LIQUIFIED NATURAL GAS TERMINAL

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CONTENT

1. DESCRIPTION

LIQUIFIED NATURAL GAS TERMINAL (LNG)

Singapore uses more than 80% of imported natural gas for electricity purposes. Natural gas is mainly imported from Malaysia as well as Indonesia. In 2006, the Singapore government recognized the importance of carrying out a liquefied natural gas (LNG) project as an alternative to meet the needs of the current population as well as for future generations.

PROJECT CHARACTERISTICS:

Value	S$1.7 billion
Terminal capacity	6 Mtpa
Feasibility study	2005
Order	2006
Start project	March 2010

MAIN OPERATIONS

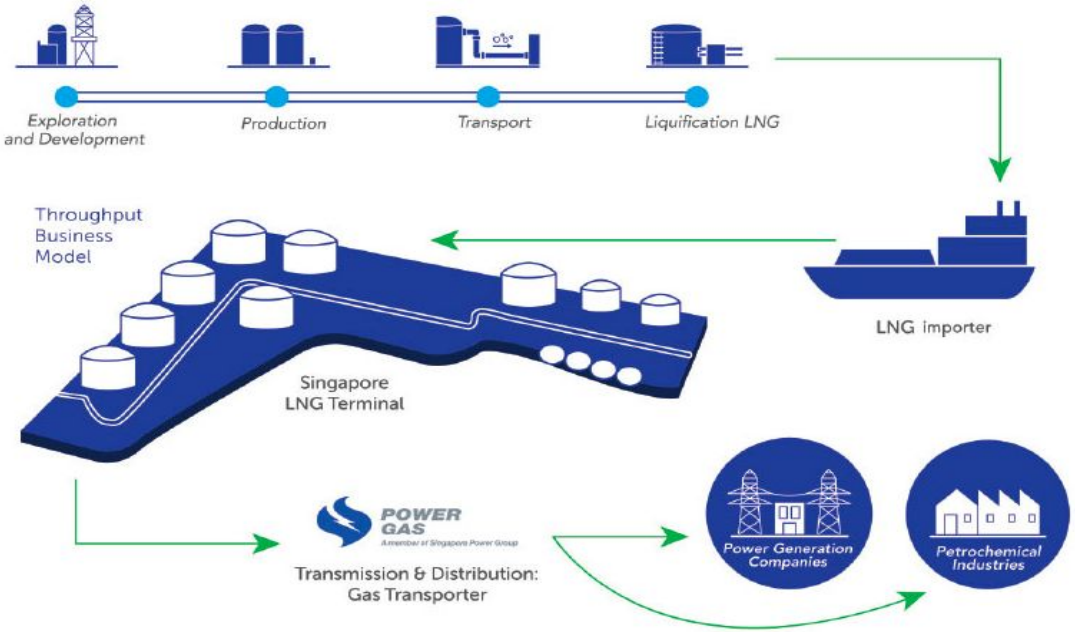


Figure 1: Importing, Reloading, Regasification and Storage

The liquefied natural gas terminal is a reception facility for the unloading of LNG tanker cargoes. The project includes several ports specially designed for export and LNG products.

