

SEARICA POWERING A SUSTAINABLE MARITIME FUTURE

THE CRUISE INDUSTRY PERSPECTIVE

MAIKEL ARTS
GENERAL MANAGER MARKET INNOVATION
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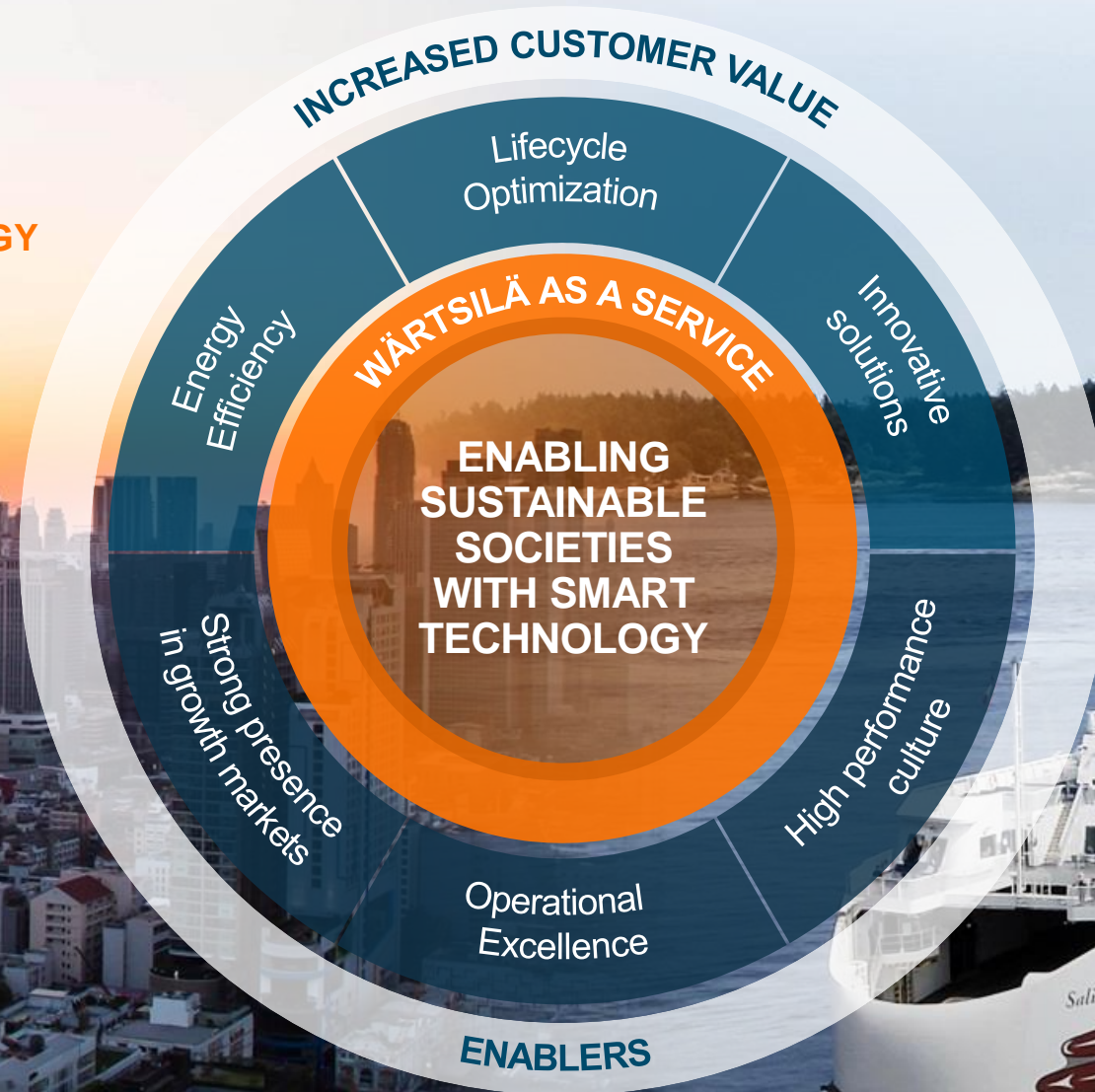


