

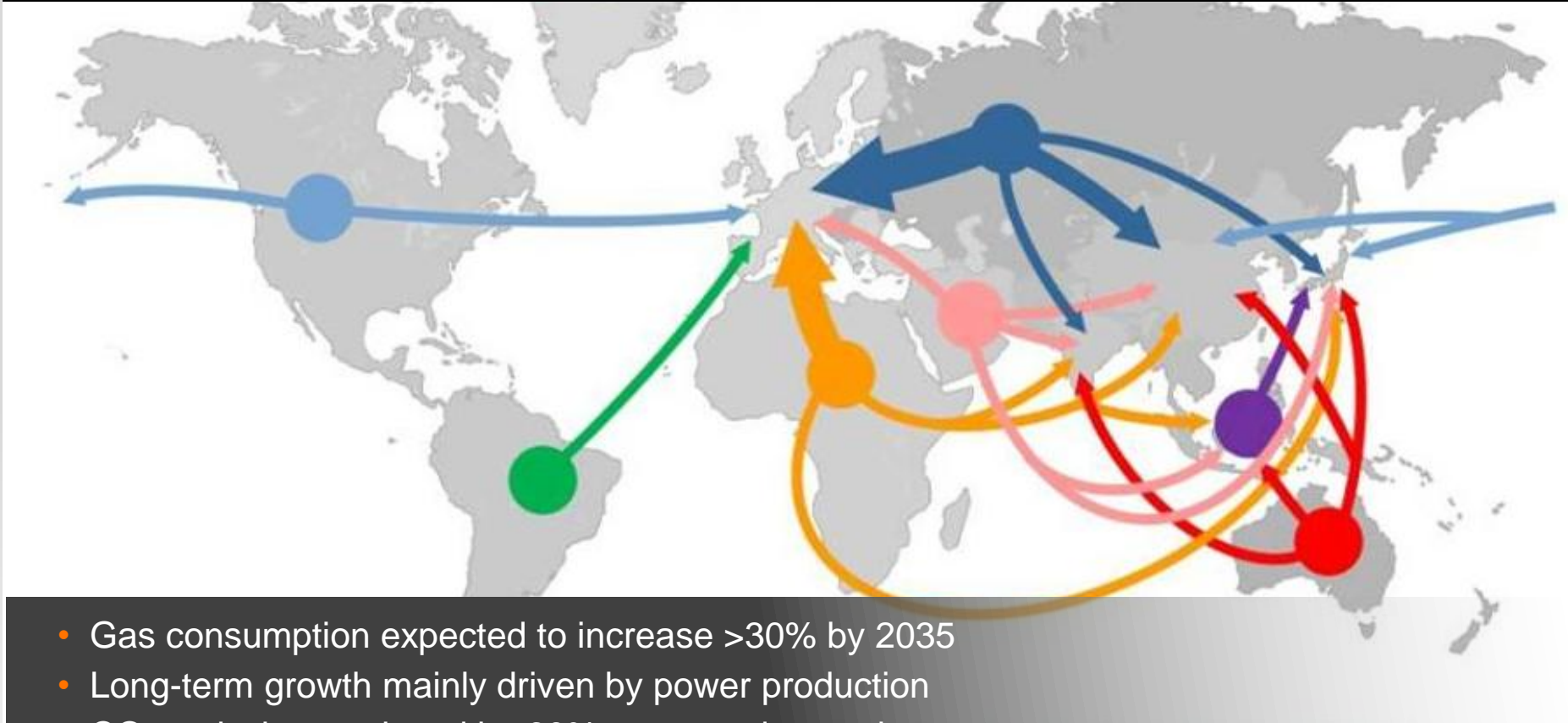


# WÄRTSILÄ'S ROLE IN THE GAS VALUE CHAIN

**TORE LUNDE**

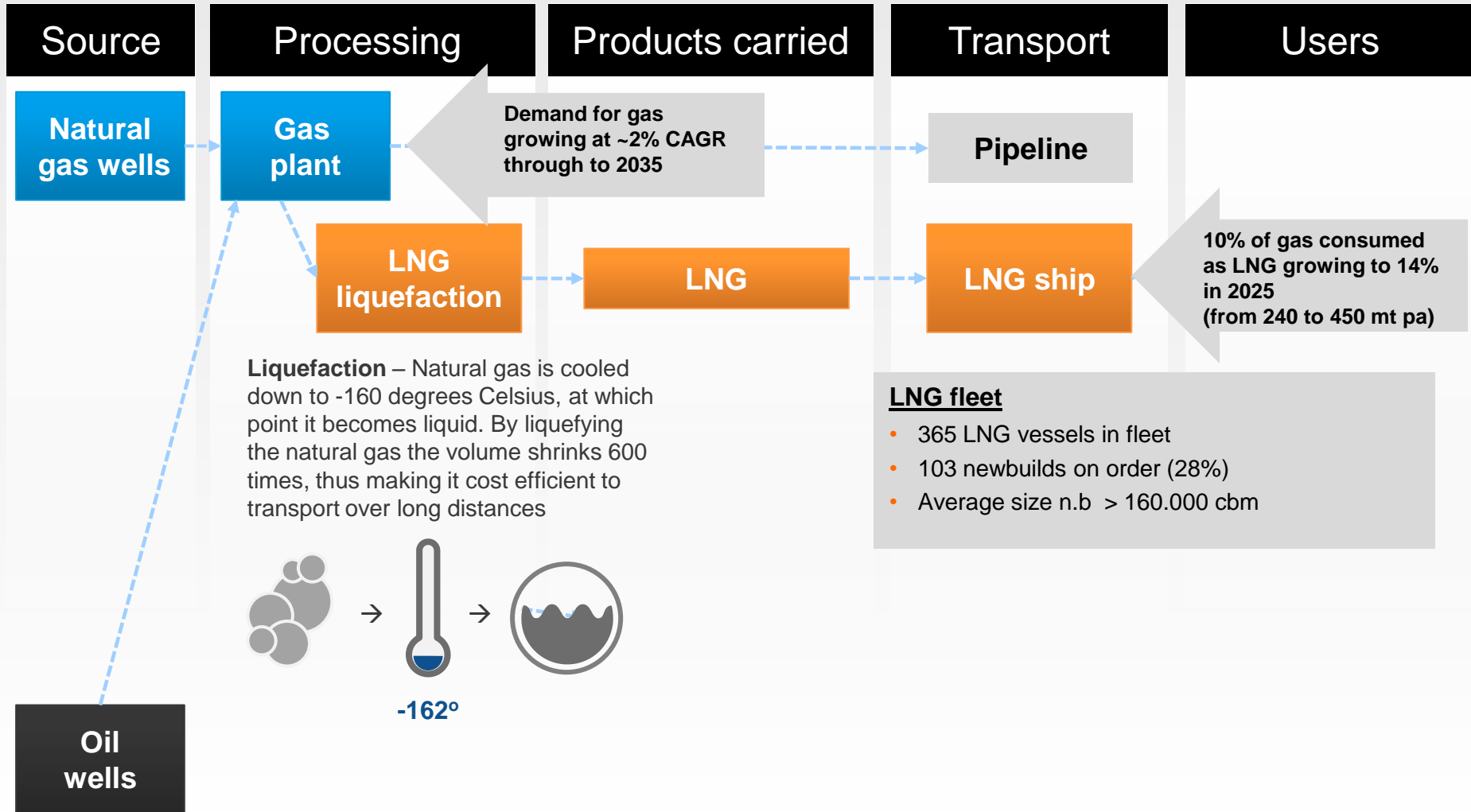
Director, Wärtsilä Oil & Gas Systems

## World Energy Outlook 2012 by OECD/IEA: Major global trade flows 2035

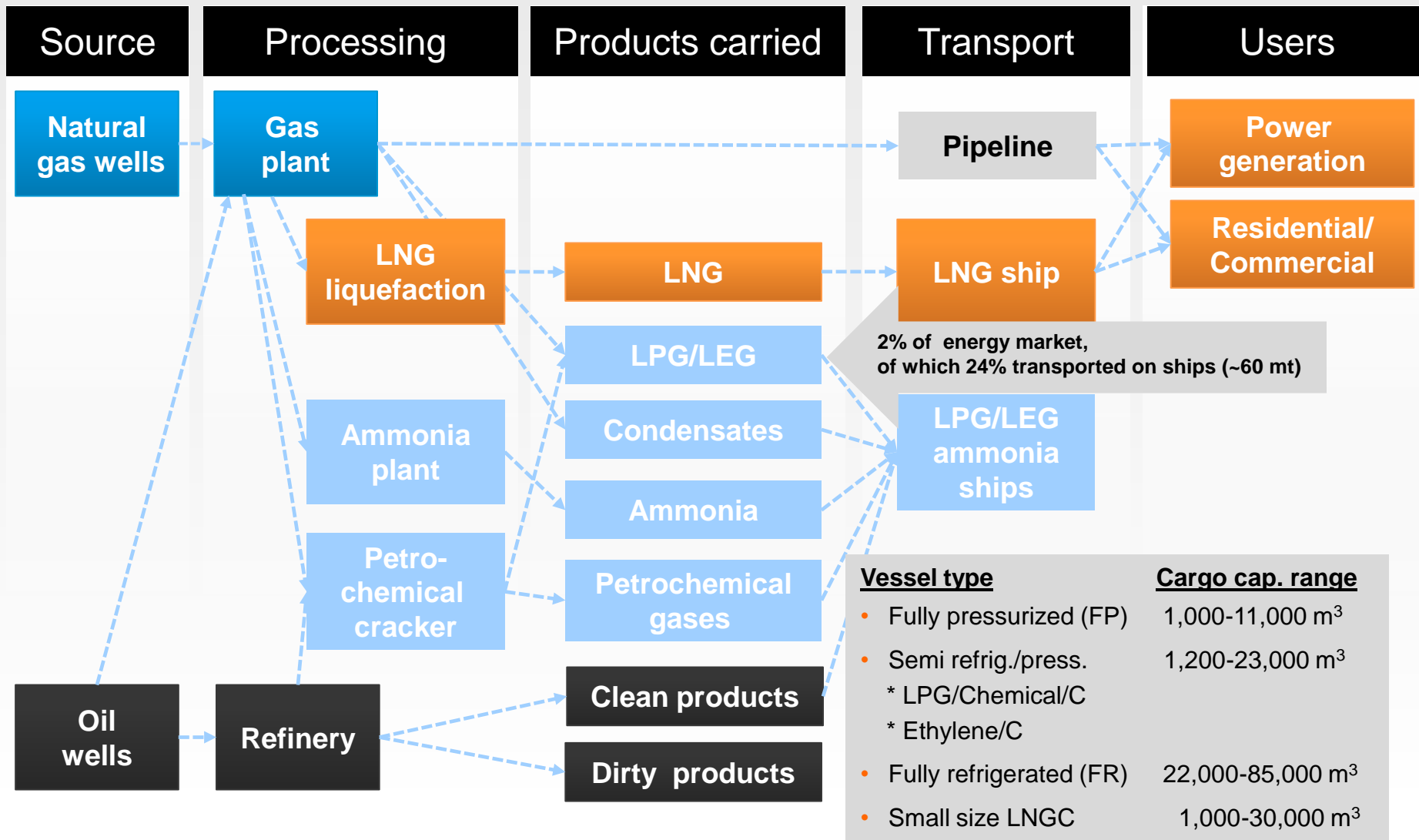


- Gas consumption expected to increase >30% by 2035
- Long-term growth mainly driven by power production
- CO<sub>2</sub> emissions reduced by 60% compared to coal
- Highest demand growth in emerging economies/non-OECD countries
- Mismatch between location of resources and consumers

