

Faced with international climate obligations and domestic pressure, Singapore has recently raised its climate goals significantly. The government has affirmed its intention for carbon emissions to peak before 2030 and for Singapore to attain net zero greenhouse gas emissions by 2050. However, as Singapore transitions to green energy, there remains much uncertainty if this transformation, coupled with rapidly evolving geopolitics, would present vulnerabilities to energy security. Hence, this paper seeks to investigate Singapore's possible paths to achieve these goals while enhancing energy security. Key parameters of energy security in the Singaporean context are identified to determine how different policy decisions would influence them. To model the key parameters, necessary variables were distilled for modelling and simulation in the base model. Through literature reviews and understanding the local environment-economic-energy nexus, the base model was developed with the required variables. Based on the structure of this model, dynamic hypotheses were then formulated. Thereafter, model validation was conducted with structural, behavioral, and dimensional consistency tests, before ascertaining the dynamic hypotheses with model simulations. Insights from the base model simulations revealed that the increasing energy demand and the growing reliance on fossil fuels would pose significant challenges in Singapore's energy security. Hence, there is a need for new policies to tap into new energy supply solutions, such as hydrogen or low carbon electricity imports, while furthering efforts to reduce energy demand, such as in the Singapore Green Plan 2030. Pivotal key variables were identified with sensitivity analysis, which provided further insights into the development of an energy strategy towards 2050. Policies were then proposed, and their systems were integrated into the base model to act as leverage points. It was found that the integration of the proposed energy policies into a central strategy would best improve Singapore's energy security. However, Singapore would still be unable to achieve its net zero carbon emissions by the midcentury. Other strategies were proposed to address this gap, such as through the development of carbon capture, utilization and storage capabilities, and the purchase of international carbon credits. Hence, this paper illustrates a possible pathway to how Singapore's energy security could achieve sustainability in the economic, energy supply chain and environmental dimensions by investigating through a system dynamics approach, novel for a resource-scarce nation.