Plenary Session III: LNG for a Green Energy Transition

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Service Offered by FueLNG

Truck to Ship (TTS)
LNG Bunkering

Ship to Ship (STS)
LNG Bunkering

LNG Distribution to
Industrial Customers

50% 50%

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A venture between Keppel and Shell

Shell & FueLNG : Many Firsts in Singapore

Singapore's first LNG Bunkering to Harbourcraft by LNG trucks

Singapore's First LNG Bunkering of an LNG Fuelled Oil Tanker

Asia's First Ship to Containership LNG Bunkering in Singapore

LNG Bunkering of World's first Newcastlemax Bulk Carrier

Cool Down and LNG Bunkering of World's Largest LNG fuelled Container vessel

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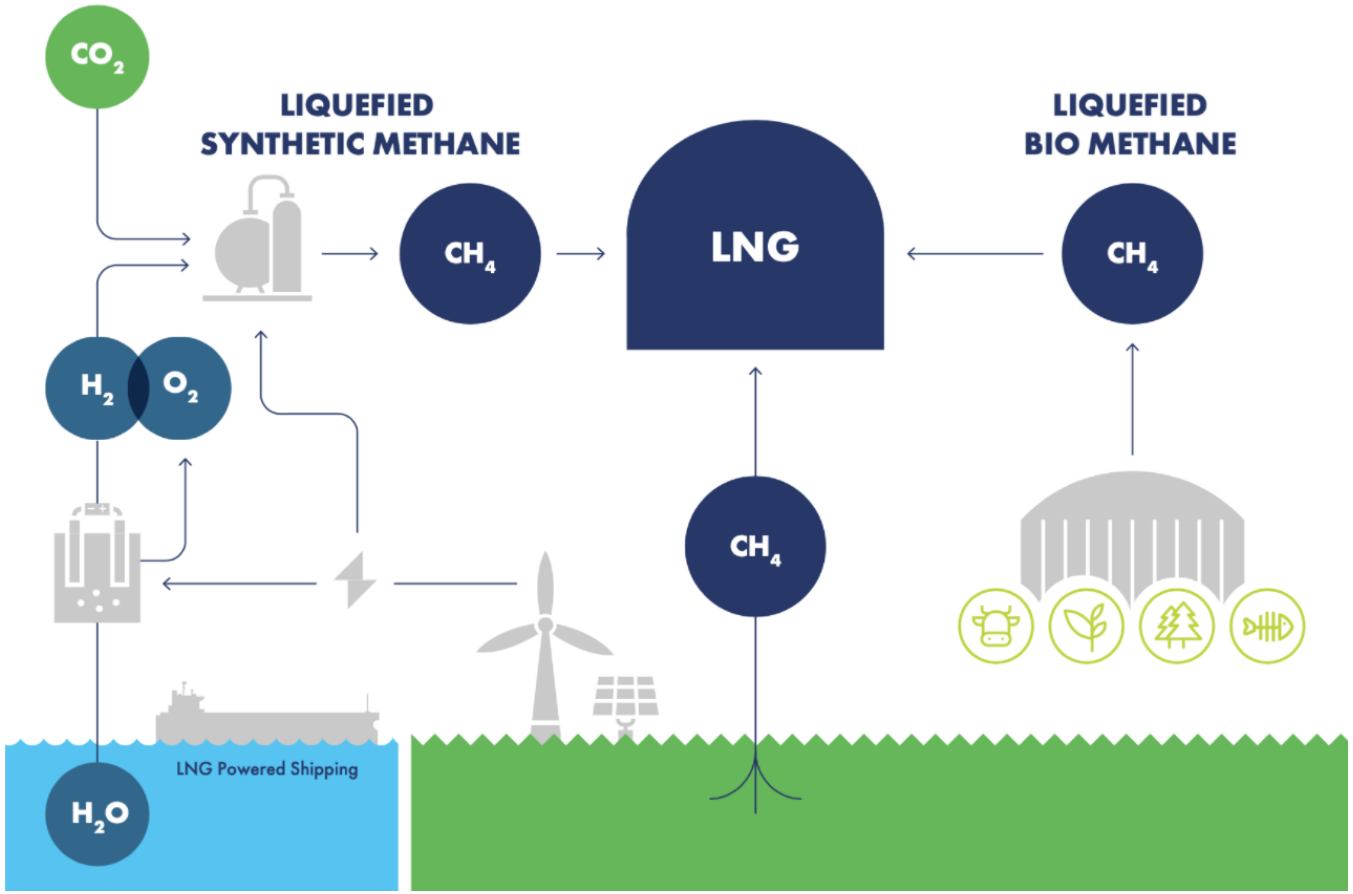
2030 is tomorrow: 2050 is one ship lifetime away



