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# Energy potential from residual biomass towards meeting the EU renewable energy and climate targets. The Italian case



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## HIGHLIGHTS

- Overview of the EU renewable energy and climate policy.
- Assessment of the availability of lignocellulosic residual biomass in Italy.
- Evaluation of energy potential.
- Estimation of greenhouse gas savings according to the European target and indicators.

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## ABSTRACT

The biomass sector has a strategic role in energy renewables policy, according to the National Renewable Energy Action Plans (NREAPs), elaborated in compliance with the Directive 2009/28/EC. Planning a suitable use of biomass for energy purposes call for the clear definition of the biomass potential, that has to be periodically updated by inventories for all EU countries.

The aim of this paper has been the assessment of the available residual biomass, particularly lignocellulosic, in the Italian territory, to evaluate the potential for bioenergy, particularly for electricity and heat generation. The greenhouse gas savings according to the European target and indicators have been estimated on the national scale. Particularly, the total final energy which could be generated from 22,208,455 t/y of residual biomass assessed in Italy, is equal to 4.57 Mtoe, nearly 2.7% of the gross Italian energy consumption in 2013 and the total savings of GHG emissions coming from this bioenergy generation, are close to 52 Mt CO<sub>2</sub>eq for the entire Italian territory per year. The conclusions underline that an appropriate bioenergy policy can help decarbonise the economy, enhance the reliability of the energy supply and additionally it can revitalise rural areas.

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## 1. Introduction

Italy's energy supply has always heavily affected by the imports, frequently coming from unstable regions, as evidenced by the geopolitical and social tensions of recent years.

In 2013 this dependence was 76%, which means that out of total gross energy consumption of 171 Mtoe (million tonnes of oil equivalent) 129 Mtoe were imported (Terna, 2014), at a cost of 55.8 billion euros representing around 3.6% of the Italian Gross Domestic Product (UP, 2014). This issue stresses the need to diversify the energy supply and to address the most significant economic and environmental concerns of the energy system.

In the last 10 years, Italian energy policy increased the use of renewable energies, driven also by the political strategy of the European institutions.

In line with the provisions of the Directive 2009/28/EC and of the Commission Decision of June 30th 2009 (European Parliament and the Council, 2009), Italy, in 2010 adopted the National Renewable Energy Action Plan (NREAP) (Italian Minister of Economic Development, 2010), in which specific measures to achieve the mandatory targets are illustrated.

Among the renewable energies, bioenergy is expected to play a significant role. We stress that the adequate measures on the boost in the use of energy from biomass have to take into account biomass availability, because the most part of biomass demand will still be met by domestic supply by 2020, but after this period imports of biomass from both EU and third countries could increase. So, the issue of the adequate supply of sustainable biomass

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feedstock call for studies and analysis at different scales to assess its realistic energy potential (European Commission, 2014; Zhou et al., 2011). These considerations stimulated this paper.

The residual biomass and particularly lignocellulosic, generated by the agricultural, forest and agro-industrial sectors, is a widespread, abundant material not classified as waste and is a potential feedstock for bioenergy which could potentially overcome some limits, e.g. competitiveness with other sectors (food, industry), and in response to other factors such as limited land availability (Rathbauer and Wörgetter, 1999; IEA, 2008). Residual biomass is more convenient due to the environmental and economic aspects (Demirbas, 2008): GHG (greenhouse gas) savings are much more useful than those from traditional biomass, such as dedicated crops and, in conjunction with this consideration, many incentives to use it for energy purposes have been allocated (Italian Minister of Economic Development, 2012). However, it will be necessary to evaluate the efficiency of biomass use along all supply chains, to subsequently prioritise the most efficient chains and applications.

We underline that one of the main constraints concerning the chain of energy production from residual biomass is the supply of feedstock: these biomass resources are not concentrated, they have wide territorial dispersion and their collection and transportation may be difficult. As a consequence, logistic aspects play a key role and heavily affect costs of biomass. Thus, a correct evaluation of the potential biomass and the feasibility of the energy production chain require knowledge of a given area, e.g. at regional or national scale, depending on the length of the entire chain which has to be considered. It should be highlighted that the economic analysis of the entire supply chain of energy from residual biomass will be carried out in the future research.

