# Biomass potential for future investments in Western Balkans, Moldova and Ukraine.

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## Abstract

Renewable energy sources (RES) remain to a great extend unexploited in the countries of the Energy Community i.e. Western Balkans, Moldova and Ukraine. Current use of biomass, mainly for heating purposes in the residential sector, is however significant in all the countries due to the economic and social status. Moreover recent estimates have indicated biomass as the most significant renewable source for future energy utilization. Most of the existing studies regarding biomass provide information on a national level and are based on different methodological approaches, resulting in significant discrepancies and making comparison difficult. This study analyses the biomass potential from agriculture and forestry in the Energy Community Contracting Parties (CP) using a homogenous methodological approach based mainly on data from national statistics, enabling the comparative analysis of the outcomes. The technical potential has been estimated and presented graphically at a NUTS3 level. Regions of high biomass concentration with potential for the development of bio-energy projects have been identified. Finally indications on the most promising technology options for the heat and electricity sector are presented.

**Keywords:** Energy Community, biomass technical potential, investment opportunities

### 1. Introduction

In line with its overall energy strategy the EU has set up the process to promote RES in the Energy Community[1]. Efforts to incorporate the new RES Directive (2009/28/EC) in the Contracting Parties (CPs) legislation have been initiated and a specific Renewable Energy –Task Force (RE- TF) has been established for this purpose. In this respect biomass has been identified by all the CPs as one of the most significant RES for future development.

All CPs depend heavily on imported fossil fuels to cover their energy needs. Energy dependence is high ranging from 44% in Croatia to 95% in Moldova [IEA 2008; IEA 2010]. With the exception of large hydro in some of the countries, renewable energy sources remain largely unexploited in all countries. Current biomass consumption for energy purposes is also significant in the Western Balkan counties and Moldova with a relatively smaller contribution in Ukraine. However, this is mainly attributed to the inefficient use of fuelwood for heating and cooking in rural areas [Domac et al. 2009; FAO 2010] leaving a great amount of the biomass potential unexploited.

Based on the above, there is clear opportunity to reduce energy import dependency by further developing the biomass market and promoting the use of new efficient technology options in both the electricity and heat sectors [Perakis et al. 2010].

The main aim of this study was to:

- to evaluate potential biomass supply from agriculture, forest and municipal waste;

[1] The Energy Community Contracting Parties are the countries of the Western Balkans, namely Albania, BiH, Croatia, FYROM, Montenegro and Serbia as well as Moldova and Ukraine.

- to map and examine patterns of biomass potentials;
- to assess possible market sectors that could actually exploit the biomass resources that have been identified and quantified by this study.

## 2. Approach

The study employed a bottom-up approach to estimate biomass potentials (Figure 1). Data from various sources were used, such as statistics from national and international organisations as well as published and unpublished surveys and studies. Moreover, considerable effort was taken to assess the credibility of data, through numerical cross-checks as well as more subjective (but no less important) "sense-checking" by team members in consultation with colleagues and peers and direct communication with local experts. The reference year for all calculations was 2008.

Two types of feedstocks were considered, namely agricultural biomass including field crop, arboricultural and livestock residues and forest biomass including fuelwood, forest residues and wood industry residues.

First the *theoretical potential* was estimated based on total primary production of specific crops as well as on production of wood and wood products. The *technical potential* was further calculated taking into consideration the practical availability of biomass by using factors describing other competing demands, the need for residues to stay on the land to replenish soil nutrients, difficulties in collection and handling of biomass etc.

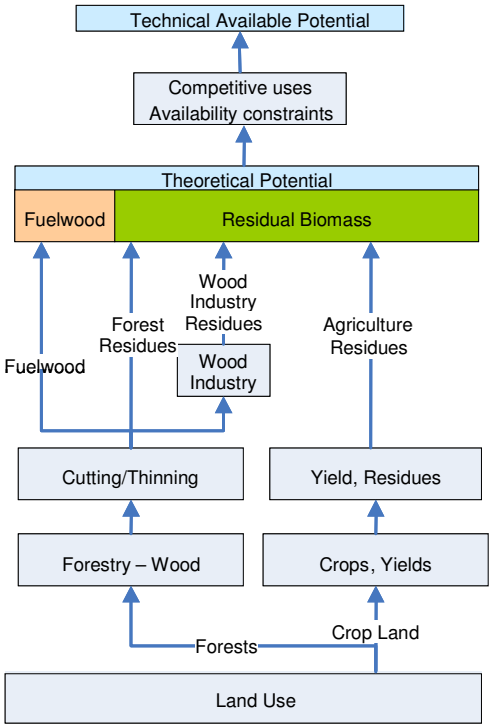


**Figure 1. Bottom up approach to estimate biomass potential.**

Following, based on the energy system of each CPs the most promising technology options for further investigation are also suggested.

