



EUROPEAN BIOMASS INDUSTRY ASSOCIATION

Biomass for electricity, heating and cooling

**European market potential and major risks affecting a sustainable
production**

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Biomass for electricity, heating and cooling: European market potential and major risks affecting a sustainable production

1. Introduction

Given the positive impact of solid biomass as large scale feedstock for energy production, the market demand for high quality biomass is becoming larger every year. In 2012, the total EU27 biomass supply for electricity, heating and cooling amounted to 103.3 Mtoe (See figure 1), of which 95,7 Mtoe was domestically produced. These amount is projected to increase by nearly 37% up to 132 Mtoe by 2020. On the basis of these results, an efficient standardization strategy, able to monitor a large scale market and, at the same time which could secure healthy environment is needed. The Commission published during the last week of July a new report on the sustainability of solid and gaseous biomass used for electricity, heating and cooling. The document addresses the concerns expressed by the Parliament and key actors regarding the sustainability of bioenergy, concerns which have already been taken into account in several EC Communications.

It is general consensus that biomass can contribute to the EU energy security, in so far as the majority of biomass demand is met through domestically produced raw material and imports are supplied by diversified sources. In the case of additionally mobilised biomass, there is also a potential for new sources of income along the whole biomass value chain, from cultivation to harvest, processing and conversion into electricity, heating and cooling. When waste is used as a bioenergy feedstock, this helps to reduce the amount of waste being landfilled with positive environmental and economic impacts. In a recent publication, the European Commission has presented its new Communication “Towards a Circular Economy” which establishes a common and coherent framework aimed to boost a transition from a linear to a circular economy and thus, to foster green growth, increase resource efficiency and create new jobs. The focus of the communication falls on fostering saving resources, reusing, repairing and recycling them. This new approach would be based on a combination of regulations, market-based instruments, incentives, information exchange, especially concerning the economic instruments and the creation of voluntary schemes for producers. In addition, an efficient value chain would benefit farmers and forest owners and support rural development. Just to give some more interesting figures, in 2012, the European bioheat and bioelectricity sectors generated a total turnover of at least EUR 33 billion and employed over 374,800 people. This growing biomass consumption for heat and power generation was driven by the National Renewable Energy Action Plans (NREAP), which have increased the use of biomass from 86.5 million tons of oil equivalent (Mtoe) in 2012, to 110,5 Mtoe in 2020.

2. Short overview on European Bioenergy market.

Biomass consumption for only heat generation increased from 40 Mtoe in 1997 to 51.2 Mtoe in 2002, 61.5 Mtoe in 2007 and 74.9 Mtoe in 2012, equal to the 14.2 % of 525.7 Mtoe of total heat generation in the EU.

At present, biomass heating is used mainly in households for heating space (over 50% of the overall bioheat) but a consistent biomass amount feeds small-scale heating plants and district heating systems. Just to present a valuable example, E.On Sweden, which is the largest private company for biomass district heating in Sweden, supplies heat to approximately 21,700 customers.

Bioenergy contribution to heating and cooling consumption from both solid biomass and biogas is projected to increase from 73.3 Mtoe in 2012 to 85.4 Mtoe in 2020, although bioenergy relative share in the final renewable heating and cooling consumption will decrease from over 85% to about 76% as other technologies such as thermal solar will grow faster. Solid biomass will continue to be the main source of heat from biomass in 2020, providing 80.9 Mtoe (89.5% share of total bioheat), followed by biogas with 4.5 Mtoe (4.9% share) and bioliquids with 5 Mtoe (5.5%).

The same NREAPs give a forest biomass grow expectation from 71 Mtoe in 2012 to 73.6 Mtoe in 2020, although its relative share of overall biomass supply will decline from 74.4% to 55.7%. is projected to increase by nearly 37% to 132Mtoe by 2020. In particular, National Renewable Action Plans foresee a strong expansion of wood for energy use and agriculture biomass for energy by 2020. The NREAPs also estimate a growth in agriculture biomass for energy, (mainly in the form of residues and agricultural by-products), which is projected to grow significantly from 13.2 Mtoe in 2012 to 41.7 Mtoe in 2020, equal to a share increase from 14% to 31.6%. Thirdly, the relative contribution of biodegradable waste is projected to increase in absolute terms from 10.8 Mtoe in 2012 to 16.7 Mtoe in 2020. Furthermore, imports from third countries, especially from Canada, USA or Russia, are also projected to keep on growing up to 15-30 million tonnes from 4,3 in 2013. Still, the share of this type of energy in relation to other green energies is expected to fall from a 54% to a 45% by 2020 due to the faster deployment of other renewables.

