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Transport of High Value Gases using LNG

LNG Assisted Ethylene Transport

- Transport Ethylene Made at Low Cost to High Value Regions, Safely, Economically, and in Greater Volume.
- Ethylene is typically made from Ethane or Naphtha
- Naphtha, an Ethylene Precursor, is expensive compared to Ethane
- Little Ethylene or Ethane is transported by sea going vessel
- There is a wide manufacturing cost difference globally

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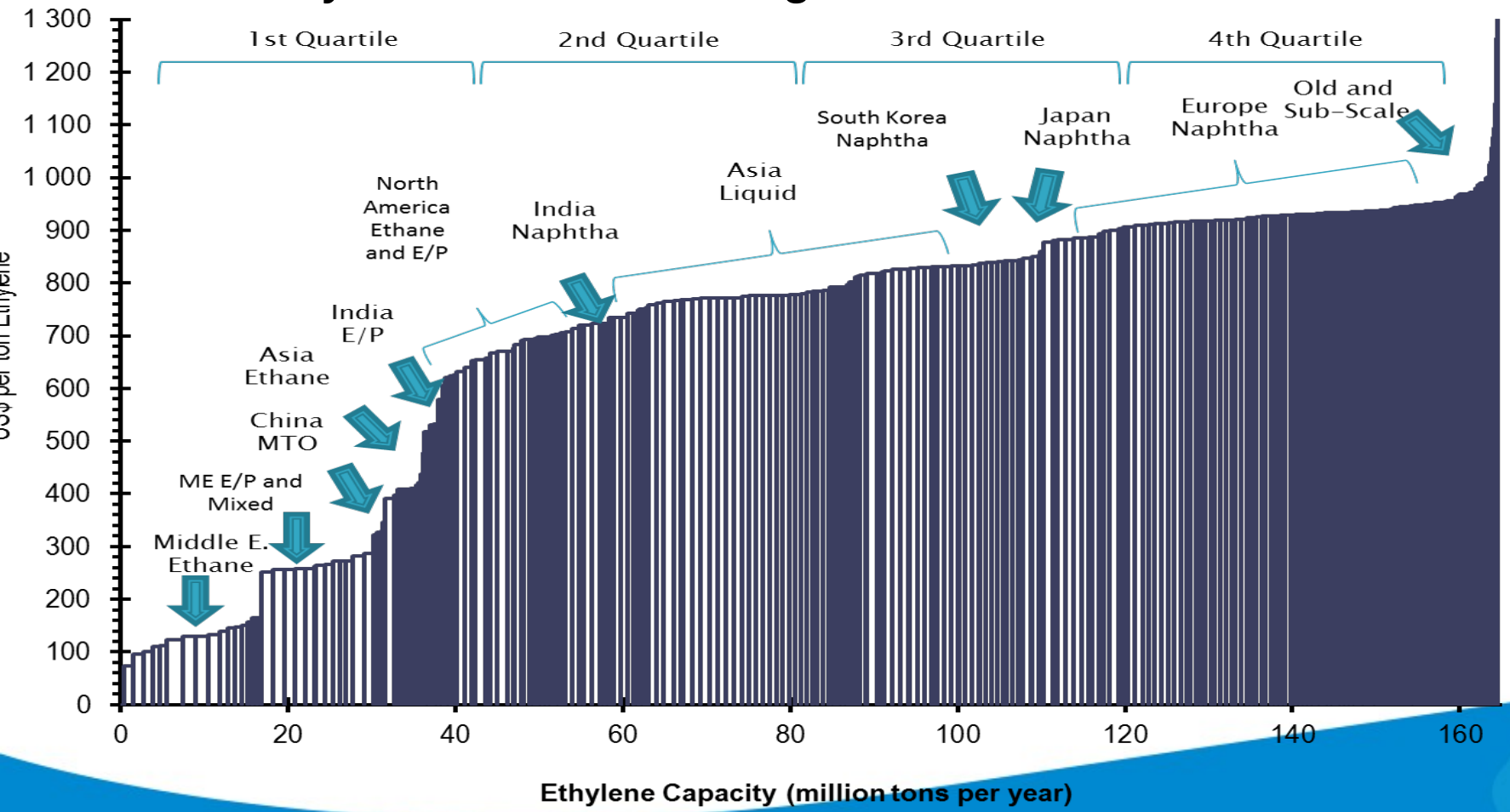
Ethylene Manufacturing Cost Around the World



