

# **Approach to changing LNG market -- Largest-scale LNG plant and diversification of projects --**

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- Train capacity increase
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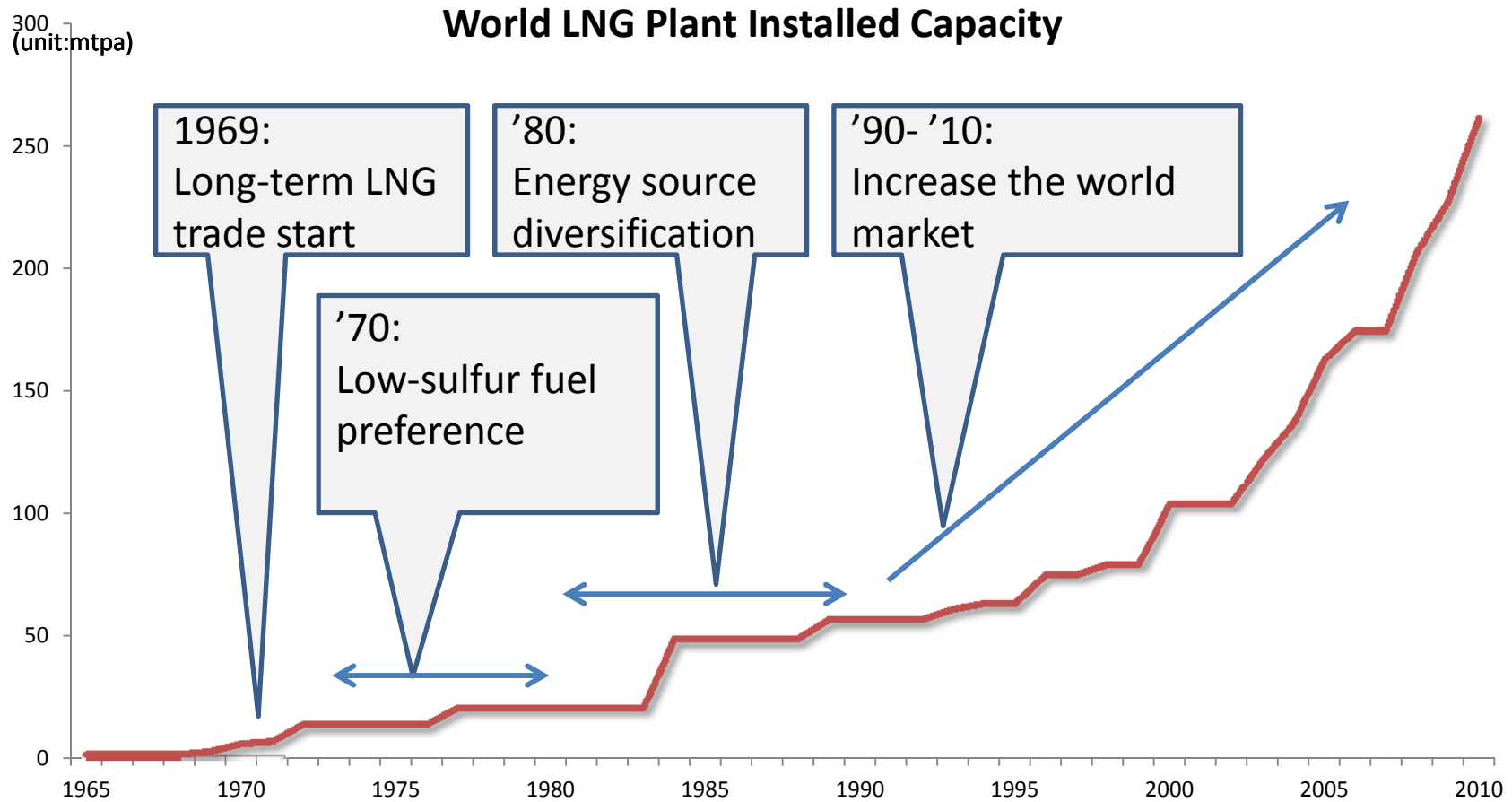
## 3. Challenge for the future

