Opponent review of the dissertation thesis submitted by student Ing. Michel Kolaříková:

Evaluation of solid biofuels made of hemp (*Cannabis sativa* L.) from two different localities – Czech Republic and Moldova

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The present work deals with the possibilities of using industrial hemp as a source of energy for heating. The author presents a complex assessment and solution from the energy and environmental points of view. This topic is currently relevant particularly for developing countries as it is documented in the Thesis for the Republic of Moldova. In case of the Czech Republic, I see the possibilities of its utilization mainly on the family farms. The use of this renewable resource is supposed to be a complementary production and in direct link with the growing practices where the studied crop has other positive effects on farming.

The Thesis is based on two assumptions, i.e. a positive energy balance and a positive environment impact in comparison with the fossil energy sources. In addition to the supposed confirmation of both assumptions, the work brings a number of information which shows the suitability of using hemp as renewable energy source as well as it provides specific data on its appropriate use for these purposes.

The Thesis is elaborated on 82 pages of relevant text; the structure is standard as for scientific works. There are - an abstract, content, and list of abbreviations, tables and figures at the beginning of the Thesis. The first chapters (Introduction, Literature Review) describe the context of renewable energies' use in depth, including their impact on sustainable development and a comprehensive assessment of the issue. From the text is also visible the focus of the work on comparison of initial conditions for use of renewable energy sources in two different countries, one of which is economically developing. The Republic of Moldova was chosen as a convenient object. This part of the Thesis is elaborated detail enough, using scientific references, and it justifies in a suitable way the necessity of this kind of work and presented objectives. The main objective then is to evaluate biofuels from hemp in terms of energy use and environmental impact. As well, there are additionally and properly stated three specific objectives.

The following chapter "Material and Methods" describes the steps of growing trials, i.e. cultivation and harvesting, including different conditions in both localities. Afterwards, the Thesis presents methodology of measurements in accordance with technical standards, principles and methods of energy balances for 4 growing scenarios, along with description and calculations of energy inputs for the final calculation of EROEI. The LCA method for hemp is also depicted with the definition of scope, purpose and interpretation methods. Whole this part of the work logically follows the introductory chapters and allows obtaining and evaluating the information in a comprehensive way in order to achieve the objectives.

The chapter 5 of the Thesis presents the achieved results and their discussion. The output energy values are clearly shown in two tables (Table 10, Table 11). The yield values/results confirm the information obtained from the literature and take into account the author's earlier published works. In this context arises the question: ***Why the BEY value was stated?***

The results also affirm the decrease of moisture content during the spring harvest. This fact is documented in detail in the in Fig. 16, which was created in the framework of previous author's cooperation in the experiments. The advantage of low moisture content during the spring harvest is significant only if the large volumes of biomass are harvested, which would have to be artificially dried in case of an autumn harvest. However, if we accept the assumption of natural drying after the autumn harvest, the lower spring yield becomes a disadvantage. At this point, it would be important to answer question: ***What is the reason(s) of lower DM value in spring?***

Material and energy inputs for the fuel production are item-by-item presented in the chapter 5.1.2. The values, which are apparently adopted from some expert information system, are well arranged into the tables and contain necessary information for calculation of input energy values of all four production scenarios. These energy inputs are also clearly expressed in pie charts. The result of the calculations is the energy balance for four tested scenarios for heat production (EROEI). And hereby, the assumption of the dissertation Thesis was confirmed. The assessment of environmental impact of the mentioned technology is subsequently presented in the next part of this chapter and it confirms the second assumption.

In the conclusions of the Thesis, the obtained results are suitably presented in interconnection with the practical use; and the work is also supplemented by the cited references.

According to my opinion, taking into account the good quality of the submitted work and considering the achieved results, this Thesis fulfils all the necessary requirements. The objectives of the work have been met and relevant results have been evaluated.

Therefore after successful defence I recommend to grant the author by academic title "doctor" abbreviated as Ph.D.

In Prague, 20. 9. 2017

Ing. Petr Hutla, CSc.