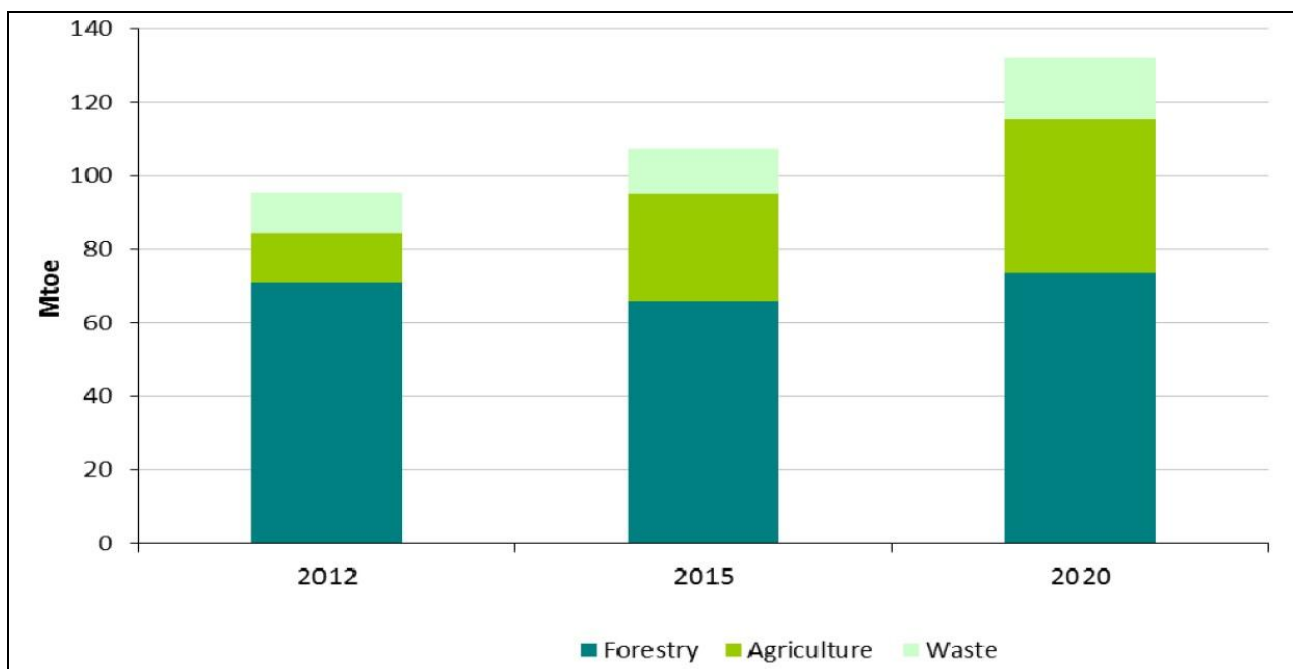


Figure 1: EU biomass supply for electricity, heating and cooling (Mtoe, 2012-2020).
 Source: National renewable energy action plans (NREAPs) and 2011 progress reports.

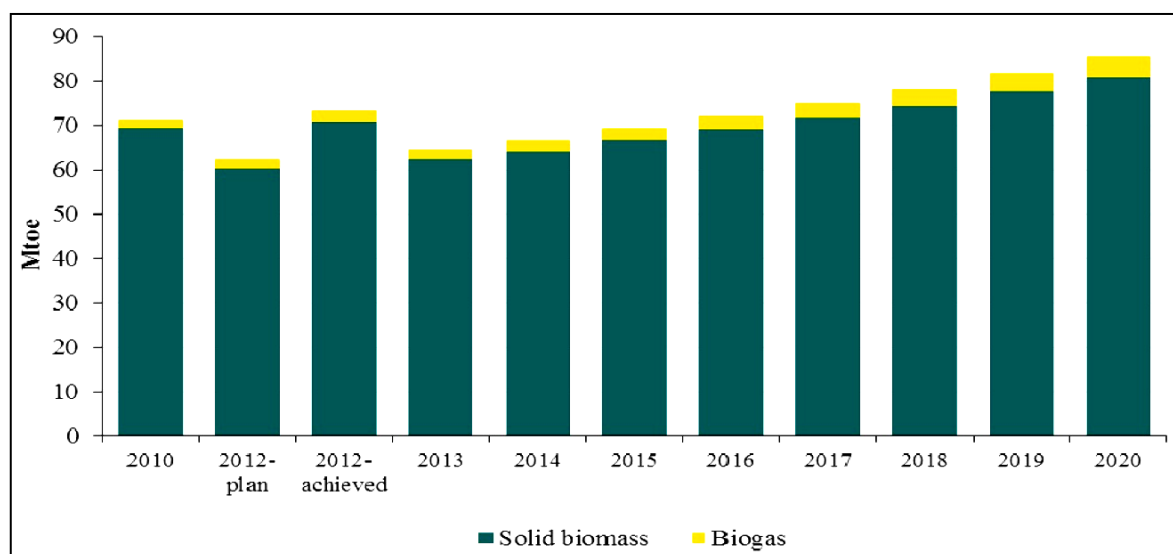


Figure 2: Outlook for total EU heat and cooling demand from solid and gaseous biomass. (2012 -2020, Mtoe). Source: Progress Reports, National Renewable Energy Action Plans, 2012

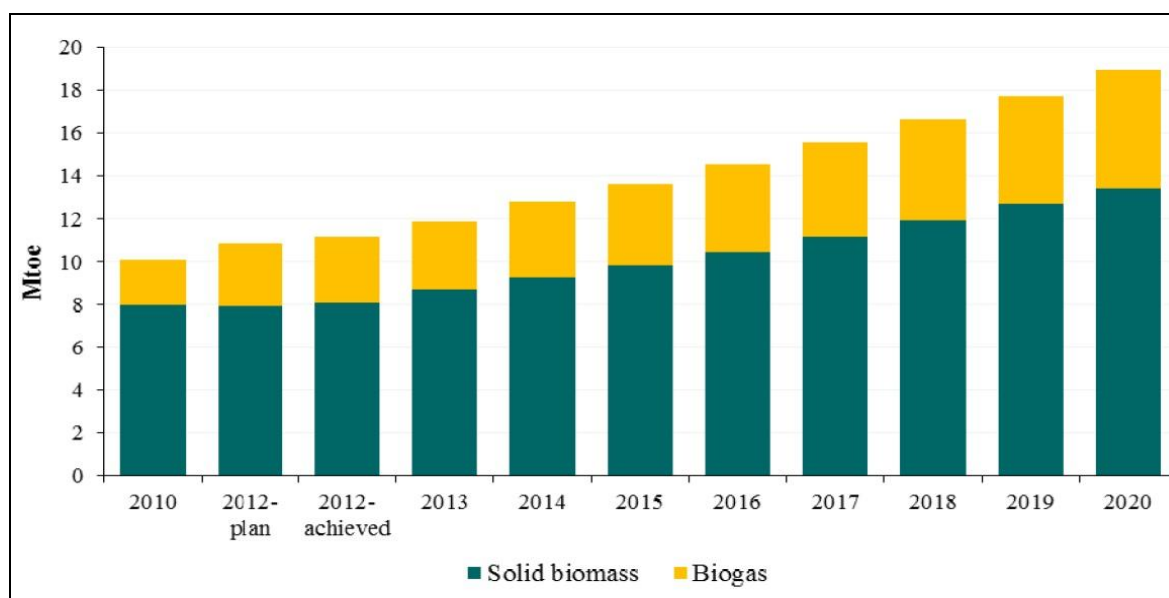


Figure 3: EU electricity demand from solid and gaseous biomass (2012-2020, Mtoe). Source: Progress Reports, National Renewable Energy Action Plans, 2012