ENERGY

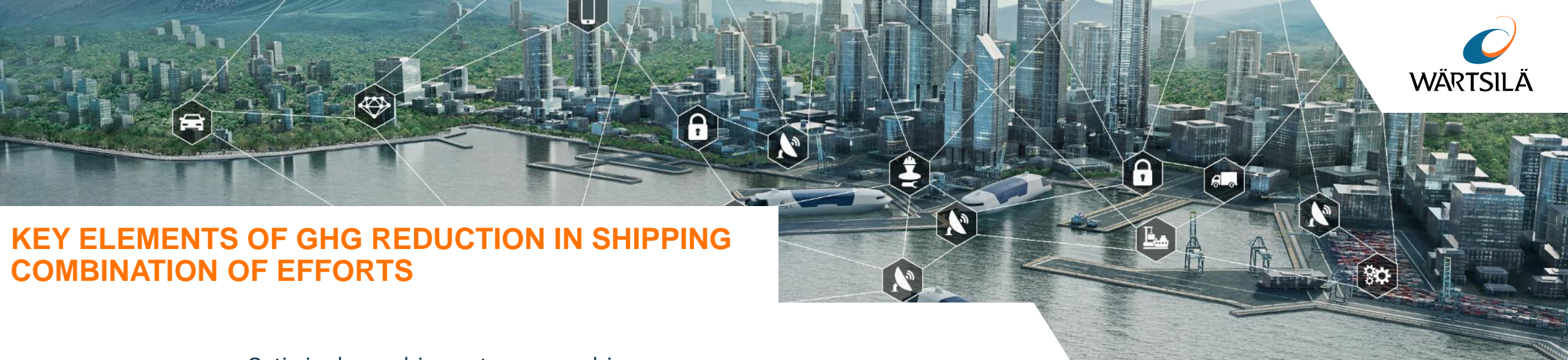
INCREASING DEMAND FOR
CLEAN AND FLEXIBLE ENERGY

MARINE

DEMAND FOR CLEAN AND
SAFE TRANSPORTATION



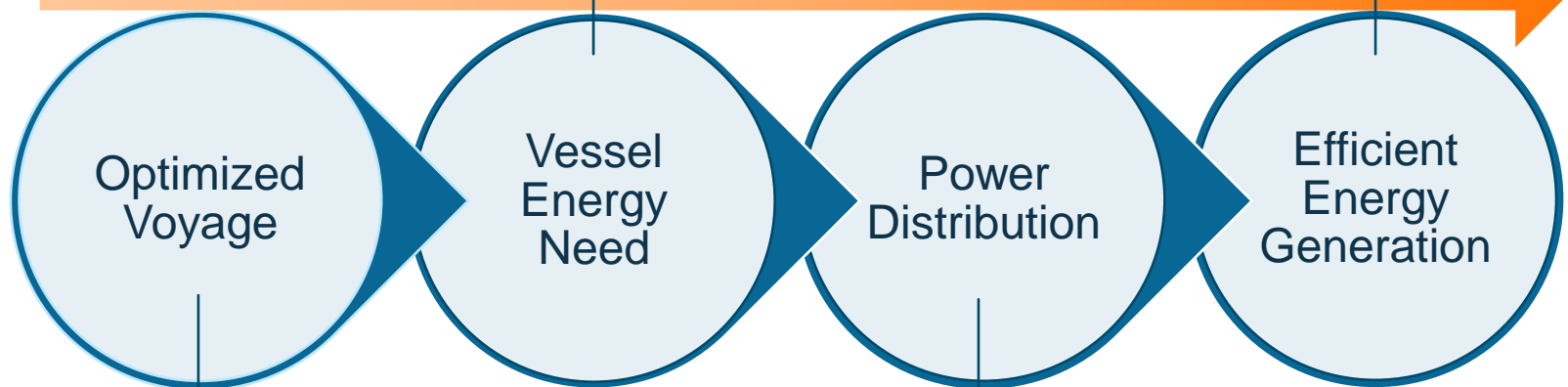
KEY ELEMENTS OF GHG REDUCTION IN SHIPPING COMBINATION OF EFFORTS



Optimized propulsion systems, propulsion energy saving devices, hull and ballast optimization, trim optimization, air lubrication

Highest efficiency and cleaner fuels

Increasing price per ton of CO2 emission avoided



Electrification of vessels not to be forgotten in segments where possible (IWW, short distance ferries, etc.)

