

CIRCULAR ECONOMY

TOWARDS A LOW CARBON PETROCHEMICAL AND PORT CITY DEVELOPMENT THROUGH CIRCULAR ECONOMY IN PENERANG, JOHOR, MALAYSIA: A REVIEW

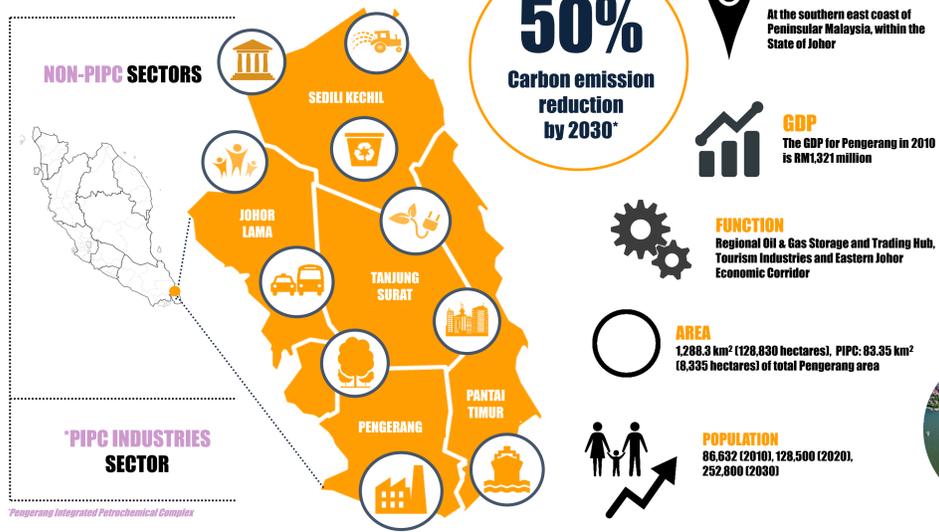
MUHAMMAD AKMAL HAKIM H., GABRIEL LING H.T., L.W. CHAU, C.S. HO, W.S. HO & AHMAD MUZAMMIL I.
UTM – LOW CARBON ASIA RESEARCH CENTRE,
UNIVERSITI TEKNOLOGI MALAYSIA
3RD INTERNATIONAL FORUM ON SUSTAINABLE FUTURE IN ASIA/
3RD NIES INTERNATIONAL FORUM
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ABSTRACT

Pengerang, Johor, Malaysia is planned to become the largest regional petroleum refinery and trading hub in Southeast Asia and therefore will be the focal point in Asia and other parts of the world, under the Malaysia's National Key Economic Area. In the context of petrochemical industry, this paper attempts to apply the concept of Circular Economy (CE) by providing an underlying understanding of CE and community to Pengerang towards achieving its vision of Clean, Green, Smart and Safe Pengerang by 2030. Aside from reviewing general policies of CE implementation, taking into account population, GDP, container throughput and green low carbon plans with carbon emission reduction targets, this paper reviews five best practices with respect to state-of-the-art CE-based green initiatives adopted by international cities with petrochemical and port industries, such as Rotterdam (Netherlands), Kaohsiung (Taiwan), Antwerp (Belgium), Gothenburg (Sweden) and Chiba (Japan). Through the study (Benchmarking findings), a framework consisting of suitable green and low-carbon initiatives is highlighted; CE measures and programmes which deemed potential and feasible in Pengerang are also described. Some of the CE, green measures and policies which can be adapted for Pengerang context are found in various scope and sectors such as energy efficiency, renewable energy, clean mobility, green knowledge exchange, residual waste and biodiversity management. This paper concludes that in order to acquire more understanding towards low-carbon city development through CE approach, it requires continuous awareness and involvement of the potential stakeholders as well as further research in Pengerang.

INTRODUCTION

PENERANG, JOHOR, MALAYSIA



This review aims to provide a clear policy understanding of implemented programmes to achieve a low carbon or green development from *selected world port cities with oil and gas industries in terms of GHG mitigation measures and sustainability initiatives with emphasis on the Circular Economy (CE) framework in PIPC and NON PIPC sectors* i.e. (1) decarbonising PIPC industries; (2) green port management and logistics; (3) smart agriculture; (4) green mobility; (5) sustainable energy system; (6) low carbon green urban settlements and tourism; (7) green network; (8) sustainable waste management; (9) low carbon smart community and lastly, (10) green urban governance as an enabler.