Last but not least, approaching the aspect of actual biomass competitiveness, it must be considered that high quality wood pellets largely represent the most used biomass for combustion in the world. The EU imports of wood pellets have risen from 2.7 million tonnes in 2010 up to 4.3 million tonnes in 2013. By 2020, EU wood pellet imports from third countries are expected to be in the range of 15-30 million tonnes (equal to about 6-12 Mtoe). Environmental sustainability of primary used feedstocks represent now a key aspect to take in account for the future developments of biobased sector.

Compared to the waste biomass potentially available in Europe, imported wood pellets for energy production has a larger environmental impact, both for the long time growth of trees and the long distances covered for transportation. For instance, the EUwood study has investigated the feasibility of meeting increasing EU wood demand for energy and material use through domestic supply. By comparing the potential demand for wood for all uses with the 'realistic' potential supply in 2020 and 2030, they found that under a medium biomass mobilisation scenario, the expected demand is likely to exceed the potential before 2020 and therefore imports from third countries will be needed.

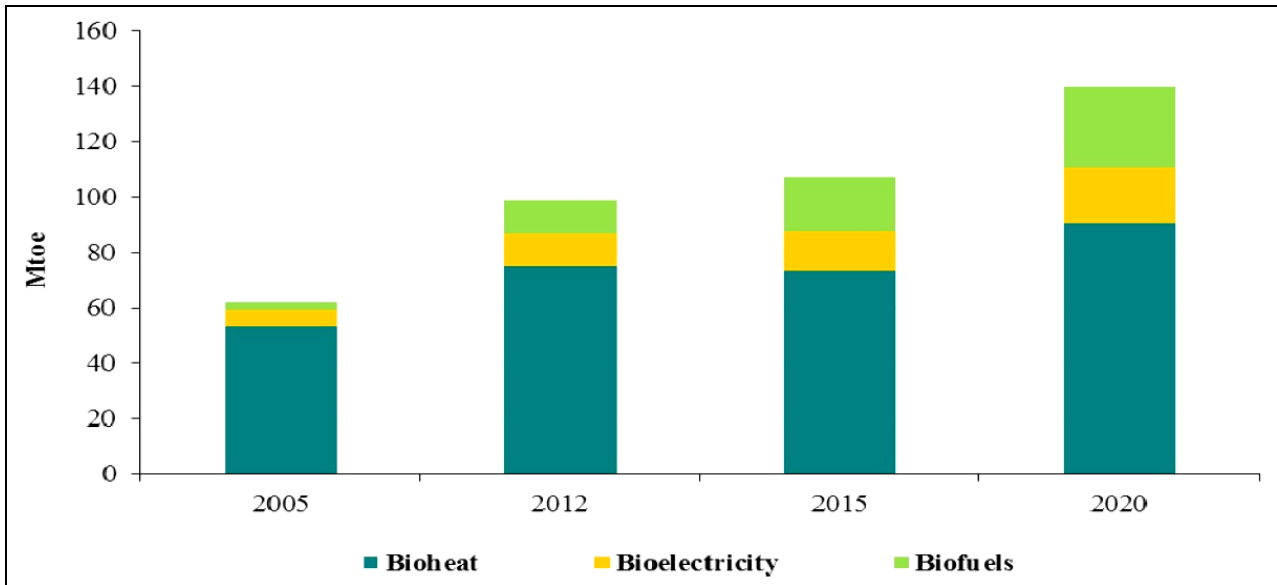


Figure 4: Outlook for EU final bioenergy demand (Mtoe, 2012-2020). Source: Progress Reports and National Renewable Energy Action Plans.

