

Natural Gas Hydrate Transportation and Storage*

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- Natural gas is a mixture of small hydrocarbons commonly as a fuel and a chemical feedstock. Areas of high natural gas supply are generally far from areas of high natural gas demand, necessitating shipping.
- Natural gas hydrates are a solid phase of natural gas and water that forms a crystalline lattice. Hydrates condense the volume of natural gas, which is desirable for shipping and storage.
- Transportation of natural gas using hydrates requires three major stages.
 1. Production: The synthesis of hydrates from water and natural gas.
 2. Shipping: The transportation of hydrates from the production to the regasification plant.
 3. Regasification: The dissociation of hydrates to natural gas and water.
- Natural gas hydrates have a higher total annualized cost per ton of methane than LNG for the transportation of natural gas primarily because LNG has a higher energy density than natural gas hydrates. For a plant capacity of 2 mtpa and a transportation distance of 4,000 miles the total annualized cost for natural gas hydrates is \$160/ton compared to \$105/ton for LNG at an M&S index of 1000.
- Natural gas hydrates have a lower return on investment than LNG for the transportation of natural gas. For a plant capacity of 2 mtpa, a transportation distance of 4,000 miles, and revenues of \$120/ton of natural gas, the return on investment for natural gas hydrates is -5% and for LNG is 4.5% at an M&S index of 1000.
- Natural gas hydrates have a lower fixed capital investment per ton of methane than LNG for a peak-shaving process. For a plant capacity of 2 mtpa the fixed capital investment for natural gas hydrates is \$108/ton and for LNG is \$260/ton at an M&S index of 1000.
- Natural gas hydrates have a higher return on investment than LNG for a peak-shaving process. For a plant capacity of 2 mtpa and sales of \$120/ton the return on investment for natural gas hydrates is 35% and for LNG is 12% at an M&S index of 1000.
- Transportation of natural gas using hydrates is uneconomical when compared to LNG.
- Natural gas hydrates are economically favorable for peak-shaving compared to LNG.