



2022 KOREAN-HELLENIC MARITIME COOPERATION FORUM

How to respond to IMO GHG Regulation

Dr Kanghyun Song

Head of Decarbonization R&D Center

Korean Register

The background of the slide is a composite image. The left half shows a large container ship with a blue hull and a red upper section, heavily loaded with multi-colored shipping containers. An airplane is visible in the sky above the ship. The right half shows the same ship from a different angle, sailing on a blue sea under a bright blue sky with white clouds. The text '01. IMO GHG Regulations' is overlaid in white on the left side of the image.

01. IMO GHG Regulations

VISION >>>

Decarbonization

Phase GHG emissions of ships out ASAP in this century

TARGET >>>

1. Carbon Intensity to decline

- Further Phases of EEDI for New Ships

2. Carbon Intensity to decline

- (tCO₂/ton·mile) 40% by 2030 and 70% by 2050 compared to 2008

3. GHG emissions to peak and decline

- Peak GHG emissions as soon as possible
- (Total annual emissions) 50% by 2050 compared to 2008

2018-2023 Short-term measures

- Improvement of EEDI and SEEMP
- Develop technical and operational energy efficiency measures for both new and existing ships with three-step approach
- Existing Fleet Improvement Programme
- Speed optimization and reduction
- Measures for methane and VOCs
- National Action Plans, Technical cooperation and capacity-building, Port development (AMP etc), R&D activities, Incentives for first movers, Lifecycle guidelines for fuels, GHG study

2023-2030 Mid-term measures

- Programme for alternative fuels
- Operational energy efficiency measures for both new and existing ships
- Emission Reduction Mechanism (MBM)
- Technical cooperation and capacity-building, Feedback mechanism

Beyond 2030 Long-term measures

- Zero-carbon or fossil-free fuels
- Emission Reduction Mechanism

VISION >>>

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Phase GHG emissions of ships out ASAP in this century

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After Cop26, carbon neutral of shipping

2100 => 2050

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Beyond 2030 Long-term measures

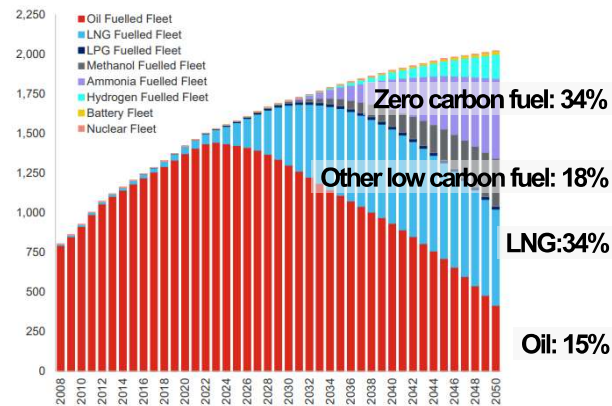
- Zero-carbon or fossil-free fuels
- Emission Reduction Mechanism

Decarbonization Scenario



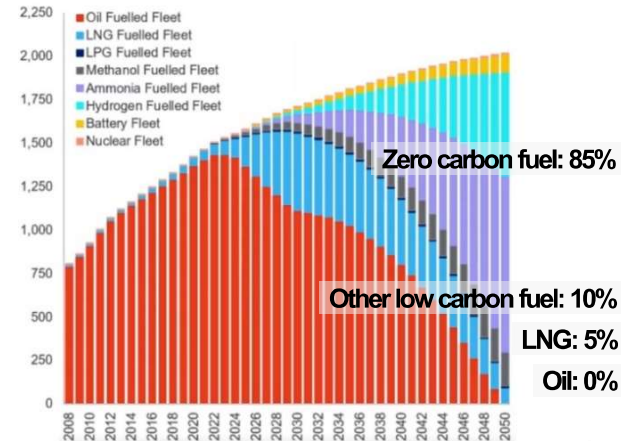
* IMO Initial Strategy (50% by 2050)

Fleet Development, Average Year, m. GT



* Net-zero target (100% by 2050)

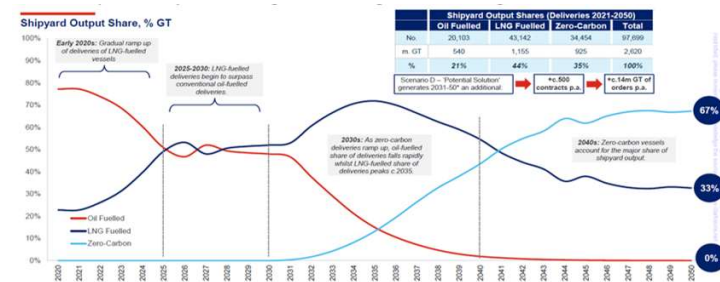
Fleet Development, Average Year, m. GT



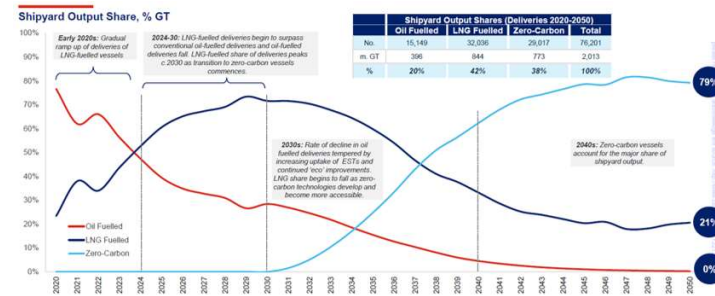
Source: Clarksons Research, Fuelling Transition: Tracking the Economic Impact of Emission Reductions & Fuel Changes, September 2021 webinar

Source: Trevor Crowe, The shipping sector to 2030, Clarksons research, 2019 & 2020

✓ Oct. 2019 report (order based)