- Site diversification
- Diversification of refrigerant compressor driver type
- Resource diversification
- Advanced receiving terminal

## 4. Summary

# 1. World LNG market

## 1.1 Development history



# 1.2 Japanese contribution



(LNG Plant)



(Receiving Terminal)



(LNG Carrier)

# 2. Response to LNG market change

## 2.1 Train capacity increase

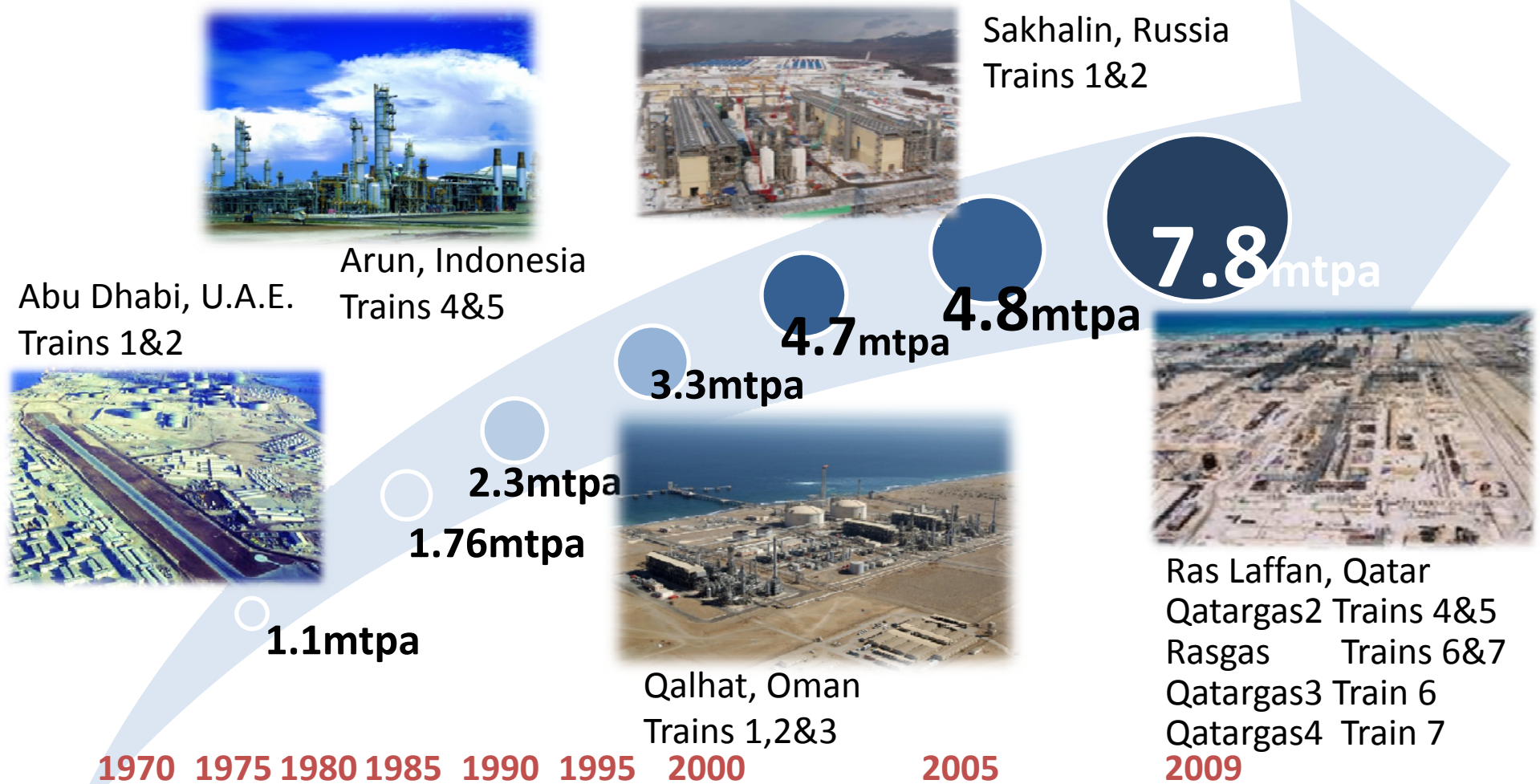


Photo: Courtesy of Abu Dhabi Gas Liquefaction Co., Ltd. Perusahaan Pertambangan Minyak Dan Gas Bumi Negara Qalhat LNG S.A.O.C. Sakhalin Energy Investment Co., Ltd. Ras Laffan Liquefied Natural Gas Co., Ltd.(II) Qatar Liquefied Gas Co., Ltd(2) (3) & (4).

## 2.2 Severe weather conditions

- Cold in Sakhalin



(Courtesy of Sakhalin Energy Investment Company Ltd)