The aim of this paper is the assessment of the available residual biomass, particularly lignocellulosic, in the Italian territory, to evaluate the potential for bioenergy production of each region, as well as of the whole nation, and the GHG savings coming from it (Karaj et al., 2010). After a brief introduction, an overview of the EU renewable energy policy and Italian renewables consumption and indicators, is carried out. Then, Section 3 illustrates materials and methods used for mapping the biomass feedstock in the Italian regions. The estimate of the Italian potential of the residual biomass assessed to produce bioenergy has been provided. The relative environmental benefits on the national scale and the estimation of GHG savings according to the European target and indicators have been shown in the results and discussion section. The conclusions with policy implications underline the issue of considering biomass as a suitable tool to increase the decarbonisation of the energy system, but they also stress the importance of assessing the availability of supply of sustainable biomass feedstock in order to satisfy domestically its demand for all uses and mitigate the increase of the imports. Based on these considerations and taking into account its constraints, bioenergy needs to be included in a new renewable energy policy. At the end of the paper Appendix shows the assessment data of residual biomass per crop and region.

## 2. Overview of the European and Italian climate-energy policy and renewable energy sector

### 2.1. Climate-energy policy

The EU directive 2009/28/EC on the promotion of the use of renewable energy, has introduced a stable legislative framework laying down national mandatory targets for the overall share of energy from renewable sources in final consumption for each Member State in order to achieve at least a 20% share of

renewable energy in the Community's gross final consumption of energy in 2020. A 20% reduction in GHG emissions and a 20% improvement in energy efficiency have also been promoted and encouraged. The directive allowed Member States to decide on the most-efficient technology path and support scheme to achieve these targets.

As said, in line with the provisions of this Directive, Italy provided the NREAP which identified the measures to meet the mandatory targets.

In particular, the Italian target of final energy consumption that must be covered by renewable sources in 2020 was 17%, which, according to the NREAP, will be the average of about 26% for electricity, 17% heating and cooling and 10% for transport. This means that in 2020 the final consumption of renewable energy must be 22.62 Mtoe (taking into account a scenario by strong energy efficiency measures). All the objectives and measures have been brought together in the National Energy Strategy (NES) (Italian Minister of Economic Development, 2013), defined during a planned National Conference on Energy and the Environment. In 2013, in line with energy policy of the EU that sets more restrictive decarbonisation goals, Italy enacted its NES, whose targets are more ambitious than the National Renewable Energy Plan in terms of GHG emissions (–21%), share of renewables (19–20%) and energy efficiency (24%, as a reduction of total primary energy supply) (Fig. 1).

While the EU is making good progress towards meeting its climate and energy targets for 2020, an integrated policy framework for the period up to 2030 is needed. So, in January 2014 the European Commission proposed the 2030 policy framework for climate and energy which aims: (1) to make the European Union's economy and energy system more competitive, sustainable and secure, (2) to set a target of 27% for renewable energy used at EU level by 2030 and an indicative target of 27% of increasing energy efficiency, which is to be reviewed in 2020 (with 30% target in mind). The core of the framework is the binding target to reduce EU domestic greenhouse gas emissions by at least 40% by 2030, compared to 1990.

On October 23rd 2014, the European Council adopted the 2030 Framework for climate and energy, proposed by the European Commission with goals to be met by 2030. This is a gradual alignment towards the objectives of the Roadmap 2050, that are the reduction of GHG emissions by 80–95% below 1990 levels by 2050 and the share of renewable energies equal to 75% of the final energy consumption. The leading role of EU Council in finalising the 2030 Framework has been also confirmed on March 2015 when they formally approved the binding target of GHG reductions (at least a 40%) having in mind the new climate energy agreement which would be adopted in Paris on December 2015.

### 2.2. EU and Italian renewable energy consumption

The global renewable energy consumption in 2013 totalled over 1135 Mtoe (of which 856 Mtoe was hydroelectricity), with a 6% increase on 2012. The total can be divided between 55% in non OECD countries and 45% in OECD ones (REN 21, 2014).<sup>1</sup> The European Union renewable energy consumption was close to 193 Mtoe, of which 34.3 Mtoe were in Germany, followed by Italy, Spain and France.

Globally, renewable energy especially grew in the power sector, with capacity exceeding 1560 GW in 2013, increasing by 8% over

<sup>1</sup> The data changes if hydroelectricity is eliminated from the renewable energies, so the global consumption becomes 70% in OECD countries and 30% of the total for non OECD ones.

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