Power generation and recovery of higher hydrocarbons utilising cold energy during LNG regasification.

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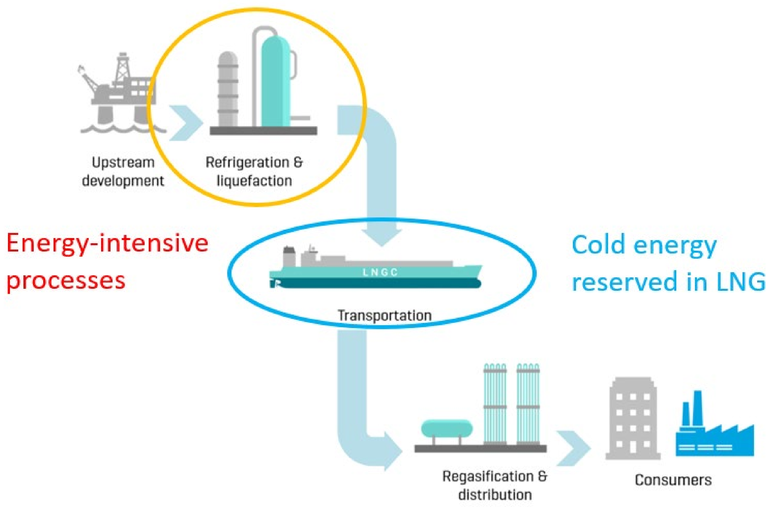
FENEX CRC THEME

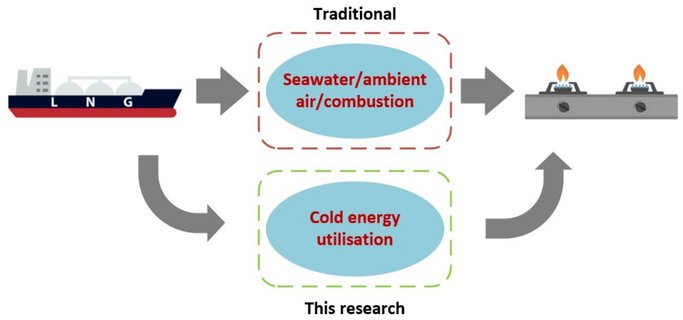
- Efficient LNG Value Chains

IMPACT AND IMPORTANCE

- LNG is the cleanest and fasting growing fossil energy resource
- Australia is one of the major exporters of LNG, with customers include Japan, China and South Korea
- The liquefaction processes are among the most energy-consuming operations within the LNG value chain
  - ➢ Usually involve multiple refrigeration cycles
  - ➢ Can cost over 40% of the total energy in the LNG value chain
- Around 830 kJ·kg^{-1} of energy is reserved in LNG as cold energy and is potentially usable

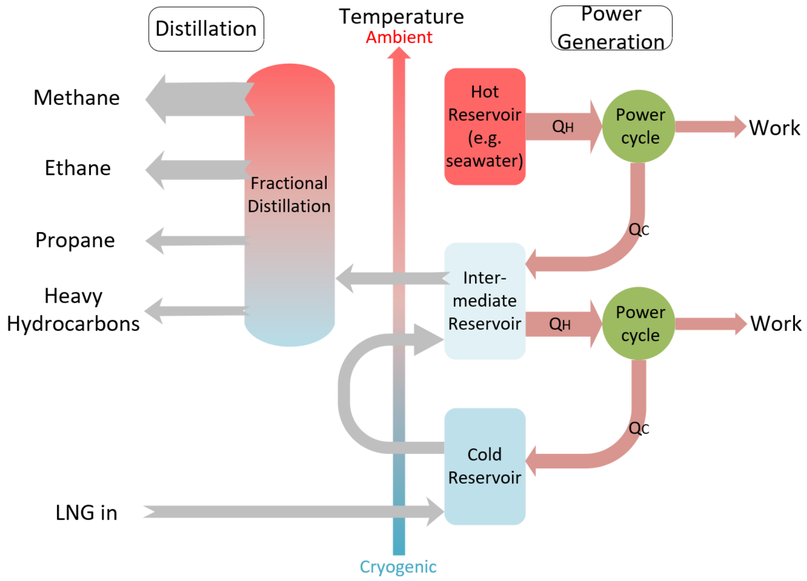


- At the receiving terminal, LNG must be regasified back to natural gas before it can be further transported to end users through pipeline
- Traditionally, this is done by warming up LNG using sea water, ambient air, or partial combustion of the natural gas
- The potentially usable cold energy is lost to the surrounding
- With the rapid increase in LNG consumption, the waste of this cold energy is becoming more significant
- Preceding studies of LNG cold energy utilisation include:
  - ➢ Power generation, natural gas liquid (NGL) recovery, air separation, seawater desalination, carbon dioxide capture, data centre cooling, food processing, etc.



