University of Pannonia, Faculty of Information Technology

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Ph.D title submitted by Andreja Nemet

OPTIMISATION AND INTEGRATION OF RENEWABLE ENERGY GENERATION AND MANAGEMENT OPTIONS

I would like express my appreciation to Prof. János Abonyi for reviewing my thesis. I would like also to acknowledge his assistance in the phase of preparation for defence of the thesis before an appraising committee in a public discussion. Prof. Abonyi pointed out ways to improve the thesis via his individual comments and observation.

The reviewer had pointed out four question and remarks. The question and related answers are the following.

- Although Section 2 gives an excellent overview of renewable energy sources, it is not related to the topic of the thesis. I think instead of this textbook-like material, a detailed analysis of the related literature of (online) modelling, optimization, scheduling and process integration should be presented.

  Thank you for the comment. The title of the thesis is Optimisation and integration of renewable energy generation and management options, therefore, a review of all renewable energy sources have been provided in order to make an overview of the current state by recommendation of the Thesis supervisor. The main topic of the Thesis is making estimation of solar collector design and its heat integration within processes and other systems rather than the modelling, whilst the scheduling is out of the scope. The overview of Pinch Analysis is therefore also included (Chapter 4) that is a part of Process Integration related to the topic of thesis.

- The proposed MILP based linear approximation assumes that the whole profile of solar irradiation is known. I think this information is available only at the end of the day. I assume the variations of the supply in a cloudy day could be much higher than the differences between the actual and the approximated steady state values of a time slices. Since the variance of the irradiation is higher than the approximation error, I think the application of MILP for the approximation of a univariate function is a kind of overengineering

Thank you for the comment. The author do agree that irradiation profile is known at the end of the day, however when performing a design of the system a forecast regarding possible operating is usually required. The author do agree as well, that the difference between cloudy day can be higher than the difference between the approximation and real values. However, the MILP approach offers a solution with smaller numbers of time interval in order to enable application of graphical tools presented in Chapter 4.

- It is stated that "the aim is to minimise the number of Time Slices, in order to simplify the computations in the following steps of the integration procedure." One of the main contributions of the thesis is that it presents an extremely simple steady state model, so simple algebraic equations (implemented in an excel spreadsheet) are suitable for the calculation of the feasibility of energy integration. From this viewpoint, I do not see why the computational complexity is critical, why the number of time slices should be minimized. Please compare the computational complexity of the model and the MILP based optimization of the time slices.

  Thank you for the comment. The author agree, that it might not be emphasized clearly. However, in the thesis different tools for different purposes are developed. A MILP based optimisation of number of Time Slice offers a procedure to obtain lower number of time intervals in order to enable evaluation of Solar Thermal Energy integration when applying a graphical approach for integration. This approach is based on Pinch Analysis and helps to visualise the potentials of the case study under evaluation. It can be helpful in numerous cases as the range of temperature interval the design requires as well as the minimal mass flow-rate required in dependence of specific heat of the transfer media can be provided. The graphical approach can reach high complexity without decreasing the number or time intervals. In Excel spreadsheet a different approach is presented, where a measured or short-term forecasted values of solar irradiation are applied for monitoring and short-term forecasting of the integrated amount of solar thermal energy when the decision about the design has already been made.

- The inlet and outlet temperatures from collectors and from storage are varying from one TSs to another. However, these temperatures have great importance during integration, therefore some assumptions were made in order to be able to determine those temperatures (The outlet temperature of collector and the storage temperature after heat exchanges are determined based on a simple as described in following Chapters 5.1 and 5.2.)
  Please discuss why not measured values are used.

  Chapters 5.1 and 5.2 contains a description of the methodology for making a preliminary design of the solar collector integration system, therefore, at this stage no measured values are available as the system will be put in operation in some later time. Therefore, some average predicted values has been applied in order to perform the analysis.

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Mrs. Andreja Nemet