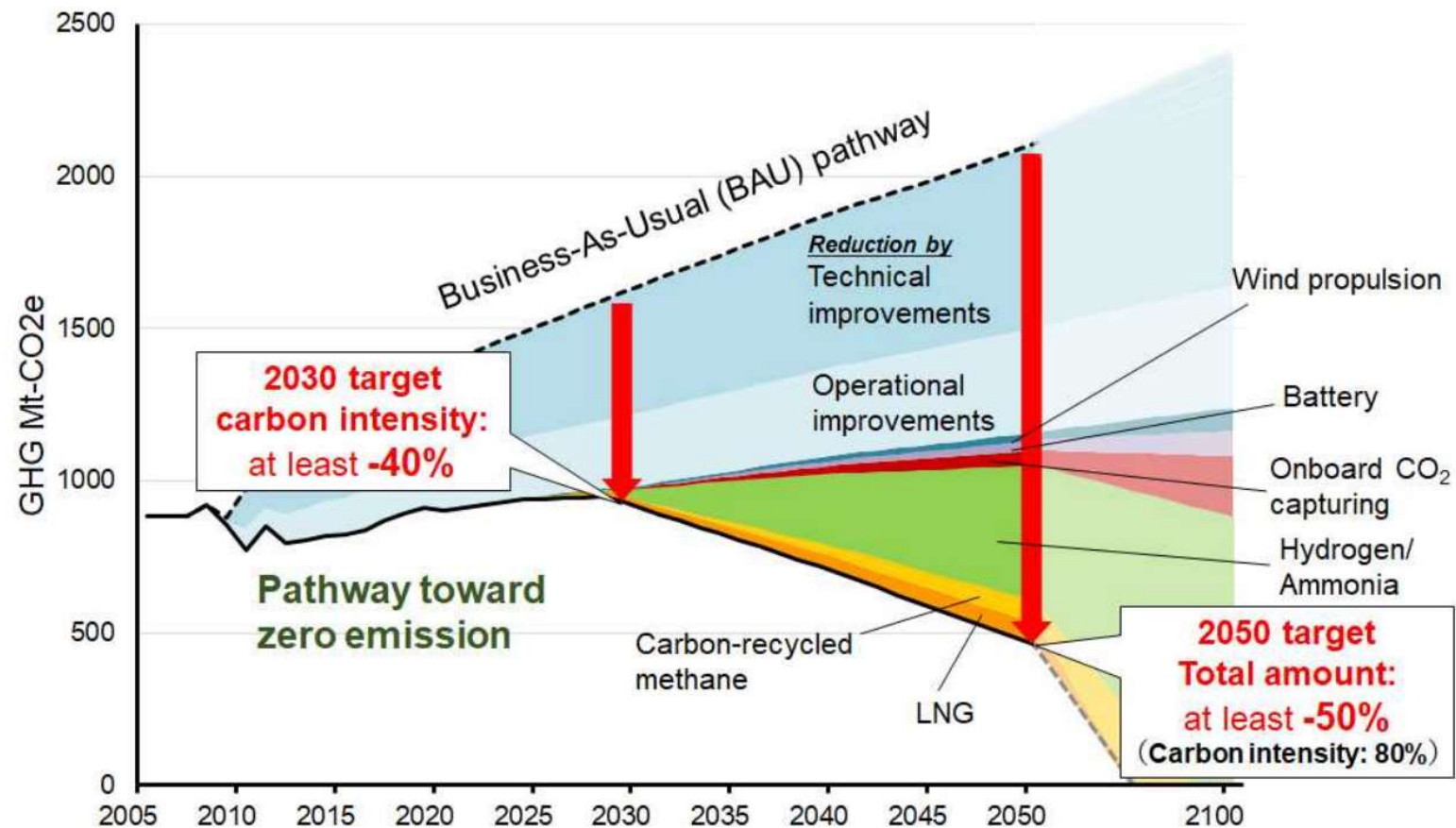


✓ Mar. 2020 report (order based)



✓ ? after decarbonation target year changed to 2050

Decarbonization Regulation/Measures

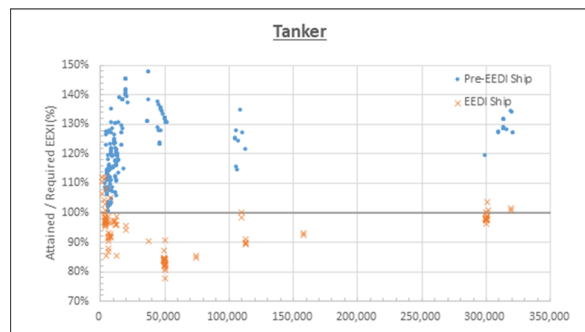


Source from JSTRA

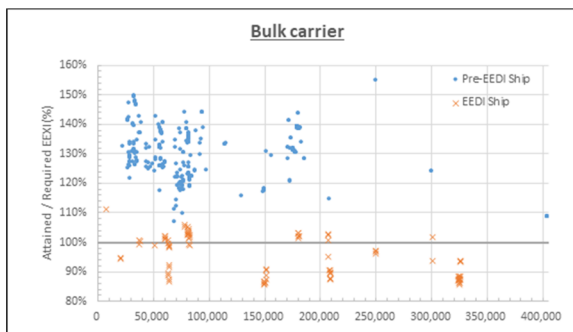
EEXI calculation data



적용선박	총합	만족	불만족	불합격률
PRE-EEDI 선박	333	9	324	97%
EEDI 선박	107	79	7	7%
합계	440	88	331	75%



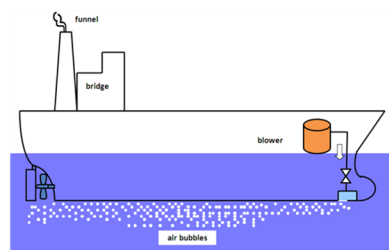
적용선박	총합	만족	불만족	불합격률
PRE-EEDI 선박	366	0	366	100%
EEDI 선박	45	58	31	34%
합계	456	58	397	87%



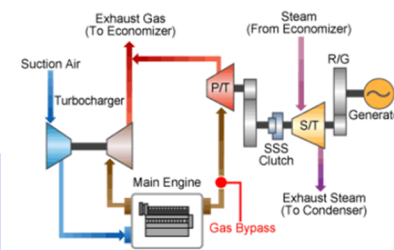
Category A



Category B



Category C

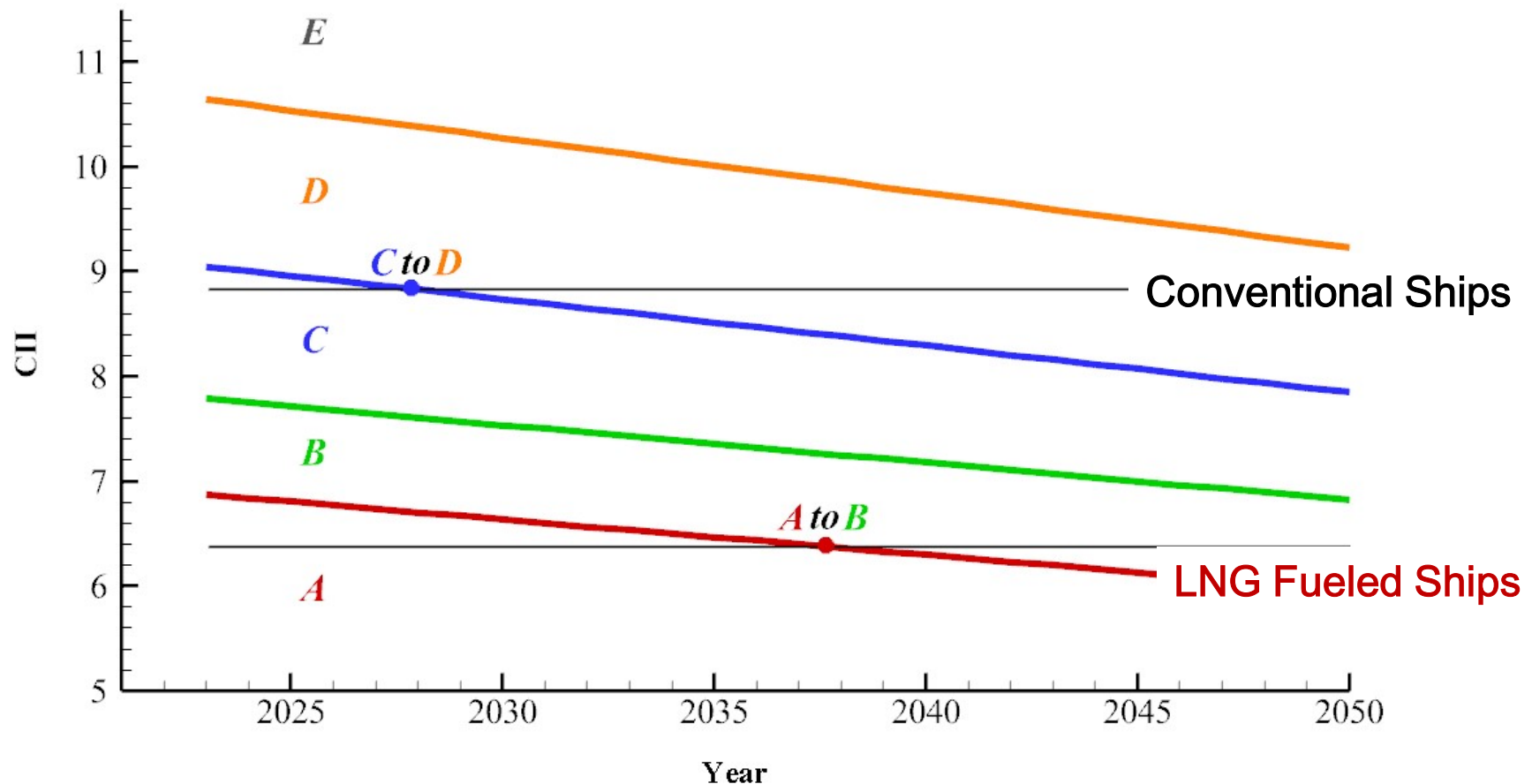


CII(Carbon Intensity Indicator Rating)