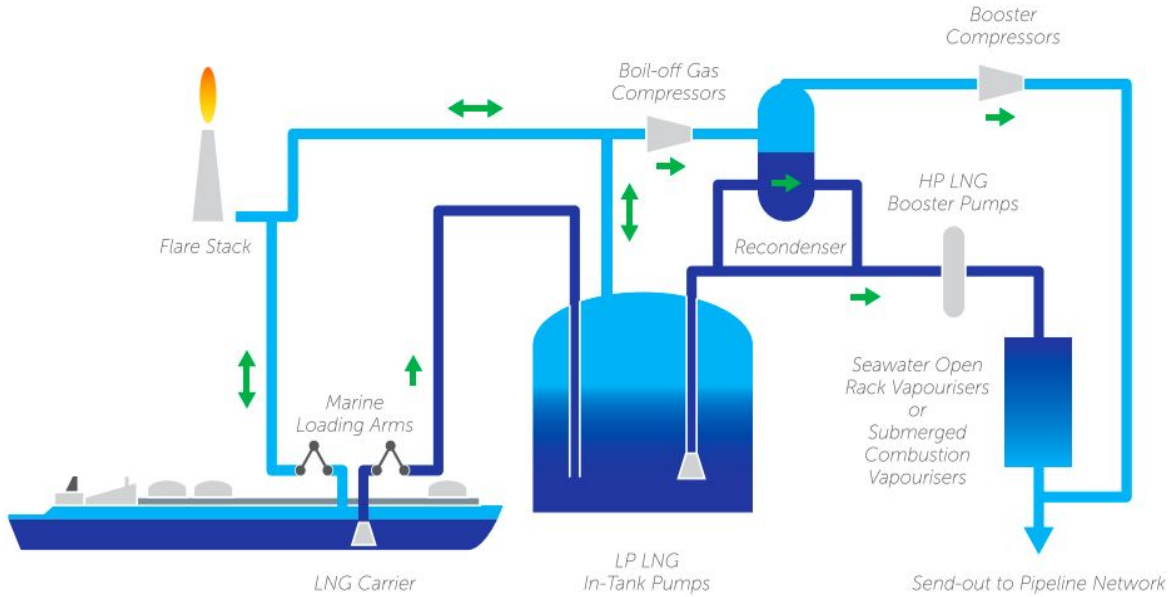


Figure 2: Regasification process

1. Receiving and Unloading of LNG from ships
2. Storage or tanking
3. Compression and regasification
4. Transmission

PROJECT CHARACTERISTICS

Key equipment capacities	
LNG Storage Tank	3 x 180 000m^3 ; 1 x 260 000m^3
Main Jetty	Designed for 120 000m^3 to 265 000m^3 LNG carriers
Secondary Jetty	Designed for 60 000m^3 to 265 000m^3 LNG carriers
Unloading/Reloading Rate	12 000m^3 of LNG per hour

- Initially the terminal is planned with two storages, one jetty for an initial capacity of 3,5 Mtpa.
- In november 2010, SLNG decide to add a third thank, second jetty for a capacity of 6 Mtpa.
- In 2017, a fourth thank as been added for a capacity of 11 Mtpa.

PHASES 1 AND 2

Three tanks and two jetties

PHASE 3

Additional fourth tank

2. LOCATION

- Located at the southernmost tip of Jurong Island.
- Occupies a 40-hectare plot.
- The Singapore LNG Terminal is the first open-access, multi-user LNG terminal in all of Asia.
- This location allows the terminal to receive and store LNG from carriers. Can easily be sent out to the local market and consumers.

ABOUT THE LOCATION

- Accounted for water levels (metres). Including wave height, over projected time periods.
- Terminal is run solely for LNG operations and is not part of a public port.
- Has 3 LNG storage tanks each able to hold 180,000m^3.
- Approved for a S $700 million expansion.
- Added a fourth LNG storage tank, this one is the largest in the world. will be able to receive a full cargo load from a Q-Max carrier, the largest LNG carrier in the world.
- Expansion necessary to enhancing energy security and meeting increasing domestic demand.
- Further opens up business opportunities in the regional and global LNG markets according to the Chief Executive Officer of SLNG.

WHY BUILD HERE ?

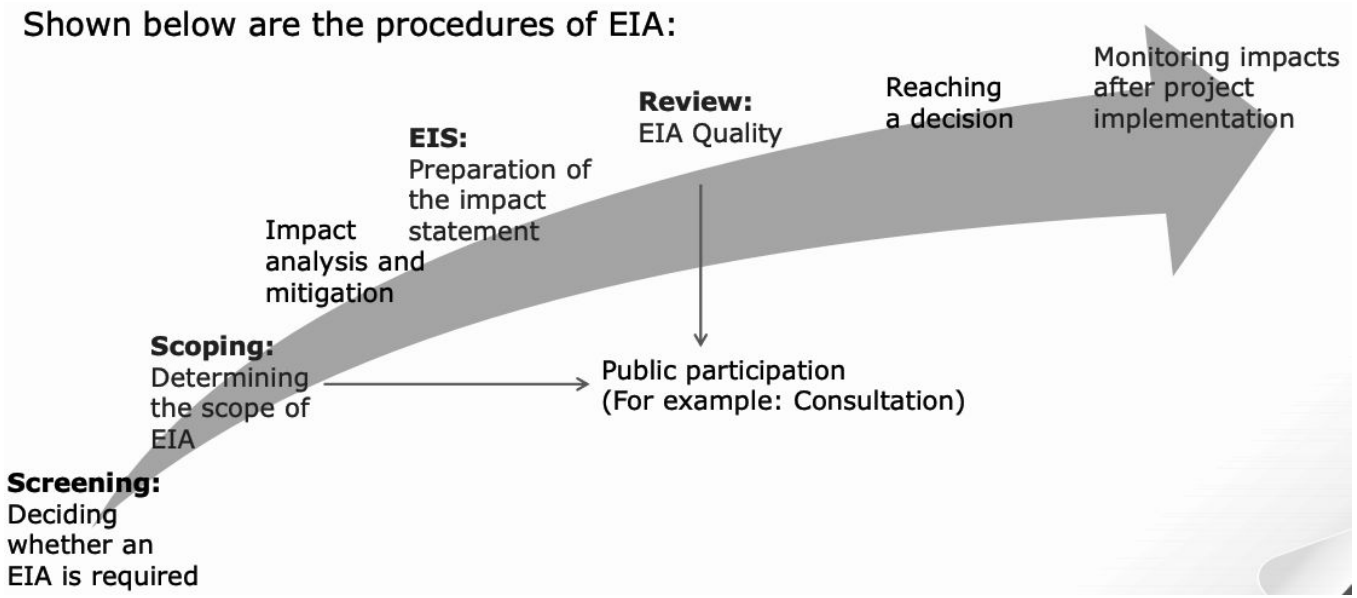
- Singapore is known to be a major ship repair and maintenance centre.
- There is natural tie between the shipyard and vessel cool-down services. Attracts LNG ships to undergo repairs there.
- Singapore's ideal geographical position is right in the middle of major LNG shipping routes
- closely located to key shipbuilding centres such as China, Japan and South Korea
- The location is convenient and will help attract customers.

