

Biomass potential to secure energy needs in critical situations: Methods and the case example of the Czech Republic

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Overview

The share of imports on total primary energy consumption (PEC) has been somewhat more favourable in the Czech Republic than is the average in the EU (45% compared to 55 % in the EU). However, this share will grow in the coming years as a result of fast deployment of domestic coal sources. The Czech Republic, similarly to other EU countries will become more and more dependent on energy imports. Energy security and securing energy supplies in critical situations therefore start to play more important role in the state's energy policy.

In the same time, thanks to its characteristics (storage ability, even dissemination and planning possibility) biomass as the most important domestic and renewable energy source represents suitable biofuel supply to energy production (heat, electric) in critical situations in peace times (e.g. energy cuts, break downs or intentional damages to critical infrastructure) as well as in international crises connected with energy cuts. Even though economic, technical, legislative and ecological barriers limit current biomass use in the Czech Republic, in times of crises, for a limited period of time, it may be possible to mobilize significantly higher share of biomass potential and to use it to cover at least part of energy demand – mostly from the critical infrastructure needed to ensure functioning of municipalities, regions and the whole state.

The paper analyses methodical approach to identification of critical situations, in which the domestic biomass can serve as a source for operation of critical infrastructure, and to identification of the biomass potential that can be mobilized, taking into account time of initiation of the crisis as well as its length. The approach is based on the use of GIS models, in which so called “islands of survival” are established around the electricity and heat plants using biomass (power plants and cogeneration plants, biogas stations, etc.). For such areas, the GIS model allows to identify the potential (in different time periods) of biomass that can be mobilized while respecting the needs of food security, real logistic linkages and collection distance and biomass production options in the given area.

Application of this method to identify critical situations and to define biomass potential for energy supply in these situations is demonstrated on selected areas and selected critical situations in the Czech Republic.

Methods

The potential of biomass is analysed using methodology for evaluation of potential of forest and agricultural lands with utilisation of GIS with regard to food security scenarios of the Czech Republic. Biomass potential includes also areas managed by forests enterprise of the Ministry of Defence. Optimized logistic centres, routes and utilisation points (power and heating plants) are suggested based on analysis of the critical situations planes and technological possibilities of energy companies. Possibilities of biomass utilisation in selected power and heating plants in critical situations caused by scarcity of fossil fuels are evaluated including economic analyses of biomass extraction and utilization.

Biomass potential for energy supply in critical situations is based on two main types of critical situations – short-term crises (lasting several months to a year) and long-term crises. The first type of crisis originates in sudden loss of energy supply and the biomass potential is bound by available and attainable biomass from agricultural land (e.g. higher use of straw, use of otherwise unused permanent grasslands) or by biomass that can be quickly mobilised from forest (at the expense of lower forest exploitation after crisis). In case of long term crises and cuts of primary energy sources it is possible to develop biomass intentionally planted on agricultural land, respecting food security. The agro-technical possibilities, availability of seed and other barriers then limit the speed of energy biomass growth.

Model for biomass potential using GIS is based on identification of soil and climatic conditions of individual land areas (both agricultural and forest) and assignment of respective biomass yields for the individual energy crops and forestlands. The algorithm that uses information in GIS allows to identify the biomass collection area needed to cover the identified energy needs (respecting the real possibilities of biomass collection from transport infrastructure), as well as to define for the given area the biomass potential and transport distance to the areas of biomass consumption.

Results

Biomass is a key domestic renewable energy source in the Czech Republic. In long-term horizon the estimated biomass energy potential reaches cca 250 – 300 PJ (about 12 -15% of current primary energy consumption). However, biomass is not only a possible substitute to imported primary energy sources, but it can also be considered as an important strategic energy source, which can supply specific areas in critical situations characteristic by cuts in imported primary energy sources.

The article therefore presents results of analysis of critical situations in the Czech Republic, in which biomass can be used to supply the critical infrastructure of municipalities, regions and state. The article also presents the methodical approach to set biomass potential for the given area from the point of view of biomass that can be mobilized in short-term and in longer run. The results of the analysis are demonstrated on selected areas and selected critical situations in the Czech Republic.

Conclusions

Biomass is a locally available renewable energy source, which can contribute to solving primary energy source cuts in times of international energy crises as well as other situations connected with energy supply cuts. Assessment of real possible contribution of biomass to solving such critical situations requires identification of the critical situations in energy supply, identification of cases in which biomass can contribute to ensure energy supplies and identification of real potential of biomass mobilisation in such cases.

The real possibility of biomass contribution in turn requires respecting production possibilities of agricultural land and forest land, time horizon of energy biomass development, collection distance and logistic chains to the points of biomass consumption. Models using GIS are a suitable instrument, which allows to respect all interlinks and constraints for biomass potential identification, as well as suitable environment for presentation of the results through map data.

The results of the analysis of biomass contribution to energy supply in critical situations is an important input both for energy policy development respecting energy supply security and crises solution, and for identification and removal of potential barriers, which hinder such biomass use.

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