Source: https://sea-lng.org/wp-content/uploads/2020/04/SEA-LNG_Alternative_fuels_narrative_V22.pdf
Source: https://sea-lng.org/why-lng/decarbonisation/

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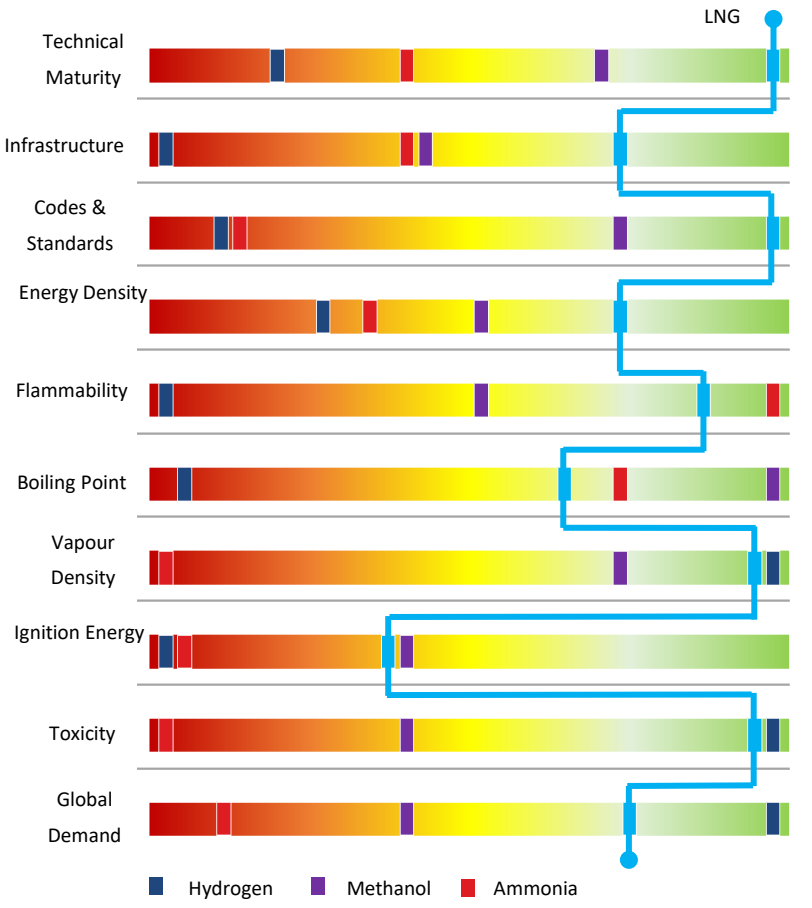
LNG is the best option today and, in the future

LNG is the best option today



Source: DNV

Compared to LNG, every alternative fuel has its advantages and barriers

	Green Hydrogen	Green Ammonia	Green Methanol
✓	• Carbon free, non toxic, & suitable for multiple segments • Enables future fuel alternatives • Unlocks higher efficiency fuel cell technology	• Carbon free, non cryogenic • Some existing shipping experience related to bulk carrying of ammonia • Can be used with ICEs in combination with pilot fuels	• Carbon neutral • Being used in a small number of vessels as a fuel • Can be used with existing technologies and be a 'drop-in' in some MGO, HFO infrastructure
✗	• Highly cryogenic -253ºC • No existing shipping experience & maritime infrastructure	• Highly toxic & corrosive • No existing experience of ammonia used as a fuel • Bunkering at ports with ammonia holds many potential treats and still to be accepted	• Not carbon free and mildly toxic • Inefficient production process • Low interest from other segments & higher potential cost than other alternatives

Source: DNV

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LNG Bunkering Infrastructure in Asia – In Operation

Infrastructure
In operation
Decided
Under discussion

Source: DNV, Kaguya; Image courtesy: Kawasaki Heavy Industries, SM JEJU LNG2 Image courtesy: Korea Gas Corp.'s (KOGAS), Avenir Advantage Image courtesy Avenir LNG