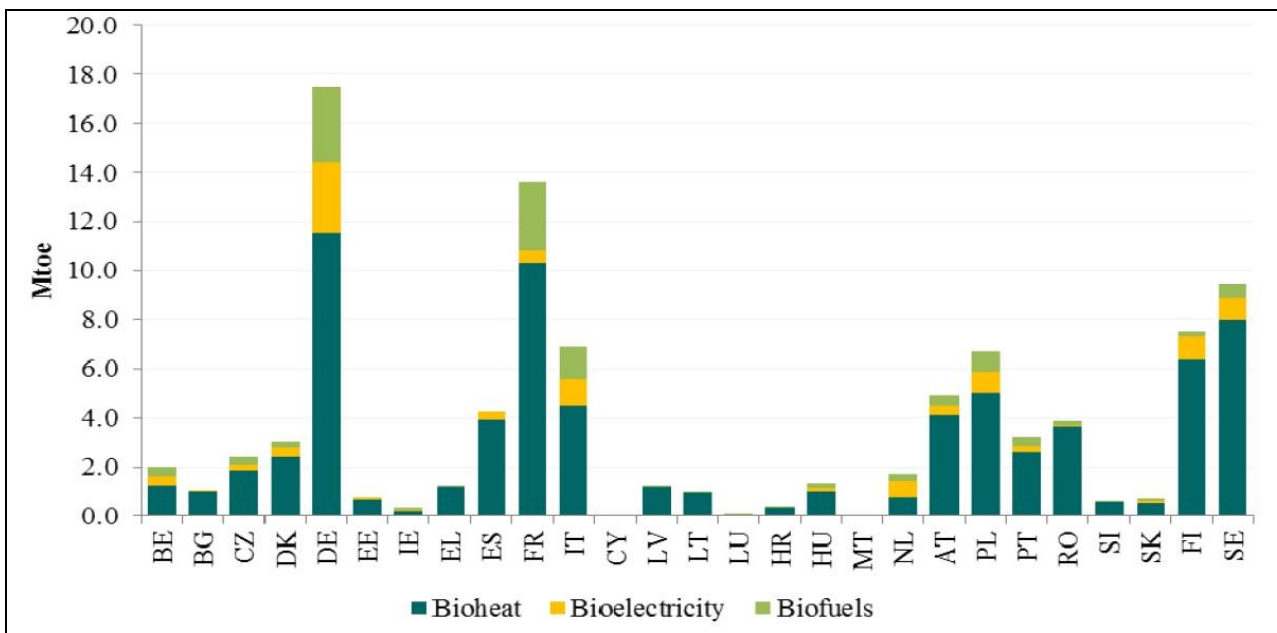


Figure 5: Final bioenergy demand by Member State (2012, Mtoe). Source: Member States Progress Reports on Renewable Energy

There are several well established schemes that certify forestry and agricultural products supported to provide a basis for new bioenergy certification schemes. Since 2013, most of the major European utilities that use biomass, (mostly wood pellets), have funded the **Sustainable Biomass Partnership (SBP)** with the aim to develop sustainability standards & processes. The SBP has elaborated a harmonized sustainability standard and plans to test it on the ground through pilot projects during the second half of 2014, with the view to make the scheme fully operation by early 2015. However, the EU biomass supply potential, including forestry and agricultural residues, is huge and an efficient standardization and supply chain of this solid biomass waste would strongly contribute to reduce the 15-30 MMT of wood pellets we expect to import from third countries in 2020.

In order to be able to valorize the EU potentials and to create a valuable bioeconomy based on the huge amount of biomass residues available in the 28 Member States, big efforts will be needed both at EU and national level. Biomass sources, as well as supply chain strategies and sustainable end products should be integrated in new specific regulation programmes.

Likewise, the Commission shall keep on closely monitor the origin and end-use of biomass in the EU and further develop biomass policy, maintaining a stable and predictable regulatory framework. Below, the latest report published by the EC on sustainability criteria of solid biomass for heating and electricity.

3. Biomass Production sustainability. Present bottlenecks and support measures to reduce the environmental impact

Overview and analysis of the EU Commission Staff Working Document on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU. Date 28/07/2014

The above mentioned EC report reviews national biomass sustainability criteria in order to check the current situation of EU Member states. It finds that while half of the Member States have adopted regulations promoting higher efficiency of bionergy production, only Belgium, Italy and UK have adopted greenhouse gas (GHG) saving criteria for biomass. Regarding sustainability criteria (sustainable forest management, criteria for agricultural biomass, etc.) Belgium, Hungary, UK and by the end of the year the Netherlands have adopted the following sustainability measures.

These differences on national sustainability schemes may create some market distortions, but the existing EU tools on technical standards should be enough in order to manage any future problem.

The document examines a 6 types of sustainability risks for the production and use of biomass:

- 1.Unsustainable feedstock production
- 2.Land use, land use change and forestry
- 3.Lifecycle GHG emission performance
- 4.Indirect impacts
- 5.Efficient energy conversion
- 6.Air quality impacts.

In the paragraph below, EUBIA focuses on the unsustainable production of biomass in the EU, both concerning forests and agricultural farms, analysing limits and potential new support measures.

3.1. Unsustainable feedstock production.

In the case of forests management:

It is not easy to determine the forestry biomass availability in Europe, due to the complicated collecting system and to the variable amounts of feedstock available. However, it has been calculated that about 200 million cubic meters of forestry residues are available in EU (about 35-50 MToe/y not utilized). These data are calculated on the basis of a medium and not intensive mobilization. However, one of the main barriers is represented by the uncertainty of the potential evaluation.

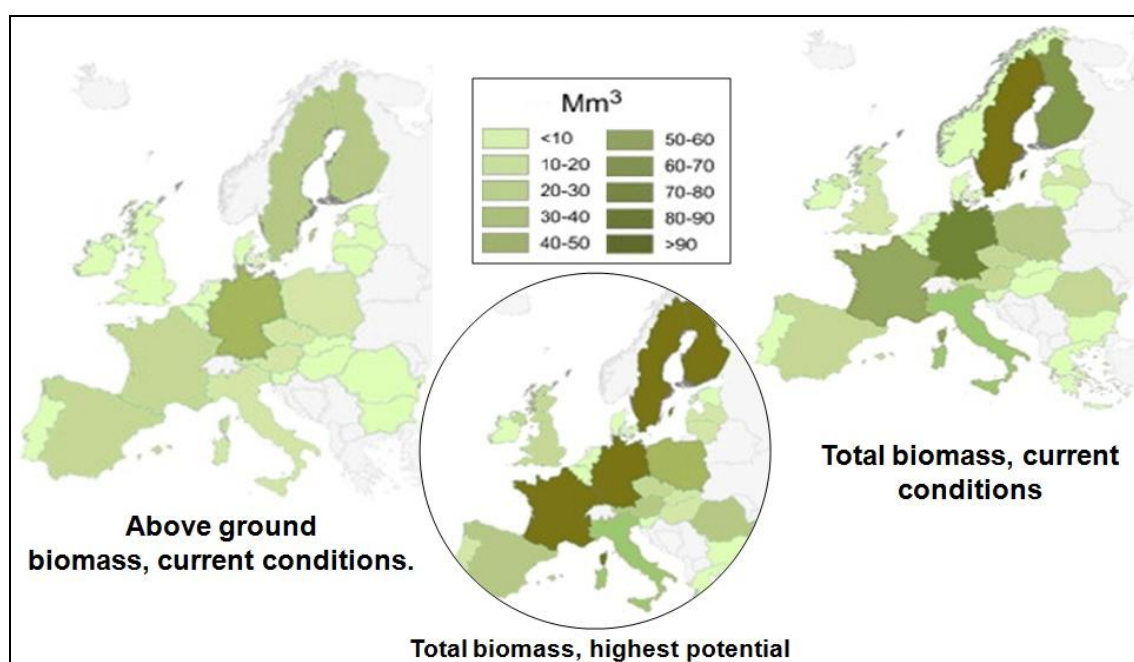


Figure 6. Average estimates of forest wood biomass potentials in Europe in 2012. Source University of Eastern Finland et al. 2012

