

UNCTAD

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Extractive Industries and Sustainable Job Creation

**Utilizing the liquid natural gas in small scale application
in power generation, industrialization and
as alternative Vehicle fuel**

By

Abdalla Altayeb Abdalla
Managing Director
3ACryogenic FZE, United Arab Emirates

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*Utilizing the liquid natural gas in
small scale application in power
generation, industrialization and
as alternative Vehicle fuel.*

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Africa's portion of the world's natural gas

- Africa is emerging as a major supplier of natural gas as new gas discoveries emerge to reshape the world's energy landscape.
- The region is rapidly establishing itself as a world-class natural gas producer led by Algeria, Nigeria, Angola, Egypt, and Equatorial Guinea.
- Recently two new countries have joined them as key players : Mozambique and Tanzania. The newly discovered gas fields of these two countries have put them on par with the reserves of the largest gas suppliers in the world today.

Africa's portion of the world's natural gas

- According to the 2012 BP Statistical Energy Survey, in the year 2011 Africa had proved natural gas reserves is about 6.97% of the world's known supply and is equivalent to 71.7 years of current production.
- In 2012, other resources reported, Africa's technically recoverable natural gas reserves as substantially higher than that, an amount constituting almost 10 percent of the world's total.
- With the new "Super giant" discovery of gas off the Egyptian coast in the Mediterranean field "30 trillion cubic feet of gas", will change African natural gas reserves as substantially higher than the stated 10%.

Africa - Liquefied Natural Gas (LNG)

- There are several LNG plants in Africa producing and exporting LNG to different destination.
- Algeria, has added two new LNG plants for exports at Arzew and Skikda which are producing more than 9 MTPA.
- Egypt, there is LNG plant at Idku Egypt producing 3.6 MPTA since 2005 and at Damietta.
- Equatorial Africa, the Soyo LNG plant in Angola, producing 5.2 MTPA
- Equatorial Guinea, the Malabo plant, on Bioko Island has been producing since 2007 a capacity of 3.7 MTPA.

Africa - Liquefied Natural Gas (LNG)

- Nigeria, rich with an estimated 5300 bcm of gas and rising investments in gas production, is well on its way to becoming the world's-largest liquefied natural gas supplier. One of the largest new additions is the LNG plant on Brass Island with capacity of 9.9 MTPA .
- Mozambique, will be invested initially more than \$30 billion in natural gas sector to build capacity to produce 20 MTPA of liquefied natural gas (LNG), with the first exports due to start in 2018.
- There are more LNG train are under development such the one in Tanzania, JV between BG-Ophir; Statoil-Exxon.

Utilization of natural Gas in Africa

- 100% of the produced LNG in Africa is contracted on long term basis for export, mostly to Europe and far East.
- As for now only small parentage of the produced Natural Gas (NG) is been compressed and transported through pipeline mainly to produce electricity and as CNG for vehicle in Egypt and Nigeria.
- Using the NG for development of the industrialization, domestic and extractive industry is very limited.
- Logistics are a key constraint to transport the NG, where there is limited pipeline or indeed transport infrastructure.
- The flare gas is considered as abandon source of NG for utilization in many African countries.

The basic concept of Virtual-Pipeline

- Virtual-pipeline is an alternative method of transporting natural gas to places where there are no pipeline networks available.
- It is based on a modular system of compression or liquefaction, transport and decompression and/or re-gasification of natural gas, which communities, industries, gas stations and others can use.
- In virtual-pipelines compressed/liquefied natural gas is transported by various modes - highway, railway, waterways and the sea.

CNG-Virtual Pipeline

- CNG-Virtual Pipeline: the gas is compressed from 5 bar to 250 bar and then stored in CNG Jumbo trailers (7-10 t of gas) at pressure from 70 - 250 with a volume reduction from 60 to 225 times the volume occupied under standard conditions.
- The trailers is driven to customers who's not connected to the gas grid.
- Once the CNG trailer/jumbo trailer at the customers' premises the gas pressure is reduced to 4 bar and supplied to different application where the fuel oil/LPG is being used.
- A backup trailer of gas is delivered before all of the gas has been consumed to ensure continuity of supply disruption.