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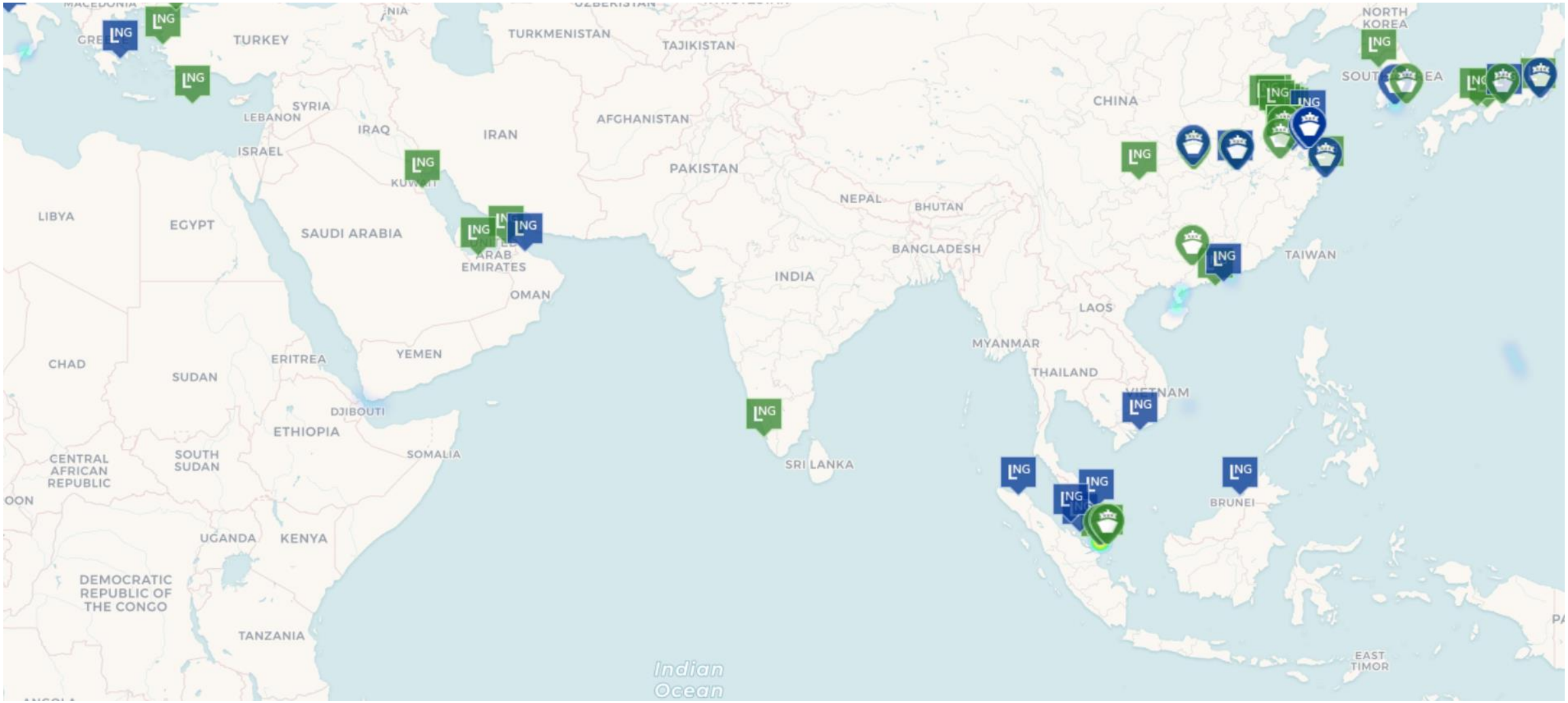
LNG Bunkering Infrastructure in Asia – Decided



