

## **Biomass potential assessment in Central and Eastern European Countries and opportunities for the Ukraine.**

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**Abstract** This paper discusses an approach to determine future biomass production potentials and cost supply curves based on a bottom-up approach. The approach uses detailed data on NUTS3 level for Central and Eastern European Countries and results in biomass supply curves for different scenario conditions that could occur in a European setting. A first assessment of the Ukraine reveals that even with modest assumptions, the Ukrainian agricultural sector could supply 2,000 to 3,000 PJ of primary biomass per year on medium term (i.e. 2010-2015). Cost levels of liquid fuels produced from biomass (such as methanol or Fischer-Tropsch diesel) could end up around 6 Euro/GJ, which is about competitive with production costs of diesel and gasoline from mineral oil. Given the growing demand for biofuels in particular in the EU, biofuels could prove an extremely valuable export commodity for the Ukraine on shorter term already.

### **Background and Rationale**

Large-scale energy crop production requires large land areas, which could lead to changes in agricultural land use patterns. Land use for energy crop production competes with land use for food production, forestry or environmental protection and nature conservation. This requires better insight in the possibilities and consequences of using agricultural land in a country or region for biomass production.

Central and Eastern European accession countries (CEEC) have huge land resources and their agricultural production is characterized by comparatively low labour and agricultural production costs and relatively low productivity. Their accession means being part of the Common Agricultural Policy (CAP) and other European policies and legislation. It is expected that this change will stimulate a further rationalisation of agriculture. It has to be avoided that large areas of farmland are abandoned and unemployment is created as a consequence of policy reforms and competition with agriculture in Western Europe.

Therefore, biomass production in CEEC could serve as alternative for the agricultural sector. When it turns out that the bio-energy potential in the CEEC is large enough and could be realized at competitive cost levels, CEEC's could contribute significantly in meeting the EU's Kyoto commitments of reducing CO<sub>2</sub> emissions by supplying bio-fuels to the European market. To answer these questions, a regional biomass potential assessment is implemented for the CEEC<sup>1</sup>. This project does not include the Ukraine. However, in this paper we will discuss the results and consequences of the insights gained for the Ukraine. This discussion is backed up by a separate evaluation carried out in the Ukraine including site-visits, interviews with key parties and collection of specific data [4].

### **Methodological approach for bottom-up analysis of biomass potentials and cost supply curves (approach reported in more detail in: [1]).**

The regional biomass potential assessment is implemented for a set of scenarios. The methodology is based on land use changes over time. A certain amount of land is needed to meet the required production for food (derived from agricultural crops and livestock) and wood products. The surplus available land can possibly be used for biomass production. As this concept is only feasible when biomass production is profitable for the stakeholders involved, price and cost-relations are included in the assessment. Final deliverable are cost-supply curves from different sources (energy crops, residues) and production systems for the CEEC.

The scenarios used for the regional biomass potential assessment characterize the main current and future drivers in Europe related to agriculture and land use. They are placed in the context of the SRES scenarios from the IPCC. Relevant drivers in Europe are for example the debate about ecological agriculture, GMO or the WTO negotiations. These drivers are translated to quantitative

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parameters (for example level of trade, self-sufficiency, yield levels) and subsequently used in the analysis of the regional biomass potential assessment.

Table 1: Set of scenarios used in regional biomass potential assessment CEEC

Scenario	Story line
V1	There is a liberalization of trade. There are no market barriers in the world for agricultural products. EU specializes in products, which are competitive in world market. There is a strong increase in import and export products.
V2	Policies are regionally orientated. There is an uneven economic development in Europe. Trade barriers exist between the Western and Eastern European market. The agriculture in CEEC has difficulties to compete with agriculture in WEC because of struggles as lack of investment, technology and implementation of EU policies and legislation.
V3	There are no internal trade barriers in Europe. CEEC has completely adapted the EU legislation and can compete fully with WEC agriculture. Common Agricultural Policy (CAP) regulates agriculture in Europe. Aim of CAP is that farmers can compete with world markets. CAP reforms in Europe are in full implementation.
V4	There are no internal trade barriers in Europe. Europe protects its own internal market strongly. EU strives for self-sufficiency in its own food and energy need. Internal trade has increased. External trade of products in world market is limited.
V5	EU has a priority for sustainable development and nature conservation. Biodiversity, protection of rural areas and maintenance of the vitality of forest and grassland areas has a high concern. There is a tendency of greening of agriculture.

### Regional biomass potential assessment

A general overview of the methodology of the regional biomass potential assessment is shown in figure 1. The total available biomass potential in a Nuts-3 region is the sum of biomass from energy crops and agricultural and forest residues.

The regional biomass potential assessment is based on land use changes over time for a set of scenarios. A scenario, with a defined set of parameters, requires a certain demand for food and forest products. A certain area of agricultural land and forestland will be needed to meet this demand. The size of this area will depend on 1) demand and 2) the defined production system (productivity).