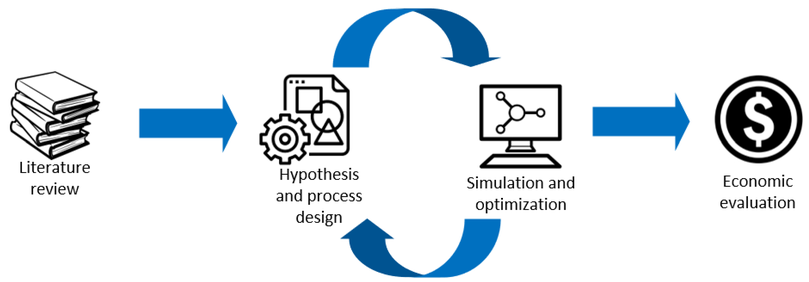
AIMS AND OBJECTIVES

- The overall aim: develop an integrated system that generates power and recovery heavy hydrocarbons simultaneously during regasification



- To achieve the overall aim, there are four specific research objectives:
  - ➢ To identify different power cycle options
  - ➢ To determine the proper distillation strategies
  - ➢ To develop an integrated system
  - ➢ To analyse and optimise the proposed system

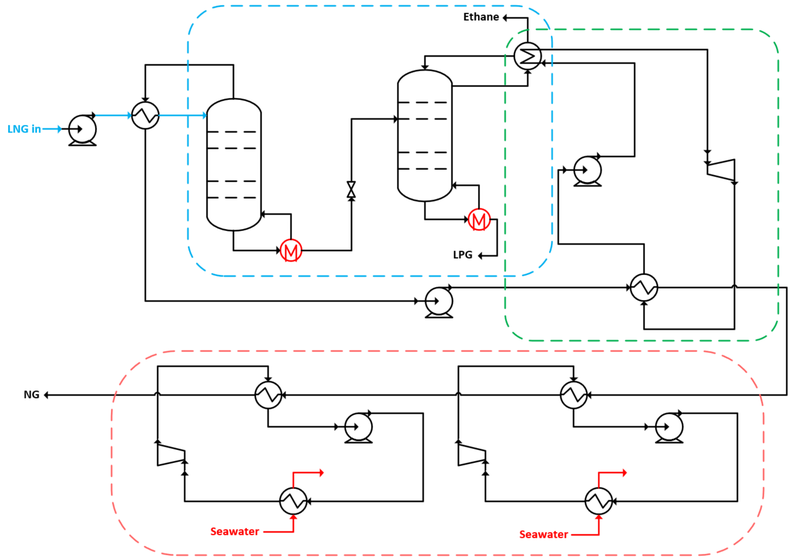
RESEARCH METHODOLOGY



Simulation and optimisation

- The proposed models will be created and simulated in Aspen HYSYS software
- The simulations will be controlled and optimised using programming language such as python, MatLab or visual basic for application (VBA)
  - ➢ VBA has an Aspen simulation workbook add-on, which can control a simulation case; while the other languages require a short coding for the connection
  - ➢ These programming languages can run complicated algorithms to optimise a design, especially when multiple parameters or objectives are in conflict

PRELIMINARY RESULTS



A preliminary design composed of two distillation columns and three simple Rankine power generation cycles is simulated

- Ethane and LPG are separated with a purity of over 97% and 99%
- The system has a net power output, where the two power cycles have 16% and 8% thermal efficiency
- It is noted that the ambient temperature can have significant effects on both power generation efficiencies and the purities of hydrocarbons extracted

ANTICIPATED OUTCOMES

- Knowledge
  - ➢ To understand the thermodynamics balance of different working fluids at cryogenic conditions
  - ➢ To understand the effects of various parameters on the products of distillation columns
- Engineering design
  - ➢ To align various parameters and include cycles/equipment that yield the best results
  - ➢ To justify the designs by revealing the economic performances

PROJECT RESEARCHERS

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PROJECT PARTNERS

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