LNG Ships are Known Technology

LNG shipping capacity

- **Jan 2017 there were 439 Active LNG vessels**
- **121 new builds are expected in the next 5 years**
- **New build capacity 160,000 cubic meters and larger**
- **~ 800 Million cubic meters annual transport capacity**

LNG annual transport

- **569 Million cubic meters (241 Million Tonnes) in 2014**
- **578 Million cubic meters (245 Million Tonnes) in 2015**
- **609 Million cubic meters (258 Million Tonnes) in 2016**

http://www.igu.org

Ethylene - Important Facts

- Ethylene Production is Expanding in North America due to Shale Gas – in 2017 by 37 MTY*
- 2017 Worldwide Ethylene Production is more than 154 MTY and growing 3.5%/YR over next 5 years**
- Ethylene is currently shipped as a boiling liquid in small refrigerated ships
- The Manufacturing Cost Differential for Ethylene made from Naphtha is expected to stay near $600/tonne***

* https://www.platts.com/news-feature/2017/petrochemicals/global-ethylene-outlook/index
**Wood Mckinsey https://www.youtube.com/watch?v=4dZL-c4SXVw&app=desktop
***http://media.corporate-ir.net/media_files/IROL/11/110877/05_Global_Ethylene_Market_Outlook_Eramo.pdf

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Typical LNG Export Terminal

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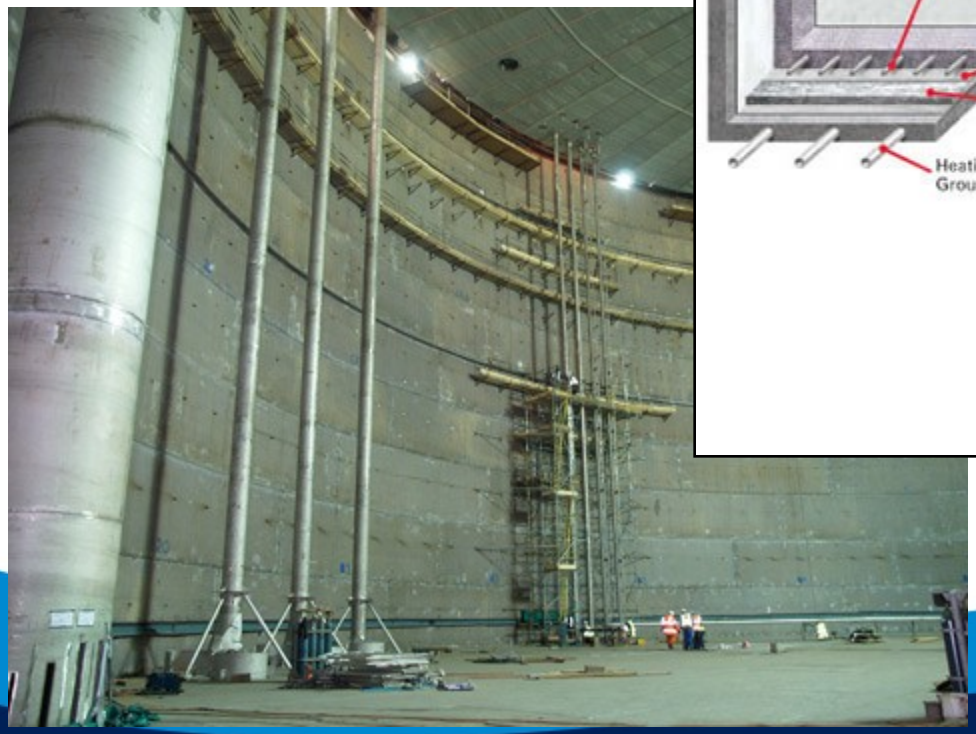
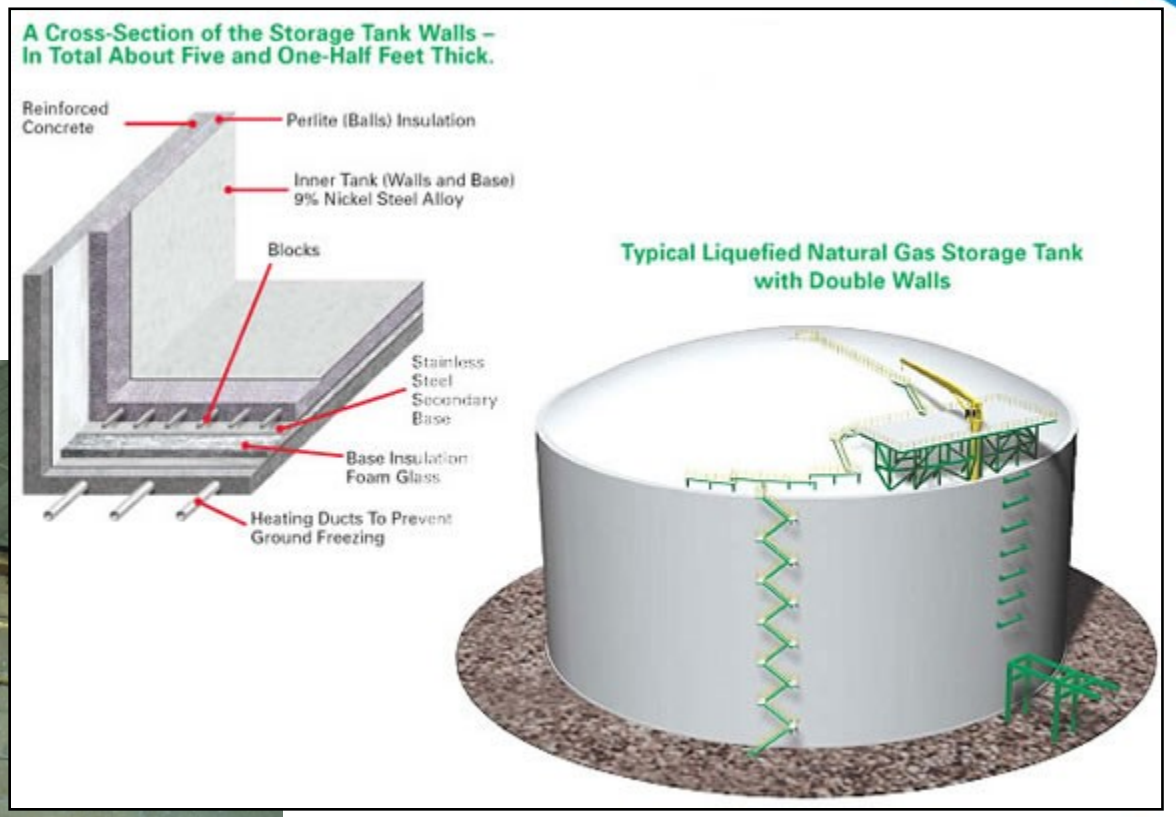
LNG Storage is Technologically Advanced





