# The global potential of biomass energy: An estimation of the ranges

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## Introduction and background

Many studies have been undertaken to assess the future biomass energy potential (Hoogwijk, Broek et al. 2000). However, such studies often do not include all sources of biomass and are not always transparent in the procedure for calculating the energy potential. Furthermore, many studies tend to neglect or even avoid analysing the competition between various functions for land and various functions for existing residues (Hoogwijk, Broek et al. 2000). This paper also assesses the global primary biomass energy potential, however we mainly focus on the underlying relations and factors that influence the potential and we explored the ranges rather then give exact numbers. This study is the result of the GRAIN project (UCE 2000). Seven biomass resources are included (Table 1) and the contributions of several resources are compared.

Table 1: The biomass resource categories used to assess the range of the potential.

| CATEGORY |
|---|
| Category I: Biomass production on surplus agricultural land |
| Category II: Biomass production on degraded lands. |
| Category III: Agricultural residues |
| Category IV: Forest residues (incl. material processing residues) |
| Category V: Animal manure (dung) |
| Category VI: Food organic waste |
| Category VII: Bio-materials |

## Approach

The analysis of biomass energy potential is mainly based on existing studies. The differences in results from the various studies give a transparent overview of the aspects that influence the primary biomass energy potential. For this analysis first, the studies on the global bio-energy potentials have been reviewed. Second, the potential production of energy crops was assessed combining knowledge on land-use, future world-wide demand for food and possible systems for food production. Based on more detailed assessment studies, the potential availability of biomass residues was analysed. The potential future demand of biomass for production of materials as a possible competitor was assessed based on historical trends in bio-material utilization and correlation found with economic parameters. Finally, ranges of land use and possibilities for

biomass production and possible utilization of biomass residues and organic wastes were translated into energy potentials. The chosen timeframe for this exercise is 2040/2050.

**Results**

The ranges of all different biomass resources are combined (Table 2).
Since the different biomass resource categories (Table 1) are related to each other and hence, it is impossible to assess a potential for each category independent of the other categories. The real possible contribution based on all categories can therefore NOT be seen as the mean of the ranges in Table 2.

Table 2: Contribution of each category to the global site potential

| Category | Main assumptions and remarks | Potential bioenergy supply on long term in EJ |
|---|---|---|
| Category I: Biomass production on surplus agricultural land | Potential surplus agricultural area. Two production systems: High External Input and Low External Input are used. A large surplus requires structural adaptation of HEI agricultural production system. When this is not feasible, the bio-energy potential could be reduced to zero as well. A yield of 3 – 15 MG/ha is assumed. | 0 – 910 |
| Category II: Biomass production on degraded lands. | Based on a literature review of existing studies on the potential of deforestation on degraded land. Assumed yield of 1 – 5 MG/ha | 7 – 95 |
| Category III: Agricultural residues | Estimations from various studies. Potential depends on yield/product ratio and the total agricultural land area as well as type of production system | 10 - 27 |
| Category IV: Forest residues | The (sustainable) potential supply from the global forest areas is unclear since these areas include bioreserves. Estimations based on various studies | 0 - 16 |
| Category V: Animal manure (dung) | Estimations based on various studies | 9 - 25 |
| Category VI: Tertiary residue (organic waste) | Estimate on basis of literature values. Strongly depends on economic development, consumption and the use of biomaterials. No detailed studies were found | 3 |
| Category VII: Bio-materials | Based on relation between GDP and biomaterial demand. Including the possibility of cascading. | Minus<br><br>(0) 104 – 172 |
| Total | Most pessimistic scenario: no land available for energy farming; only use of residues and organic waste. No land for bio-materials was assumed.<br>Most optimistic scenario: intensive agriculture with large areas in use for biomass production and large amounts of residues, therefore only minimum amount of agricultural residues are assumed. | 29 - 1059 |

**References:**

1. Hoogwijk, M., R. v. d. Broek, et al. (2000). A review of assessments on the future global contribution of biomass energy. 1ste World Conference and Exhibition on Biomass for Energy and Industry, Sevilla.
2. UCE (2000). GRAIN: Availability of biomass for energy generation (In Dutch). Utrecht, Utrecht Centre for Energy Research: 36+6 bijl.