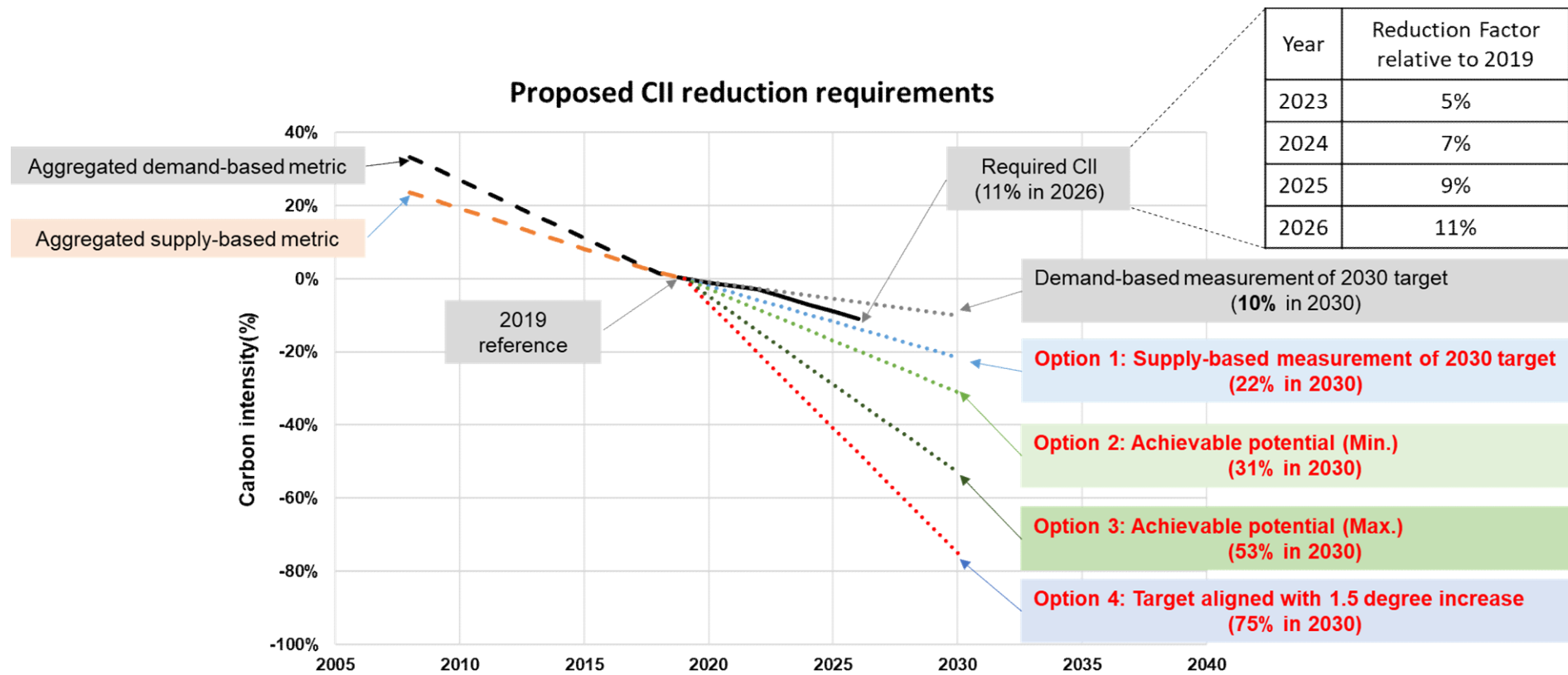


✓ Corrective actions & SEEMP revision

- Rated as D for 3 consecutive years
- Rated as E for one time



CII reduction factor options under IMO discussion



- 2019 ~ 2026: CII Reduction factor was decided. (11% in 2026)
- 2027 ~ 2030: Decided later after reviewing the effectiveness of CII in IMO

CII simulation



SHIP TYPE	SHIP NAME	DWT	DISTANCE [nm]		CO2 EMISSION [ton]		ATTAINED CII		REQUIRED CII (2020)	CII RATING											
			2020 DCS	EPL IMPACT	2020 DCS	EPL IMPACT	2020 DCS	EPL IMPACT		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Cargo	TANAKA MARU	10,000	40,577	37,177	7.27	6.74	7.53	C	C	C	B	C	C	C	D	E	E	E			
								C	C	C	C	C	C	C	D	E	E	E			
								C	C	C	C	C	C	D	D	E	E	E			
								B	B	B	B	B	C	C	D	E	E	E			
								B	B	C	B	C	C	C	D	E	E	E			
								B	B	B	B	B	B	B	D	D	E	E			
								C	C	C	C	C	C	D	D	E	E	E			
								D	D	D	C	C	C	C	D	E	E	E			
								A	A	A	A	A	B	B	C	D	E	E			
								A	A	A	A	A	A	A	B	D	E	E			
								C	C	C	B	C	C	C	D	E	E	E			
								A	A	B	B	B	B	B	C	D	E	E			
								B	B	C	C	C	C	C	D	E	E	E			

02.

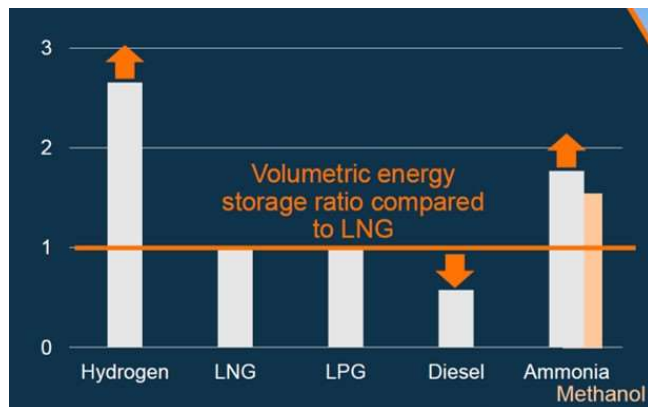
Zero Carbon Fuels (Ammonia, Hydrogen)