Theoretical potentials can be quoted as the total forest biomass that could be harvested annually within biophysical limits (difficult lands, lack of access roads...) without depleting the existing forest stock. Actually, these potentials are rarely reached due to another common barrier, which consists on the technical, physical limits of extraction of wood from the ground, or during the pruning activity. Biomass for bioenergy production, if not efficiently monitored, can negatively affect forest biodiversity and carbon stocks through deforestation and unsustainable forest management within the EU and globally.

However, in Europe forest biomass for energy is currently largely produced as a complementary co-product of wood material/fibre products. Therefore it is unlikely that bioenergy demand is associated to direct deforestation. In fact, as a result of afforestation programmes, natural succession of vegetation and abandonment of farming, EU forest area has increased growing by around 2% in the EU area in the last decade. The conversion of natural forests to agricultural land remains at high levels but there is no evidence that it is driven by demand for forest biomass for heat and power in the EU.

However, in order to preserve a sustainable exploitation of forests, EC launched in March 2013 the EU Timber Regulation, which addresses the risk that forest biomass (for all uses, not just energy) has been harvested in contravention of the legislation applicable in the country of harvest. This measure prohibits the placing on the EU market of illegally harvested timber or timber products, including wood fuels such fuel wood, wood chips and pellets. A number of EU policy measures have been put in place in order to address the abovementioned risks.

In September 2013, the Commission adopted a new EU Forest Strategy with the view to address in a holistic way the overall increasing demands put on forests by many end-uses, including bioenergy. In the forest sector, resource efficiency means using forest resources in a way that minimises impact on the environment and climate, and prioritising the forest outputs that have higher added-value, create more jobs and contribute to a better carbon balance.

To this end, the EU forest strategy introduces the concept of "cascade" use of wood Which should be used in the following order of priorities: wood-based products, extending their service life, re-use, recycling, bio-energy and disposal. In some cases, different approaches may be necessary, for example in cases of changing demand or environmental protection. The 2020 objective of this strategy is to ensure and demonstrate by 2020 that all EU forests are managed according to the principle of sustainable forest management (SFM).

Regarding the Agricultural sector:

The sustainability risks related to agricultural biomass are mainly consisting in the loss of biodiversity, soil and water resources associated with intensive agricultural production etc. However, more than forestry, agricultural residues huge amount could represent a valuable solution to avoid pellets importation and to largely increase the sustainability of bioelectricity generation. Biomass agricultural wastes potential contribution to EU final energy consumption is estimated to be about 26% of final electricity and 6% of total final energy. However, to reach these values, would require overcoming a set of barriers currently hindering sector development. One of the main relevant issue is the Biomass mobilization.

Transporting agricultural residues is usually feasible only on short distances due to the low bulk density and to the degradability of the feedstock. A processing plant must be reachable in a restricted area in order to save the transportation expenses (i.e. 10-20km). Of course, after the collection, first stage refined biomass must be transported to centralized units to be further refined and compacted becoming a valuable "standard" solid fuel for several applications. Another factor to take in account to maintain the sustainability of agricultural biomass for energy is represented by the common practice consisting in leaving agricultural residues "in situ" in order to maintain soil organic nutrients.

Negative environmental impacts may be associated when large scale use of residues enters into competition with the biological role that straw plays (i.e. the recycling of organic matter into soil, protection of the soil surface and structure, nitrogen retention in soils and limitation of nitrates release during the autumn period), potentially causing damages to soil fertility and deterioration of biodiversity. However, just a reduced part (25-35%) of all residues should be left on the soil. Training farmer on this opportunity (also to diversify their markets) is very important to increase the feedstock availability. Given the local specificity of, for instance, the amount of straw left “in situ”, regional approaches are being promoted as planning concept in different countries and applied to restricted rural areas in order to evaluate the sustainability limits of residue availability.

