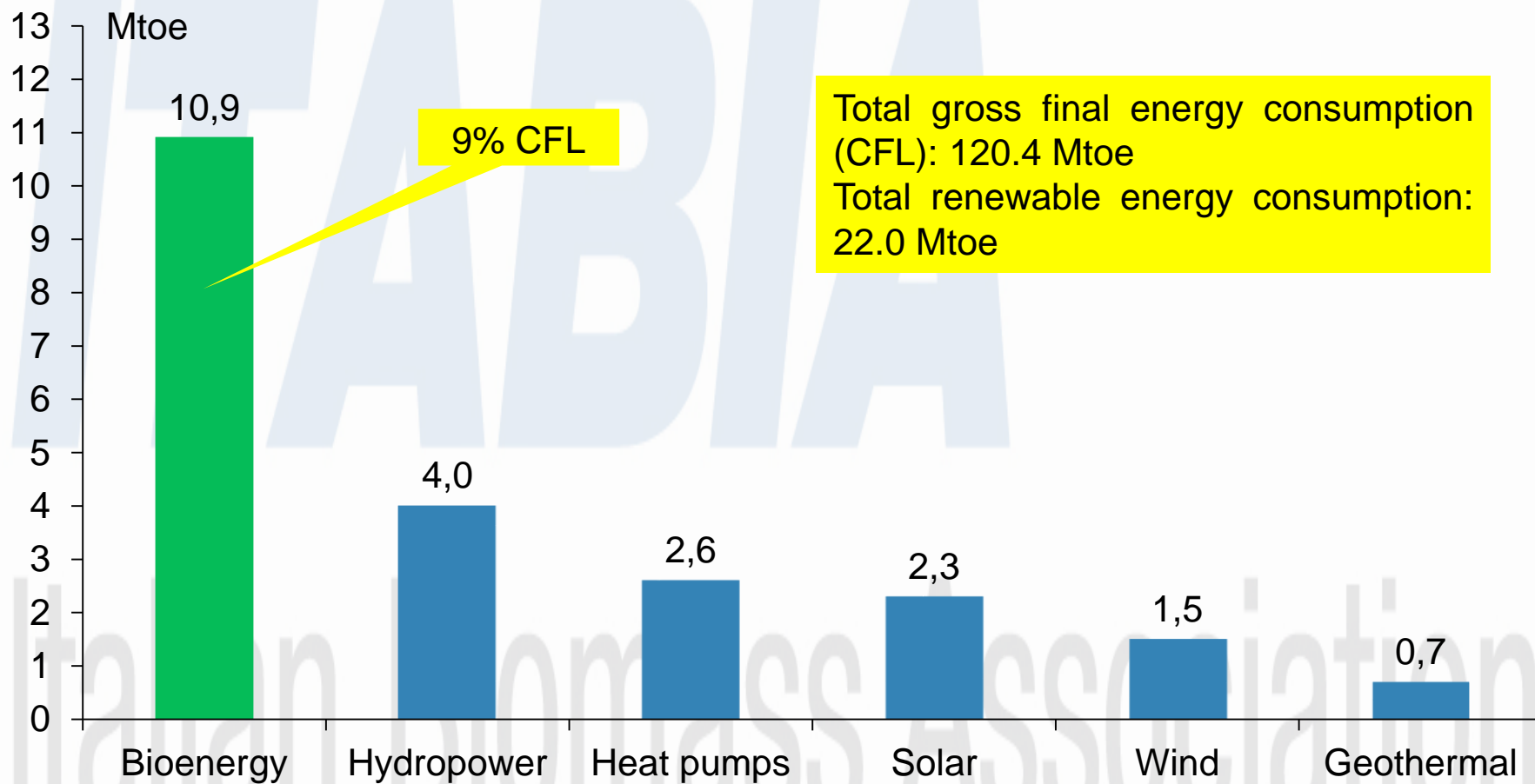
- Bioenergy is a **continuous and programmable** energy source, that can relay on a wide range of raw materials (waste biomass and or suited crops) and on proven and reliable technologies:
 - Heat from solid biomass (civil and industrial use)
 - Electricity from solid biomass, biogas and bioliquids
 - Liquid biofuels (biodiesel, HVO, ethanol/ETBE) from dedicated crops
 - Biomethane from fermentable biomass



Contribution to gross energy consumption from renewable energy sources in Italy in 2017