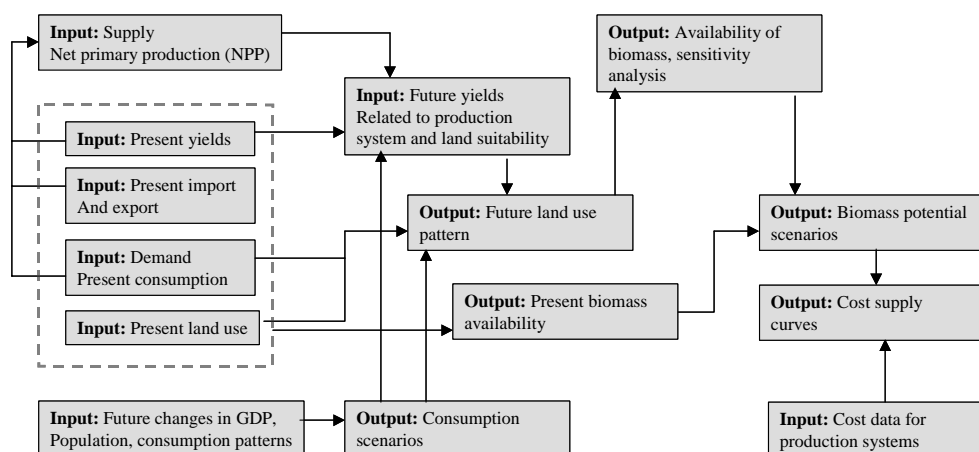


Figure 1: General overview of methodology and data requirement for regional biomass potential assessment CEEC

The current land minus the required future land for crop, livestock and wood production gives the surplus available land for biomass production. Surplus available land can be used for energy crop cultivation. The biomass from energy crops is calculated by multiplying the available surplus agricultural land with the productivity data for energy crops.

The main parameters, defined in the scenario's, that influence the required land for food and thus the land available for biomass production are demand of forest and food products and (agricultural) productivity.

### Cost-supply curves

The technical biomass potential is translated into economic potential by estimating the production costs based on the level of technology applied to produce the bio-energy. Final deliverable are the cost-supply curves. Figure 2 shows an overview of the procedure used to calculate the production costs of bio-energy. Production costs for biomass are collected for different land suitability types and production systems. A pre-condition for the implementation of this approach is that sufficient data are available on a regional level. Being able to work on a detailed level is relevant for detailed insights; current results illustrate that there can be a large variation in production costs on a sub-national level for energy crop production, which emphasises the need for accurate and detailed data. Figure 3 gives aggregated cost supply curves for 2015 for Poland for the 5 scenario's described. Those results indicate that the (additional) biomass production potentials can be large (up to three times as much biomass as currently available). However, scenario assumptions have a strong influence on the potentials. The 'ecological' scenario V2, which assumes extensive agriculture, can result in even lower biomass availability compared to the current situation. Furthermore, costs are affected by the scenario's. Scenario V1 gives the most favourable cost figures, with the bulk of the (large) potential below the 2 Euro/GJ range. As could be expected, a more protective European policy can lead to large biomass production potentials, but also higher costs for the biomass produced.

### Potentials for the Ukraine.

The presented approach and first results are produced for CEEC countries, but so far exclude the Ukraine. Nevertheless, given the large land surfaces of productive land in the Ukraine and current productivity in agriculture, the basic conditions for biomass production are very favourable. This is also highlighted by more

aggregated, global studies on biomass production potentials (see [2] and [3]), where under any scenario assumed, Eastern Europe (and in particular Ukraine and Western Russia) jump out as stable potential biomass production regions

A first assessment of the Ukraine reveals that even with modest assumptions, the Ukrainian agricultural sector could supply 2,000 to 3,000 PJ of primary biomass per year on medium term (i.e. 2010-2015). Cost levels of liquid fuels produced from biomass (such as methanol or Fischer-Tropsch diesel) could end up around 6 Euro/GJ, which is about

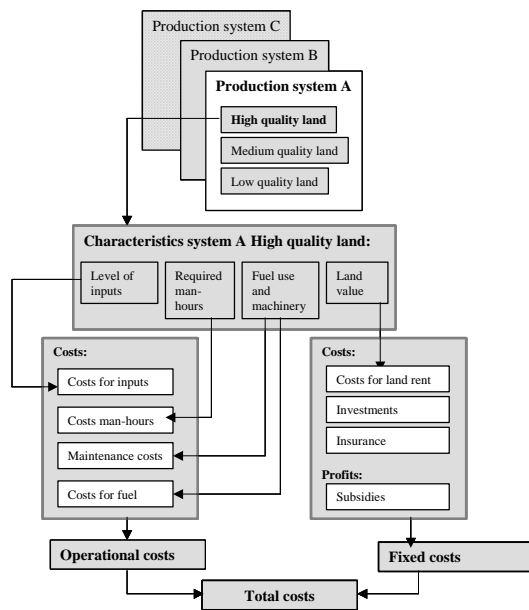


Figure 3: The data requirement in a region for production system A (in this example) on high quality land. The same procedure is applied for other land qualities.