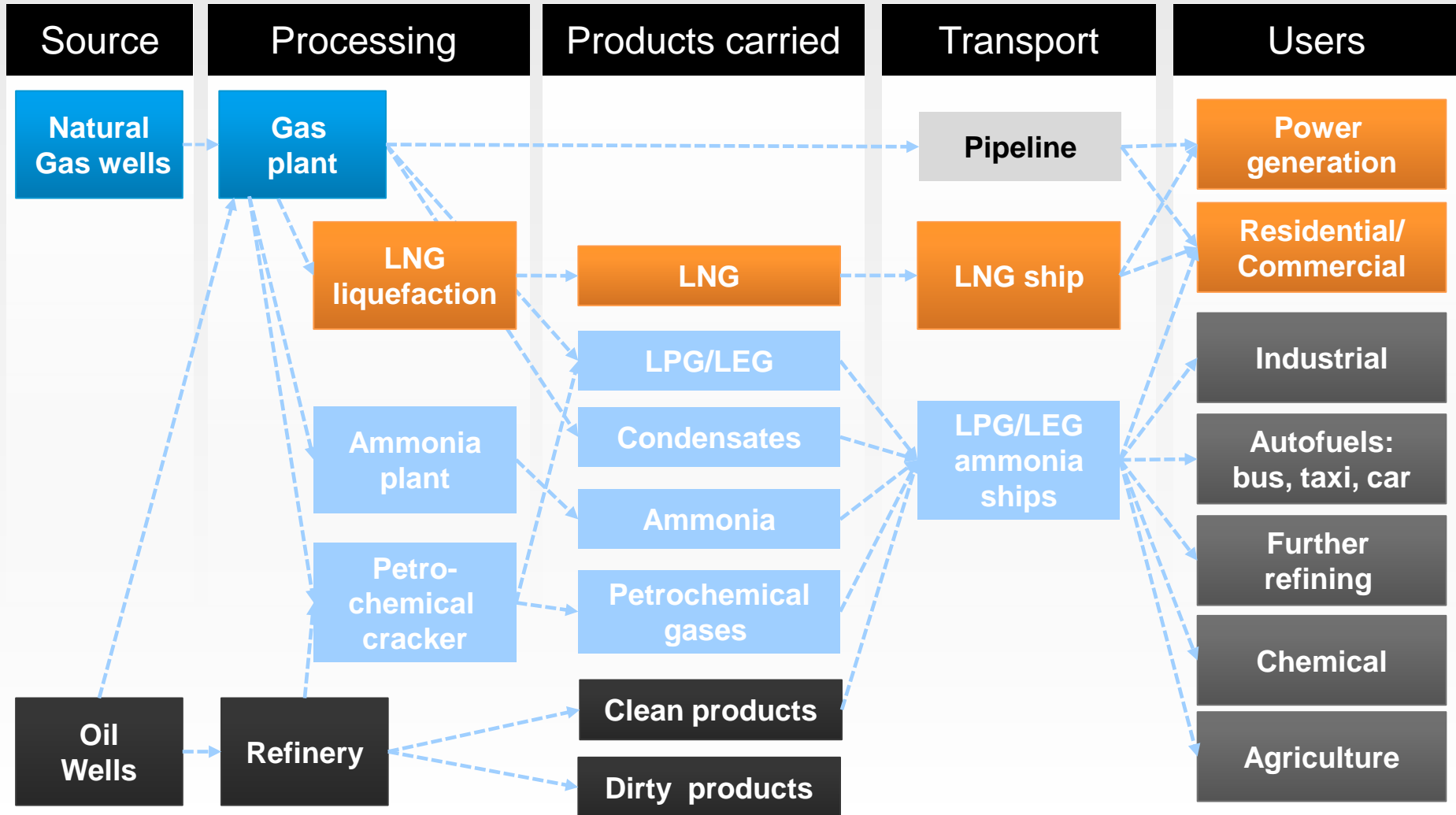
# LNG and LPG distribution/shipping value chain