- Hot in Qatar

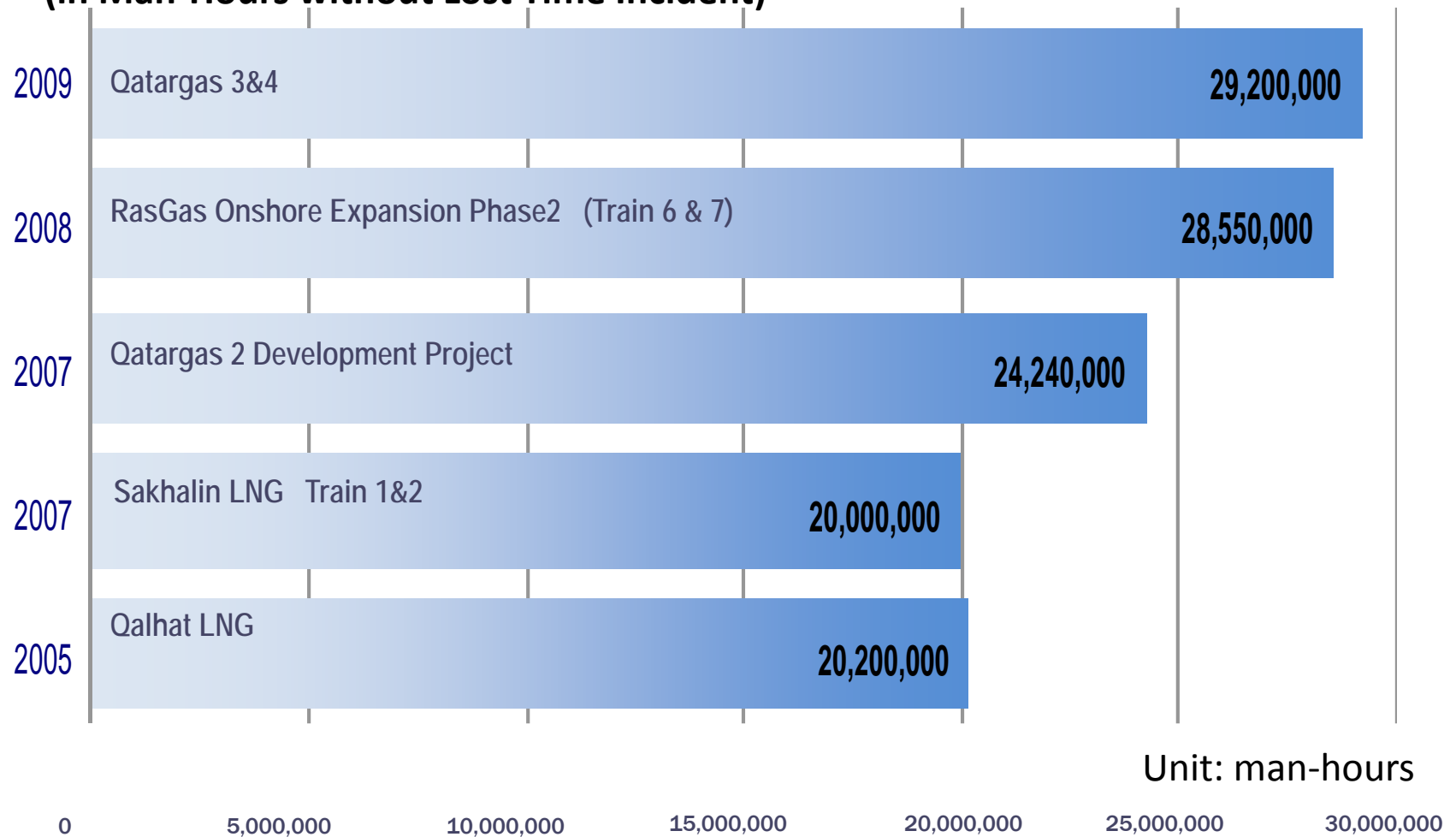


(Courtesy of Qatar Gas Company Ltd)

## 2.3 Secured safety & reliability

### Safety Records in LNG Plant Construction

(in Man-Hours without Lost Time Incident)



## 2.4 Mega-project management

Mono-dzukuri Nippon, Minister's Award

For the achievement of the 6 trains parallel/ simultaneous construction of the world largest LNG plants (7.8mtpa each)

