Chapter 5

Conclusion

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CHAPTER 5

Conclusions

Rapid urbanisation has led to a remarkable rise in energy demand across countries in the Association of Southeast Asian Nations (ASEAN) and East Asia in the last few years, particularly the use of fossil fuels in the power and transport sectors. The International Energy Agency (IEA) expects the total primary energy demand in the ASEAN region to increase by 80 percent in 2040.

Therefore, energy efficiency and conservation (EEC) is the main policy agenda towards achieving energy sustainability across ASEAN and East Asia. One of the strategies to achieve energy sustainability is to introduce low-carbon or energy technologies in the town planning to boost energy efficiency and decrease the use of fossil fuels, through the concept of eco towns. This will help manage the rapidly growing energy consumption levels in urban areas and achieve a more secure and sustainable energy future of the country.

For Brunei Darussalam, the town of Bangar in the district of Temburong would be the ideal candidate for an eco town model as Temburong is highly regarded as the 'Green Jewel of Brunei'. Furthermore, the Ministry of Development has raised the possibility of establishing an eco town or smart town within the district to reduce its carbon footprint through application of green and environmentally friendly technology.

This study looked into three main areas that will potentially achieve the energy efficiency aims, mainly through a combination of individual modelling and analysis and in an integrated approach: building technologies, transport, and smart grids.

Building Technologies

Green building rating systems have been developed and implemented by many countries as a way to address the needs to sustainably utilise natural resources while mitigating negative environmental impacts. Singapore and Malaysia are two ASEAN countries that have successfully embarked on such a rating system with achieved benefits such as reduction in water and energy bills, improved indoor environmental quality, improved connectivity and community living, and others.

A reduction in energy consumption in buildings could be achieved through the implementation of building energy regulations such as energy standards and codes that cover all aspects of a building (structural, construction, drainage, etc.). Such regulations currently exist in nearly all developed and some developing countries (Organisation for Economic Co-operation and Development members), regardless of the political, social, and economic situation in these countries. Singapore, Malaysia, Thailand, Indonesia, Viet Nam, Japan, the Republic of Korea, and Brunei Darussalam are a few countries that have adopted building policies and regulations.

Current building technologies comprise passive and active design strategies, for which the former should be adopted first before considering the latter for any energy-efficient building. The passive design strategy of a typical energy-efficient building considers 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 a sophisticated energy management system and lighting control system. As the development and advancement of energy-efficient technologies are on the rise, the use of information and communications technology (ICT) could be integrated which allows for efficient management of energy usage of public and corporate facilities and infrastructures. The use of solar thermal cooling as well as district cooling systems could also contribute to significant energy savings and reductions in greenhouse gas (GHG) emissions.

To assess the potential energy efficiency improvements through the adoption of energy-efficient building technologies, an energy use index (expressed in $kWh/m^2/year$) is used to determine and compare building energy efficiencies. For an eco town, a more detailed assessment of the energy saving potential can be carried out using established energy simulation software on various building types, such as offices, schools, shopping centres, higher education institutes, hospitals, and others.

Issues, challenges, and recommendations are listed in the table below:

Issues	**Challenges**	**Recommendations**
1. Lack of direction and framework 2. Weak project management 3. Changing requirements 4. Changing project personnel	1. Allocation of project budget for advance planning	1. Conduct a foresight planning 2. Establish a project management framework and master plan 3. Establish owner's project requirements
1. Different interpretation in developing an eco town	1. Consistency of competency in the town planning, design, project management, and construction teams	1. Identify and establish a green building rating system for the eco town project. 2. Use advanced design software with simulation capabilities

Transport

A common characteristic of today's developing cities is the rise in motorisation and relatively poor public transport infrastructure. Hence, public transport is insignificant compared to private transport. The consequences of this are not only economic loss, but also, to the same extent, energy loss and air pollution from wasted energy combustion during traffic jams. To mitigate these problems, policy measures applying the 'Avoid, Shift, Improve' (ASI) approach are being used for policy making or analysis:

- Avoid: pursuing less traffic through compact city design or change of lifestyle
- Shift: using public transport with higher efficiency instead of private vehicles
- Improve: increasing use of greener and more efficient technologies and implementation of necessary policies.

There is generally a non-linear correlation between passenger vehicle ownership and gross domestic product (GDP) per capita in the countries in ASEAN and East Asia, with ownership growing at a relatively slower rate at the lowest level of per capita GDP and then increasing until reaching a saturation level at the highest per capita GDP level. Similarly, energy demand in these countries has been rising generally.

In Brunei Darussalam, road transport is one of the sectors with a significant energy demand. The increase in population, and hence private vehicles, has been accompanied by an increase in GHG emissions of approximately 5 percent since 1990. As a result of overwhelming use of private vehicles, Brunei's public transport is still in its infancy. Therefore, the Land Transport White Paper and the Land Transport Master Plan that outline the policies and strategies to improve the country's transport infrastructure were introduced.