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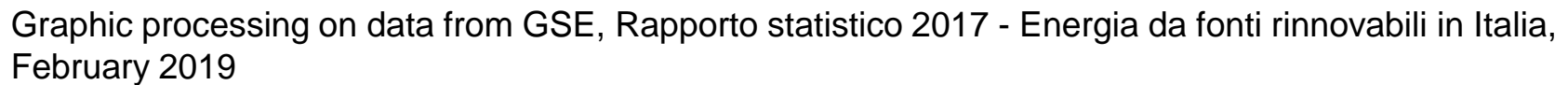
Italian Biomass Association



Graphic processing on data from GSE, Rapporto statistico 2017 - Energia da fonti rinnovabili in Italia, February 2019



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- Plant material produced from dedicated crops
- Plant material deriving from the exclusively mechanical treatment of dedicated agricultural crops
- Plant material produced by forestry, forest maintenance
- Plant material produced by mechanical treatment of wood (e.g. shavings, chips)

- Plant material produced from dedicated crops
- Plant material deriving from the exclusively mechanical treatment of non-dedicated agricultural crops
- Plant material produced by forestry, forest maintenance and pruning
- Plant material produced by mechanical treatment of virgin wood (bark, sawdust, shavings, chips)



Source: D.M. 152/2006 Allegato X, parte II, sez. 4



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Solid biomass for thermal uses in Italy from 2012 to 2017 (TJ)

	2012	2013	2014	2015	2016	2017
Total direct consumption	279,828	281,558	244,494	277,342	268,041	292,025
Residential	277,893	277,698	237,623	267,682	258,465	282,916
Industry	980	2,300	3,489	6,110	5,422	4,866
Trade and services	888	1,485	2,488	2,119	2,691	2,746
Agriculture	67	75	894	1,431	1,462	1,477

- In 2017, direct consumption of solid biomass (firewood, pellet, charcoal) for thermal uses was about 292,000 TJ, corresponding to **7 Mtoe**
- To such consumption must be added the ones used for the production of derived heat, including 3,276 TJ (58.5 ktoe) from biomass fueled district heating plants

Source: GSE, Rapporto statistico 2017 - Energia da fonti rinnovabili in Italia, February 2019



Direct consumption of solid biomass for thermal uses

	Lower calorific value (MJ/kg)	2015		2016		2017	
		Amount (x 1,000 t)	Energy (TJ)	Amount (x 1,000 t)	Energy (TJ)	Amount (x 1,000 t)	Energy (TJ)
Fuelwood	13.911	16,709	232,436	15,991	222,456	17,481	243,184
Pellet	17.284	1,938	33,490	1,976	34,161	2,203	38,070
Charcoal	30.8	57	1,756	60	1,848	54	1,663
Total		18,703	267,682	18,028	258,465	19,738	282,916

- In 2017 have been used in Italy, for domestic heating only, **more than 19.7 million tons** of solid biomass