CNG-Virtual Pipeline

- The transportation of CNG is complex and it involves risks of accidents due to the high pressure operation.



CNG-Virtual Pipeline

- High pressure storage on a transport.
- Filled with a compressor located at a pipeline.
- Transported full for empty = two trailers needed.
- Expansion (for full use of trailer content) and recompression on site needed.
- Expensive to produce, transport, and use.

LNG vs. CNG



A single LNG trailer

is equivalent.....

.....to three CNG trailers

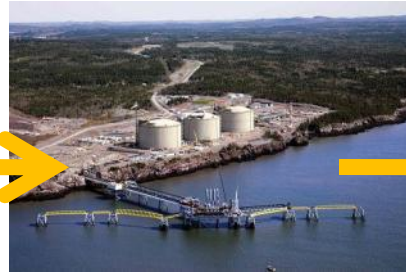
LNG-Virtual Pipeline

- LNG-Virtual pipeline: The liquid natural gas (LNG) is transported from the terminal or small LNG liquefier by LNG semitrailer or ISO container at 3 - 5 bar.
- The LNG is unloaded into existing LNG cryogenic storage tank with MAWP of 11 bar. the cryogenic storage tank is customized to be refilled each 2 weeks.
- The LNG is re-gasified using ambient or steam heated vaporizer and supplied to different application where the fuel oil/LPG is being used.