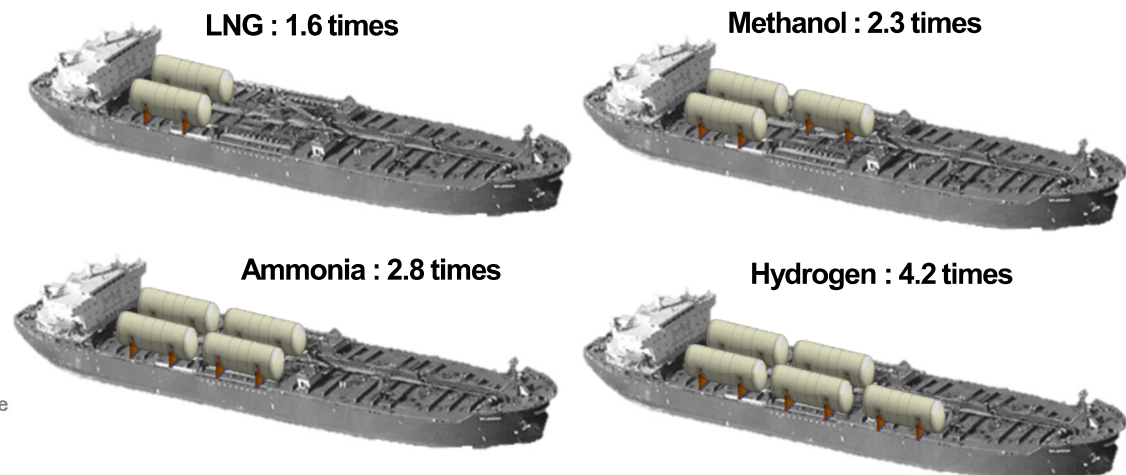
Comparison of alternative marine fuels

Energy storage type	Supply energy (MJ/kg)	Energy density (MJ/L)	Required tank volume (m³)	Supply pressure (bar)	Injection pressure (bar)	Emission reduction compared to HFO Tier II (%)			
						SOx	NOx	CO ₂	PM
HFO	40.5	35	1,000	7-8	950				
Liquefied natural gas (LNG, -162°C)	50	22	1,590	300 methane	300 methane	90-99	20-30	24	90
				380 ethane	380 ethane	90-97	30-50	15	90
LPG(including Propane/Butane)	42	26	1,346	50	600-700	90-100	10-15	13-18	90
Methanol	19.9	15	2,333	10	500	90-95	30-50	5	90
Ethanol	26	21	1,750	10	500				
Ammonia(liquid -33°C)	18.6	12.7	2,755	70	600-700	90-95	-	95	90
Hydrogen(liquid -253°C)	120	8.5	4,117						

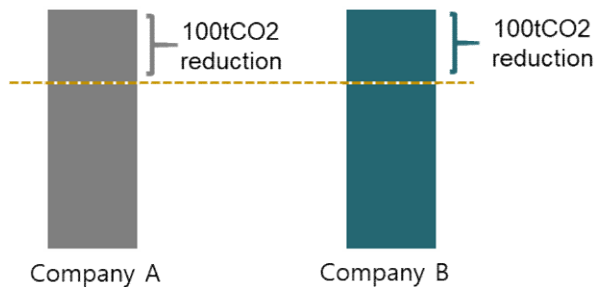
Source: MAN energy solutions, Engineering the future two-stroke green-ammonia engine, 2019



Source: Sebastiaan Bleuanus, Enabling green H2 usage in current and future maritime power generation, Wartsila, Motorship conference 2019



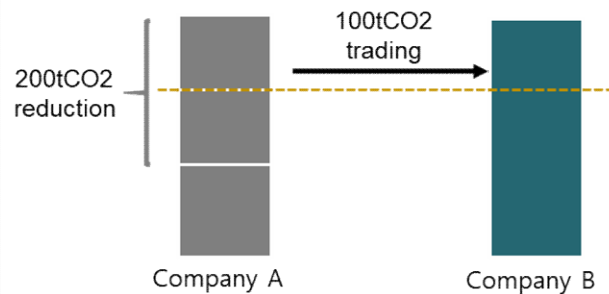
As-is



	Company A	Company B
Reduction Target	100tCO ₂	100tCO ₂
Marginal Abatement Cost	\$10/tCO ₂	\$30/tCO ₂
Direct Reduction	100tCO ₂	100tCO ₂
Reduction Cost	\$1,000	\$3,000

Total Reduction Cost : \$4,000

To-be



	Company A	Company B
Reduction Target	100tCO ₂	100tCO ₂
Marginal Abatement Cost	\$10/tCO ₂	\$30/tCO ₂
Direct Reduction	200tCO ₂	-
Allowance Price	\$20/tCO ₂	
Reduction Cost	-	\$2,000

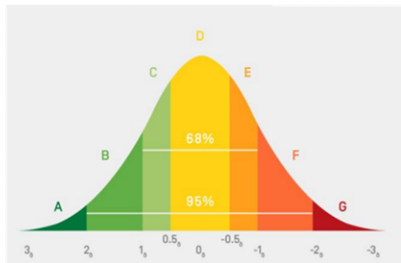
Total Reduction Cost : \$2,000

**Provision of EU ETS
impact assessment**

Carbon Neutral Drive of Industry



RIGHTSHIP



"Shell now needs to go further with our own ambitions, which is why we aim to be a net-zero emissions energy business by 2050 or sooner. Society, and our customers, expect nothing less."



BP sets ambition for net zero by 2050, fundamentally changing organisation to deliver

12 February 2020



MAERSK

To accelerate the transition to carbon-neutral shipping, Maersk has set a new and ambitious target in 2018 of having net-zero CO2 emissions from operations by 2050.

RE 100



The CMA CGM Group heads towards carbon neutrality by 2050

0 ZERO

CO₂ emissions (2050 goal)

50%

CO₂ emissions (2030 goal)

*Compared to 2008 / Based on total emissions

Source: Homepages of Each Corporate



Towards Carbon Neutral Shipping



**SEA CARGO
CHARTER**

**C clean
CARGO**
Sustainable
Transportation



**POSEIDON
PRINCIPLES**

FO
LNG

Ammonia, Hydrogen, Carbon neutral

FO
LNG

Ammonia, Hydrogen, Carbon neutral

Incentives from IMO, EU

FO
LNG

Ammonia, Hydrogen, Carbon neutral

Incentives from IMO, EU

Incentives from Financial circles

FO
LNG

Ammonia, Hydrogen, Carbon neutral

Incentives from IMO, EU

Incentives from Financial circles

Incentives from Cargo owners, Chatterers

Conventional Fuels VS Zero Carbon Fuels



FO
LNG

Bio fuel, Synthetic LNG, CCS

Ammonia, Hydrogen, Carbon neutral

Incentives from IMO, EU

Incentives from Financial circles

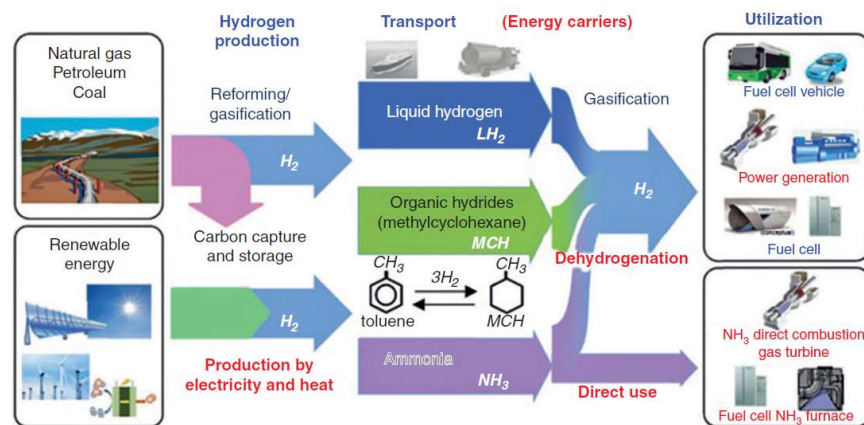
Incentives from Cargo owners, Chatterers

Fuel price (Ammonia)

Developing overseas CO₂ free hydrogen supply chain

Feasibility Study of Overseas Hydrogen Supply Chain

- Overseas Hydrogen Production
- Transportation by Ship (LH₂, LOHC, NH₃)
- Domestic Utilization



