CMA SHIPS – LNG Program
Achievements and Challenges

Symposium on alternative low-carbon and zero-carbon fuels for shipping
(9 and 10 February 2021)
EXECUTIVE SUMMARY

- AN AMBITIOUS PROGRAM
  1.4K, 15K, 23K TEUS: VESSELS MAIN FEATURES & EQUIPMENT
  AN INDUSTRIAL PARTNERSHIP FOR AN INDUSTRIAL PROJECT

- A DECISIVE STEP TOWARD ENERGY TRANSITION
  EEDI & CII
  23K EMISSIONS MEASUREMENTS AND PERSPECTIVES

- A USE RATE IN PERMANENT PROGRESS
  USE RATES RAMP UP
  BRAKE SPECIFIC FUEL/GAS CONSUMPTION COMPARISON (g/kWh)

- A SUPPLY CHAIN UNDER CONSTANT DEVELOPMENT
  BUNKERING FACILITIES
  BUNKERING OPERATIONS & RETEX

- A STRONG TRAINING PROGRAM

- CHALLENGES FACED AND ROOM FOR IMPROVEMENT

- CONCLUSION
AN AMBITIOUS PROGRAM

THE VISION

“We are paving the way for a maritime transport industry where both economic competitiveness and growth will go hand in hand with sustainable development and the fight against climate change [...] and we will go further to build an even cleaner industry”
The Energy Efficiency Design Index (EEDI), which measures the environmental footprint of a vessel, is improved by 20% compared to a conventional vessel. The result is a reduced carbon footprint and improved air quality, particularly for populations living in coastal areas and in port cities. LNG Technology also allows the use of organically-produced biomethane made from agricultural and domestic waste. Biomethane is a renewable energy that emits up to 80% less CO2 compared with conventional fuel.

During the first LNG bunkering of the CMA CGM Jacques Saadé, the use of biomethane - via the purchase of Guarantee of Origin certificates for 13% of the total fuel delivered - significantly reduced the carbon footprint of the LNG used in this operation.

A better energy efficiency than its equivalent running on fuel oil.

-99% in SOx Emissions  
-91% in airborne particulate matter  
-92% in NOx Emissions  
Up to -20% in CO2 emissions
AN AMBITIOUS PROGRAM: LNG MASTER SCHEDULE

CMA Ships Estimated Readiness JJ/MM/YY vs Lines request DD/MM
#26 LNG Vessels

#4 Series

#4 Shipyards

## DELIVERED

1. **1.4 K Teus:**
   - Containerships Nord
   - Containerships Aurora
   - Containerships Polar
   - Containerships Arctic
   - Containerships Borealis

2. **23 K Teus:**
   - CC Jacques Saade
   - CC Champs Elysées
   - CC Palais Royal
   - CC Louvre
   - CC Rivoli

3. **14 K Teus:**
   - CC Tenere
   - CC Scandola

**#12 LNG-powered vessels delivered**

## TO COME

1. **1.4 K Teus:**
   - Containerships Stellar

2. **23 K Teus:**
   - CC Montmartre
   - CC Concorde
   - CC Trocadero
   - CC Sorbonne

3. **15 K Teus:**
   - CC Patagonia
   - CC Kimberley
   - CC Everglade
   - CC Galapagos
   - CC Greenland

4. **14 K Teus:**
   - CC Iguacu
   - CC Bali
   - CC Symi
   - CC Arctic

**#14 LNG-powered vessels to come**
1.4K TEUS: VESSELS MAIN FEATURES & EQUIPMENT

NORDIC / CONTAINERSHIPS
CSSC Wenchong H5510 ~3 / 5538 / 5543

**MAIN PARTICULARS**
- Length overall: 169.95 m
- Length between perpendiculars: 160.90 m
- Breadth: 28.9 m
- Depth: 14.85 m
- Draught, design: 8.5 m
- Draught, scantling: 9.6 m
- Air draught: m
- Deadweight on Td: Ton
- Deadweight on Ts: 19,500 Ton
- Lightship weight: 9,060 Ton
- Service Speed: 19.15 Ton
- SWEM: xxxx t.m.