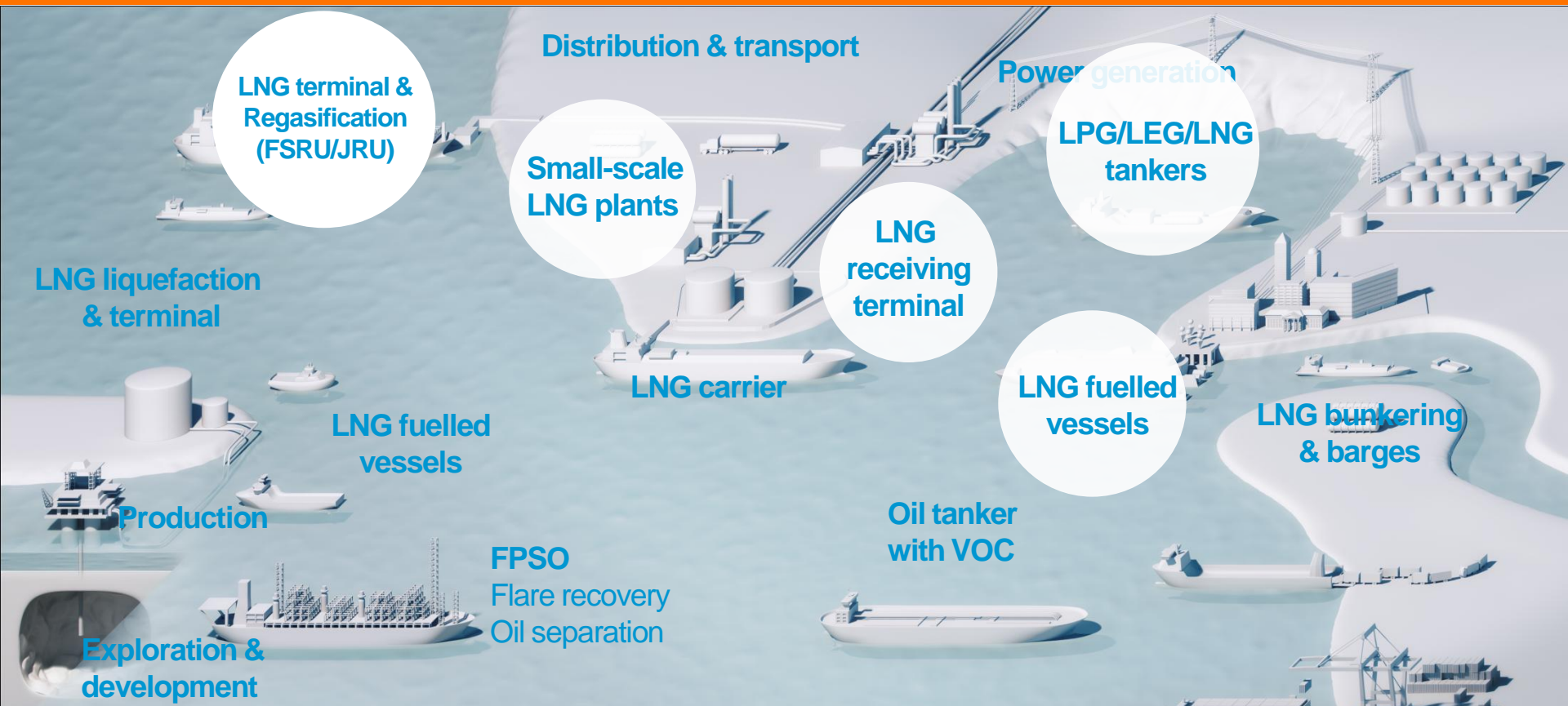
# LNG and LPG distribution/shipping value chain