The advent of on-road electromobility will continue to drive down battery prices, but for longer haul applications, physics preclude the use of full electric ships.

Use of data for optimised speeds and routing and digital port integration

Hybrids and associated battery storage, power-take-in from renewable sources such as wind, solar

THE DEVELOPMENT OF ENGINE TECHNOLOGY IS ONGOING

Fuels of the future

Verified: 2003

LNG



Bio- or Synthetic methane

Can readily be used in liquid form with equipment made for LNG.

Technology focus on higher efficiency and lower methane slip.

LNG as fossil, Bio or Synthetic can be mixed.

Verified: 2015

Methanol



Bio- or Synthetic Methanol

A methanol conversion package is available for the ZA40 engine.

The next step is to industrialise this technology on the relevant portfolio engines according to market needs.

Indicative: 2020, Verified: 2021

Ammonia



Synthetic Ammonia

We have already technologies that are capable of using Ammonia.

The needed combustion concepts to maximise engine performance and related safety technologies are currently being investigated

Indicative: 2020, Verified*: 2025

Hydrogen



Synthetic Hydrogen

Our gas engines are already able to blend LNG with up to 25% hydrogen, and combustion concepts have made for 100% hydrogen.

Our future efforts will be directed towards maximising engine performance.



Synthetic fuels use H₂ produced from as basis.

Bio fuels produced from sustainable Bio sources such as waste from Agri, Household, Forestry

* timing depends on the market demand

ENERGY WISE..



1 m³
of fuel
oil

- Easy storage
- Carbon emissions
- Local Emissions
- If produced as bio fuel only local emissions
- Challenge to mix

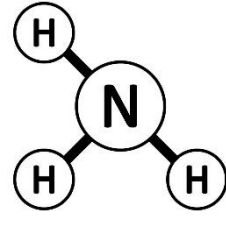
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1,75 m³
of CH₄ /
LNG

- Storage -153 deg
- ≈ 20% lower carbon emissions as fuel oil
- Hardly local emissions
- As bio-fuel or synthetic fuel no Carbon emission
- Easy mixing

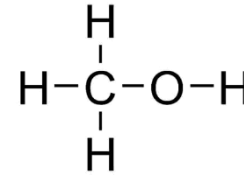
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3.0 m³ of
AMMONIA /
NH₃

- Storage -33 deg
- No carbon emissions when produced as synthetic fuel
- Highly toxic
- Still local emissions
- Availability

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2.63 m³ of
METHANOL
/ CH₃OH

- Storage 20 deg
- As bio-fuel or synthetic fuel no Carbon emission
- Toxic
- Still local emissions.
- High price (as green fuel)
- Availability