Source: DNV

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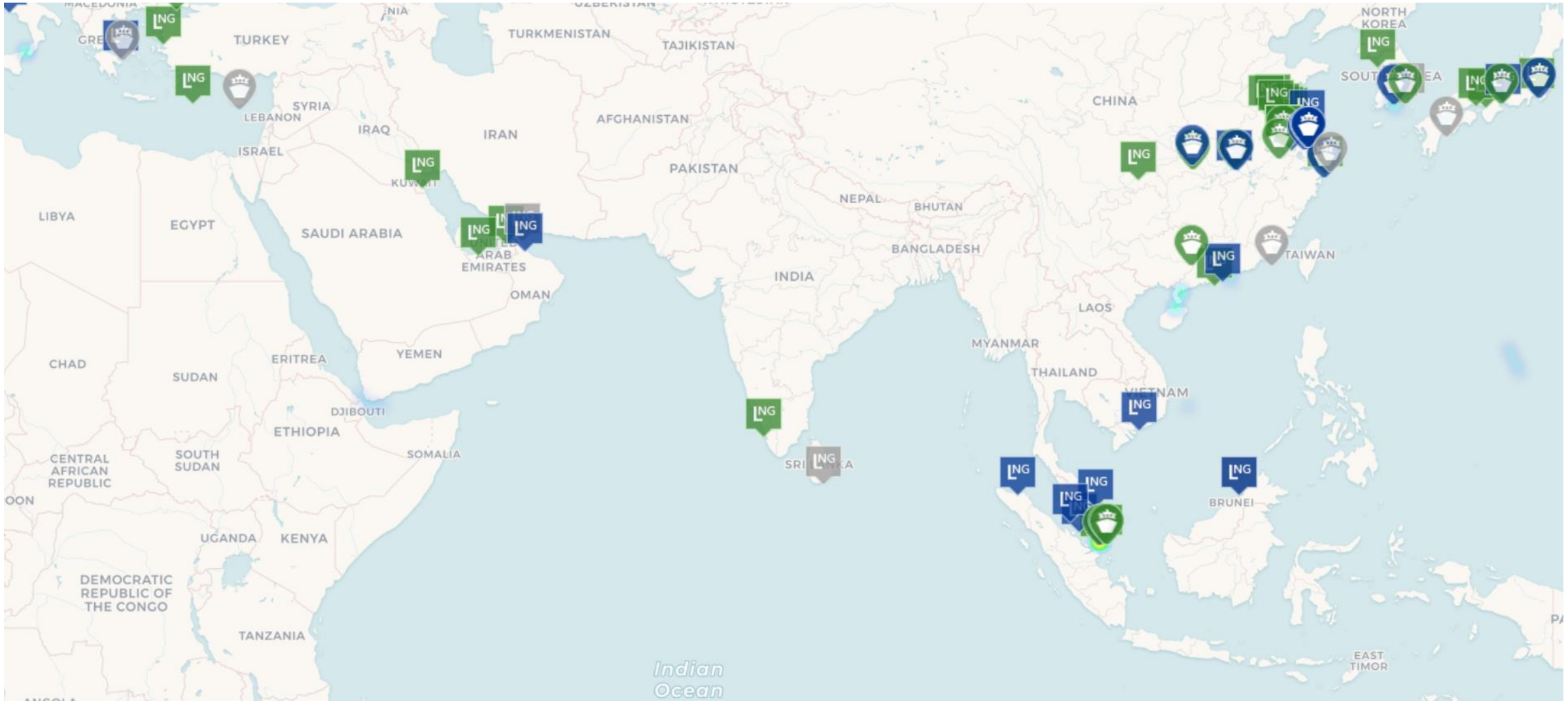
LNG Bunkering Infrastructure in Asia – In Discussion



Source: DNV

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Roadmap of LNG bunkering in Singapore

Sept 2015

- Launch of $12 million co-funding program for LNG-fueled vessels by MPA

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A venture between Keppel and Shell

PAVILION ENERGY

Jan 2016

- Award of LNG Bunkering Licenses to FueLNG and Pavilion Energy
- Formation of FueLNG

2017

- LNG Bunkering Roundtable
- **Launch of TR 56 Technical Reference for LNG Bunkering**
- Port dues incentives launched by MPA

Sept 2017

- First LNG truck to ship bunker for Golar Hilli commissioning.

2018 - 2019

- First two LNG powered tugs delivered in Singapore; Jurong Port LNG bunker ready
- LNG Bunkering Vessel (LBV) shipbuilding contract signed.
- First STS LNG Bunkering Carried out in Singapore.

2020 onwards

- **Launch of updated TR 56 Technical Reference for LNG Bunkering**
- FueLNG Bellina Singapore's first LBV starts operations
- Asia's first SIMOPS and LNG bunkering to Container vessel carried out.