Source: Clean Energy, 2018

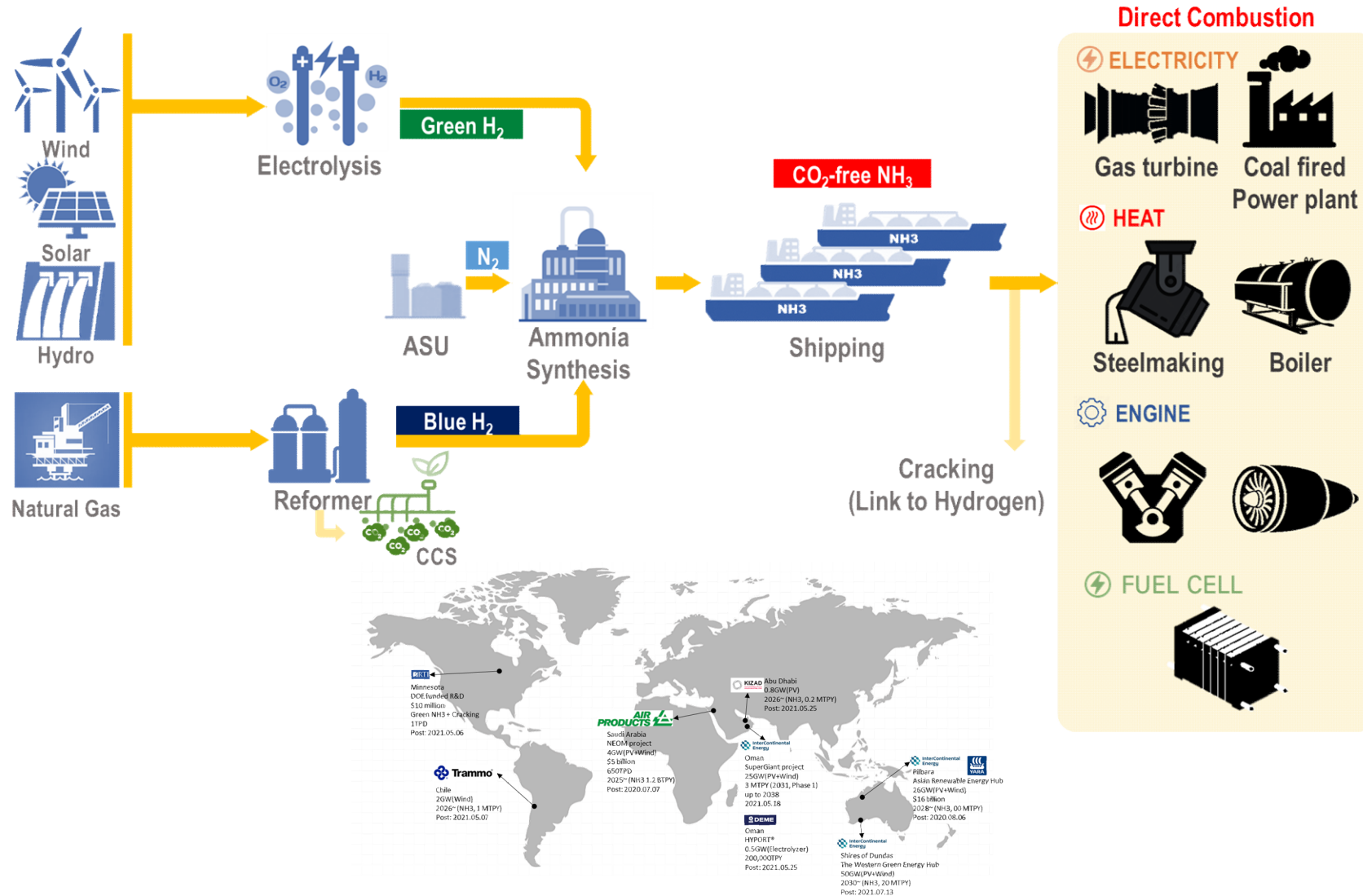
Participating Green Hydrogen Overseas Business Group

- Goal : Importing clean hydrogen from overseas before 2030
- MOU between 30 Companies and MOTIE
- Operated by Production, Storage/Transport*, Utilization parts

* KR leads Storage/Transportation part



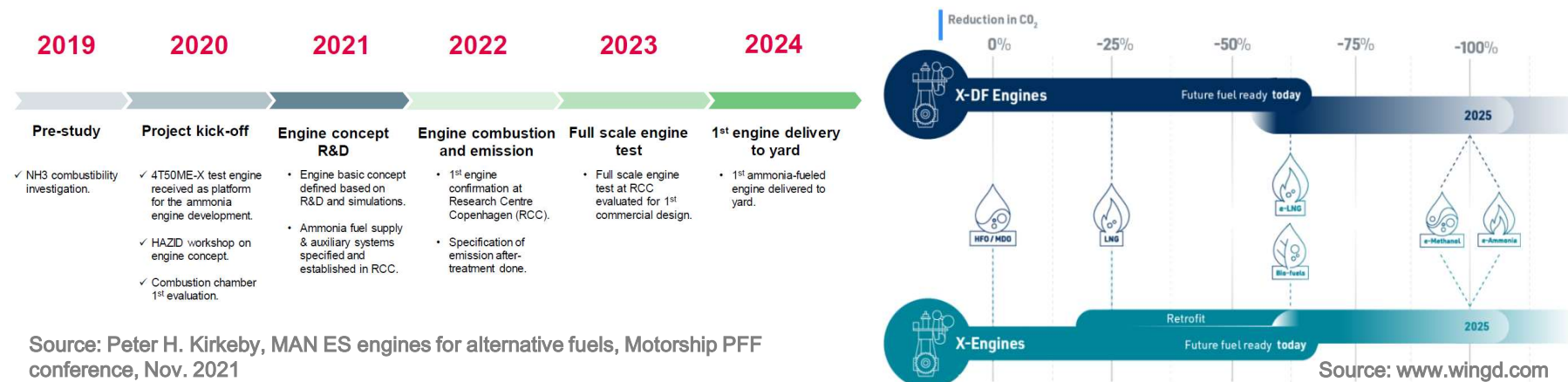
Green/Blue Ammonia Price



Ammonia engine development



✓ Trends of R&D of ammonia fueled engines by engine manufacturers (2 stroke)



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Supported by:



Federal Ministry
for Economic Affairs
and Energy



MAN Energy Solutions

on the basis of a decision
by the German Bundestag

* AmmoniaMot project(~Dec. 2023)