The basic concept of classic LNG chain



Base load plant



LNG carrier



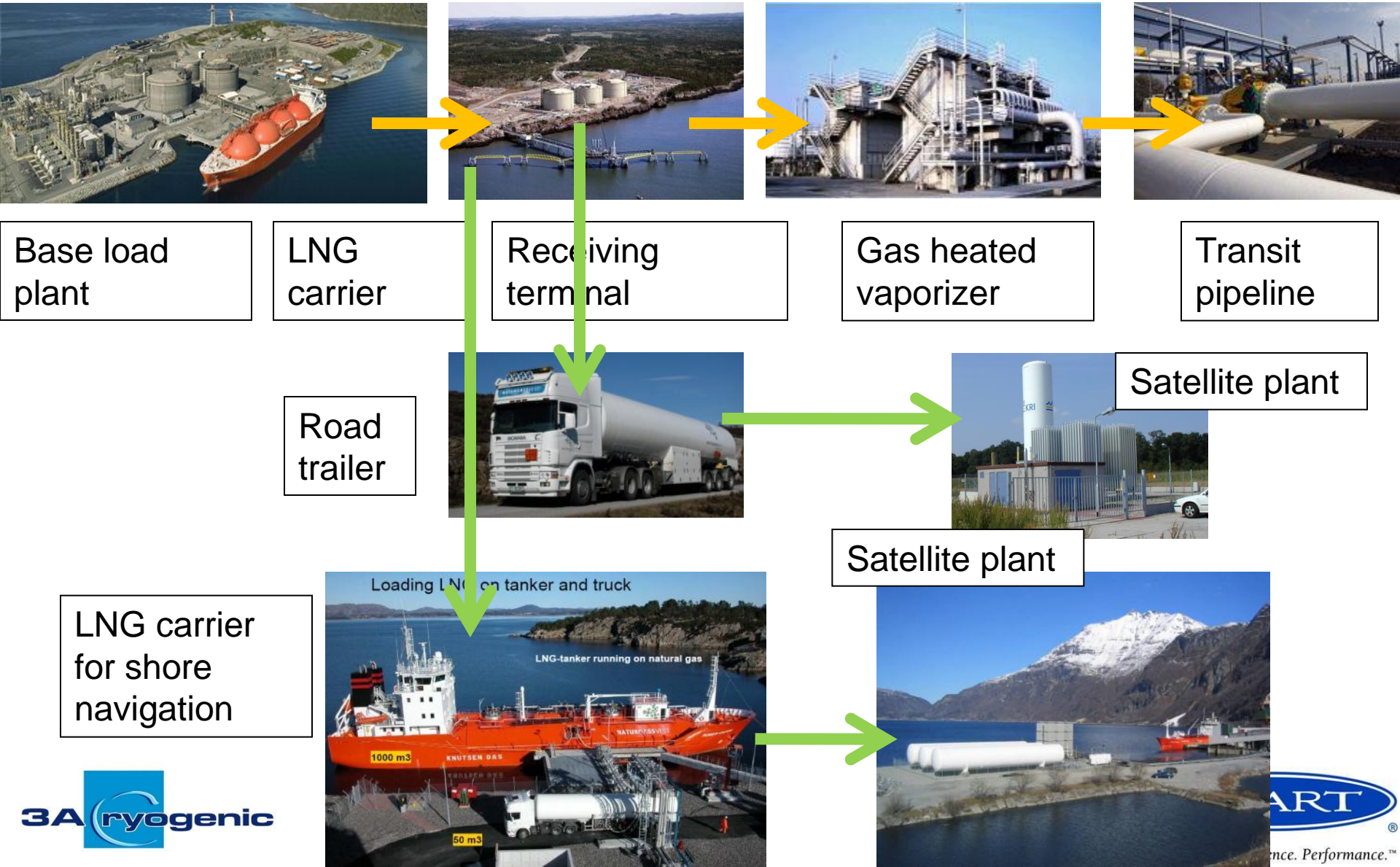
Receiving terminal

Gas heated vaporizer

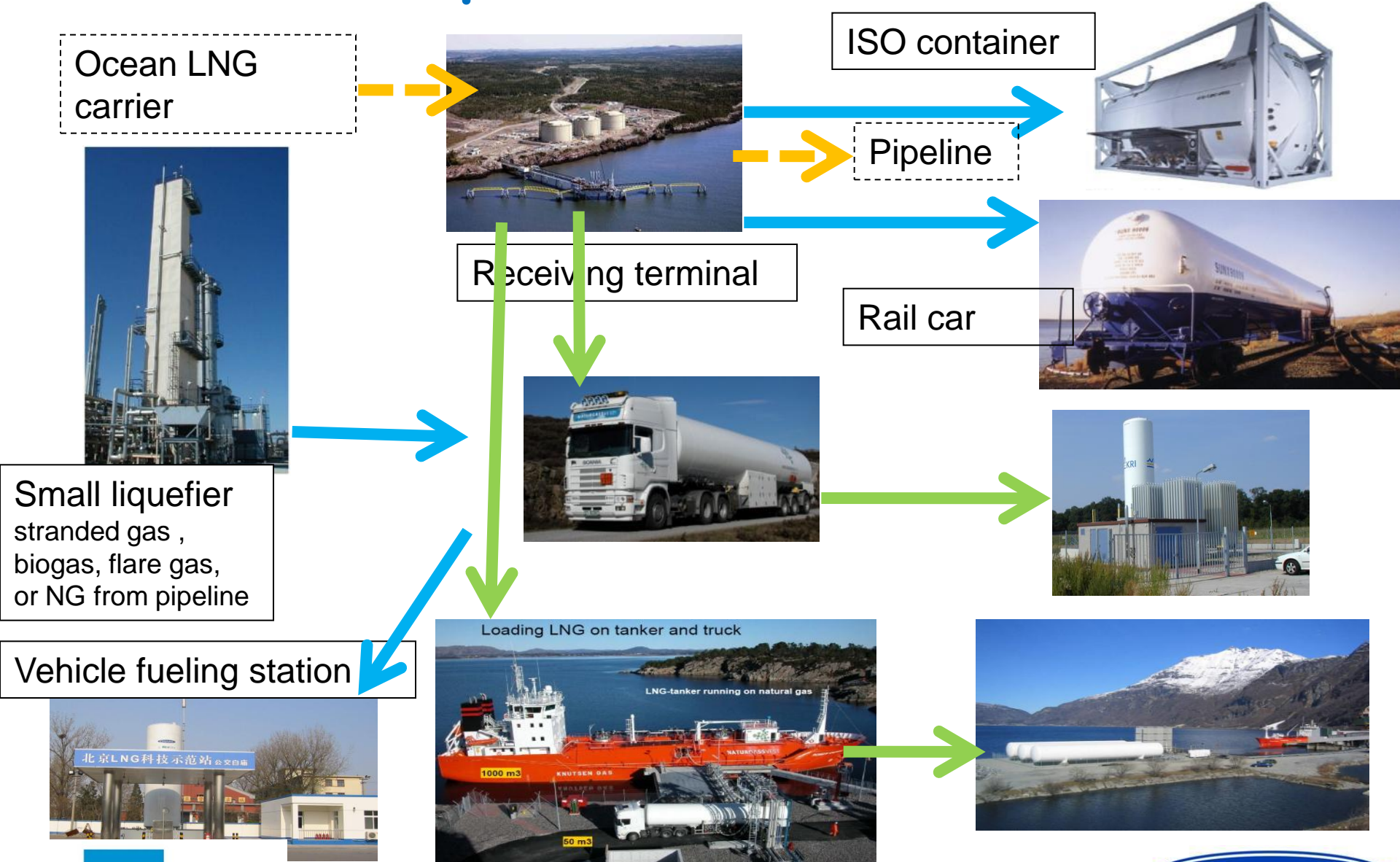


Transit pipeline

The concept of extended LNG chain



The concept of advanced LNG chain



Sources of LNG for Virtual Pipeline

- Onshore receiving terminals equipped with track of loading arms.



Sources of LNG for Virtual Pipeline

Local liquefier on a local wells:

Small wells can be effectively exploited by building local liquefiers with LNG distribution with trailers.

Local liquefier on a local:

sources just as stranded gas ,
biogas, flare gas,

Local liquefiers on long distance pipelines:

Distribution of LNG to satellite stations in regions with limited possibilities of building pipelines because of geo-morphological limitations



On site liquefaction economical aspects (1)

- Small liquefaction of LNG is justified in case of own sources of gas (small local wells, biogas, coal gas, flare gas).

The costs are to be compared to costs of pipeline transport from distant gas fields (price of gas and transport)

On site liquefaction economical aspects (2)

- Small liquefaction of LNG from Transit pipeline and its branches is justified in case, when it **competes to other, more expensive kinds of energy** at the end user (fuel oil, diesel, LPG)

Filling area for 4 trailers at the LNG terminal



Road transport



LNG trailer 56 000 liters, 7 bar, non-vent holding time 80 days