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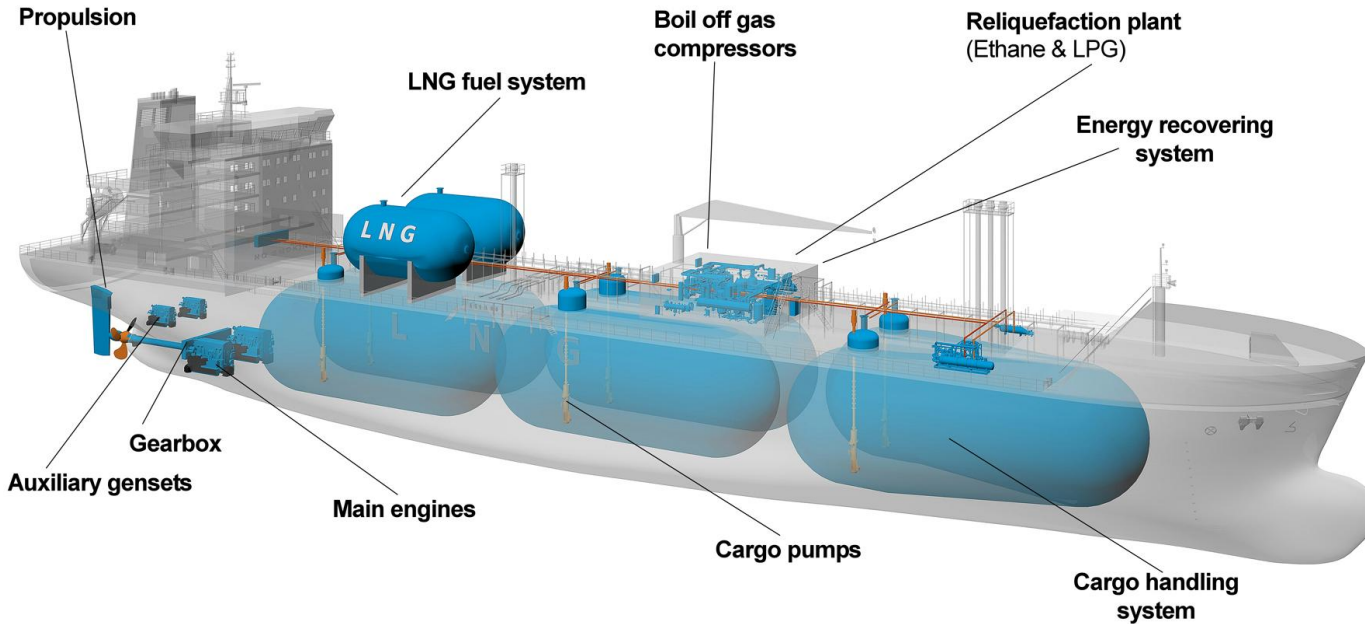