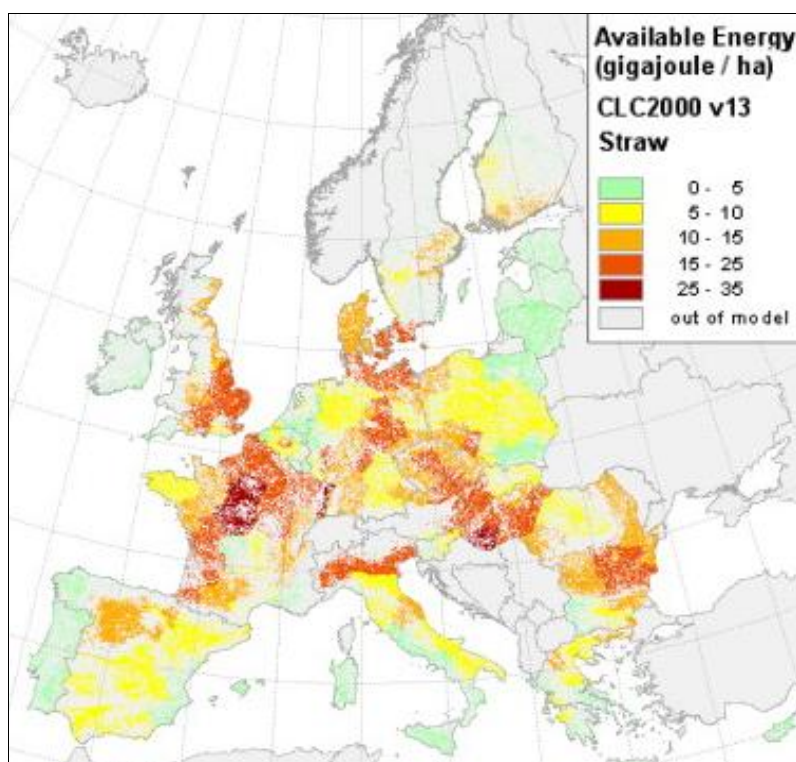


Figure 7. Potential energy from agricultural residues distribution in EU28 countries. Source:European Commission, JRC, Institute for Energy and Transport. F. Monforti et.all. 2012

Environmental impacts of energy crop plantations depend on several factors. In some cases, plantations of short rotation coppice may require high fertilisation, with negative impacts on soils and water, and may lead to compaction of soils. It should be noted, however, that plantations of short rotation forestry, with longer rotation periods, are not or little fertilised in the EU. The use of food crops, like maize or fiber sorghum for biogas must be regulated in order not to affect the biodiversity with large intensive monocultures, but also to make the market value of food crops increasing rapidly. This consequence is one of the most critic in the long-term analysis of bioeconomy development.

In any case, the Common Agriculture Policy (CAP), aimed to reduce the environmental impact of agricultural production have has been recently reformed for the period of 2014-2020 and substantial changes have been introduced concerning environmental protection.

Next future objectives target the farmers and the local actors, for example, "30% of direct payments to farmers will be subject to compliance with a new set of environmental "greening" measures" is reported in the EC report.

To convince farmers to collect and store part of their residues, regional, local authorities should promote a public-private contract where local supplier will be involved. This solution will secure a constant amount of biomass they could sell every year at a fixed price, depending on the agreement reached with customers. At present, even though the EC efforts, several issues must be considered. The lack of suitable machineries for the recovery and collection of residues is a relevant barrier after harvesting. But this can be defined a short term issue thanks to the investments and research activities now focusing on this sector. Machineries for compactation of biomass residues to be utilized directly on fields for a first stage refining process would partially solve the problem.

In fact, a first stage pelletization of raw, wet biomass increases the bulk and energy density of the material, reducing transportation and storage costs. Of course, after the collection, first stage refined biomass must be transported to centralized units to be further refined and compacted becoming a valuable "standard" solid fuel for several applications. In addition, a valuable and efficient producer-buyer collaboration or mandate for utilities for their use in power plants (i.e. straw pellets) would be required in order to secure a strong market for agricultural residues.

3.2. The impact of land use, land use change and forestry (LULUCF).

Three main aspects related to the wrong or lack of forest management can be identified as responsible of the increasing carbon emissions. In particular, the biogenic carbon lost is a consequence of deforestation, forest degradation and unsustainable agriculture practices. Since 2013, the EU is moving towards including this sector in the climate policy. On the basis of these factors, United Nations Framework Convention on Climate Change (UNFCCC), does not include biomass combustion emissions in the CO₂ total emissions calculation. Thus, emissions are given by land use, land-use change and forestry. Both Kyoto protocol and the EU Emission Trading Scheme accounts biomass as having a zero emission combustion factor. In particular, since 2013, EU Parliament and Council adopted a Decision on LULUCF emissions, in order to start to include this important climate factor in the related EU climate policy.

3.3. The lifecycle GHG emission performance.

Several calculation methods are available for the calculation of the whole value chain GHG emissions. The result might depend on a series of factors such as the type of feedstock, agriculture techniques, transport, processing and the efficiency of the conversion into electricity, heating or cooling. Given the most commonly used methodologies for the GHG emissions evaluation, it is considered to be good practice for existing bioenergy installations to achieve GHG savings of at least 70% compared to the fossil fuels comparators. This equates to lifecycle emissions of less than or equal to 86 kg CO₂ equivalent per MWh of biomass heat generated, to 201 kg CO₂ equivalent per MWh of biomass electricity, and 78 kg CO₂ equivalent per MWh of biomethane injected into the grid.

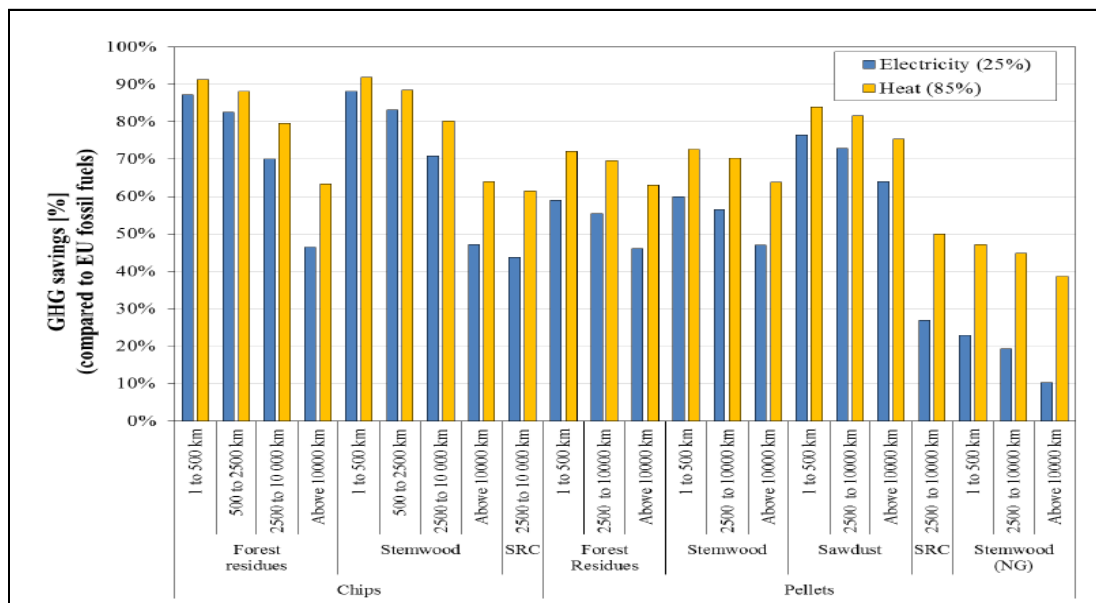


Figure 8: Default GHG saving performance of solid biomass. Source: Joint Research Centre 2014.