(Chart Ferox for Naturgassvest, Norway)



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Road transport



LNG trailer 49 200 liters, 4.8 bar,
(Chart Ind. for USA DOT regulations)



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Intermodal transport with ISO containers (20 ft)



20 foot ISO container 20 400 liters, 10 bar,
LNG or Liquid Ethane or Liquid Ethylene (and LOX, LIN, LAr)
(Chart Ind., Inc. or Chart Ferox)



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Intermodal transport with ISO containers

Design codes: ISO 1496, ADR, RID, IMDG, EN 13530, GOST-R
Certificates: CSC, ADR, RID, UN T75, IMDG IMO-7, TPED

(40 foot)



Filling 84%:

12991 kg LNG

Holding time 81 days

Filling 92%:

15534 kg LNG

Holding time 30 days

40 foot ISO container **43 500 liters**, 10 bar,
tare weight 12 000 kg, gross weight 30 480 kg, LNG or Liquid Ethane
or Liquid Ethylene (*Chart Ferox*)



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Advantage of ISO containers

Possibilities of intermodal transport:

road - railway - river - sea - ocean

without transfer of liquid from one vessel to other

without intermediate storage

without conflicting with national regulations

LNG road transport commercially verified

The case studies from Europe showed that, its feasible to transport LNG to Central Europe from liquefiers and onshore terminals about 1500 to 1800 km from the point of use, is cost competitive, comparable to pipeline gas available at the site.