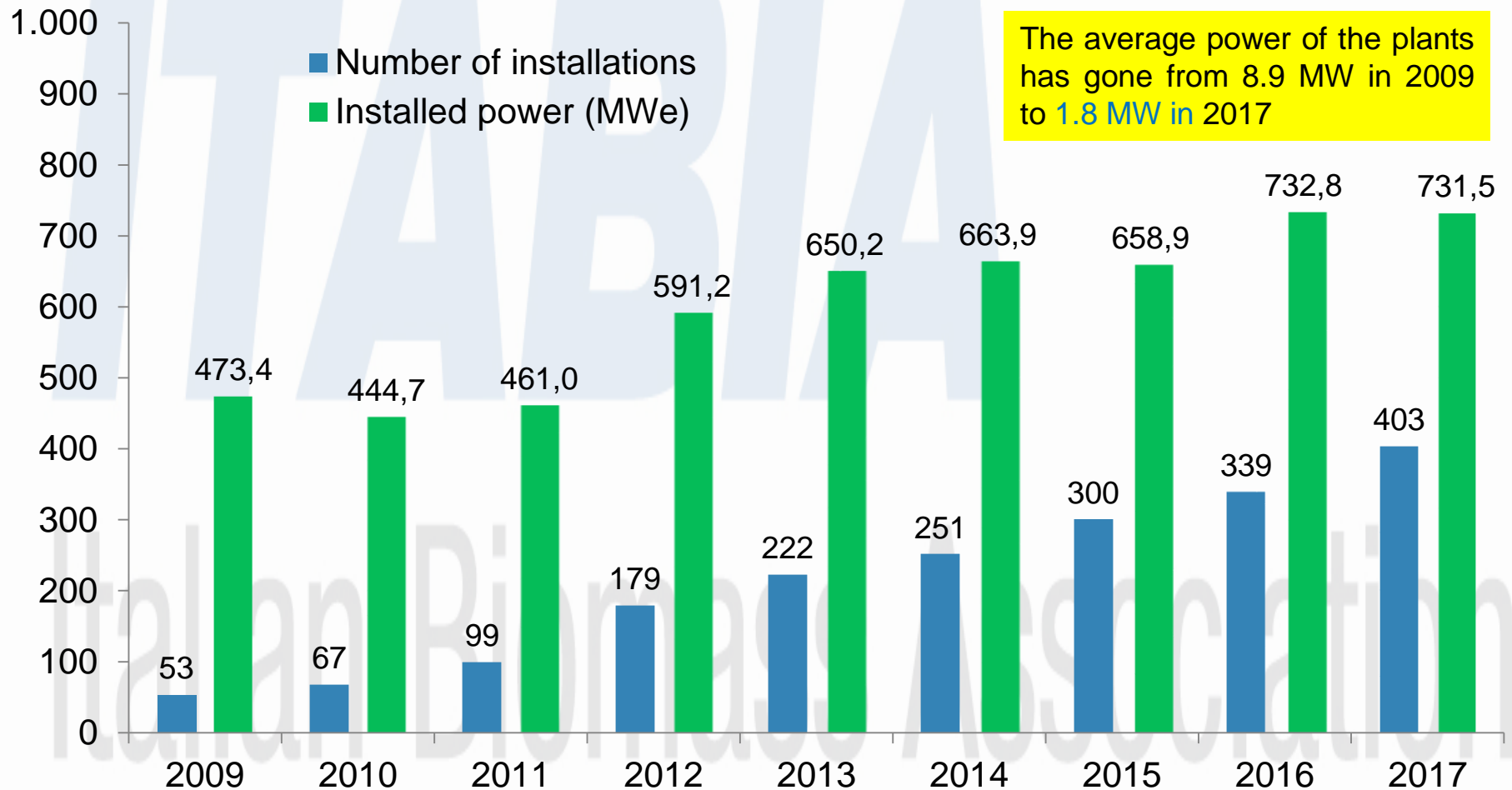
Source: GSE, Rapporto statistico 2017 - Energia da fonti rinnovabili in Italia, February 2019



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Renewable electricity production from solid biomass in Italy from 2009 to 2017



Graphic processing of data from GSE, 2011 - 2019



Bioenergy and territory

- Bioenergy is the renewable energy source most closely linked to the territory, because:
 - Contributes to the protection of the natural environment through the recovery and valorization of waste and residues, in particular those produced from agricultural, livestock and forestry activities
 - Can facilitate recovery of marginal or degraded land by means of the introduction of non-food crops for energy production and act as a driving force for the correct management of the woodland heritage



The Italian forest heritage

- The Italian forest heritage covers a total of about 11 million hectares, equal to **36.4%** of the whole national surface
- The national forest area has increased by 72.6% from 1936 to 2015, mainly due to the **spontaneous re-colonization** of abandoned agricultural lands and pastures
- Despite the presence of a substantial forest heritage, woody withdrawals affect approximately **18-37% of annual biomass growth** (Southern Europe average: 62-67%)
- The annual medium production in 2000-2015 years can be estimated around **8 million m³**, of which about 60% are firewood



Source: MiPAAFT - RaF Italia 2017-2018, March 2019



Import and export of wood and solid biofuels in Italy (x 1,000 m³)

	2016		2017	
	Import	Export	Import	Export
Rough wood	3,949	204	3,752	214
Firewood	1,095	18	906	19
Wood for industry	2,854	185	2,846	195
Wood chips	1,235	16	662	47
Wood pellet	1,678	43	1,895	30
Total for energy use	4,008	77	3,463	96

Source: MiPAAFT - RaF Italia 2017-2018, March 2019



The “missing biomass”

- The national production of biomass, from forest cutting operations and, to a much lesser extent, dedicated tree crops (poplar) is estimated at around 4-5 million t/year
- Consumption is instead more than 20 million t/year, and "official" imports amount to about 2.5-3 million t/year
- There is therefore a huge discrepancy (more than 10 million t/year) between real and apparent theoretical consumption due to:
 - Not registered import by other European Union Countries
 - Forest uses escaping statistical surveys
 - Recycling of used wood and wood industry processing waste
- Use of biomass from non-forest sources, such as pruning hedges, orchards, trees and agricultural and agro-industrial residues



Residual biomass in agriculture and in the agro-industrial sector

An updated assessment (2018) of the availability of residual biomass in the agricultural and agro-industrial sector was carried out by ITABIA within the European project H2020 **ENABLING** (Enhance New Approaches in Biobased Local Innovation Networks for Growth), which aims to stimulate the market for bioproducts by facilitating contact between the agricultural and industrial sectors



Availability of agricultural residues

- **Potential availability:** the fraction of residuals calculated by applying specific coefficients (residual/hectare) to the surfaces engaged by the analyzed crops
- **Actual availability:** the fraction of residues that, starting from the potential ones, would be economically and technically possible to collect. Consideration must therefore be given to elements such as the splitting of companies or their concentration in certain areas, the share of biomass already used for other uses within the farm or not, etc.