**CLASS: ABS**
- A1: Container Carrier, E, + AMS, +ACCU, SH, SHCM, TCM, UWILD, ICE CLASS 1A, RW, CPS, GFS/(DFD), BW, GP, RRDA, CSC, CLP, V

**TANK CAPACITIES**
- Heavy fuel oil: 815 m³
- Marine diesel oil: 155 m³
- LNC: 850 m³
- Fresh water: 106 m³
- Ballast water: 8,700 m³

**MAIN ENGINE**
- WINCO: 7RTFLEX 50DF
- MCR: 10,000 kW @ 124 RPM
- HFO spec (ME/Aux. Eng. /Boiler): 700/700/700/580 St
- Propeller type: CPP 4 Blades
- Bow / stern thruster: 920 / 720 kW

**FUEL OIL CONSUMPTION OF MAIN ENGINE**
- L.C.V.: 10,200 kcal/kg
- D.F.O.C at NCR: 35 MT / day of LNG + 1MT / day of MGO
- 46 MT / day
- Cruising range: 3,200 NM on LNG
- 16,000 NM on fuel

**POWER SUPPLY**
- Diesel Generators: 1 * 1110 + 3 * 620 kW
- Shaft generator: 1800 kW
- Emergency Generator: kW

**CARGO HATCH COVER**
- Type: Flap type
- Stack weight: 60 MT/20ft & 90 MT/40ft

**COMPLEMENT**
- Crew of 19 persons

**VESSEL CAPACITIES**
- With max. number of Containers
  - IMO visibility guideline: 944 TEU

**ON DECK (6 tiers)**
- Total: 536 TEU
- Rows max. in holds / on hatches: 9 / 10 Rows
- Tiers max. in hold / on hatch: 5 / 6 Tiers
- El. Plugs (for reefer Container)
- Total: 372 FEU
- Stability (ox tEU, hetero at Ts): xxx TEU
- Stability (14 tEU homo, at Ts): 120 TEU
- (based on 8ft 6inches, 45% Container VCG)

**NAVIGATION EQUIPMENT**
- 2 -consoles Radar Plant with ARPA
- ECDIS
- 1 - Auto Pilot / 1 Gyro compass
- 1 - DGPS navigator + 1 DGPS
- 1 speed log dual axis and 1 echo sounders

**TONNAGE**
- GT: 17,960
- NT: 6,875
- Suez GT: xxx
- Suez NT: xxx
# 14K TEUS: Vessels Main Features & Equipment

## EPS 15 000 Teus Dual Fuel

HHI (S990 -995)

### Main Particulars

- **Length over all**: 366 m
- **Length between perp**: 350 m
- **Breadth**: 51 m
- **Depth**: 20.85 m
- **Draught, design**: 14.5 m
- **Draught, scantling**: 16 m
- **Air draught**: Less than 69.2 m
- **Deadweight on Td**: 134 800 Ton
- **Deadweight on Ts**: 158 800 Ton
- **Lightship weight**: Xx.xxx Ton
- **Service Speed**: 1.52 knots
- **TD, NCR, 1% Sea Margin**:
- **SWBM**: 8 300.00 kN.m

### Class: LR

+100A1 Container Ship, ShipRight (SDA, FDA, FDA SPR, WDA2, CM, ACS(BR)), *WMS, UI, +LMC, LPPF(GF, NG), UMS, with descriptive notes: ShipRight (BWMP(T), IHM, S CM)

### Tank Capacities

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNG Membrane tank</td>
<td>12 000 m³</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>5 300 m³</td>
</tr>
<tr>
<td>Marine diesel oil</td>
<td>1 400 m³</td>
</tr>
<tr>
<td>Lubricating oil</td>
<td>xxx m³</td>
</tr>
<tr>
<td>Fresh water</td>
<td>500 m³</td>
</tr>
<tr>
<td>Ballast water</td>
<td>41 300 m³</td>
</tr>
</tbody>
</table>

