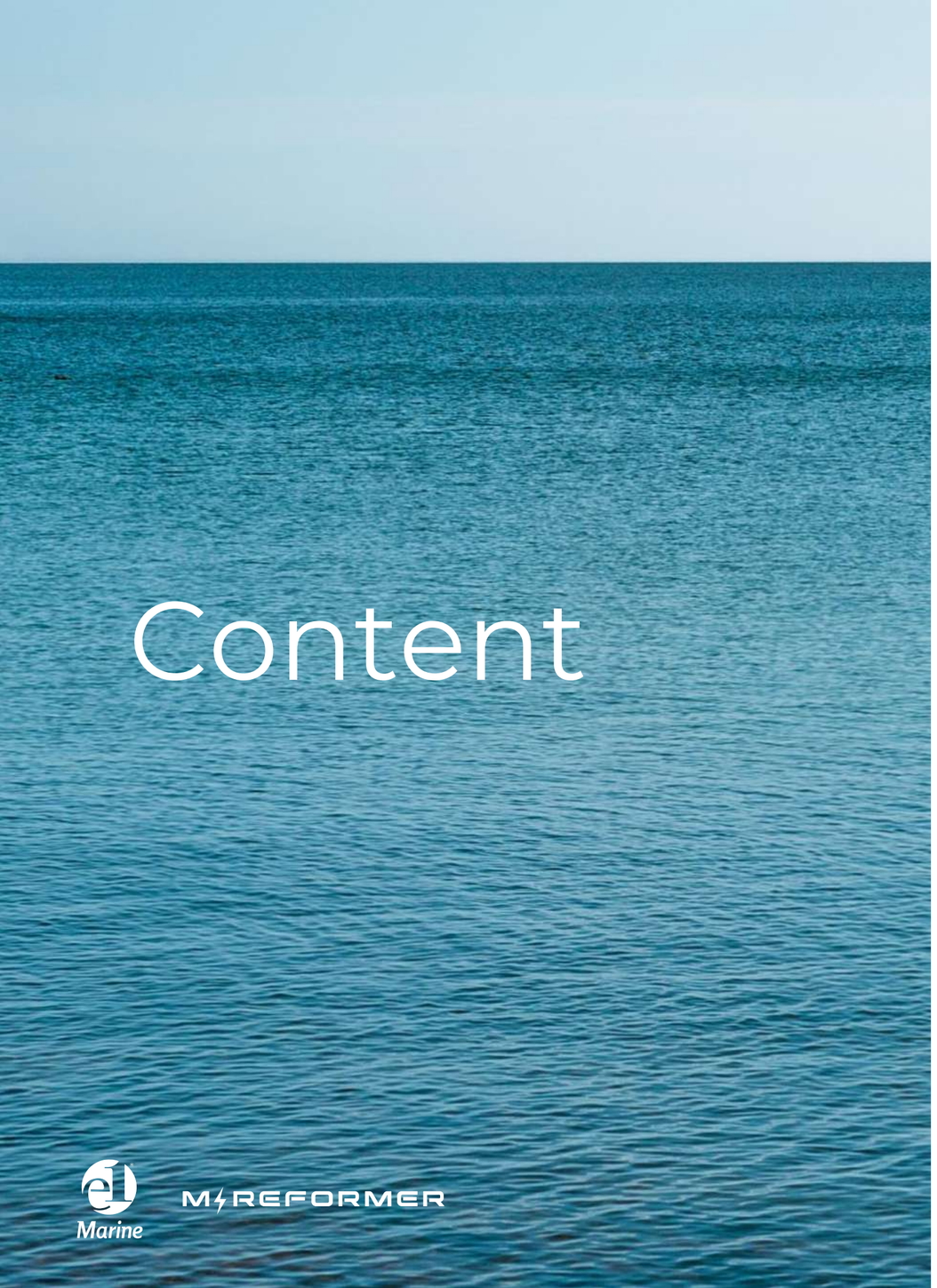
e1 Marine

Methanol Reformer as manufacturer

Off-Grid & Sustainable & Mobile energy solutions

e1marine.com | asancho@methanolreformer.es



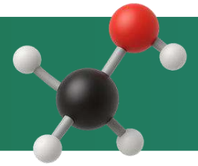
Content

Marine

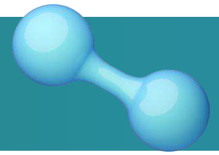
M REFORMER

Hydrogen & Electric production on-site & on-board

Off-grid - Sustainable - Mobile



Methanol
Methanol & DI water



Hydrogen
Gas

Maritime regulatory overview

Regulatory framework driving maritime decarbonisation

IMO - International Maritime Organization (Global regulation)

- IMO 2023 GHG Strategy (latest adopted strategy).
- -40% carbon intensity by 2030.
- Net-zero GHG emissions by or around 2050.
- Basis for future mandatory measures and penalties.

imo.org – 2023 IMO GHG Strategy

EU Legislation (Regional regulation)

- **EU ETS (from 2024):** CO_2 emissions from ships ≥5,000 GT calling EU/EEA ports.
- **From 2026:** Progressive inclusion of CO_2, CH_4 and N_2O emissions.
- **FuelEU Maritime:** GHG intensity limits on energy used on board.

