UNIVERSITI TEKNOLOGI MARA

SOLAR THERMAL INSTALLED CAPACITY MODEL FOR INDUSTRIAL HEATING PROCESS IN MALAYSIA USING SYSTEM DYNAMICS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The enabling policy framework and support programs in Malaysia for Renewable Energy (RE) have focused on grid electricity power generation over thermal applications. A significant energy from fuel can be reduced if some portions of heating use in industries is replaced by solar thermal energy. However, no guideline for solar thermal application for large-scale thermal energy and application in commercial building and industries, high investment cost and risks, lack of knowledge, technology know how, and effective policies have hampered the industries' acceptance and investment in solar thermal. Therefore, this study proposes three models: 1) Solar Thermal Acceptance Model (STAM), 2) Solar Thermal Investment Decision Model (STIDM) and lastly, 3) Solar Thermal Installed Capacity (STIC). STAM and STIDM are basic models to the STIC. Both models were combined and enhanced as final process of STIC model. The STAM model predicts the solar thermal acceptance behaviour among the industry. Technical acceptance such as the availability of local supply and technology supply, technical information and other influence factors including cost, exposure, company needs, and applicability were incorporated in the model. The STIDM model simulates the investment decision considering the techno-economic and risks of the project. Finally, the STIC model was developed incorporating the STAM and STIDM to predict the installed capacity behaviour. The models were established employing System Dynamics simulation for analysing a complex system in a quantitative and qualitative way. A survey from SIRIM were used. The STAM results have shown that technical acceptance and cost of the system have big impact on the acceptance. with the business-as-usual perception of industries toward the technology, the simulated acceptance level among the industries in Malaysia is low (<1%), although the trend is increasing over the simulation years. The STIDM results revealed the risk factors have bigger influence compared to the techno-economic and have shown increment in the decision to invest each year. Lastly, the STIC model has predicted that the behaviour of solar thermal installed capacity is increasing tremendously with incentives provided for over the 20 years simulation period. The inclusion of various incentives in the system have reduced the risks, thus increase the investment decision and solar thermal installed capacity. The solar thermal installed capacity is expected to reach 579 k MWth with incentive as compared to 264 k MWth in year 20. A comprehensive STIC model developed can be used by the policy makers to study various policies and incentives for renewable heating energy considering acceptance level and industries investment.

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