### Main Engine

- **Model**: M8A90ME-C10.5 GI-ESR8TC
- **Type**: EGR TC Gen out
- **SMCR**: 46 630 kW x 75.7 RPM
- **Fixed pitch propeller**: x Blades
- **Bow**: 1 x 3 000 kW

### Fuel Oil Consumption of Main Engine

- **D F/G at NCR**: 111.5 MT/day
- **DFOC at NCR**: 137.6 MT/day
- **Cruising range (diesel mode)**: 22 800 NM
- **Cruising range (gas mode)**: 23 700 NM

### Power Supply

- **Diesel Generators**: 4 x 3,700 kW
- **Emc’y Generator**: 250 kW

### Cargo Hatch Cover

- **Type**: Steel pontoon type
- **Stack weight**: 90 MT/20ft & 100 MT/40ft
- **Panel weight**: Max 45 tons of each panel (excluding container loose fittings)

### Complement

- **Crew of 32 + 6 Suez crew**

### Vessel Capacities

- **IMO visibility guideline**: On deck (11 tiers) 1 000 FEU
- **In hold**: 0 FEU
- **Total**: 1 000 FEU

### Navigation Equipment

1. Caming station
2. ECDIS
3. Auto Pilot / 2 Gyro compass
4. DGPS navigator
5. 1 speed log

### Tonnage

<table>
<thead>
<tr>
<th>GT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>xxx</td>
<td>xxx</td>
</tr>
</tbody>
</table>

Suez GT: xxx  Suez NT: xxx
15K TEUS: VESSELS MAIN FEATURES & EQUIPMENT

CMA CGM NEWBUILDING 15 000 TEUs DUAL FUEL
CSSC (H2654 - H2658)

**MAIN PARTICULARS**
- Length overall: 366 m
- Length between perpendiculars: 355 m
- Breadth: 51 m
- Depth: 30.2 m
- Draught, design: 14.5 m
- Draught, scantling: 15 m
- Air draught: Less than 67.5 m
- Deadweight on Ts: 150,000 Ton
- Deadweight on Ts: 165,000 Ton
- Lightship weight: 46,500 ton
- Service Speed: 22 knots
- SWBm: 8,900,000 kN.m

**CLASS: BV**
- BV, I+HULL, +MACH Container Ship, dual-fuel
- Unrestricted Navigation, +VERISTAR-HULL
- FAT25, WHISP2, +AUT-UMS, MON-SHAFT,
- INWATER-SURVEY, CF3(WBT), CLEANSHIP,
- GREEN PASSPORT EU, AUT-PORT, LASHING-
- WW, LI-HG52, ESA, +ALP, SDS

**TANK CAPACITIES**
- LNG Membrane tank: 14,022 m³
- Heavy fuel oil: 2,556 m³
- Marine diesel oil: 1,522 m³
- Lubricating oil: 652 m³
- Fresh water: 616 m³
- Ballast water: 42,000 m³

**MAIN ENGINE**
- WINGO: 10X92DF
- MCR: 51,000 kW x 80 RPM
- HFO spec (ME/Aux. Eng./Boiler): 700CrSt
- Fixed pitch propeller: 5 Blades
- Bow: 2° 2' 500 kW

**FUEL OIL CONSUMPTION OF MAIN ENGINE**
- L.C.V at 42 700 KJ/kg
- D.F.G.C at NCR: 156.4 MT/day
- DPOC at NCR: 193.6 MT/day
- Cruising range: 22 000 NM

**POWER SUPPLY**
- Diesel Generators: 4 x 4,320kW
- EM/Cy Generator: 1 x 2,800kW
- EM/Cy Generator: 340 kW

**CARGO HATCH COVER**
- Type: Steel pontoon type
- Stack weight: 90 MT/20ft & 160 MT/40ft
- Panel weight: Max 45 tons of each panel
- (excluding container loose fittings)