# Our expertise in the gas value chain



- |   |  |   |  |  |
|---|--|---|--|--|
| <ul style="list-style-type: none"> <li>• LNG fuel gas systems for OSVs</li> </ul> | <ul style="list-style-type: none"> <li>• On- &amp; Offshore small scale liquefaction</li> <li>• Antiflaring/VOC</li> <li>• Oil separation</li> <li>• Gas FPSO</li> </ul> | <ul style="list-style-type: none"> <li>• LNG fuel gas systems</li> <li>• LPG, LEG &amp; LNG cargo handling</li> </ul> | <ul style="list-style-type: none"> <li>• Jetty &amp; Floating regasification</li> <li>• Bunkering &amp; barges</li> <li>• Receiving terminals</li> </ul> | <ul style="list-style-type: none"> <li>• Gas/LNG distribution/logistics</li> <li>• Feed gas to Power plants</li> </ul> |
|---|--|---|--|--|

## Reference: Series of multigas carriers for Evergas



### Package with integrated:

- cargo handling system
- gas supply system
- propulsion systems

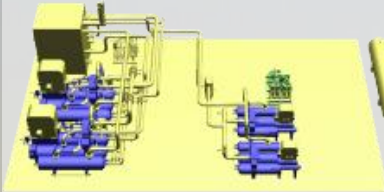
## Market development

- Increased LNG production & shale gas production will impact trading & trade patterns
- Regional & local LNG terminals, coastal transport and LNG bunkering will grow
- Newbuild market is expected to remain strong for all gas ship sizes/types
- China and Korea dominate newbuilding of gas carriers, global owners will participate in supplier selection

## Reliquefaction and Regasification

### LNG C "Al Bahiya"

- Q-flex built as DSME, operated by STASCO
- Equipped with Hamworthy's Mark III LNG Reliquefaction system



### FSRU "Golar Freeze"

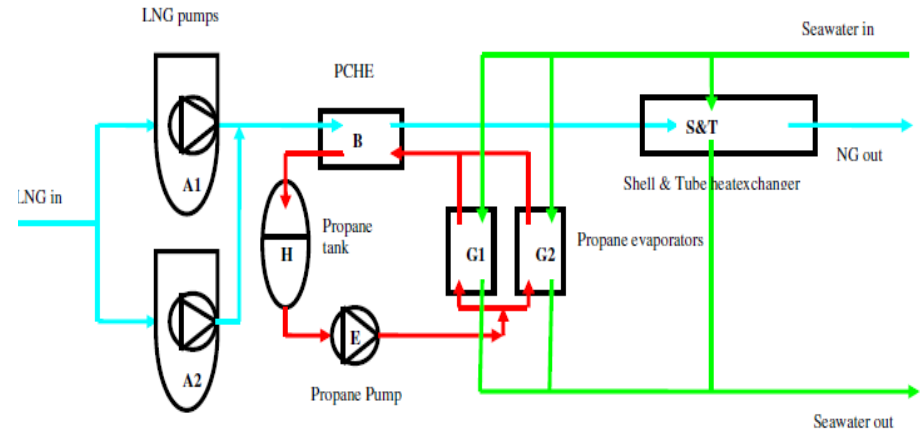
- Owned by Golar LNG Energy
- Equipped with Hamworthy's Regasification system



COOL DOWN (reliequfy) ↔ WARM UP (regasify)



## Floating Storage and Regasification Unit (FSRU)



- Why such solutions:
  - Increased demand for clean energy, power shortage, diversification, lack of gas infrastructure, easier permits, fast track, relocation possibility, cost competitive
- Gas supply goes normally to power plant or city pipeline, typically 10-30 M Sm<sup>3</sup>/d @ 100 bar
- Applied for newbuilds, retrofit on existing LNG carriers, barge or directly on a jetty
- Fast track project: ~18 months for conversion, typical lease of FSRUs imply low CAPEX
- The current demand for LNG creates many opportunities in e.g. SE Asia, ME, India, China, S America – currently about 30 new opportunities

## Regasification systems for FSRUs and jetty installations



- Seawater-propane: 3 x 221 tons/h trains (3x50%)
- Send-out pressure and capacity: 70 bar / 442 tons/h (500 MMscf/d)
- Single-lift module: 32x20x13 m, 945 t dry weight
- BOG recondenser capacity: 24 tons/h per train