A study on forecasting the passenger vehicle ownership and the corresponding energy demand and GHG emissions up to 2035 using a regression model was conducted based on three different scenarios: the business-as-usual (BAU), fuel economy improvement (FEI), and electric passenger vehicle (EPV) scenarios. The BAU scenario was used as a base case where no policy measures on energy efficiency would be implemented, whereas the FEI and EPV scenarios consider penetration of vehicles with higher fuel economy values and penetration of electric vehicles, respectively. For the FEI scenario, energy savings of 397 kilotonnes of oil equivalent (ktoe) would be achieved from the BAU level in 2035, corresponding to a GHG emissions reduction of 1.14 million tonnes of CO_2 equivalent. Penetration of electric vehicles in the EPV scenario would further increase the savings to 432 ktoe, corresponding to a GHG emissions reduction of 1.31 million tonnes of CO_2 equivalent.

Issues, challenges, and recommendations are listed in the table below:

Issues	Challenges	Recommendations
1. Fast pace of growth in private motorisation 2. Faster growth of road infrastructure 3. Minimal use of public transport 4. Lack of policies in promoting fuel diversification and use of energy-efficient vehicles	1. How to saturate the growth of low-efficient vehicles and increase the use of more efficient ones 2. Allocation of budget for urban planning	1. Establish and implement fuel economy regulations which will allow more efficient vehicles to enter the market and reduce the share of low-efficient ones in the market 2. Improve land use and urban planning for a compact city, provide more walkways, and reduce car trips 3. Improve ridership and expand the public transport system

Smart Grid

Smart grids play an important role in eco towns in that they help in the reduction of GHG emissions. A smart grid aims to put into practice sustainability, dependability, flexibility, affordability, and scalability:

- Sustainability: avoiding climate change and limiting the use of fossil fuel and other natural resources
- Dependability: supplying stable and quality power for use in technology-intensive industries, such as the semiconductor device manufacturing and automotive industries
- Flexibility: also related to the sustainability and stability of the power system. If variable renewable energy, such as wind and solar power, is integrated, flexibility is necessary to establish a balance between demand and supply using dispatchable power sources, such as thermal and hydropower plants.
- Affordability: obtained by avoiding extremely expensive technologies, such as nuclear fusion reactors, global super-grids, space solar photovoltaic (PV), and artificial photosynthesis
- Scalability: especially important for the development of an eco town.

Generally, a smart grid (*a*) delivers energy more efficiently, (*b*) provides the capacity to integrate more new renewable energy into existing networks, (*c*) provides the ability to manage increasing numbers of electric vehicles, (*d*) enables customers to have greater control of their energy, (*e*) provides a considerable capacity to reduce global carbon emissions, and (*f*) stimulates an array of new business models in the energy sector. However, smart grid deployment requires policy and regulatory interventions in terms of funding, standards, and policies that affect consumers. Public utilities must be assured of financial and regulatory support allowing them to recover their investments. Any smart grid deployment should refer and conform to smart grid standards that are developed by international standards institutes or agencies. Furthermore, public awareness of smart grids is important so that customers can fully capture the incentives or service options that warrant behavioural changes.

One of the first steps for the realisation of a smart grid is the establishment of a smart grid road map. Generally, there are five steps in defining the priorities of a road map, based on global smart grid road maps of various utilities:

- Step 1: Establish a vision and identify pillars. Under this stage, the long-term vision for smart grids is established based on energy sector goals. Also, key roles and responsibilities are defined.
- Step 2: Establish a timeline and goals for each phase. The timeline, either incremental or phases, for achieving the smart grid vision is established.
- Step 3: Establish pillars of action. Pillars of action are established based on the road map vision. Also under this stage, risks, costs, and potential barriers are analysed.
- Step 4: Propose technology and functional applications. Under this stage, policies, regulations, and technologies for each period and each pillar are suggested. The challenges associated with smart grid implementation are addressed.
- Step 5: Develop metrics and monitoring. This stage develops smart grid performance metrics to measure the success of implementation.

Issues, challenges, and recommendations are listed in the table below:

Issues	Challenges	Recommendations
1. Lack of funding on smart grid investments 2. Lack of clear smart grid standards 3. Lack of customer interest	1. How to encourage utilities to invest in smart grids 2. How to promote full deployment and replication of smart grid technologies 3. How to communicate to customers the benefit of smart grid investments	1. Establish policies on cost recovery mechanisms 2. Introduce standardisation and interoperability of technologies 3. Provide customer feedback 4. Introduce measures that provide automated end-user demand and energy efficiency response 5. Introduce time-of-use (TOU) pricing schemes 6. Ensure customer protection