Small scale LNG applications examples

LNG satellite (evaporation) station



GasPak solution

- LNG storage (20 – 43,5 m³)
- evaporation skid in ISO frame (150 – 700 Nm³/h)
- Easy & fast installation / relocation

TURN KEY DELIVERY



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Small scale LNG applications examples

LNG satellite (evaporation) station



Optimised solution

- LNG storage (30– 80 m³)
- Standardised evaporation capacities
- optimised configuration for a quick installation (3-4 days)

TURN KEY DELIVERY



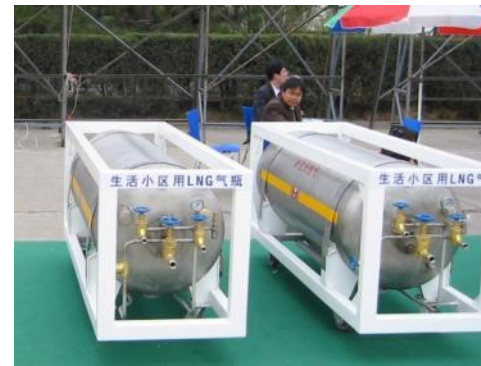
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Focus on applications (future)

- **LNG Microbulk**

delivery to stranded small living areas and individual family houses using

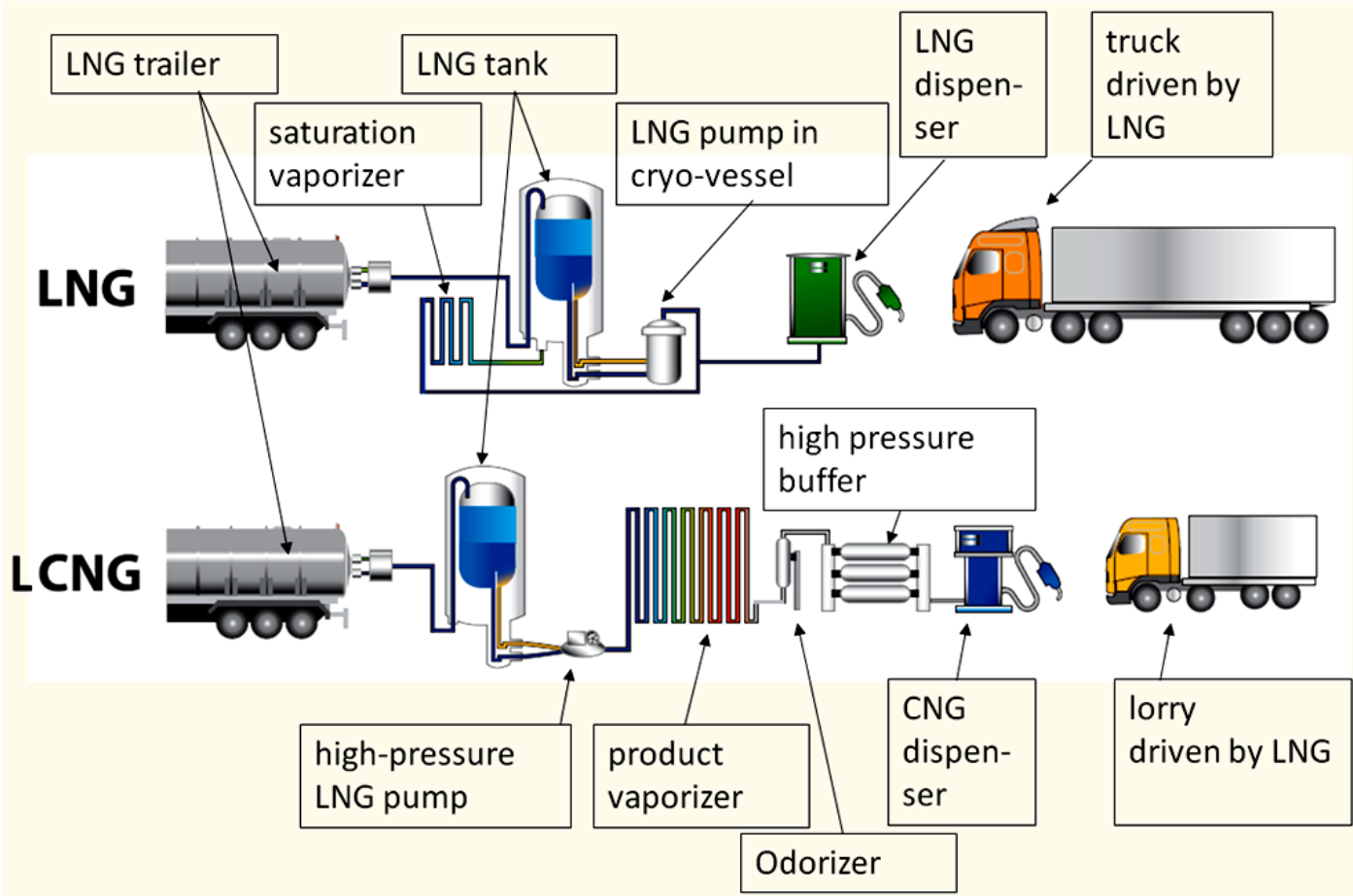
- small storage tanks 600 to 2000 liter LNG at max 12 bar
306 to 436 Nm³
sufficient for a family house for heating and warm water
 - for 2 to 4 weeks in winter
 - three months in summer
- small road tankers with easy access for onsite filling