**COMPLEMENT**
- Crew of 37 p + 7 Suez crew

**VESSEL CAPACITIES**
- With max. number of Containers
- IMO visibility guideline
- On deck (12 tiers): 9 144 TEU
- In hold: 6 110 TEU
- Total: 15 254 TEU
- Rows max. in holds/on hatches: 16 / 20 Rows
- Tiers max. in holds/on hatches: 11 / 11 Tiers
- El. Plugs (for reefer Container): 1 400 FEU
- On Deck: 400 FEU
- In Hold: 1 800 FEU
- Total: 10 160 TEU
- Stability (14 VTEU homo. at Ts): 0.8666
- (based on 8t. 3inches, 45% Container VCQ)

**NAVIGATION EQUIPMENT**
- 2 - Multipurpose consoles Radar Plant with ARPA
- 3 - ECDIS/conning (Multipurpose consoles)
- 1 - Auto Pilot / 2 Gyro compass
- 2 - DGPS navigator
- 1 speed log single axis, 1 speed log triple axis and 2 echo sounders

**TONNAGE**
- GT: 153 870
- NT: 69 253
- Suez GT: xxx
- Suez NT: xxx
23K TEUS: VESSELS MAIN FEATURES & EQUIPMENT

CMA CGM NEWBULDING 23 000 Teus DUAL FUEL

CSCC – HZ & JN

EEDI : 6.036 under LNG (7.289 under HFO, estimation)

MAIN PARTICULARS

Length over all 309.0 m
Length between perp 393.9 m
Breadth 61.3 m
Depth 33.5 m
Draught, design 14.5 m
Draught, scantling 16 m
Air draft 75 m
Deadweight on Td 189 260.5 Ton
Deadweight on Ts 221 250.6 Ton
Lightship weight 67 104.7 Ton
Service Speed 21.55 knots
(Ts, NCR, 1% Sea Margin)
SWBM 1 430 000 t.m

CLASS : BV

2. Unrestricted Navigation, VERISTAR HULL FAT 25
3. Aut-UMS, Monshft, In Water Survey, CPS (BWT)
4. CLEANSHIP: GREENPASSPORT, EU
5. Aut-Port, Lashing WW, LI-HG-S2, ESA, +ALP, SSS

TANK CAPACITIES

LNG 18 600 m³
Heavy fuel oil 2 500 m³
Marine diesel oil 1 500 m³
Lubricating oil 800 m³
Fresh water 550 m³
Ballast water 55 500 m³

MAIN ENGINE

WNGD 12X02.DF
MCR 63 840 kW @ 88 RPM
HFO spec (ME/Aux. Eng./Boiler) 700/700/7000St
Fixed pitch propeller
Bow 5 Blades
Bowl 2* 3 000 kW

FUEL OIL CONSUMPTION OF MAIN ENGINE

(L.C.R=42 700 KJ/kg)

D.F-G at NCR 192 MT/day
DFOC at NCR 238 1 MT/day
Cruising range 21 000 NM

POWER SUPPLY

Diesel Generators 2x Wartsila 9L34DF 4320 kW
4x Wartsila 8L34DF 3840 kW

Emergency Generator 340 kW

CARGO HATCH COVER

Type Steel pontoon type
Stack weight 90 MT/20RT & 220 MT/40RT
Panel weight Max 45 tons of each panel
(excluding container loose fittings)

COMPLEMENT

Crew of 40 p + 7 Suez crew

VEssel Capacities

With max number of containers

IMO visibility guideline
On deck (12 tiers) 13 028 TEU
In hold 9 784 TEU
Total 22 812 TEU

Rows max. in holds/on hatches 22 / 24 Rows
Tiers max. in holds/on hatches 12 / 12 Tiers
(Hold: 11 x 6'6" or 8x6'6" x3x9'6")

El: plugs (for reefer Container)
On Deck 1 400 FEU
In Hold 800 FEU
Total 2 200 FEU

Stability (10 l' TEU, hetero at Ts) 19 838TEU
Stability (14 l' TEU homo; at Ts) 14 810 TEU
(based on 6ft ginch, 45% Container VCG)

NAVIGATION EQUIPMENT

1 – Multipurpose consoles Radar Plant with ARPA
2 - ECDIS/TT, conning
1 – Auto Pilot / 2 Gyro compass
2 - DOPS navigator
1 speed log single axis, 1 speed log triple axis and
2 echo sounders