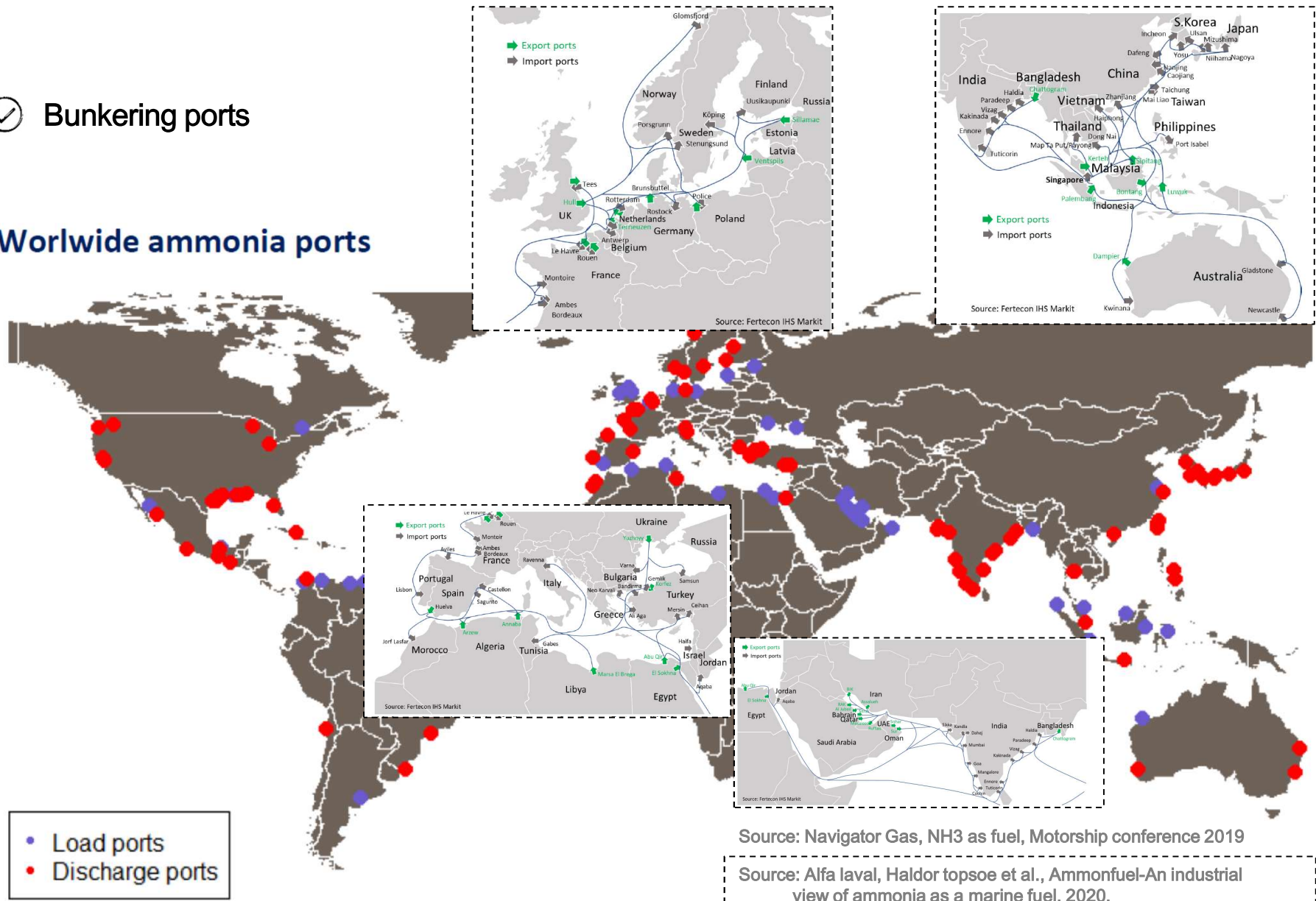
* Indicative: 2020
Verified: 2022

Bunkering Infra



✓ Bunkering ports

Worldwide ammonia ports

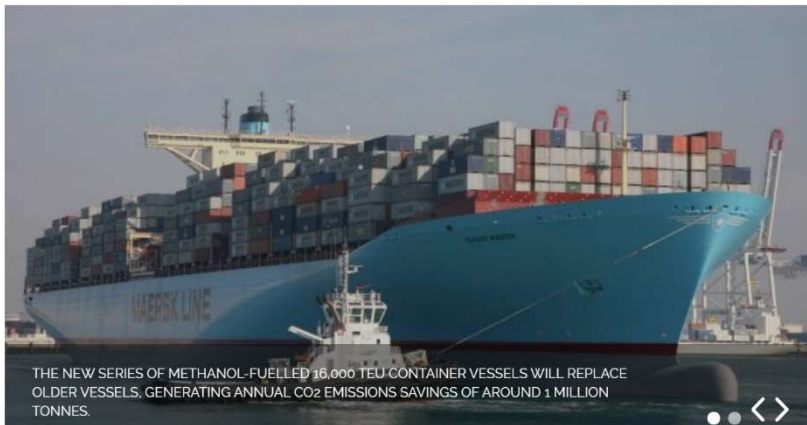


Carbon Neutral Fuel (e/bio Methanol)



HHI LANDS 8+4 METHANOL-FUELLED 16,000 TEU ORDER FROM MAERSK

HOME >> NEWS >> SHIPS & YARDS >> HHI LANDS 8+4 METHANOL-FUELLED 16,000 TEU ORDER FROM MAERSK



THE NEW SERIES OF METHANOL-FUELLED 16,000 TEU CONTAINER VESSELS WILL REPLACE OLDER VESSELS, GENERATING ANNUAL CO₂ EMISSIONS SAVINGS OF AROUND 1 MILLION TONNES.

Source: www.motroship.com, 24 Aug. 2021

A.P. Moller-Maersk has placed an order with Hyundai Heavy industries for 12 x 16,000 teu container vessel newbuildings. The order for the **dual-fuel methanol-fuelled** newbuildings, which will be operated on **carbon neutral methanol**, includes an option for a further 4 vessels.

MAERSK's 2020 sustainability report



Biodiesel

Drop in fuel

But **availability** and **other sectors need it**



Methanol

(bio-methanol and e-methanol)

Already in operation and liquid at normal conditions

But, **scalability** and **green production questions**

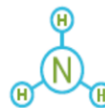


Lignin fuels

A new biofuel based on biomass residue (lignin) and alcohols (methanol or ethanol)

Price-competitive

But, **In development stage, scalability** and **infrastructure for supply questions**



Ammonia

(green ammonia)

Fully zero emissions fuel and can be produced at scale

But, **Safety, toxicity** and **infrastructure challenges**.

Dependent of **cost/maturity of electrolyser technology**

Source: Simon C. Bergulf, Decarbonization of shipping: New fuels, new regulatory framework, new reality around the corner. IMO symposium on alternative low-carbon and zero-carbon fuels, 2020.

03.

GHG Strategy



- ✓ **IMO regulation**
 - GHG Strategy
 - CII
 - IMO ETS, Carbon Tax
- ✓ **Technology development**
 - LNG(Methane Slip), Ammonia(Engine, Safety, N2O, Ammonia slip),
Hydrogen(Large capacity FC, Insulation)
 - CCS(Energy, Volume, Value chain of Harbor), ESD(Payback)
- ✓ **Fuel Infra**
 - Fuel price, Mass production, Bunkering infra

● **IMO(global) & EU(local) GHG regulations (2030, 2050, ETS)**

● **Alternative fuels(incl. alternative power sources)**

- ✓ FO + Biofuel
- ✓ LNG + CCS + Synthetic LNG
- ✓ LNG + (ammonia, hydrogen, etc.)
- ✓ Methanol
- ✓ Ammonia, hydrogen
- ✓ Fuel cell, batteries, Hybrid

● **Energy Saving Device**

● **Bunkering Infra, Fuel price**

***Consideration of
various technical
measures***

***Need overall
approaches***

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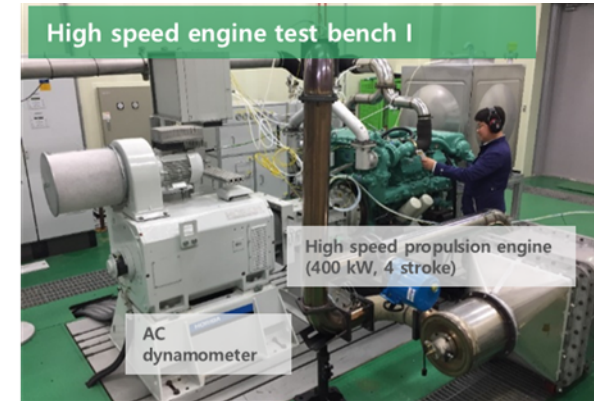
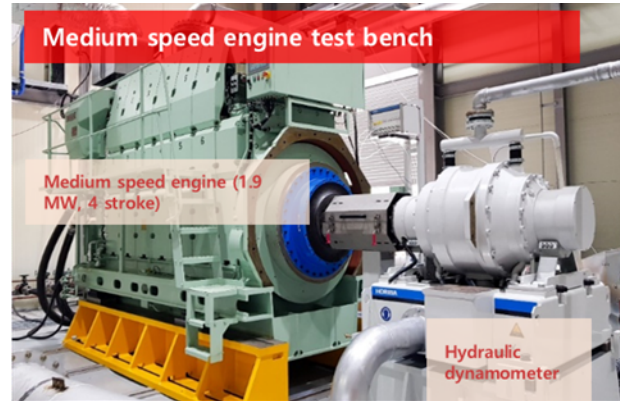
● **Bunkering Infra, Fuel price**

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***Need overall
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 **Cost Effective Solution**

 **Flexibility**



Greenship TCC : Internal Combustion Engine



MASTC: Electric propulsion



LSC: LNG bunkering simulation



- [illegible]

- Preserving the best interests, Creating a better world




수소추진선박 발커링 위험도 평가

HAZID REPORT

SYSTEM SAFETY RESEARCH TEAM
KOREAN REGISTER

KR-HAZID-0001-001 (REV. 01)
OCTOBER 2023



6. HAZID 결과

수소추진선박의 발커링에 대한 HAZID 분석 결과, 총 53개의 위험 5.3에 제시한 위험도 매트릭스에 따라 각 위험도와의 위험도 저수율 허용범위를 위험 5.1과 비교하여 총 1번이 확인되었고, 검토사항으로 다음 단계에서 불시치 위험도를 유독도를 고려하여 평가함.