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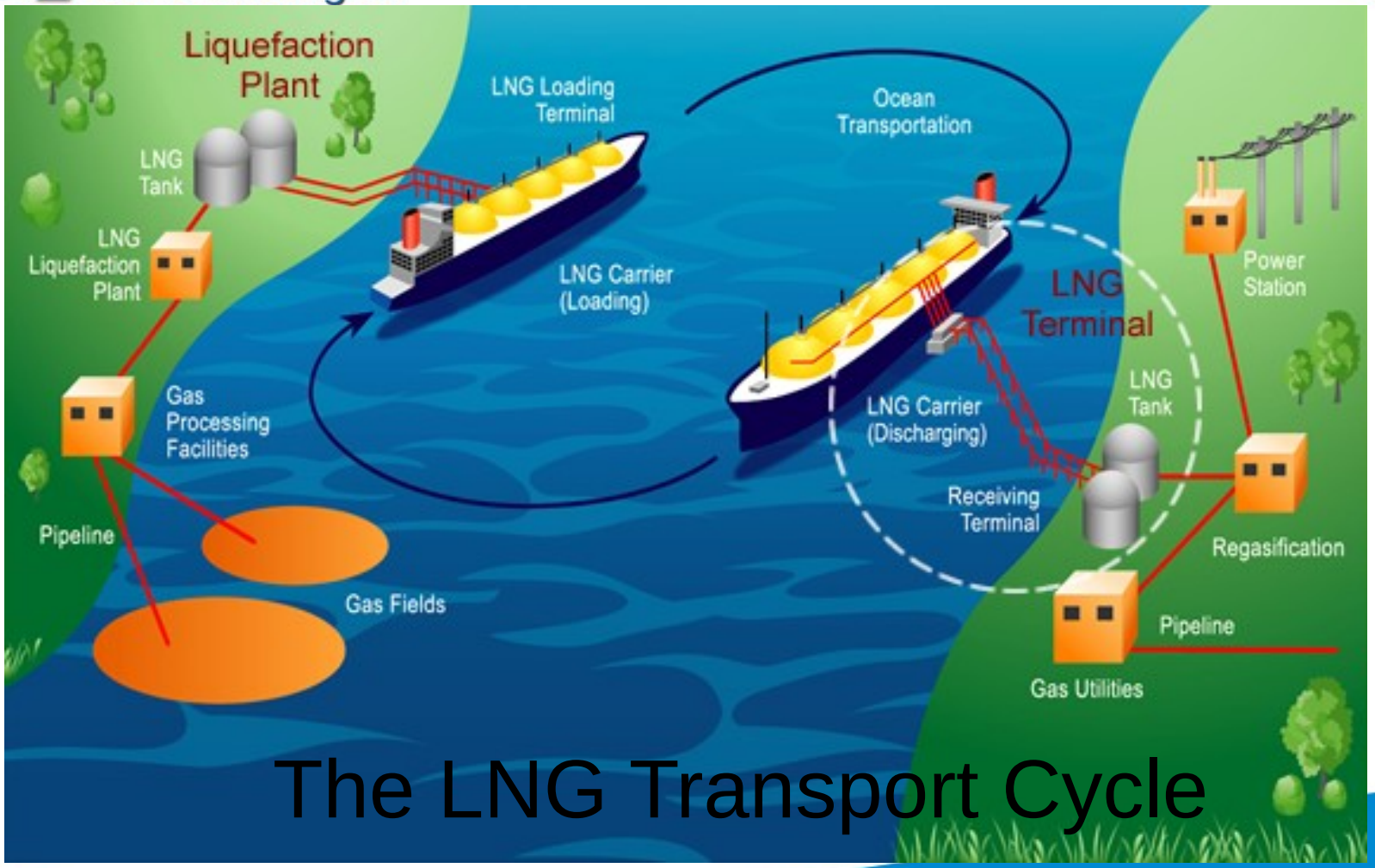