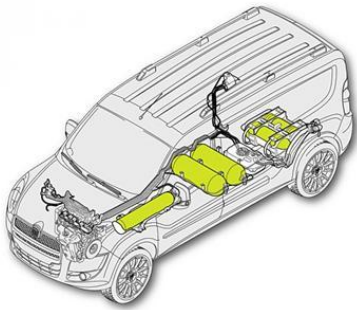
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Small scale LNG applications examples

LNG / LCNG vehicle fueling station



Bus fuelled by LNG, by Chart



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LCNG station Bergen, Norway



Transport from manufacturing works to the site

LNG for drilling Rigs

- LNG MOBILE REGASIFICATION TRAILER"
- The LNG Mobile Re-gasification Trailer is designed to provide an uninterrupted supply of natural gas to power generator sets used on Oil & Gas drill rigs.



LNG for heavy duty truck in mining

- LNG powered trucks are the ideal distribution vehicle for Virtual Pipeline solutions.
- Traditionally powered by diesel and with a number of vehicles operating within a small radius,



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Conclusions

- The utilization of the virtual-pipeline must not be treated as a steady and definite alternative, but as a faster way to take the natural gas to places where there is no technical or economical viability for the conventional pipeline.
- **The LNG Virtual-Pipeline** is a passport to new frontiers, and for the future utilization of conventional gas supply.
- Given this case, the system of **LNG Virtual-Pipeline** can be transferred to a new region, power generating, industrialization, exploitation, vehicles, domestic, development of rural areas and framers,.....

Conclusions

- With respect to possibilities of progressive direct LNG distribution to final user.
the provisions for filling trailers should be included into any initial project of a marine terminal.
- Small LNG liquefiers are the best solution for utilizing the exploited NG from small well and flare gas.
- LNG transport is mostly less energy-demanding than CNG systems.
- LNG virtual pipeline is ideal solution for utilizing the natural resources

Thank you



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Abdalla Altayeb Abdalla

Tel.: +971 (06) 5260441

Fx.: +971 (06) 5260442

Cell: +971504812086

aabdalla@3acryogenic.com



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