**Jetty Regasification Unit** for Petronas' LNG terminal Melaka, Malaysia – March 2012

## Regasification systems for FSRUs and jetty installations



### Order book:

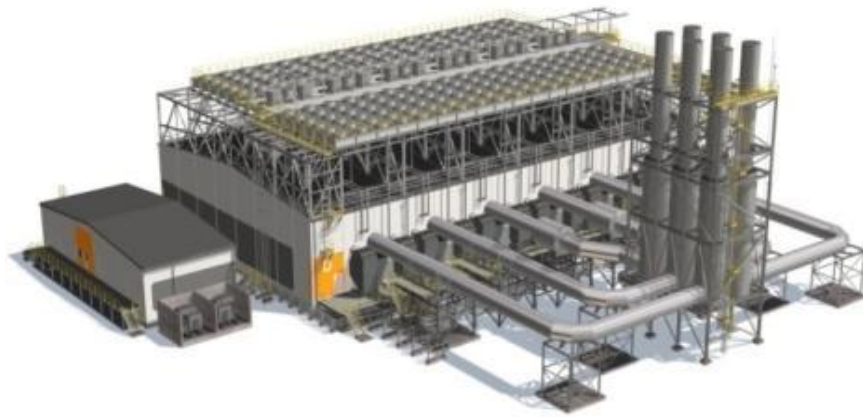
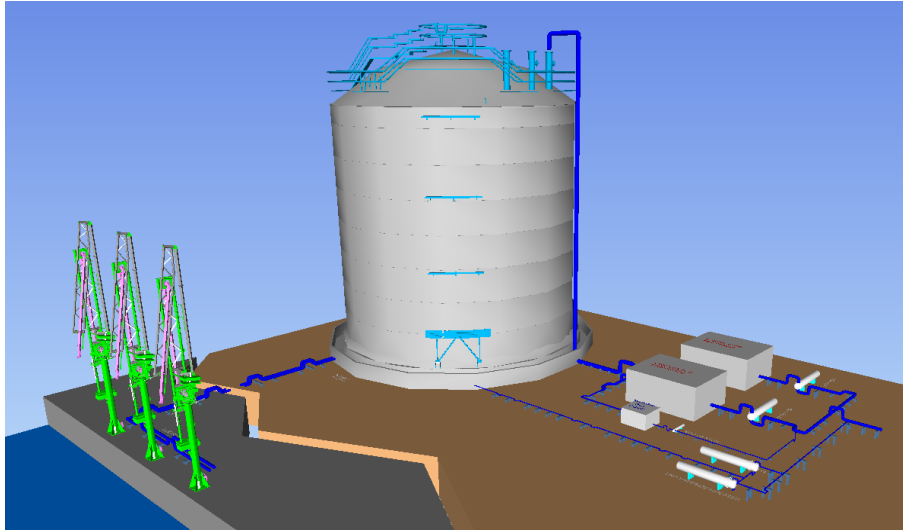
Deliveries to 4 Floating Storage Regasification Units (FSRU) at HHI for Höegh LNG

## Wärtsilä's competitive advantage based on scope of offering

- Ship design and main equipment
- Supply of LNG terminal
- Supply of Power Plant
- Operation
- Maintenance
- Financing



## Typical LNG terminal EPC scope of supply



### Ship Power:

- BOG compressors
- Vapour return blowers
- LNG-in-tank pumps
- Vaporiser units
- Plant process engineering
- Control system
- Process guarantee

### Power Plants:

- Civil works
- LNG storage tank
- Loading arms
- Buildings
- Flare
- Installation
- Piping
- Electrical
- Fire fighting
- Power plant