The LNG Transport Cycle

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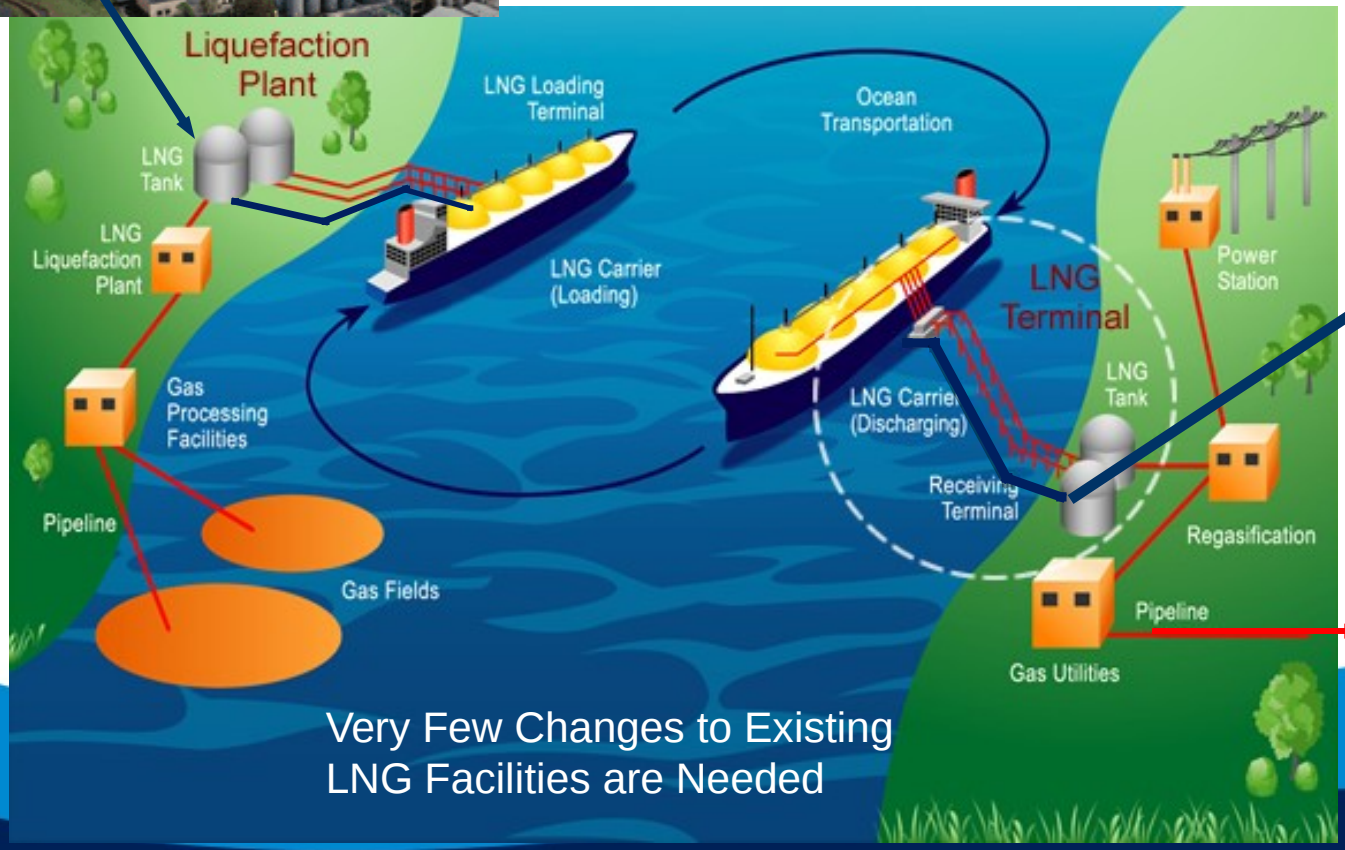
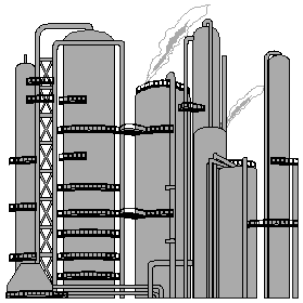
Ethylene Manufacturing Plant