## 3. Biomass supply potentials

The estimated total biomass potentials in each country are presented in Table 1 and are shown graphically in Figure 2.

Ukraine exhibits by far the highest potential (510 PJ) due to its significant size with nearly 88% of it deriving from agriculture. The same structure of biomass potential stands for Moldova as well with only 13% of total biomass coming from forests. The estimated biomass potential in Western Balkan countries rises in total up to 217 PJ, 44% of which is forest based. The respective contribution of each biomass feedstock type to the total potential is presented in Figure 3.

Figure 4 illustrates the relevant share of the biomass potential to current (2008) primary energy supply, where it can be seen that a significant amount of the energy needs in each country can be met from the utilisation of biomass.

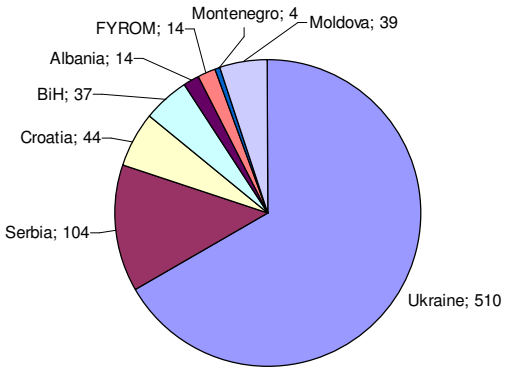


**Figure 2. Estimated biomass potentials (PJ).**

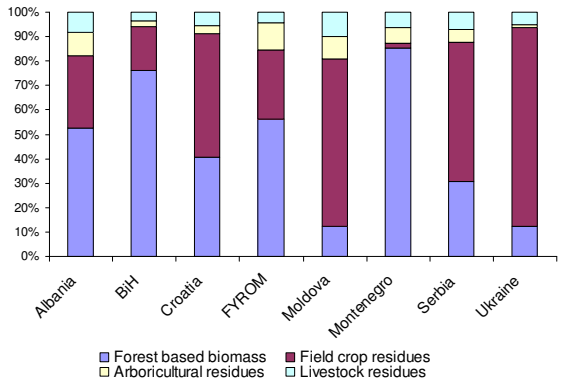


**Figure 3 Contribution of biomass feedstocks to the total potential.**

**Table 1. Biomass potentials (PJ).**

| | Albania | BiH | Croatia | FYROM | Moldova | Montenegro | Serbia | Ukraine |
|---|---|---|---|---|---|---|---|---|
| **Forest based biomass** | 7,59 | 28,04 | 18,10 | 7,84 | 4,88 | 3,31 | 31,62 | 62,36 |
| **Field crop residues** | 4,22 | 6,63 | 22,33 | 3,97 | 26,58 | 0,07 | 59,12 | 415,37 |
| **Arboricultural residues** | 1,40 | 0,84 | 1,39 | 1,53 | 3,61 | 0,25 | 5,47 | 6,66 |
| **Livestock residues** | 1,21 | 1,30 | 2,51 | 0,62 | 3,88 | 0,25 | 7,35 | 25,39 |
| **Total** | **14,42** | **36,81** | **44,32** | **13,95** | **38,94** | **3,88** | **103,57** | **509,78** |

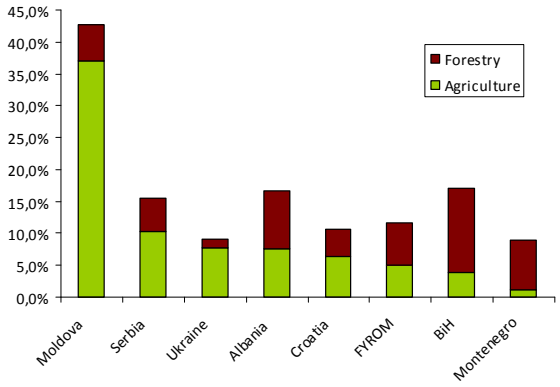


**Figure 4. Estimated biomass potentials as a percentage of each country's TPES.**

## 4. Heat & electricity market opportunities

This section assesses possible market sectors that could actually exploit the biomass resources that have been identified and quantified by this study in some detail. This considers a number of technological approaches and market sectors. Assumptions are taken which are necessarily high-level and approximate, and are open for challenge. Despite this, the section shows that the resources represent varied, sizeable and replicable opportunities for investment in modern power and heat generation technologies. Use of indigenous, renewable resources would contribute to energy-independence and give environmental benefits notably - but not only - carbon reduction. The focus was on conversion technologies that are proven commercially and are already widespread elsewhere in the EU. More advanced conversion technologies were not included. It is possible that such technologies may become preferred over the time-frame to 2030, but that is speculative.