## Small scale LNG production

Feed gas

LNG production

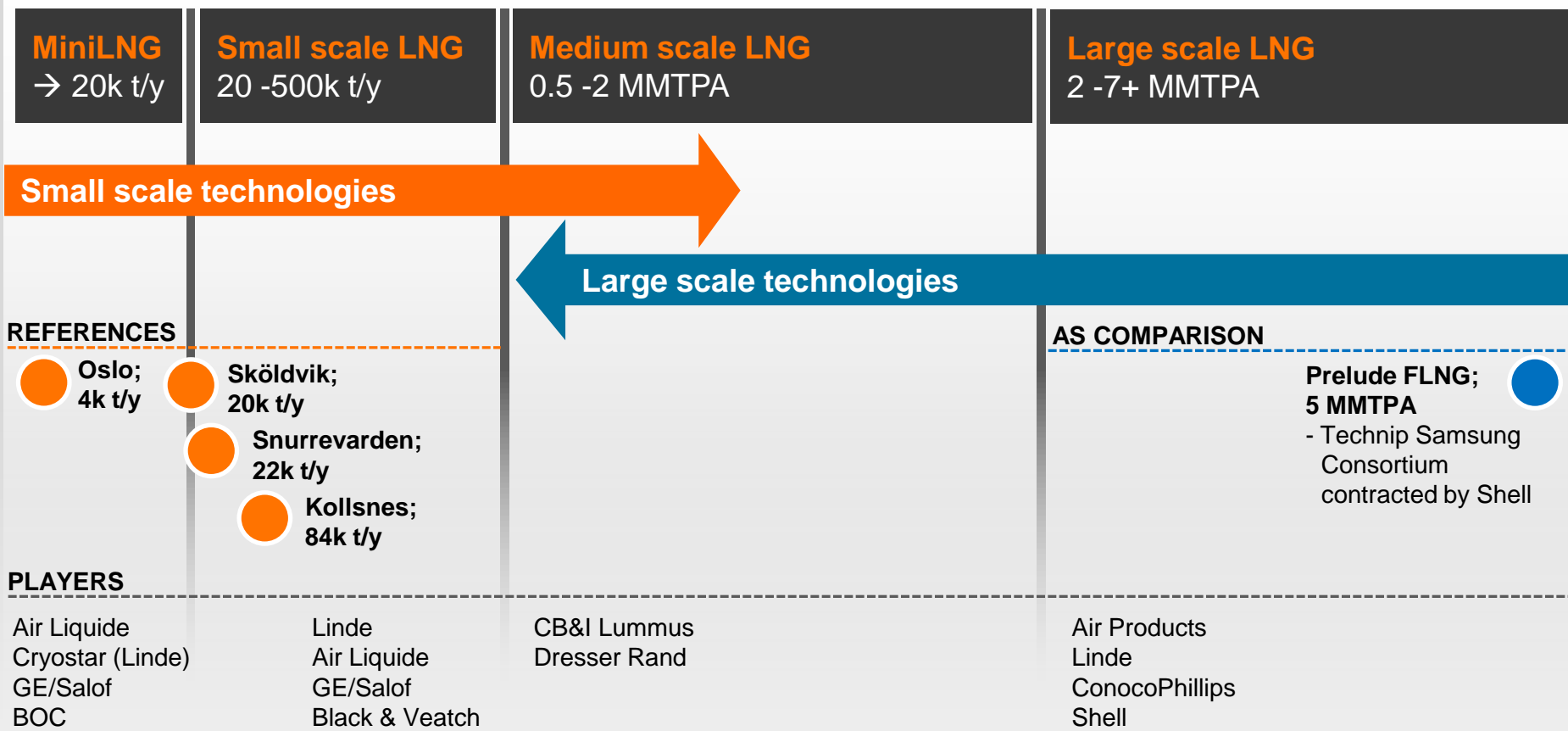
Storage

Transportation & distribution

End users



## Our area of operation in the LNG production space



We are a **small scale contractor** offering mini, small scale and medium scale liquefaction plants with production capacity up to 1 MMTPA

## Small Scale LNG production – References



**Snurrevarden**

- First free-standing small scale LNG plant in Northern Europe delivered March 2003
- EPCIC contract with GASNOR
- Technology feasibility and robustness demonstrated



**Kollsnes II**

- 2 x capacity of Kollsnes I (Linde plant)
- EPCIC contract with GASNOR
- Contract awarded fall 2005, full production August 2007
- Liquefaction process based improved Brayton cycle compared with Snurrevarden



**Gasum, Finland**

- EPCIC contract w/o civil work
- Liquefaction based on liquid N2 from nearby separation plant
- Tank capacity 3 x 689 m3
- Start-up June 2010



## New MR test plant – Moss, Norway



- Test plant for newly developed Multi Refrigerant liquefaction process
- LNG liquefaction capacity 100kg/h
- In operation as of March 2013
- LNG in closed loop, evaporated by air heater
- Verified technology and process simulations

## Biogas liquefaction plant – Oslo, Norway



- Our 1<sup>st</sup> commercial biogas liquefaction plant
- Biogas created from household organic waste
- Liquid Biogas (LBG) to be used on city buses
- LBG production capacity 11 tons/day
- Production started October 2013
- Includes gas pre-treatment, liquefaction, storage and export

## ONGOING DEVELOPMENTS

- Standardise solutions for different capacities
- Use feed-gas from different types of sources
- Versions for marine application (BOG reliquefaction)

## Gas fuelled vessels – market drivers



- **Main drivers** for the gas fuelled vessel market:
  - Environmental awareness & regulations
  - Fuel price
  - Gas availability
- **Environmental incentive**  
LNG enables emission reduction:
  - NO<sub>x</sub> – 92%
  - CO<sub>2</sub> – 23%
  - SO<sub>x</sub> – 100%
  - Particulates – 100%

## LNGPac – Reference: Viking Grace



- Wärtsilä market leading position in dual-fuel engines supports Gas Solution's growth ambitions
- We have also developed concepts for bunkering vessels/barges, further facilitating the transition to using LNG as the primary marine fuel



**WÄRTSILÄ**