Tonnage:

GT : 236583
Suez GT : 139 799
NT : 101 823
Suez NT : 220 018
AN INDUSTRIAL PARTNERSHIP FOR AN INDUSTRIAL PROJECT

7 years of R&D

3 JIP

10+ leading industrials & partners

Ship construction: CSSC
Ship certification: Bureau Veritas
Engine design: Win GD
Gas handling system, auxiliary systems: Wärtsilä
LNG tanks design: GTT
LNG pumps: Cryostar
LNG refueling systems: Total/Rotterdam harbor/RWG

#3 Joint Industry Projects
(CMA CGM, DSME, CSSC, DNV, ABB, OMT, GTT)

THE LNG TANK

THE WIN GD X92 DUAL FUEL ENGINE.
### A DECISIVE STEP TOWARD ENERGY TRANSITION

#### THE ENERGY EFFICIENCY DESIGN INDEX

<table>
<thead>
<tr>
<th>DF</th>
<th>EEDI</th>
<th>EEDI with S/G</th>
</tr>
</thead>
<tbody>
<tr>
<td>23K</td>
<td>6.32</td>
<td>6.09</td>
</tr>
<tr>
<td>15K</td>
<td>6.54</td>
<td>6.29</td>
</tr>
<tr>
<td>1.4K</td>
<td>16.41</td>
<td></td>
</tr>
</tbody>
</table>

The graph illustrates the EEDI values for different DF categories, with lines indicating required EEDI values from different years.
A DECISIVE STEP TOWARD ENERGY TRANSITION

THE CARBON INTENSITY INDEX PATHWAY

Process of Carbon Intensity Index

1. Define a reference line of efficiency vs Deadweight
2. Define the reduction factor over the time
3. Define non compliance penalties

Estimated mean speed reduction if no efficiency improvement

LNG powered vessels have already reached 2030 target and have the potential to further improve
The goal is to **reduce the emission** from the main engine and **optimize** the use of the auxiliary engines:

- Use of the **cold energy** of the LNG to recover frigorie for the accommodation and the vessel usage instead of producing it.
- Recycling of the **exhaust gases** to reduce the methane slip and use the thermal energy to produce electricity.
- Optimize the **power management system** to operate the auxiliary engines on an optimal load.
- Add a **shaft generator** to avoid using the auxiliary engines and increase the load on the main engine (which increase its efficiency).

The design of the engine has been reviewed between the number 1 and the number 6 with a focus on the piston rings. It allows a **reduction of the methane slip** during its actual operation, below 62%.
The operation selected is the main leg of the **FAL1** between Singapore and Suez corresponding to most of our major customers’ needs.

<table>
<thead>
<tr>
<th>Consumption/day</th>
<th>Diesel engine with scrubber</th>
<th>Dual Fuel engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFO 3.50%S</td>
<td>174.4 t</td>
<td>0 t</td>
</tr>
<tr>
<td>VLSFO 0.50%S</td>
<td>0 t</td>
<td>0 t</td>
</tr>
<tr>
<td>MDO</td>
<td>0 t</td>
<td>0.8 t</td>
</tr>
<tr>
<td>LNG</td>
<td>0 t</td>
<td>147.4 t</td>
</tr>
</tbody>
</table>

*Unburn fuels*  
No THC* measurements available  
2.38 t of Methane  
AE: 0.31 t + ME: 2.06 t

<table>
<thead>
<tr>
<th>Emissions/day as computed by IMO</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>543 t</td>
<td>408 t (-24.9%)</td>
</tr>
<tr>
<td>SO₅</td>
<td>1.35 t</td>
<td>0.014 t (-99%)</td>
</tr>
<tr>
<td>NOₓ</td>
<td>15.4 t</td>
<td>1.21 t (-92.1%)</td>
</tr>
<tr>
<td>PM10</td>
<td>0.24 t</td>
<td>0.08 t (-66.7%)</td>
</tr>
</tbody>
</table>

