## **LNG Vaporizer Technology Review**

**ryoquip** reviews the increasing constraints which dominate the selection of best available technologies for LNG re-gas facilities. The optimal decision for LNG vaporization varies depending upon an ever-changing landscape of environmental concerns and proven technologies. Major sources of heat remain the same, but how they are applied individually and in combination may well determine the immediate and long-term viability of a project.

The five available sources of heat have not changed much in all of history. These are fuel, mechanical energy, heat sinks of water and air, and solar radiation. The sources are listed in order of their cost, fuel being the most expensive source of heat, water and air being the least costly, while radiation remains prohibitively expensive to capture. The order shown also represents the ease of accessibility of the heat as well. Air is the most difficult of the four practical main sources of heat, while fuel is the easiest and to date solar energy is impractical as a source of heat supply. However, there is one technology currently available that benefits significantly from solar energy Ambient Air Vaporizers (AAV's).

Any company may choose to weight the wide variety of decision drivers differently, but the range and type of drivers are about the same for most facilities that were questioned. In summary fashion, these include:

1.	Initial capital cost	(CC)
2.	Space required	(SR)
3.	Installation cost	(IC)
4.	Installation time	
5.	Operating cost including maintenance and chemicals	(OC)
6.	Life cycle cost [key integrated measure of cost]	(LCC)
7.	Ease of operation – Simplicity	(SC)
8.	Range of effectiveness	
9.	Efficiency	
10.	Reliability	
11.	Operational flexibility	
12.	Environmental impact	(EI)

## Graph Trim Heat Required for Competing LNG Vaporizer Technologies



Below is a list of technologies used historically as well as several proposed within the past 10 years. Some have since been successfully applied, others remain under consideration.

## **Considered Technologies**

Amb Air Vap, Direct contact [Nat Draft]	(AAV)
Air w/ Intermediate Fluid Vaporizer	(AIFV)
Direct Seawater Shell & Tube	(SS&T)
Direct Seawater Open Rack Vaporizer	(ORV)
Fan Assisted Amb Air	(FAV)
Heated Water Circulating Vaporizer	(WCV)
Seawater Intermediate Fluid Vaporizer	(SIFV)
Submerged Combustion Direct Contact	(SCV)
Waste Heat Recovery	(WHR)



Doing a quick, but thorough economic analysis results is a chart showing the Life Cycle Cost of the various options. [see Figure 2]

## Conclusions

All of the recently developed ambient air vaporizer systems examined were capable of heating LNG to suitable pipeline temperatures. All of the ambient systems will require some trim heat at ambient temperatures below the pipeline target temperature. All have different cut off temperatures where the systems are unable to economically withdraw heat from the atmosphere. [see Figure 1] This is where a significant difference first appears in the comparisons.

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