Ethylene Transported with LNG





Pure Ethylene

Pure Natural Gas

USA Ethylene Transported with LNG

- Plans under way to build US Ethylene Export Terminals (EET)
- If EET not present, alter one typical train of an LNG export terminal then modify Cold Box, add Ethylene Storage, and Loading Arm
- Cost to purchase Liquid Ethylene is about $750/tonne (USA)
- Purchase 540,000 tonnes/year, Annual Cost of Goods $405M

- Using a single 180k CBM ship, fill with 90,000 tonnes of L.Ethylene, 6 trips per year. Assume Ethylene destination value is $1300/tonne. Estimated Delivery cost is $50/tonne. Zero value assumed for LNG.

  Annual Estimated Gross Revenue: $ 675M

- Annual Estimated Gross Profit: **$270M**

1 http://www.barchart.com/commodityfutures/Mont_Belvieu_Spot_Ethylene_(PCW)_In-Well_Futures_Futures/IME?mode=l&view=

GCC Ethylene Transported with LNG

Cost to purchase Liquid Ethylene is about $250/tonne (Qatar)

- Purchase 720,000 tonnes/year, Annual Cost of Goods $180M

- Using a single 180k CBM ship, fill with 90,000 tonnes of L.Ethylene, 8 trips per year. Assume Ethylene destination value is $1300/tonne. Estimated Delivery cost is $50/tonne. Zero value assumed for LNG.

  Annual Estimated Gross Revenue: $ 900M

- Annual Estimated Gross Profit: **$720M**

PURE LNG SHIPMENT FROM USA TO CHINA

Cost to purchase LNG is about $200/tonne* (USA)

- Purchase 540,000 tonnes/year, Annual Cost of Goods $108M

- Using a single 180k CBM ship, fill with 90,000 tonnes of LNG, 6 trips per year. Average LNG Contract price $375/tonne*. Estimated Delivery cost is $40/tonne.

  Annual Estimated Gross Revenue: $181M

- Annual Estimated Gross Profit: **$73M** VS US Ethylene GP **$270M (3.7X)**

-Based on current GCC LNG cost the above scenario will yield

Gross Profit **$111M** VS GCC Ethylene GP **$720 (6.5X)**

***Based on average price of MMBTU in USA and China 2018**

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SUMMARY

-New and expanding Market segment
-New use for LNG ship designs
-Patent protected technology
-Much higher profits than competition
-Business growth easily achieved

GRANTED PATENTS

METHOD OF STORING AND TRANSPORTING LIGHT GASES
USPTO 9,683,703 – June 20, 2017

METHODS AND SYSTEMS FOR STORING AND TRANSPORTING GASES,
GCC 005204 – March 16, 2017

METHOD OF STORING AND TRANSPORTING LIGHT GASES
ALGERIAN NATIONAL INSTITUTE OF INDUSTRIAL PROPERTIES 8303 – February 11, 2014

Patent Applications

AGT has currently 5 Patent Applications in the USA and 1 in GCC.