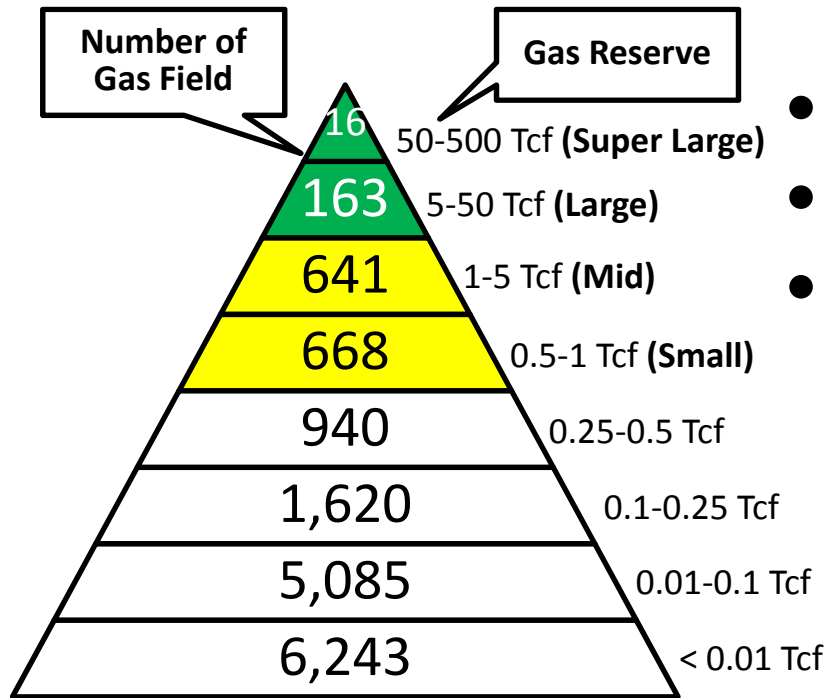




# 3. Challenge for the future

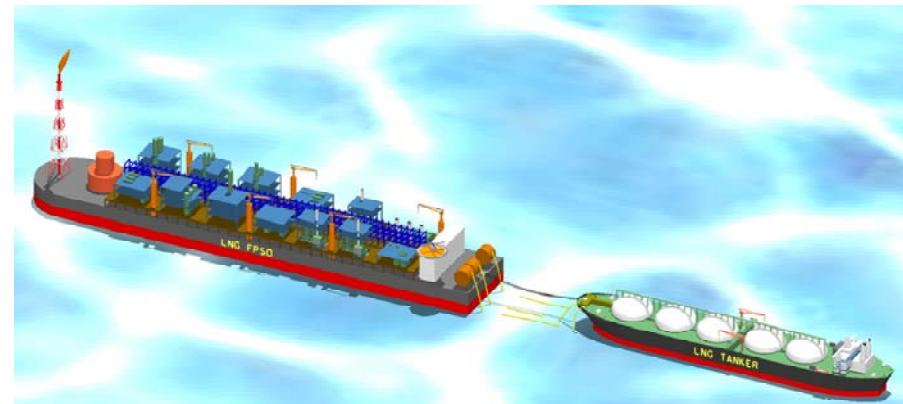
