

## Executive Summary

The Association of Southeast Asian Nations (ASEAN) has been a remarkable driving force of economic growth for the past decades. Due to its robust growth, energy has been a backbone to support this growth. It is estimated that energy demand in ASEAN has grown 2.5 times since 1990 and is expected to triple by 2035. Therefore, ASEAN will need to apply the concept of a low-carbon city or eco town to reduce the energy demand and to mitigate the emissions of greenhouse gases (GHGs) as both increasing energy demand and CO<sub>2</sub> emissions could threaten the future sustainability of the energy supply and impact the environment, health, and tourism, and thus the quality of life. Therefore, this study on 'the eco town project' focuses on the introduction of current and future energy efficiency technologies for buildings, road transport, and smart grids. The key findings from this study are the following:

For energy efficiency in buildings, the green building system rating tool and concept have been provided from global experience. The concept aims to achieve benefits as a result of reduction in water and energy bills, improved indoor environmental quality, improved connectivity and community living, and others. In the ASEAN and East Asia region, Singapore, Malaysia, Thailand, Indonesia, Viet Nam, Japan, and Brunei Darussalam are some of the countries that have adopted building policies and regulations. Currently, building technologies comprise passive and active design strategies. The passive design of energy-efficient buildings takes into consideration the building's orientation, facades, use of insulating materials, use of daylighting, and natural ventilation. The active design strategy includes the use of energy-efficient air-conditioning and lighting systems coupled with sophisticated energy management systems and lighting control systems by using information and communications technology (ICT) to allow for optimum efficient management of energy usage of public and corporate facilities and infrastructures. The use of solar thermal cooling as well as district cooling system could also contribute to significant energy savings and reductions in GHG emissions.

For transport energy efficiency, the study focuses on highly efficient economy vehicles, transport modes, and a public paradigm shift using the 'Avoid, Shift, Improve' approach in policy making. 'Avoid' means policy measure pursuing less traffic through compact city design or change of lifestyle, 'Shift' means using public transport with higher efficiency instead of private vehicles, and 'Improve' means improving the penetration of greener and more efficient technologies and implementation of necessary policies. It is generally observed that as disposal income increases, so does private car ownership. In most ASEAN countries, car ownership is on the rise and has yet to reach saturation at the highest per capita gross domestic product (GDP) level. In Brunei Darussalam, road transport is one of the sectors with a significant increase in energy demand. The increase in the population, and hence private vehicles, has been accompanied by an approximately 5 percent increase in GHG emissions since 1990. As a result of the overwhelming use of private vehicles, Brunei Darussalam's public transport is still in its infancy. Therefore, the Land Transport White Paper and Land Transport Master Plan that outline the policies and strategies to improve the country's transport

infrastructure were introduced. In analysing the transport demand in Brunei, the business-as-usual (BAU) case showed that the fuel economy improvement (FEI) scenario could save 397 kilotonnes of oil equivalent (ktoe) from the BAU level in 2035, corresponding to a GHG emissions reduction of 1.14 million tonnes of CO<sub>2</sub> equivalent. The penetration of electric vehicles (EPV) scenario would further increase the savings to 432 ktoe, corresponding to a GHG emissions reduction of 1.31 million tonnes of CO<sub>2</sub> equivalent.

A smart grid is an important component of a potential eco town as it helps in the reduction of GHG emissions through its smart system to reduce energy demand. A smart grid aims to put into practice key power grid functions of sustainability, dependability, flexibility, affordability, and scalability of energy efficiency. 'Sustainability' means avoiding climate change and limiting the use of fossil fuels and other natural resources. 'Dependability' means to supply stable and quality power for use in technology-intensive industries such as semiconductor device manufacturing and automotives. 'Flexibility' is also related to the sustainability and stability of the power system. The smart grid system can handle a high penetration of variable renewable energy, such as wind and solar power, and the system can establish a demand and supply balance using dispatchable power sources, such as thermal and hydropower plants. 'Affordability' is obtained by avoiding extremely expensive technologies. 'Scalability' is especially important for the development of an eco town. A smart grid can deliver energy more efficiently, to integrate more new renewable energy into existing networks, to manage increasing numbers of electric vehicles, to enable customers to have greater control of their energy, and to reduce global carbon emissions through demand respond management.