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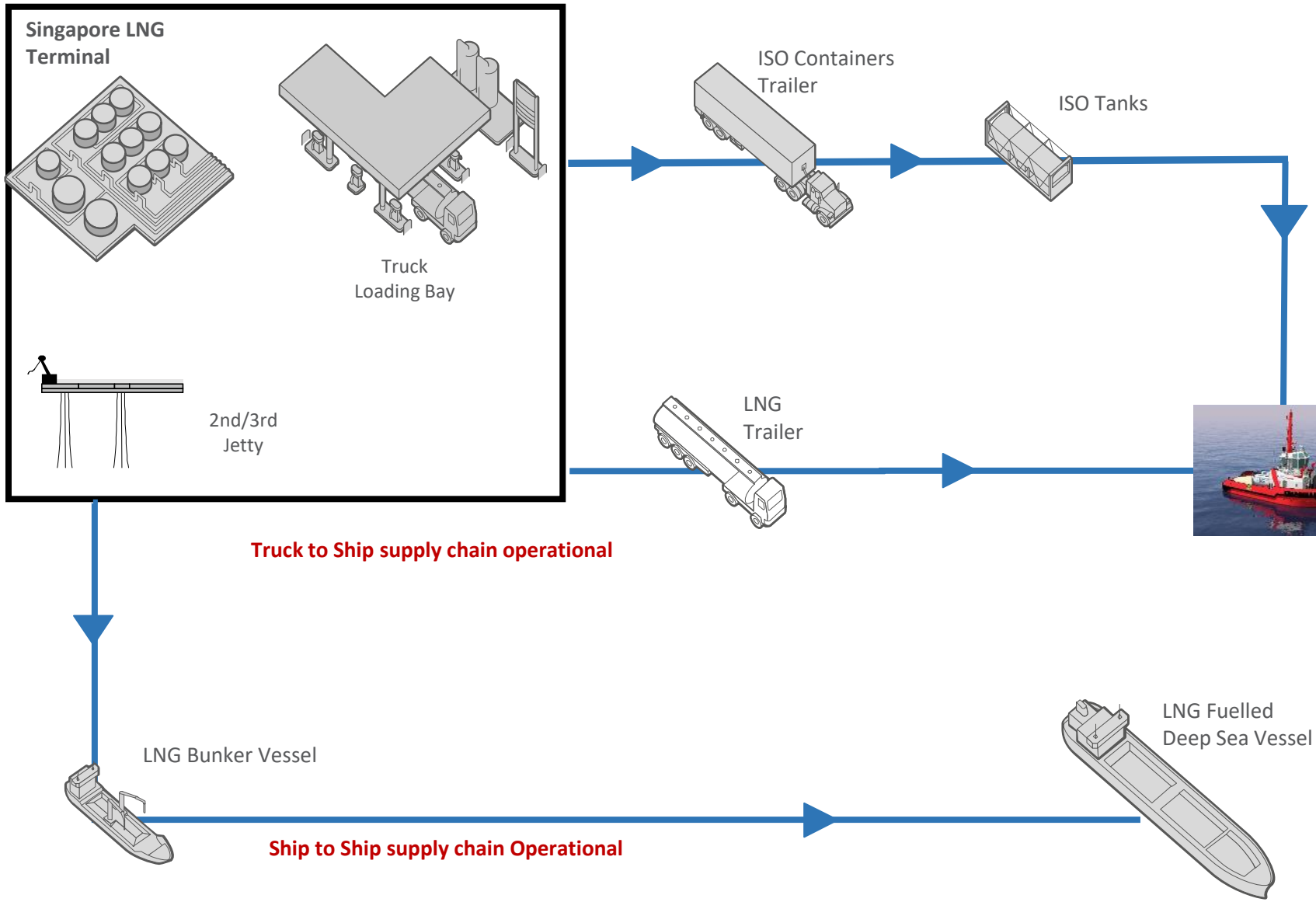
Singapore LNG supply chains



Truck to Ship

- Flexible hose connects ship to the truck, which is parked alongside the vessel on the port jetty
- Marine Segment: Smaller boats: Service, Tugboats, Naval/Coastguard, Small Offshore.
- Operational time: Typically ~2 hours

LNG fuelled harbourcraft

Industrial Small Scale LNG Storage

Photo from Chart website

Ship to Ship

- Marine Segment: Containers, Tankers, Bulkers, RORO
- Operational time: Typically 12~14 hours

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рахмат
danke
謝謝
ngiyabonga
teşekkür ederim
spas
Баярлалаа
mersi
kia ora
barka
welalin
tack
спасибо
faafetai lava
vinaka
blagodaram
dank je
misaotra
matondo
paldies
grazzi
mahalo
tapadh leat
спасибі
kiitos
dankie
dhanyavad
nanni
nandri
thank you
gracias
хвала
asante
manana
bedankt
bayarlalaa
gràçie
hvala
mauruuru
köszönöm
dankon
aciū
akun
obrigada
murakoze
tenki
enkosi
djiere dieuf
tau
mochchakkeram
дякую
mamnun
chokrane
dziękuję
chnorakaloutioun
gratias ago
gràcies
sulpáy
taiku
go raibh maith agat
sobodi
děkuji
sagolun
sukriya
kop khun krap
arigatô
takk
dakujem
trugarez
obrigado
mèsi
ありがとう
tanemirt
grazie
didi madloba
najis tuke
terima kasih
rahmet
ευχαριστώ
diolch
dhanyavadagalu
shukriya
mercé
мерси
kam sah hamnida
rahmat
তোমাকে ধন্যবাদ
감사합니다
xièxie
merci