여론불가능한 위험 시나리오	Hazard A06-4 :
Reddix : 인위	발커링 보조와 배내물도 인접부 LH
관조사항	
1. 위험도와의 평가 결과 a. 화재와의 인접 LH 수출을 감지할 수 없음, 고압성 수소 감지 가능 없음, electric leak detector 없음 b. 불꽃의 불꽃을 감지하기 LHAU flame detector 없음, 설치, 수소 화재 발생 시, 불꽃의 소문 수소화물과 화재의 불꽃이 있는 화재 위험성	
평가결과	
a. 발커링 시점 열을 제어할 수 없음 - 배내물도 인접 water control 없음 - 배내물도 화재 delay 없음 - 배내물도 주변 소화장치 (가스/유체)가 없음 - 배내물도 화재 없음 - 화재의 적발과 화재의 열을 줄일 수 없음	
b. LH4 미충 분소 및 배내물도 발생 시 화재의 발생 (연관사항 내에서 LH4 미충 분소 내부 화재로 인해, 인접부 열 발생 시 화재의 발생) 소외되었을 경우 화재 시나리오를 LH4 미충 분소 발생 시 화재 발생 시나리오로 변경함	
3. 발커링 위험 위험/연관/인접/배내물도 위험도, 총 위험도 LH4 미충 분소 발생 시 화재로 safety zone 없음	
4. 화재의 위험도 (발커링 / 인접/배내물도) 평가 결과 (발커링 소외됨)	
5. LHAU 화재, 배내물도, 배내물도 등 화재의 위험도, 화재 발생 화재 시나리오 없음	
6. 발커링 시점 화재 위험도	
7. 적발의 화재 시점 화재 위험도	

- [illegible]

