

# CAN MALAYSIA MEET ITS RENEWABLE POWER PLANT EXPANSION TARGET BY 2015? EVIDENCE FROM SYSTEM DYNAMICS MODEL

Salman Ahmad, Razman Mat Tahar

*Faculty of Technology, University Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang*

## ABSTRACT

Malaysia having more than 65% of electricity generation from fossil fuels has been trying to incorporate renewable resources in the fuel mix. System Dynamics modelling and simulation approach is used to model capacity expansion target by 2015. The system dynamics model consists of construction, incentives and investors' behavioral feedback, in making an investment decision. Analysis under optimistic settings reveals that investments fail to achieve the target of 985Megawatts of renewable capacity.

*Keywords:* Renewable energy, System dynamics, policy simulation

## INTRODUCTION

World's energy demand has been growing steadily since the last two decades. The most powerful drivers of this are growth in population and income. Total electricity generated in the World in 2010 was 213251.1 Trillion Watt-Hour (TWh) which is a 5 % increase from 1990 (International Energy Agency, 2011). Depleting fossil fuel resource resulting in price escalations, environmental degradation from electricity production, and increasing demand calls for diversifying the fuel mix for electricity generation with renewable resources.

In Malaysian electricity is primarily generated by fossil fuels. Natural gas contributes 65%, coal 28% and diesel 2% of the total electricity generated in the country (Oh, Pang, Chua, 2010). Malaysia has got 2.5 trillion cubic feet proven natural gas reserves (Asia Pacific Energy Review Centre, 2011), whereas there is a shortage of coal in the country. Coal is imported commodity, bought in international market. The Malaysian government introduced renewable as fifth fuel in the 9th Malaysian Plan. Latter, in 10<sup>th</sup> Malaysian Plan (2011-2015) it has been targeted to have more than 5% of the renewable share in total electricity production. Despite abundant renewable resources the share of electricity generated by such sources is less than 1% in total electricity generated in the country in 2011 (Sulaiman et. al, 2011) .

An effort has been made to present a simulation model that helps in understanding the dynamic behavior of the Malaysian electricity market in achieving its target of 985MW of installed capacity by 2015. The model is based on system dynamics methodology. System Dynamics incorporates non-equilibrium assumption of system, delays and bounded rationality of agents involved. These conditions prevail in the electricity sector in the form of changing demand, long lead time for permitting and siting decisions of power plants, and imperfect foresight of investors' in decision making. It is desired from the model to have insights regarding the dynamics of generation expansion. The prime objective of the research is to see whether the policy target of 985MW of renewable capacity is achievable or not.

Section 2 describes a generation expansion model whereas section 3 deals with data used for calibration. Section 4 sheds light on results and analysis followed by conclusion in section 5.

## GENERATION EXPANSION MODEL

Figure 1 shows the RE generation expansion model that has been employed in this study. The variables are linked by arrows which show the influence. The polarity determines the effect of influence: direct or inverse. Their dynamic capacity expansion is generated by two loops: construction loop and investors' loop. The construction loop is a negative loop due to the presence of 'Gap' variable . As the difference between target and RE capacity increases, compels investors to make an investment decision. This is followed by securing relevant permits and funds ( a delay), resulting in specific amount of RE capacity under construction. Power