## 3.1 Site diversification

Small to medium size & stranded gas reserve



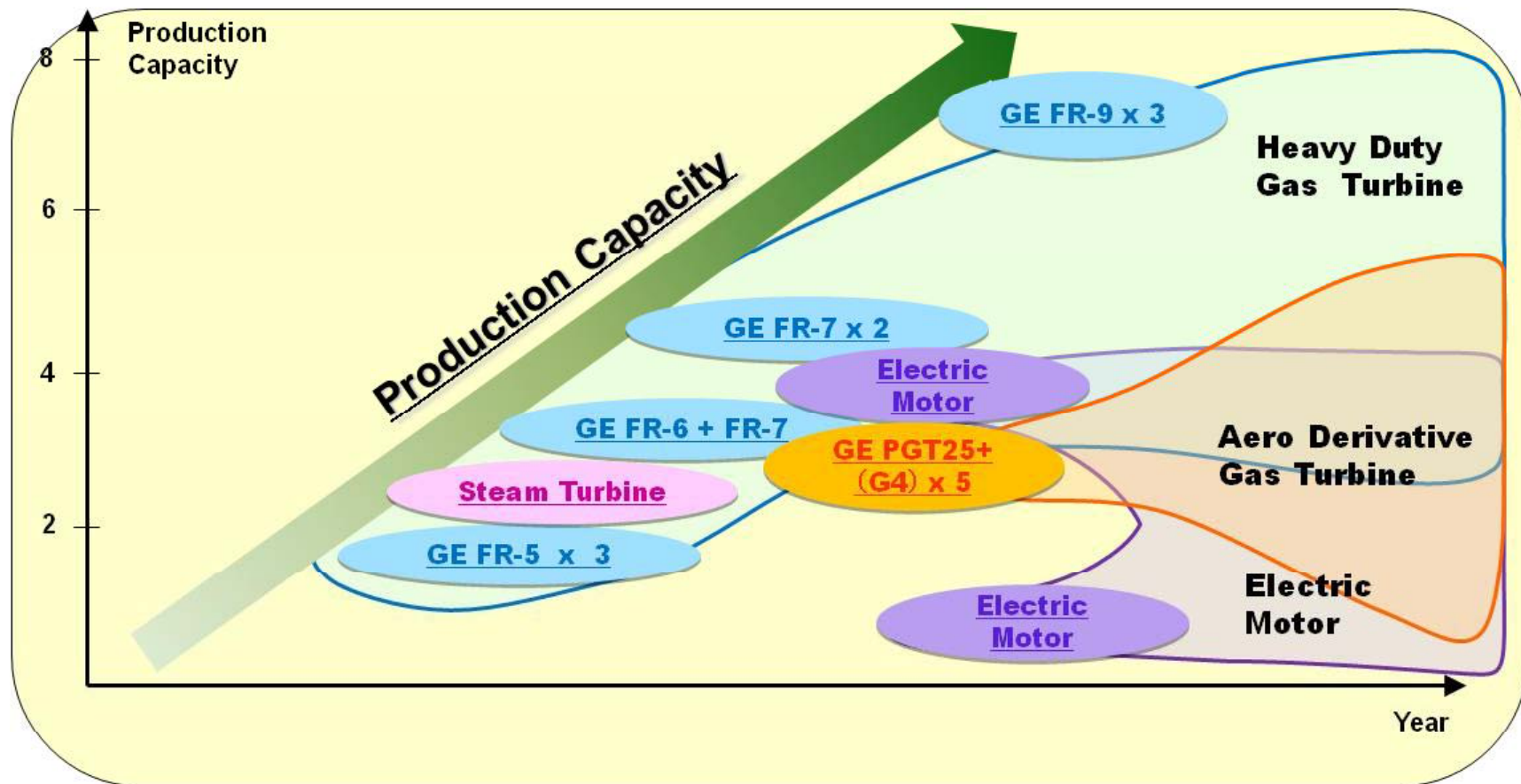
Reference: IHS Energy via JOGMEC (2008)