3. SCREENING

- Screening is the first step of the EIA process and it's incredibly important because it helps stakeholders decide whether an EIA is necessary or not **(Lim, slide 31, w.3).**
- The screening process is relatively quick and usually is completed within an hour **(Lim, slide 31, w.3).**
- When screening a proposed project, some factors to consider include:

1. **the type and scale of the project proposal (Lim, slide 29, w.3).**
   a. energy related projects could have disastrous effects if something were to go wrong.
   b. larger the project → worse impacts
2. **capital investment, the area covered, and the number of employees (Lim, slide 29, w.3).**
   a. larger project → larger investment needed
   b. would the land be used more efficiently if it were allocated to a different sector?
   c. how many people will this project employ? Will it be good for the economy?
3. **the geographical location (Lim, slide 29, w.3)**
   a. is it close to residential areas?
4. **the possibility of public opposition (Lim, slide 29, w.3)**
   a. for what reasons could the public oppose this project proposal?

SCREENING (cont.)



(Lim, slide 27, w.3)

- Based on the 4 factors listed in the previous slide, a full EIA study is required because:
  - this project falls under category A due to its potential adverse environmental impacts **(Lim, slide 35, w.3).**
  - the size and scale is very large **(Lim, slide 35, w.3).**
  - the project is sited on a coastal zone **(Lim, slide 25, w.3).**
  - it entails energy transportation **(Lim, slide 25, w.3).**

4. SCOPING

- Scoping is a process that helps identify issues that are likely to be of concern during an EIA study. The scoping process increases the efficiency of the EIA by eliminating issues of little concern **(Lim, slide 50, w.3)**
- Scoping concludes with a Terms of Reference (ToR) document that establishes the depth of analysis needed for the full EIA **(Lim, slide 50, w.3)**
- Scoping aims to:
  - identify issues that warrant more attention **(Lim, slide 53, w.3)**
  - provide a platform for public involvement **(Lim, slide 53, w.3)**
  - provide a detailed list of specific issues **(Lim, slide 53, w.3)**
  - facilitate efficient preparation for the environmental report **(Lim, slide 53, w.3)**
  - save time and money **(Lim, slide 53, w.3)**
- Alternative options must be displayed and considered during the scoping process **(Lim, slide 63, w.3)**
- Scoping is done collectively by local governments, project leaders, consultants, construction company, legal authorities, investors, and the public **(Lim, slide 56, w.3)**

SCOPING (cont.)

- LNG primary concerns:
  - **environmental impact** → "extraction of natural gas from wells and its transportation in pipelines results in the leakage of methane, primary component of natural gas that is 34 times stronger than CO2 at trapping heat over a 100-year period and 86 times stronger over 20 years" (Union of Concerned Scientists 2014)
  - **water contamination** → ocean contamination through leaks and spills (Union of Concerned Scientists 2014)
  - **proximity to residential areas** → close proximity leads to increased health risks
  - **increased air pollution due to emissions** (Union of Concerned Scientists 2014)
  - **impact on fisheries** → increased ship traffic and emissions from ships poses a threat to fisheries in the area (Union of Concerned Scientists 2014)
  - **dangers with transportation and storage** → transporting gas on ships is dangerous because a spill in the ocean is much more difficult to clean up than a spill on land. The storage capacity is also limited because of the size of the facility and the cost to store excess LNG.
    - "Unlike oil, the cost of transporting and handling LNG relative to its market price is significant." (Union of Concerned Scientists 2014)

SCOPING (cont.)