The main market sectors were as follows:

- Small scale stoves, boilers, ovens for heating and hot water in domestic properties and other buildings including schools, hospital, municipal offices etc.
- Existing coal fuelled power plants that cofire wood and/or straw.
- Existing coal fuelled district heating plants that cofire wood and/or straw.
- New build medium scale combined heat and power (CHP) units that use wood and / or straw and / or energy crops.
- Anaerobic digestion units using manures and slurries from livestock..

As depicted in Table 2, all countries except Albania and Moldova have lignite or coal fired power plants. DH units could also utilise biomass as part of their fuel. A limit of 5% on a mass basis was assumed in order to account for technical difficulties.

New biomass fired CHP units could utilise a portion of the available woody biomass in the form of woodchips. Moreover in three countries namely Ukraine, Serbia and Moldova, the quantity and concentration of agriculture residues is significant allowing or modern straw fired CHP plants. Straw could also be directly

**Table 1. Existing solid fired units for biomass cofiring. [various sources]**

| Existing solid fuelled units (MW) | Power generation | Centralised DH plants |
|---|---|---|
| **Albania** | - | - |
| **BiH** | 1.510 | 110 |
| **Croatia** | 297 | - |
| **FYROM** | 800 | - |
| **Moldova** | - | 62 |
| **Montenegro** | 210 | - |
| **Serbia** | 3.940 | 473 |
| **Ukraine** | 25.690 | 3 |

**Table 2. Suggested technology options for electricity and heat production.**

| | Albania | BiH | Croatia | FYROM | Moldova | Montenegro | Serbia | Ukraine |
|---|---|---|---|---|---|---|---|---|
| **INSTALLED CAPACITY MW** | | | | | | | | |
| **Cofiring** | - | 21 | 27 | 6 | - | - | 19 | 79 |
| **New biomass CHP (wood)** | 10 | 21 | 27 | - | - | 5 | 19 | 79 |
| **New straw fired CHP units** | - | - | - | - | 53 | - | 119 | 866 |
| **Biogas plants** | 17 | 18 | 35 | 9 | 54 | 3 | 102 | 352 |
| **Straw fired boilers** | 59 | 93 | 201 | 56 | 161 | - | 362 | 2639 |
| **Small scale heating appliances** | 32 | 156 | 70 | 58 | 39 | 22 | 199 | 329 |
| **ENERGY PRODUCTION GWh** | | | | | | | | |
| **Electricity** | 27 | 61 | 90 | 15 | 107 | 8 | 259 | 1.377 |
| **Heat** | 106 | 280 | 310 | 114 | 276 | 28 | 758 | 4.319 |

used either in decentralized small-medium, mainly farm based units producing heat for various purposes.

Animal residues could be utilised via decentralised anaerobic digestion units. The potential for such installations could be increased in case of co-digested units that could utilize agricultural residues (green biomass) or dedicated energy crops. Evidently the current significant use of fuelwood indicates that there could be opportunities for the development of a market for modern biomass heating appliances using fuelwood or pellets.

Table 3 summarised the estimated capacity of installed power and thermal units and the produced energy for each CP.

## 5. Conclusions

Biomass is an important renewable energy source for the Energy Community CPs. Current consumption represents a significant share of total energy demand, however it merely refers to traditional and inefficient residential use. The study illustrates that the under study countries have the opportunity to use indigenous biomass resources to displace significant amounts of imported fossil fuels for electricity and heat production. This would bring important economic, social and environmental benefits. The CPs could benefit from the international and European policy

framework that provides mechanisms for RES development (CDM, EU statistical transfer etc) in order to attract funds for project development.


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## References


Domac, J.; Trossero, M.; Segon, V.; Milkovic, I.; Vrebcevic, M.; Kovac, G.; Pernar, R. 2009. *WISDOM Croatia: spatial woodfuel production and consumption analysis applying the Woodfuels Integrated Supply/Demand Overview Mapping (WISDOM) methodology*. This publication is a part of deliverables of the FAO project: TCP/CRO/3101 (A) Development of a sustainable charcoal industry in Croatia. FAO Forestry Department, Rome.

FAO 2010. *Woody Biomass Energy for Sustainable Rural Development.*. TCP/YUG/3201, 2008-2010.

IEA 2008. *Energy in Western Balkans – The path to reform and reconstruction*.

IEA 2010. *Country Energy Statistics, available at* www.iea.org.

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