4. Solutions for a more efficient biomass supply chain

Facilitating raw feedstock supply chain is the first point to take in account for two main aspects: securing the adequate amount of biomass required by biorefineries, reduce the cost of raw feedstock. Both of the targets can be achieved through a well organized efficient biomass supply chain. Unfortunately, many barriers exist. Agricultural residues valorization is often limited by the difficulties and costs for the recovery, harvesting, collecting and transporting systems, which are very expensive for small farmers. In addition, some agricultural activities where biomass residues like pruning, other stalks, etc. would be available, are difficultly to handle due to the lack of suitable machineries. Furthermore, the fragmented land ownership, typical in EU member states, shows rural landscape where most of the farms are family owned. In these cases, collecting agro-forestry residues becomes much more difficult due to the lack of market information, farmers awareness on potential uses and to the lack of adequate machineries and storage facilities. The cost of agricultural residues, at the first harvesting stages, is almost zero, because the residues harvesting costs are partially included in the conventional crops harvesting system. However, part of the residues are left on the field, other are not stored and burned and, in the case of absence of animals (cows, etc..), often get lost. To avoid this issue, a general biobased-industry oriented strategy would be required at EU level, so that national governments would be obliged to support their local administration promoting an efficient valorization system. Below the strategic solution (in 6 actions) identified for improving the biomass residues potential utilisation in EU

4.1. New EU initiative

A new EU policy regulation addressed to specific conditions of areas with fragmented land ownership. On the basis of the main issues considered above, “Waste separate collection and recycling policy framework” represents a valuable example to be taken in account for the evaluation of new EU legislation.

The curbside collection concept can be re-evaluated in the framework of small agricultural family-owned activities, which represent the target of this initiative.

4.2. Farmers awareness

First of all, farmers should be informed about efficient procedures, correct residues utilization and potential role of agricultural residues for energy and biobased industry production:

- Role of modern bioenergy production, use and benefits
- Quantity of residues to be left on the field, amount of residues in excess
- Stabilisation of residues to avoid CH₄ –CO₂ emission
- Cheaper way to store and compact biomass.

Farmers should be able to get information from public campaigns, training material offered (leaflets, brochures) attached in local buildings or provided by mail like the well known food waste separation advertising campaign. The public awareness should concern not only bioenergy and biomass potential markets, but also agricultural residues potential GHG emissions, best practices for efficient storage of crop residues, etc. Another very important aspect to be taken in account is the amount of residues to be left on the soil for nutrient content preservation. It is crucial farmers to understand that less than half of the total residues produced are enough to secure a valuable soil quality.

4.3. Centralized municipal-owned units installation

There is evidence that public investment in rural infrastructure can be helpful in reducing transaction costs and enhancing market development, even more in remote regions. Policies promoting sustainable agriculture generation contributes to improve not only the biomass supply chain efficiency, but also the life quality of small farmers, which will be able to sell not only food but also non food products, diversifying their market and securing additional incomes for the future. Thus, the activity to be carried on by the local authority would include, first of all, the identification of a specific fragmented land ownership area, which will be analysed in terms of type of crops, amount of residues, etc. Then, municipalities, according to the new EU directive (and co-financing), should provide services and technologies suitable to improve the biomass valorization efficiency in the area. For instance, the contribution of local authorities would be consisting in providing storage facilities, centralized compactation units every 3-4 farms, facilitating transportation and storage efficiency (higher bulk density) of mixed agricultural residues.

4.4. Contracts among stakeholders

Not only municipalities and farmers, but other stakeholders would have a crucial role in the strategy. Indeed, the transportation, compactation and delivery of biomass should be managed by private companies, which role will be to find end users for above mentioned feedstock. As obvious, end users (power plant owners, households, other farms, biorefineries, etc..) ask suppliers to secure specific quality and quantity of feedstock.

Biomass components, quality, LHV, daily amount, annual amount, etc..must be kept constant, as they are of core importance for large plant owners and investors expected profits, costs, etc..Thus, a contract agreement would be established between local authorities and other key actors in order to create valuable conditions for promoting and securing an efficient residues supply chain. The initiative must be lead by municipalities as guarantor. (ex: transportation, collecting units for Used Cooking Oil recovery)

This contract agreement would involve the following private and public organizations:

- Agricultural farmers
- Biomass residues compactation machinery suppliers
- Transportation and storage specialized companies,
- Local Municipalities
- End users.

4.5. Supporting new companies

A pro-start-up initiative, at national and EU level would support the creation of companies specialized on residues collecting, refining and storing activities.

- Tax relief for the first years,
- Incentives based on CO2 savings, amount and type of biomass collected.

Another key aspect to be considered would be the dimension of the area covered by the company and the size of the farms (small farms usually do not have adequate machineries for transportation of residues). Municipalities would be asked to provide adequate services like: special building permission for decentralized storage, compactation units, transportation infrastructure. Due to the biological degradation of residues, with significant GHG emissions, corresponding CO2 credits should be provided to the MSW-organization, as compensation of logistic and infrastructure cost.

5. Social Credits - a new proposal for supporting large scale Biorefineries in EU

EUBIA developed a new possible financing structure to help governments provide additional capital to build bio-energy plants.