METHODOLOGY

- 1 Identify the data profile of Pengerang, base and target year
- 2 Review the best **WORLDWIDE** cities with oil & gas and other industries as case studies
- 3 Benchmark Pengerang with case studies' benchmarking variables
- 4 Produce a sets of suitable programmes/initiatives based on benchmarking with selected best practices

BENCHMARKING VARIABLES

- Population
- Population Growth Rate
- Gross Development Products (GDP)
- Industrial & Domestic Solid Waste
- Water Generation
- Recycling Rate
- Composting Rate
- Waste & Waste Water Treatment Technology
- Final Energy Supply by Sectors (Residential, Commercial, Industrial and Transportation)
- Final Energy Supply by Fuel Type (Coal, Oil, Gas, LNG, Electricity)
- Energy Efficient (EE) & Renewable Energy (RE) Technologies
- Energy Management
- Types of Industries
- Size of Operation
- Fuel Consumption
- Technology Utilisation
- Total Port Area
- Number of Terminals
- Port Throughput
- Number of Ships per day

LOW CARBON / GREEN INITIATIVES / MEASURES

CASE STUDIES



RESULTS & DISCUSSION

As Pengerang is an emerging port city, its profile is comparatively low with other global port cities. Nevertheless, Pengerang needs to be planned and developed to be a sustainable port city in order to avoid its GHG emissions to be drastically increase as the integrated petrochemical industry will take place by 2030. There is a need of having a circular economic concept based low carbon or green initiatives as policy framework to guide and facilitate the decision-making process in Pengerang.

40+ Identified key policy best practices :

CIRCULAR ECONOMY

Petrochemical & Other Industries	Energy System	Waste Management	Community
<ol style="list-style-type: none"> 1. Industrial sewage sludge recovery 2. Sustainable Industrial Waste Management 3. Promoting Material Recovery 4. Establish advanced & efficient technologies for Industrial Processes 5. Alternative fuel consumption 6. Efficient industrial cooling & heating system 7. Energy storage system 8. EE equipment for PIPC Industries 9. Promote CCIS technology in PIPC 10. Carbon capture, utilisation & storage (CCS) 11. Sustainable Industrial Waste Management 12. Scheduled waste reduction and treatment 13. Non-scheduled waste reduction, reuse & treatment 14. Promoting sustainable consumption and production (ISOP) 15. Promoting Material Recovery 16. Fostering Waste Circular Economy 17. Waste-2-Chemicals 18. Establish "Circularity Center" 	<ol style="list-style-type: none"> 1. Sourcing biodiesels for vehicles which were produced from residual animal fat. 2. Introduce electric and hybrid buses and grant scheme for electric vehicles charging stations. 3. Encourage the use of biomass and solar energy to generate energy, produce transport fuels and as a feedstock to the chemical industry. 4. Focuses on the creation of underground storage under the sea bed to capture carbon from the participating industries and energy companies. 5. Secure as a global centre for water management expertise, providing international knowledge exchange, collaboration and continuous climate change initiatives exposure. 6. Invest in biobased industry within the industrial cluster area. 7. Identify opportunity for stakeholder's cooperation and business in managing residual material flows in the city. 8. Promote effective sustainable energy management through incentives for EE & RE 	<ol style="list-style-type: none"> 1. Sustainable Municipal Solid Waste Management 2. Nurture a zero waste culture 3. Recycling of Residential waste 4. Recycling commercial Waste 5. Effective waste transportation 6. Scheduled waste reduction and treatment 7. Non-scheduled waste reduction, reuse & treatment 8. Sustainable Sewage Sludge Management 9. Improved sewage treatment and sludge recycling 10. Sustainable Construction and Demolition Waste Management 11. Reuse and recycling of construction and demolition waste 12. Fostering Waste Circular Economy 13. Promoting Sustainable Consumption and Production (SCP) 	<ol style="list-style-type: none"> 1. Cool Biz, Warm Biz practice - room temperature is set to 28°C in the summer 2. Implement energy conservation monitoring at home 3. Practising green purchasing 4. Water saving programs - Purchasing water saving equipment and storage, and utilisation of rainwater 5. Promotion of community greening through forests and coastal conservation activities 6. Zero Emission Housing - Primary energy consumption during construction and rebuilding will be zero 7. Install solar power generation and solar thermal utilisation system 8. Introduction of high efficiency lighting (LEDs) 9. Replace energy saving appliances 10. Plug-in hybrids and electric vehicles 11. Use of public transportation and bicycles 12. Implementation of car sharing programs 13. Practice of eco-driving 14. Promotion of 3R's (waste reduction, reuse and recycle) 15. Garbage separation enforcement

CONCLUSION

- There are 40+ policies in 4 key sectors (PIPC & other industries, energy, waste & community) which can be learned from outstanding champions. It is significant for petrochemical integrated refining industry which uses extensive energy and water consumption in Pengerang to be planned and monitored towards the implementation of CE.
- Nevertheless, the CE concept is not just limited with the petrochemical refining industry but it might as well benefits the community in Pengerang as a whole. The question on the feasibility, willingness of local stakeholders and authority, awareness, technology availability must be addressed quantitatively in a further study to understand the local context of CE in Pengerang.
- A social science research investigation (through a set of questionnaires, interviews and focus group discussions) is needed to be conducted among the professionals and the stakeholders of petrochemical companies to provide insight on the CE's current and future initiatives towards reducing energy consumption and emission as well the goal of realising a low carbon city in Pengerang, Johor, Malaysia.

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