- Floating facility/mini-LNG Plant
- Modularization
- Cold weather consideration



# 3.2 Diversification of refrigerant compressor driver type

## Advanced Liquefaction Technology

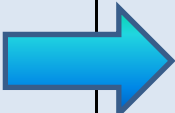
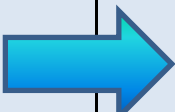



## 3.3 Resource diversification

Un-conventional resources :

Shale Gas, Tight Gas, and Coal Bed Methane (CBM)

- Features of CBM feedstock case:

High methane content w/o refrigerant component		Higher system pressure and continuous refrigerant make-up from outside
Prolonged operation preferable/Difficulties in re-start		Multi-train configuration with multi- ref. compressor
Gradual ramp-up		Reliability/Efficiency in lower turn-down (approx. 25%)

## 3.4 Advanced receiving terminal

Current technical topics:

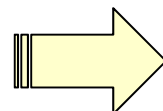
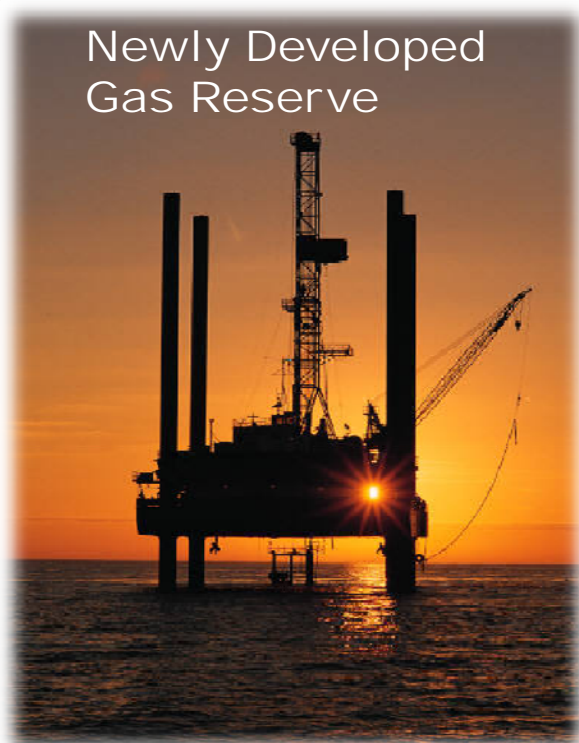
- Wide range of LNG sources:  
Lean LNG
  - Varying heating value
- BOG recovery
- Huge-capacity LNG carrier
  - Jetty strength Enforcement
  - Anchoring duration/unloading facility capacity-up
- Operation management with downstream system
- Potential cold-heat utilization



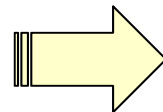
(Tokyo Gas, Sodegaura)

# 4. Summary

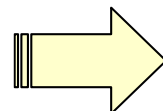
## Project diversification



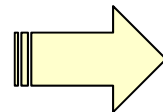
Debottlenecking  
of Existing Trains



New Mid/Small Scale LNG



Floating LNG



Unconventional Gas Use  
(CBM, Shale Gas, Tight Gas)

# Thank you