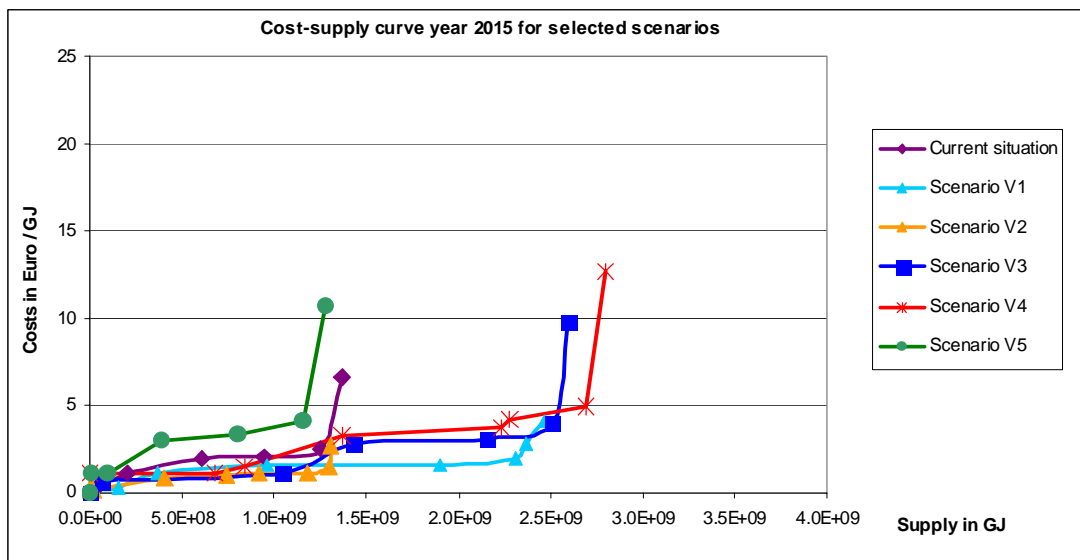


Figure 3: Preliminary results of the potential and cost analyses for biomass production in Poland for 2015, using a bottom-up approach [1].

competitive with production costs of diesel and gasoline from mineral oil.

Such amounts surpass the national demand for transport fuels and would allow for significant exports. Given the growing demand for biofuels in particular in the EU, biofuels could prove an extremely valuable export commodity for the Ukraine on shorter term already [4].

Major explanations of those favourable possibilities are the strongly reduced agricultural production since the beginning of the nineties (which illustrates the large potential productivity improvements in agriculture), the presence large land surfaces of productive land which are hardly utilised and low costs of land and labour. On longer term (after 2015-20, introduction of state-of-the-art agricultural techniques could increase this potential further. Specific opportunities may emerge from the Chernobyl Exclusion Zone (covering over 4 million hectares of land), which may be restored again by introducing short rotation coppice crops to remove radioactive elements from the soil.

In addition, Ukrainian industry is capable of producing many of the required components for advanced conversion technology such as biomass gasification-Fischer-Tropsch plants (pre-treatment, gas cleaning equipment, combined cycle technology, etc.) which may allow for lower capital costs than observed in Western European countries.

Based on the insights combined in this paper it is strongly recommended that detailed assessments are made of potential future land use changes and biomass production potentials. Such analyses are preferably made in a coherent European approach taking developments in CEEC, European agricultural and energy policies into account.

## References

- [1] J. van Dam, A. Faaij, I. Lewandowski, G. Kunikowski, A. Ragoncza, M. Rogulska, G.V. Roman, P. Pecznik, J. Weger, G. Wisniewski, *Regional biomass potential assessment in Eastern European Accession Countries*, 2nd World Conference on Biomass, May 10-14, 2004, Rome – Italy
- [2] E. Smeets, A. Faaij, *Biomass resource assessment on global scale for identifying biomass production and export potentials*, Report prepared for NOVEM and Essent, Copernicus Institute for Sustainable Development – Utrecht University, April 2004. Pp. 67 + Appendices.
- [3] M. Hoogwijk, A. Faaij, B. de Vries, W. Turkenburg, *Global potential of biomass for energy from energy crops under four GHG emission scenarios Part B: the economic potential*. (submitted to the Journal: Global Environmental Change, June 2004)
- [4] J. Hoogzaad, *Bioenergy systems for the Ukraine* (Copernicus - Utrecht University), April 2004, Pp. 100 + Appendices.