*THC: Total Hydrocarbon Content – unburnt fuels and lubricants*
**BRAKE SPECIFIC FUEL/GAS CONSUMPTION COMPARISON (g/kWh)**

### Gas fuel data:
- LHV Reference: 50000 kJ/kg
- LNG Density: 465 kg/m³

### Diesel fuel data:
- LHV Reference: 42707 kJ/kg

### LNG Density
- 465 kg/m³

---

**BSGC / BSFC Comparison - WINGD 12X92**

- **12X92 DF LNG - BSGC (g/kWh)*
- **12X92 DF MDO - BSFC (g/kWh)*
- **12X92 HFO - BSFC (MDO) (g/kWh)**

*Pilot Fuel overlooked

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**BSGC / BSFC Comparison - Diesel Generator**

- **DG DF LNG - BSGC (g/kWh)*
- **DG DF MDO - BSFC (g/kWh)*
- **DG HFO - BSFC (MDO) (g/kWh)**

*Pilot Fuel overlooked
CONTAINERSHIPS NORD
#784 days in operation

CONTAINERSHIPS POLAR
#607 days in operation

CONTAINERSHIPS ARCTIC
#422 days in operation

1.4K LNG USE RATE RAMP-UP
**CONTAINERSHIPS AURORA**
#550 days in operation

**CC TENERE**
#517 days in operation*

*Vessel is due to be deployed on MEX line- current FAL line does not allow a full round trip on LNG.
23K LNG USE RATE RAMP-UP

CC PALAIS ROYAL
#62 days in operation
96%

CC CHAMPS ELYSEES
99 days in operation
97%

CC JACQUES SAADE
135 days in operation
83%

FUEL SHARE (%)

% MDO
% LNG
% VLSFO
A SUPPLY CHAIN UNDER CONSTANT DEVELOPMENT: BUNKERING FACILITIES

- Cardissa
- Gas Agility
- LNG London
- TBN (Gas Agility sistership)
- ENN LNG bunker vessel
- MOL LNG bunker vessel
- FuelNGLNG Bellina
First Bunkering of CC Jacques Saade

- **Cargo Operations**
  - **Total Gas Agility**
  - Bunkering of CC J. Saade

- **LNG Cargo Operations**
  - **Ops duration**: 45h
  - **5200 moves**
  - **Crane split**: 4/5

- **N2 Purging Plan**: 1h, **Real**: 2.5h
- **Cool Down** (3 to 4°C/h):
  - **Plan**: 25h, **Real**: 24h
- **Finished On**: 13/11, 8:00am
  - *Estimated T*: 25°C

- **Ramp up**:
  - **Plan**: 1h, **Real**: 0.8h
  - **Pumping**:
    - **Plan**: 14h, **Real**: 13h
    - **Started**: 13/11, 08:00

- **Ramp down**:
  - 1h
- **Hose Purging & Disconnect**:
  - 4.5h

- **Barge Moored**:
  - **12-11-20 03:00**
  - **Safety Meeting Plan**: 2.5h, **Real**: 4h
  - **Hoses Connection**:
    - 2.5h