Such assessments are the more reliable the more research is limited and supported by field surveys (which is remarkably expensive from an economic point of view)



- Collection of statistical data concerning: surfaces, production and yields
- To obtain a value less sensitive to annual fluctuations, the average of the annual values is calculated. To take into account the variation in cultivated areas, market trends and yields linked to climatic factors, the data of various agricultural years are taken into account in the investigation
- In this way, average values of surfaces and productions are obtained and it is possible to make more realistic estimates of the quantities that are produced annually

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The crop residues under investigation

The ITABIA survey examined 27 different types of herbaceous and vegetable crops and 23 of tree crops

Main crops and residues covered by the ITABIA survey

Herbaceous and vegetable crops		Tree crops	
Crop	Residue	Crop	Residue
Soft and hard wheat	straw	Vine plant	vine shoots
Barley	straw	Olive tree	prunings
Oats	straw	Apple tree	prunings
Rice	straw	Pear tree	prunings
Corn	stalks, cobs	Peach tree	prunings
Sunflower	rapiers	Citrus trees	prunings
Potato	stems, leaves	Almond tree	prunings
Tomato	stems, leaves	Hazel tree	prunings
		Apricot tree	prunings
		Kiwi plant	prunings



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	Tipologia di residui			
	Agricultural (t/year)	Agro-industrial (t/year)	Total (t/year)	%
North	13,132,966	1,228,249	14,361,215	57.5
Center	3,316,313	317,929	3,634,242	14.6
South and Islands	5,445,309	1,531,198	6,976,508	27.9
Italy	21,894,588	3,077,377	24,971,965	100

Source: ITABIA - ENABLING Project, 2018



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Source: ITABIA - ENABLING Project, 2018



Region	Vineyards		Shoots
	ha	Coefficient (t/ha)	t/year
Piemonte	44,341	2.9	128,589
Val d'Aosta	445	2.9	1,290
Trentino	15,712	2.9	45,565
Friuli V.G.	22,920	2.9	66,468
Liguria	2,104	2.9	6,102
Lombardia	23,998	2.9	69,594
Veneto	84,748	2.9	245,769
Emilia Romagna	84,748	2.9	245,769
Toscana	58,613	2.8	164,116
Marche	15,668	2.8	43,870
Umbria	12,517	2.8	35,048
Lazio	22,150	2.8	62,020
Abruzzo	33,842	2.8	94,758
Molise	5,570	2.8	15,596
Campania	25,674	2.8	71,887
Puglia	25,674	2.8	71,887
Basilicata	2,511	2.8	7,031
Calabria	9,112	2.8	25,514
Sicilia	123,049	2.8	344,537
Sardegna	27,270	2.8	76,356
Total Italy	640,666		1,821,766

Estimate of vine shoots production in Italy



Biomass CHP power plant at Calimera (LE) owned by Fiusis S.r.l.

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Electricity production

- 1 MWe power TURBODEN Rankine cycle ORC turbogenerator



Φ
FIUSIS

Thermal cycle

- UNICONFORT heat recovery boiler with mobile grid burner, powered exclusively by virgin olive tree pruning (24-28 t/day)



Fine dust emissions

- 1 mg/Nm³ (limit 30 mg/Nm³)



The biomass supply for the Calimera CHP plant: an example of “short supply chain”

- The Calimera biomass CHP plant, which came into operation in 2010, uses only locally sourced biomass (olive tree pruning) in the form of wood chips.
- The collection basin consists of approximately 1,200 farms within a radius of 10 km from the plant, with a total of about 160,000 olive trees
- Pruning is done every three years and biomass production is around 10 t/ha
- Fiusis S.r.l has set up a company dealing with field harvesting and delivering of prunings to the plant

Biomass delivering and storage

- Harvesting, chipping and storage in heaps on farms
- Area for storage and drying of wood chips under cover
- Loading pit of wood chips with rakes and conveyor belt for dosing and feeding the plant



Thanks for your attention

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