-
- The photograph shows a document titled "APPROVAL IN PRINCIPLE" from the Ministry of Natural Resources. The document is dated 2017.08.01 and is related to a project named "Marine LNG Multi-bunkering". The document is signed by the Minister of Natural Resources, who has approved the principle of the project. The document also mentions that the project is part of a larger program to develop marine bunkering facilities.
- | | | | |
|---------------------|--|------|------------|
| Contract No. | MNR-2017-08-01 | Date | 2017.08.01 |
| Project | Marine LNG Multi-bunkering Project | | |
| Subject | Approval in Principle of Concept Design for Marine LNG Multi-bunkering Project | | |
| Minister's Decision | Approved | | |
- CONCEPT DESIGN FOR MARINE LNG MULTI-BUNKERING PROJECT**
- This is a concept design for the development of Marine LNG Multi-bunkering Project. The project is aimed at providing a safe and efficient way to transport and store Liquefied Natural Gas (LNG) in bulk carriers. The project will involve the construction of a new terminal facility, which will include a storage tank, a loading/unloading system, and a control room. The project is expected to be completed by the end of 2018.
- The project is being undertaken as part of a larger program to develop marine bunkering facilities. This program is aimed at increasing the capacity of the country's marine bunkering infrastructure, which is currently unable to meet the growing demand for LNG. The project is expected to contribute significantly to the country's economic growth and energy security.
- The project is being funded by the Government of the Republic of Korea. The project is being implemented by the Korea Maritime & Ocean Shipping Company Limited (KOSCO). The project is being supervised by the Ministry of Natural Resources.
- The project is being carried out in accordance with the relevant laws and regulations. The project is being conducted in a transparent and accountable manner. The project is being monitored and evaluated regularly to ensure that it meets the required standards and objectives.
- The project is expected to have a positive impact on the country's economy and environment. The project is expected to create jobs and generate revenue for the government. The project is also expected to improve the safety and efficiency of the country's marine bunkering operations.
- The project is being implemented in a timely and effective manner. The project is being completed on schedule and within budget. The project is meeting all the required standards and objectives.
- The project is being well-received by the public and stakeholders. The project is being praised for its contribution to the country's economic growth and energy security. The project is also being appreciated for its commitment to safety and environmental protection.
- The project is being successfully implemented. The project is achieving its goals and objectives. The project is making a significant contribution to the country's development.
- The project is being well-managed. The project is being executed efficiently and effectively. The project is being completed on time and within budget.
- The project is being well-coordinated. The project is being managed in a cohesive and integrated manner. The project is being supported by all the relevant parties.
- The project is being well-monitored. The project is being tracked and reported on regularly. The project is being evaluated against the required standards and objectives.
- The project is being well-evaluated. The project is being assessed and reviewed periodically. The project is being improved based on the feedback received.
- The project is being well-documented. The project is being recorded and archived properly. The project is being made available to the public and stakeholders.
- The project is being well-promoted. The project is being advertised and publicized widely. The project is being used as a model for other similar projects.
- The project is being well-maintained. The project is being kept up-to-date and current. The project is being preserved for future reference.
- The project is being well-used. The project is being utilized effectively and efficiently. The project is being put to good use.
- The project is being well-disseminated. The project is being shared and distributed widely. The project is being made accessible to all the relevant parties.
- The project is being well-implemented. The project is being carried out smoothly and without any major issues. The project is being completed successfully.
- The project is being well-executed. The project is being performed with skill and precision. The project is being done to the highest standards.
- The project is being well-performed. The project is being handled competently and professionally. The project is being done with care and attention to detail.
- The project is being well-handled. The project is being managed with confidence and competence. The project is being done with integrity and honesty.
- The project is being well-managed. The project is being organized and controlled effectively. The project is being done with transparency and accountability.
- The project is being well-controlled. The project is being regulated and supervised properly. The project is being done in accordance with the required standards and objectives.
- The project is being well-supervised. The project is being monitored and overseen closely. The project is being done under strict supervision.
- The project is being well-monitored. The project is being tracked and reported on frequently. The project is being done with constant oversight.
- The project is being well-reported. The project is being documented and communicated clearly. The project is being done with accuracy and completeness.
- The project is being well-documented. The project is being recorded and stored securely. The project is being done with thoroughness and diligence.
- The project is being well-communicated. The project is being explained and discussed openly. The project is being done with clarity and simplicity.
- The project is being well-explained. The project is being described and outlined thoroughly. The project is being done with depth and breadth.
- The project is being well-discussed. The project is being debated and deliberated carefully. The project is being done with respect and consideration for others.
- The project is being well-debated. The project is being argued and defended vigorously. The project is being done with passion and conviction.
- The project is being well-deliberated. The project is being weighed and considered carefully. The project is being done with prudence and caution.
- The project is being well-weighed. The project is being measured and compared objectively. The project is being done with fairness and impartiality.
- The project is being well-compared. The project is being analyzed and evaluated critically. The project is being done with objectivity and independence.
- The project is being well-analyzed. The project is being examined and scrutinized thoroughly. The project is being done with rigor and precision.
- The project is being well-evaluated. The project is being assessed and judged fairly. The project is being done with honesty and integrity.
- The project is being well-judged. The project is being decided and concluded wisely. The project is being done with common sense and practicality.
- The project is being well-decided. The project is being resolved and settled quickly. The project is being done with decisiveness and firmness.
- The project is being well-concluded. The project is being wrapped up and finished properly. The project is being done with finality and closure.
- The project is being well-finished. The project is being polished and perfected. The project is being done with excellence and quality.
- The project is being well-polished. The project is being refined and improved. The project is being done with perfectionism and attention to detail.
- The project is being well-perfected. The project is being optimized and enhanced. The project is being done with innovation and creativity.
- The project is being well-innovated. The project is being developed and created anew. The project is being done with originality and uniqueness.
- The project is being well-created. The project is being brought into existence. The project is being done with vision and imagination.
- The project is being well-developed. The project is being grown and nurtured. The project is being done with patience and persistence.
- The project is being well-nurtured. The project is being cared for and protected. The project is being done with love and compassion.
- The project is being well-protected. The project is being guarded and defended. The project is being done with loyalty and devotion.
- The project is being well-guarded. The project is being watched and monitored. The project is being done with vigilance and alertness.
- The project is being well-defended. The project is being fought and won. The project is being done with courage and bravery.
- The project is being well-fought. The project is being battled and contested. The project is being done with determination and resolve.
- The project is being well-contested. The project is being challenged and disputed. The project is being done with skepticism and doubt.
- The project is being well-challenged. The project is being questioned and doubted. The project is being done with humility and modesty.
- The project is being well-doubted. The project is being mistrusted and disbelieved. The project is being done with cynicism and pessimism.
- The project is being well-mistrusted. The project is being viewed with suspicion and distrust. The project is being done with secrecy and concealment.
- The project is being well-disbelieved. The project is being regarded as impossible or unlikely. The project is being done with disbelief and incredulity.
- The project is being well-viewed. The project is being seen and observed. The project is being done with curiosity and interest.
- The project is being well-regarded. The project is being respected and valued. The project is being done with honor and pride.
- The project is being well-respected. The project is being admired and revered. The project is being done with awe and wonder.
- The project is being well-valued. The project is being treasured and cherished. The project is being done with affection and fondness.
- The project is being well-admired. The project is being praised and complimented. The project is being done with enthusiasm and excitement.
- The project is being well-revered. The project is being worshipped and idolized. The project is being done with reverence and awe.
- The project is being well-worshipped. The project is being loved and adored. The project is being done with devotion and faith.
- The project is being well-idolized. The project is being glorified and exalted. The project is being done with glory and honor.
- The project is being well-glorified. The project is being celebrated and honored. The project is being done with joy and happiness.
- The project is being well-celebrated. The project is being festively and joyfully. The project is being done with celebration and triumph.
- The project is being well-honored. The project is being esteemed and respected. The project is being done with dignity and respect.
- The project is being well-estimated. The project is being valued and appraised. The project is being done with worth and merit.
- The project is being well-appreciated. The project is being recognized and acknowledged. The project is being done with gratitude and appreciation.
- The project is being well-recognized. The project is being noticed and identified. The project is being done with awareness and recognition.
- The project is being well-acknowledged. The project is being admitted and accepted. The project is being done with openness and honesty.
- The project is being well-admitted. The project is being confessed and owned. The project is being done with responsibility and accountability.
- The project is being well-accepted. The project is being welcomed and embraced. The project is being done with acceptance and tolerance.
- The project is being well-embraced. The project is being held and supported. The project is being done with warmth and hospitality.
- The project is being well-supported. The project is being backed and endorsed. The project is being done with assistance and aid.
- The project is being well-backed. The project is being reinforced and strengthened. The project is being done with power and influence.
- The project is being well-endorsed. The project is being approved and sanctioned. The project is being done with authority and legitimacy.
- The project is being well-approved. The project is being permitted and allowed. The project is being done with permission and consent.
- The project is being well-sanctioned. The project is being authorized and legitimized. The project is being done with approval and endorsement.
- The project is being well-permitted. The project is being granted and given. The project is being done with generosity and kindness.
- The project is being well-allowed. The project is being tolerated and endured. The project is being done with patience and perseverance.
- The project is being well-granted. The project is being bestowed and conferred. The project is being done with grace and favor.
- The project is being well-given. The project is being offered and presented. The project is being done with sincerity and honesty.
- The project is being well-offered. The project is being donated and contributed. The project is being done with generosity and goodwill.
- The project is being well-presented. The project is being shown and displayed. The project is being done with pride and pleasure.
- The project is being well-donated. The project is being gifted and given away. The project is being done with charity and compassion.
- The project is being well-contributed. The project is being added and included. The project is being done with participation and involvement.
- The project is being well-added. The project is being incorporated and integrated. The project is being done with unity and harmony.
- The project is being well-included. The project is being encompassed and covered. The project is being done with completeness and wholeness.
- The project is being well-encompassed. The project is being surrounded and encircled. The project is being done with protection and defense.
- The project is being well-covered. The project is being shielded and sheltered. The project is being done with care and concern.
- The project is being well-surrounded. The project is being encircled and enclosed. The project is being done with security and safety.
- The project is being well-encircled. The project is being enclosed and contained. The project is being done with control and management.
- The project is being well-contained. The project is being restricted and limited. The project is being done with boundaries and constraints.
- The project is being well-limited. The project is being bounded and circumscribed. The project is being done with limits and restrictions.
- The project is being well-bounded. The project is being defined and delimited. The project is being done with clarity and precision.
- The project is being well-delimited. The project is being separated and distinguished. The project is being done with distinction and difference.
- The project is being well-separated. The project is being divided and partitioned. The project is being done with division and separation.
- The project is being well-distinct. The project is being unique and individual. The project is being done with originality and uniqueness.
- The project is being well-partitioned. The project is being split and divided. The project is being done with sharing and distribution.
- The project is being well-divided. The project is being broken down and decomposed. The project is being done with analysis and evaluation.
- The project is being well-split. The project is being torn apart and destroyed. The project is being done with destruction and annihilation.
- The project is being well-destructed. The project is being ruined and wrecked. The project is being done with damage and harm.
- The project is being well-annihilated. The project is being obliterated and wiped out. The project is being done with erasure and deletion.
- The project is being well-obliterated. The project is being removed and eliminated. The project is being done with removal and eradication.
- The project is being well-wiped-out. The project is being cleaned and purified. The project is being done with cleansing and purification.
- The project is being well-removed. The project is being taken away and carried off. The project is being done with extraction and removal.
- The project is being well-eradicated. The project is being exterminated and destroyed. The project is being done with extinction and annihilation.
- The project is being well-cleaned. The project is being washed and scrubbed. The project is being done with cleaning and washing.
- The project is being well-purified. The project is being refined and purified. The project is being done with purification and refinement.
- The project is being well-washed. The project is being soaked and saturated. The project is being done with immersion and saturation.
- The project is being well-scrubbed. The project is being rubbed and massaged. The project is being done with friction and massage.
- The project is being well-soaked. The project is being steeped and infused.

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| <p>수소안전 안전기준개발사업
수소주입전선 평가용 및 수소운반선박 적하역 안전기준 개발</p> <p>액상유기수소운반체 적하역 지침서
Guideline for Loading/Unloading of
Liquid Organic Hydrogen Carriers</p> <p>(2차년도 연구개발 기술보고서)</p> <p>2021년 12월</p> <p>(사)한국전선급</p>  | <p>수소안전 안전기준개발사업
수소주입전선 평가용 및 수소운반선박 적하역 안전기준 개발</p> <p>기체/고체 수소 평가용 지침서
Guideline for Hydrogen Bunkering in Gaseous or
Solid State Storage</p> <p>(2차년도 연구개발 기술보고서)</p> <p>2021년 12월</p> <p>(사)한국전선급</p>  |
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Providing the **best services**,
Creating a **better world**

Thank you

Song Kanghyun
Senior vice president
R&D center

khsong@krs.co.kr
+ 82 70 8799 8754