- **Barge Unmoored**:
  - **14-11-20 08:00**

- **EOSP**
  - **11-11-20 22:00**

- **Berth**
  - **12-11-20 02:00**

- **First Move**
  - **12-11-20 04:00**

- **Last Move**
  - **13-11-20 23:00**

- **Unberth**
  - **14-11-20 12:00**

- **Berthing Time**:
  - **58h**

- **LNGBV Alongside**:
  - **53h**

- **Total Gas Agility**
### BUNKERING OPERATIONS RETEX

#### 23K Bunkering Operations

<table>
<thead>
<tr>
<th></th>
<th>CC J. SAADE</th>
<th>CC C.ELYSEES</th>
<th>CC P.ROYAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>11/11/20</td>
<td>10/12/20</td>
<td>17/01/21</td>
</tr>
<tr>
<td>End Date</td>
<td>14/11/20</td>
<td>12/12/20</td>
<td>19/01/21</td>
</tr>
<tr>
<td>BV Alongside Time</td>
<td>53h</td>
<td>54h</td>
<td>45h</td>
</tr>
<tr>
<td>Connection &amp; Preparation</td>
<td>9:03</td>
<td>13:35</td>
<td>08:04</td>
</tr>
<tr>
<td>Cooling Down</td>
<td>23:05</td>
<td>18:35</td>
<td>13:40</td>
</tr>
<tr>
<td>Bunkering</td>
<td>13:35</td>
<td>16:10</td>
<td>14:00</td>
</tr>
<tr>
<td>Deconnection</td>
<td>09:00</td>
<td>03:10</td>
<td>3:25</td>
</tr>
</tbody>
</table>

Time in HH:MM

#### POSITIVE POINTS
- Safety procedures
- Contractual aspects
- Bunkering planification
- Strong local Ops and close collaboration with RWG
- Harbor master involvement
- Simops procedures
- Technical support from GTT
- Shore expertise from CMASHIPS
- Hoses connexion

#### ROOM FOR IMPROVEMENT
- Safety Briefing
- Communication ship/Barge
- Software Update ESD/FGHSS
- Mooring fenders
- Overall timing could be 35 H with a cold tank
A STRONG LNG TRAINING PROGRAM

A dedicated Training Program has been put in place for both seafarers and shore personnel. In addition, CMA CGM Academy is now ready to offer 9 “LNG Basics” e-learning sessions to shore departments such as Operations, Chartering, or Bunkering teams.

#12 Training courses

Regulatory Training

<table>
<thead>
<tr>
<th>IGF Basic</th>
<th>IGF Advanced*</th>
<th>Live Bunkering LNG</th>
<th>Onboard period</th>
</tr>
</thead>
</table>

CMA CGM Specific Training

<table>
<thead>
<tr>
<th>LNG Practice* Simu GTT</th>
<th>Manoeuvring 23K Simu</th>
<th>Wheel House</th>
<th>ME DF WGD 2T* Advanced</th>
<th>ME DF WGD 2T Electric</th>
<th>AE DF 4 strokes* Wärtsilä</th>
<th>Gas Fire fighting</th>
<th>Maintenance &amp; DD GTT</th>
</tr>
</thead>
</table>

#800 Seafarers to be trained

- STCW compliant presential trainings: IGF Basic and Advanced (overview of LNG safety and technology)
- STCW compliant on board trainings with live bunkering and on board training
- LNG engines trainings with simulators: DF Main Engine, DF Auxiliary Engines, LNG handling
- Manoeuvring a 23K on wheel house simulator
- Safety on board with gas fire fighting

*Now available remotely
CHALLENGES TO FACE AND ROOM FOR IMPROVEMENT

CHALLENGES

Technical topics related to a prototype:
- Main Engine: a world premiere
- First membrane Tank Containment System used for LNG as fuel.
- Fuel Gas Handling System never designed for such scale.

Training program for both our seafarers and shore team:
- Low number and availability of certified IGF training centers.
- 800 seafarers to be trained in a bit more than 2 years.

AREAS FOR IMPROVEMENT

The energy performance/Emissions can still be improved by 15%, working on:
- Methane slips: joint work in progress with our suppliers
  - Post combustion/Engine design
  - Electrical load sharing
- Aerodynamics and hydrodynamics designs
- Heat recovery
A critical vector for the energy transition...

1. AN INNOVATIVE AND AMBITIOUS PROGRAM

2. AN IMMEDIATE, EFFICIENT STEP FOR THE ENERGY TRANSITION

3. A USE RATE CONSTANTLY PROGRESSING WITH LIMITED IMPACT ON OPERATION

4. A HIGH POTENTIAL FOR IMPROVEMENT / CONVENTIONNAL SOLUTIONS

5. A TRAINING CHALLENGE FOR OUR CREW AND SHORE STAFF BUT ALSO AN OPPORTUNITY TO RAISE OUR SAFETY LEVEL

6. COMPATIBLE WITH BIO LNG

...opening the way to low carbon alternative fuels.
Thank you