The economic crisis has harmed the growth of the bio-energy industry. Like other renewable energies, this bio-based industry relies on subsidies or other incentives. But the economic crisis has made governments less willing to provide subsidies, particularly in Europe. Biomass has an important role to play in the transition to a cleaner economy, but it has the disadvantage of the high cost of producing and procuring feedstock. However, the higher costs could be compensated by the creation of the benefits of the numerous jobs needed to produce feedstock and for the plant operation and maintenance. On the basis of these characteristics, it can be argued that bio-based industry could help boost economies at the same time as reducing emissions for three reasons:

- By increasing in renewable energy production, reducing the dependence and import of fossil fuels.
- By creating plenty of job opportunities, thus reducing unemployment (a huge problem in many European countries) and increasing national spending power,
- And because it has the potential to replace some fossil fuels with domestically produced feedstock, thus reducing imports with benefits on the country economic finances.

The second point – relating to job creation – represents the basis for a new support scheme we have conceptualised, which could help private investors back large-scale biomass/biorefinery activities. Biomass plants and factories operation require numerous full-time jobs in proportion to the amount of biomass processed, unlike other renewables, such as wind, solar or hydro. For example, a 2,000 hectares plantation of Sweet Sorghum in Southern Europe for bio-ethanol and electricity production provides full-time work to 100-135 people. (These calculations are based on one job per 20 hectares for only agricultural work, or one job per 15 hectares if plant operation is included). The number of employees would be higher in the case of a diversified multi-process biorefinery, where bioplastics, biochemicals and biofuels are produced. Governments could take advantage of the high labour intensity of the bio-energy industry by adopting a new biomass support strategy for investors, which we have called the "social credit support scheme".

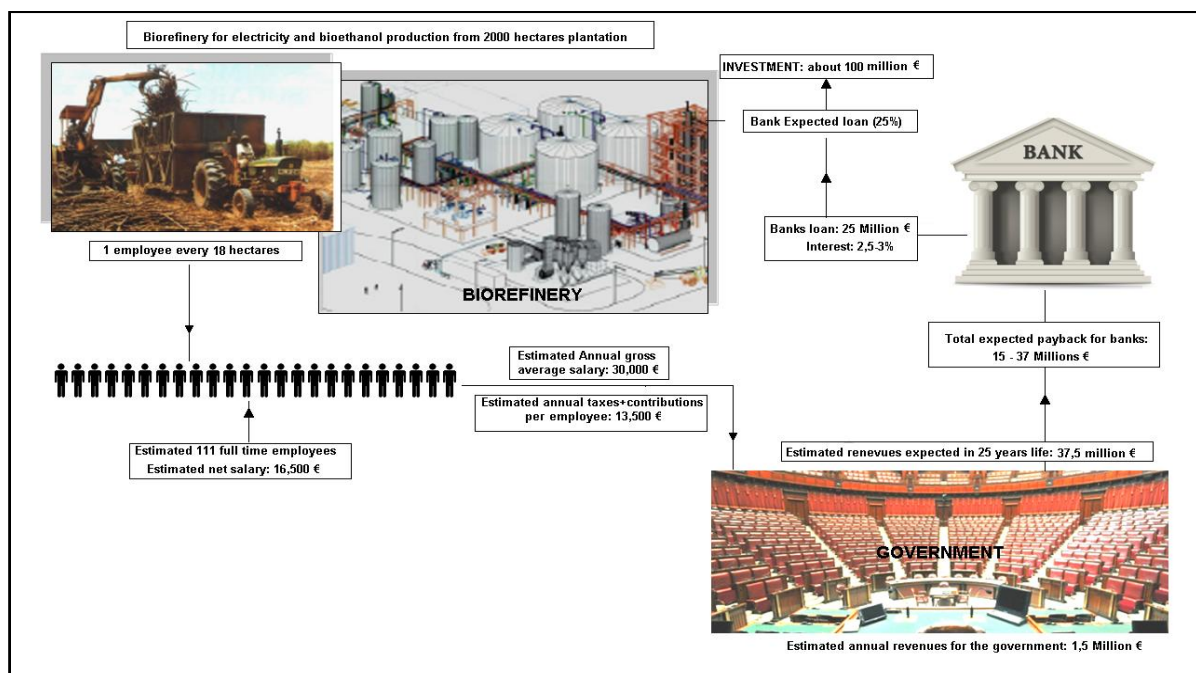


Figure 9. Concept of Social Credits Support Scheme. Source: EUBIA

The concept is based on the use of the potential accumulated salary taxation over the lifetime of the plant (about 25 years) from the number of direct permanent employees working full-time in the biomass value chain (production-refining-conversion-use). Governments receive so high monetary revenue from employers. Assuming that the overall taxes paid by the workforce over a plant's lifetime amount to about 30% of the total initial biorefinery investment.

This large tax income would allow authorities to promote reasonably-priced loans from the banking system to support initial investments in new plants. (The loans should be calculated depending on the country conditions, considering taxes and employees per project).

The state would service the interest on the loans, but could guarantee that the loan will be repaid, based on the operation of the plant for all 25 years of its life. The loan would effectively be underwritten by the cash flows from the tax income generated by the plant. Under this initiative, governments could easily pay back the money using the taxes paid by employees.

This would allow banks to apply a low interest rate to the loans to help finance initial investments in new plants – about 25-35% of the project's value at an average interest rate of 2,5%-3%. And private investors would have to find less capital to finance the plants. In addition, even though the state will have to forfeit the revenues from the taxation of bio-based industry employees, the plants would reduce unemployment, (in the EU the unemployment costs about 20-30,000 € per person). The unemployment reduction would help increase the public's spending power and reduce imports of fossil fuels. Through this strategy, countries with high biomass potential could build more easily a strong bio-based economy relying on efficient biomass supply chains and the promising bioenergy market.

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