BIOMASS POTENTIAL: STATIC AND DYNAMIC, LONG TERM AND SHORT TERM

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Overview

Renewable energy sources (RES) contribute by app. 25% to the whole primary energy production on EU28 and biomass share in this total RES contribution currently exceeds 63% [1]. Biomass is expected to play significant role in meeting EU 2030 climate-energy policy targets. Sources of easily accessible waste and residual biomass are quickly depleting and intentionally planted biomass on agriculture land and reasonable utilization of residual biomass from agriculture and from forestry started to play crucial role. Effective policy of biomass utilization development requires proper evaluation of biomass potential taking into account the all potential constraints (legal, environmental, economic) and possible dynamics of its development. Biomass potential can be also viewed as the long term sustainable potential (standard potential after inclusion of all effective constraints) and additional potential which is increase of standard potential in the short run (the period of max. 1-3 years) when some of applied constraints for standard potential are neglected. Additional biomass potential can be valuable source of energy in case of troubles with conventional fuels delivery on regional or country levels.

The paper presents methodology of standard and additional biomass potential calculation based on soil and climate parameters of agriculture land (similarly in case of forests) using Geographical Information System (GIS) on the example of the Czech Republic. Paper also discusses dynamics of biomass potential development and analyses major factors influencing and limiting biomass potential development in time.

Methods

Biomass potential on agriculture land (for given area) consists of the two parts: residual biomass from conventional agriculture and biomass from energy crop (here we assume energy crop as the source of solid biomass for burning or for transformation into solid biofuels). Expected biomass yields of individual types of conventional and energy crop (having meaning the long term average yields) can be derived from the soil and climate conditions on given land plots. Results of soil valuation in the Czech Republic (so called BPEJ system) have been used to develop methodology to determine biomass potential in given geographical area consisting of individual land plots. BPEJ system combines information on climate regions, soil type, slope and exposure and depth of soil profile and its skeleton. App. 550 valid combinations of climate region and soil type exit, each one has assigned expected yield of individual conventional and energy crops (typology of agricultural sites based on empirical data, experimental plantations and expert estimates). Biomass yields are then clustered to obtain 5-7 typical yields (or yield curves for perennial energy crop). Residual biomass of conventional crop (straw) is calculated from grain yields using straw to grain coefficients and its availability is corrected for the amount of straw used for farm animals and ploughed back into soil. Evaluation of biomass potential for given area requires determination of agriculture land utilization (percentage of permanent grasslands, percentages of individual types of conventional and energy crop) and also the logic of land allocation to individual kinds of crop – e.g. preference of conventional production.

Similarly biomass potential from the forestry is derived based on the residuals after forest harvest (in average – assuming Central European conditions – about 15% of biomass is left on site in the form of small branches, etc.). Similarly to the agriculture land, biomass potential from forestry is derived based on conditions on individual forest plots (age structure, climate zone, type of forest, etc.) [2].

Additional potential (as the short term contribution to the standard biomass potential) is derived assuming neglecting of some applied constraints – e.g. ploughing part of straw into soil, shortening of SRC plantation rotation period, change of assortment of wood from forests (part of wood originally , etc. [3].

Dynamics of biomass potential can be viewed from the two different points of view – distribution of biomass potential throughout the year – it is important esp. in relation to short term biomass potential and possible dynamics of biomass potential growth which is primarily related with the changes of agriculture land utilization. Switch from conventional crop to the energy crop can be only gradual process where several decelerating factors play role (e.g. availability of proper seeds, conservatism of farmers, only gradual changes of biomass market and biomass/agriculture subsidy schemes).

Results

Application of derived methodology of standard and additional biomass potential calculation on the example of the Czech Republic shows: (1) Original expectation for the biomass potential value (from agriculture land) should be significantly reduced (assuming priority of the conventional agriculture production). Results of biomass potential modelling indicates biomass potential from agriculture land (for 0% of energy crop and the present structure of conventional production) about 87-90 PJ [3]. (2) Increase of land allocation for energy crop increases biomass potential only in moderate way – e.g. allocation of energy crop on 15% of arable land increases (solid) biomass potential only to 107 PJ [2]. (3) Results of calculation for the Czech Republic show that the standard biomass potential can be significantly increased with additional (short term) potential – by app. 18 PJ (with relatively high variability between the regions from 10 to 40%) [3], (4) Additional biomass potential from agriculture land has strong seasonal profile with minimum during spring and autumn seasons.

Analysis of biomass potential also shows that locally available biomass (transformed into solid biofuels – pellets and briquettes) can cover the significant part of energy requirement for the space heating in small villages (below 1000-2000 inhabitants) and in the Czech Republic can serve as the competitive substitute of domestic brown coal which is still widely used for local space heating [4].

Conclusions

Effective evaluation of possible future biomass contribution to the balance of renewable energy sources requires detailed analysis of contribution from agriculture land and from forestry. Conditions on individual land plots – such as soil and climate parameters, age and type of forest, etc. significantly influences biomass yields. Utilization of average figures on biomass yields and omitting of the effective constraints can lead to the significant errors in biomass potential evaluation.

Biomass potential is not the constant value, it has seasonal profile and potential dynamics of its development in the time. Biomass potential for given region and at given time can be also viewed from the point of view of long term available potential (essential information for the investors into power or cogeneration plants in given region) and short term increase of standard potential (the important information for the planning of the development of the critical infrastructure which should ensure basic energy delivery from local sources based on locally available fuels).

References

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