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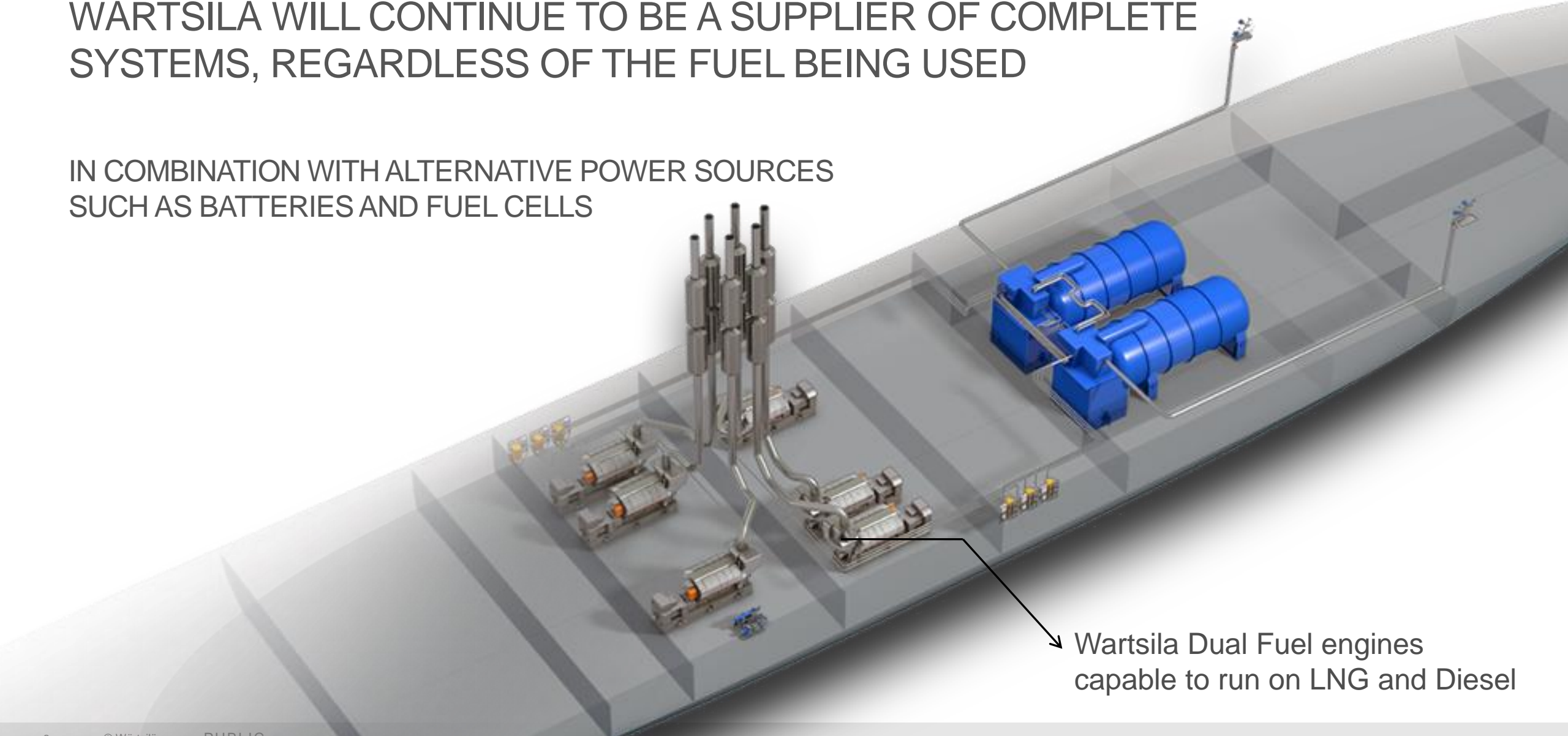


4.6 m³ of
HYDROGEN / H₂
(liquid)

- Liquid storage -253 deg
- As synthetic fuel no Carbon emission
- Storage and handling
- Availability

WÄRTSILÄ WILL CONTINUE TO BE A SUPPLIER OF COMPLETE SYSTEMS, REGARDLESS OF THE FUEL BEING USED

IN COMBINATION WITH ALTERNATIVE POWER SOURCES SUCH AS BATTERIES AND FUEL CELLS



Wartsila Dual Fuel engines
capable to run on LNG and Diesel

KEY TAKEAWAYS

1. Ports need to invest
 - The use of data to optimize the arrival, in- and out flow of shipping
 - Shore power facilities
 - Handling & bunkering future fuels
2. Fuel cells and batteries will be integrated into the power train of the future, apart from Internal Combustion Engines
3. There is no one single future fuel – there will be a whole variety of fuels in use – prepare for fuel flexibility
4. Wärtsilä will continue to be a supplier of complete systems, regardless of the fuel
5. The Wärtsilä Dual Fuel engine is an excellent choice for introducing future fuels

By scaling up the use of LNG, BIO LNG the reduction of Carbon emissions can be accelerated today. Legislation is needed.



WÄRTSILÄ