Public Participation

- public involvement for this project needs to be inclusive, transparent, relevant, fair, and responsive **(Lim, slide 13, w.3)**
- pros and cons to public involvement:

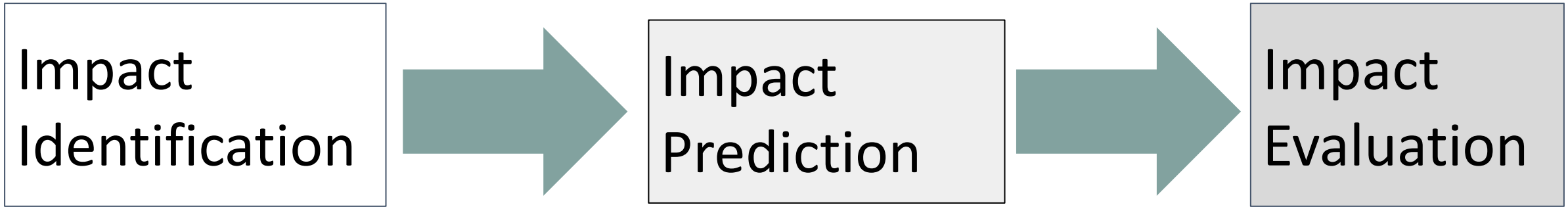
Pros **(Lim, slide 19, w.3)**	Cons **(Lim, slide 18, w.3)**
● informed public ● different perspectives ● increased trust and respect ● areas of conflict are identified ● identifies most important issues ● increased confidence in EIA	● bigger public = less efficient ● only those with adequate scientific knowledge can effectively contribute ● may not represent entire public opinion ● can add to the cost and length of time of the project

Alternatives and Tiering

- considering alternatives is mandatory because it helps attain the best possible outcomes of the project **(Lim, slide 63, w.3)**
- alternatives must be cost effective **(Lim, slide 65, w.3)**
- alternatives for this project include:
  - using energy efficient technology to minimise waste and air pollution
  - different location farther from the coastline
  - smaller capacity (build more numerous plants) to spread out the risk
  - invest in energy efficient ships to minimize pollution in waterways
  - find investors to help get money for env friendly alternatives

5. IMPACT ANALYSIS

- Impact Analysis can be separated into 3 phases including **impact identification, impact prediction, and impact evaluation** (Lim, slide 5, wk 4)
- Impact identification and prediction use the environmental baseline



POTENTIAL ENVIRONMENTAL IMPACTS

- Air Quality
- Water Quality
- Ecology
- Noise Pollution
- Cross Border Impact

AIR QUALITY

- Liquefied Natural Gas has a minimal impact on air quality and pollution
- Burning natural gas creates nitrogen oxides (NOx), which are precursors of smog, but at lower rates than gasoline and diesel for use in motor vehicles
- LNG is a cleaner gas than coal because it emits fairly low pollution as it is burned to heat and cool houses, creates energy and consumes fuel

WATER QUALITY

- Pipeline construction is detrimental to the seafloor as it resuspendents sediments.
- Water used by LNG terminals and tankers is polluted during the cycles and then discharged back into the atmosphere.

ECOLOGY

- On-site LNG terminal building and pipeline deployment smother seafloor (benthic) habitat, change seafloor substrate and induce sediment re-suspension
- Lobsters located on the pipeline line at the time of pipeline installation may be affected or will die as a result of trenching and anchoring activities
- Biocides such as chlorine used in the testing, storing, and operations of LNG are toxic to marine life (e.g., plankton)

NOISE POLLUTION

- LNG tankers produce large rates of noise during berthing, un-bearing and regasification, in comparison to LNG port building and other activities
- Noise pollution from ships and tankers are not statistically significant

CROSS BORDER IMPACT

- Since Singapore relies heavily on imports of natural gas from Malaysia and Indonesia, it has a significant cross border trade impact
- Malaysia, Indonesia, Myanmar, Thailand, and Singapore are 5 ASEAN economies with interconnected gas pipelines

RATE OF IMPACT CHART

Impact	Importance of Changes			Magnitude of Change			Perminance		Reversibility		Cumulative		
	H	M	L	H	M	L	Y	N	Y	N	Y	N	
Air Quality			X			X	X			X	X		Not Significant
Water Quality			X		X		X			X	X		Not Significant
Ecology		X			X			X		X		X	Significant
Noise Pollution			X		X		X		X			X	Not Significant
Cross Border Impact	X				X			X	X			X	Slightly Significant

Score = I * M * (P+R+C)

6. MITIGATION MEASURES

- LNG tanks built to meet international safety standards
- Terminal should be inspected regularly
- Implement a spill prevention procedure and response plan
- Treat wastewater before release
- Build pipelines significantly beneath seabed

(World Bank Group Environmental, Health, and Safety Guidelines for Liquified Gas Facilities)

CONCLUSION

Summary of Potential Environmental Effects	
Air Quality	**Not Significant**
Water Quality	**Not Significant**
Ecology	**Significant**
Noise Pollution	**Not Significant**
Cross Border Impact	**Slightly Significant**

- Suitable to be built
- Precautions taken to mitigate impact
- Project is an overall benefit

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