EU ETS maritime overview

National / port-level regulation *(example)*

- **Norway:** zero-emission requirements in selected fjords and ports
- Local port authorities may impose additional constraints
- Access restrictions increasingly linked to emission performance

COMPLIANCE MATTERS → REGULATION = COST OF EMISSIONS

ETS allowances / Financial penalties / Restricted port access

Maritime regulatory overview

Regulatory framework driving maritime decarbonisation

Emissions & Targets

- IMO & EU regulations based on **lifecycle GHG intensity of energy used on board.**
- Progressive tightening towards **2035-2040.**
- **Direct compliance increasingly** required.

NOx / SOx & Air Pollution

- Strong focus on **NOx & SOx reduction**, especially in **ports and ECAs**.
- **Non-CO_2 emissions (CH_4, N_2O)** now formally measured.
- Increased **compliance complexity for onboard fuel systems**

Operational & Cost Impact

- **Non-compliance leads to direct financial penalties.**
- **High-pressure H_2 storage and bunkering** add safety and regulatory burden.
- **Simpler fuel logistics reduce regulatory exposure.**

REGULATION DRIVES OPERATIONAL AND FINANCIAL IMPACT⟶ EMISSIONS = COST AND COMPLEXITY

Carbon pricing / Financial penalties / Operational constraints in ports

H_2 Storage & Supply Challenges for Maritime Sector

"H_2 is easy to produce, but bunkering and high-pressure storage in ports is complex and costly"

Key Challenge

- H_2 is easy to produce but **storing and supplying it at 500–1000 bar in ports is complex and costly.**
- Ships require **high-energy-density H_2**, needing compression, specialized tanks, and advanced safety measures.

Ideal situation

- **H_2 produced on-site from liquid methanol,** close to the port & ready for bunkering
- Minimizes transport, **energy loss, and safety risks.**

Non-ideal situation

- H_2 produced far from the port → **high-pressure or liquefied transport.**
- Leads to **high costs, technical risks, and reduced efficiency.**

Why methanol?

The most efficient, safe, and widely available solution for H_2 logistics

1 TRUCK OF METHANOL = **12 TRUCKS OF COMPRESSED H_2**

3.6 Tons H_2

Methanol x 1 truck
+600 km + 1.37 Tn CO_2

Compressed H_2 x 12 trucks
+ 7.200 km + 16.4 CO_2

*Source for the calculation CO_2 from trucks: Transport & Environment (2021). Easy Ride: why the EU truck CO_2 targets are unfit for the 2020s
**3.6 Tn H_2 requires 18 Tn D.I. water for the reformation process

- One 30 ton gas truck can only carry 300 kgs of H2 (**<M30 daily production**)
- One 30 ton methanol truck can carry **12 times** more.
- H2 Compressed: **1% to 5% Boil Off/day** during the whole production/transport/stock cycle)
- For long distance transportation methanol beats compressed H_2

** 250 bars pressure*

	Methanol	Ammonia	H2 High Pressure
Cost to produce H2	Lowest	Medium	Highest
Energy Carrier	Easiest	Inconvenient	Inconvenient
State	Liquid	Gas	Gas
Safety	Safe	Poisonous	Explosive
Use of conventional infrastructures	Low investments	Medium Investments	High Investments

Methanol Sources

Green vs conventional productions systems

NATURAL GAS

From conventional Fuel (Methane) - Extraction from well and reformed

CO_2 CAPTURED

Captured from conventional fuel combustion or industrial emissions.
E.g., cement, steel production...

BIO-METHANOL
produced from biomass

- From agricultural waste (Biodigestors)
- From dumping site & sewage (Direct)

→ **Methane Gas (biogas)**

$CH_4 + H_20$ steam ->
$(CO + 2H_2)$ + Catalyzer -Z CH_3OH

E-METHANOL

- Green hydrogen + CO_2 captured
- Renewable electricity

- From biomass burning
- From industrial process

→ **CO_2 captured**

$CO_2 + 3H_2$ -> $CH_3OH + H_2O$
H_2 from renewable source

Core Product: Methanol-reforming
Medium power (M18) / High power (M30)

Strong points:

- **High purity (99,997%)** H_2 for Fuel Cells (ISO 14687 for H_2 mobility)
- **No emissions of NOx & SOx & PMs**
- Low CO2 emissions (or **carbon neutral if green**)
- **Lower OPEX & CAPEX**
- **24/7 Run Times & Long lasting**
- **Independent from Grid**
- **No Operator Needed & Remote Monitoring**

Integrating Our H_2 Generator into the Containerized Solutions Portfolio

Scalability (MW) *Modularity* *Plug&Play*

Dimensions (LxWxH): 879 x 2,080 x 1,380 mm
Weight: 1,500 kg

Portfolio

We offer mobile & stationary solutions for hydrogen or power generation, depending on your environment and energy needs.

- **M30** 16,2 Kg/h 250 kW/h

Hydrogen generator

- **M18** 9,8 kgH_2/hr (equiv. 150 kW e-)

Hydrogen generator

- **Model S** 35 - 130 slm ≈15 kW/h

Hydrogen generator

- **e-Nomad – 150 kW:**

Mobile electric power generation (20 ft container).
Includes: M18/ M30 reformer, fuel cell, battery pack, power electronics & control system.

- **M2Power** 250 kW/h *by PowerCell*

Marine-ready electric power generation system.
Single-unit solution integrating a methanol reformer and fuel cell technology, designed to simplify fuel cell integration in maritime applications.

- **Mixing Station** 250 L/h

Methanol–water mixing unit for reforming applications.
ATEX-classified system designed for the safe, precise and continuous preparation of methanol–water mixtures, ensuring controlled fuel supply for methanol reformers and downstream fuel cell or hydrogen systems.

Marine Getting hydrogen to work

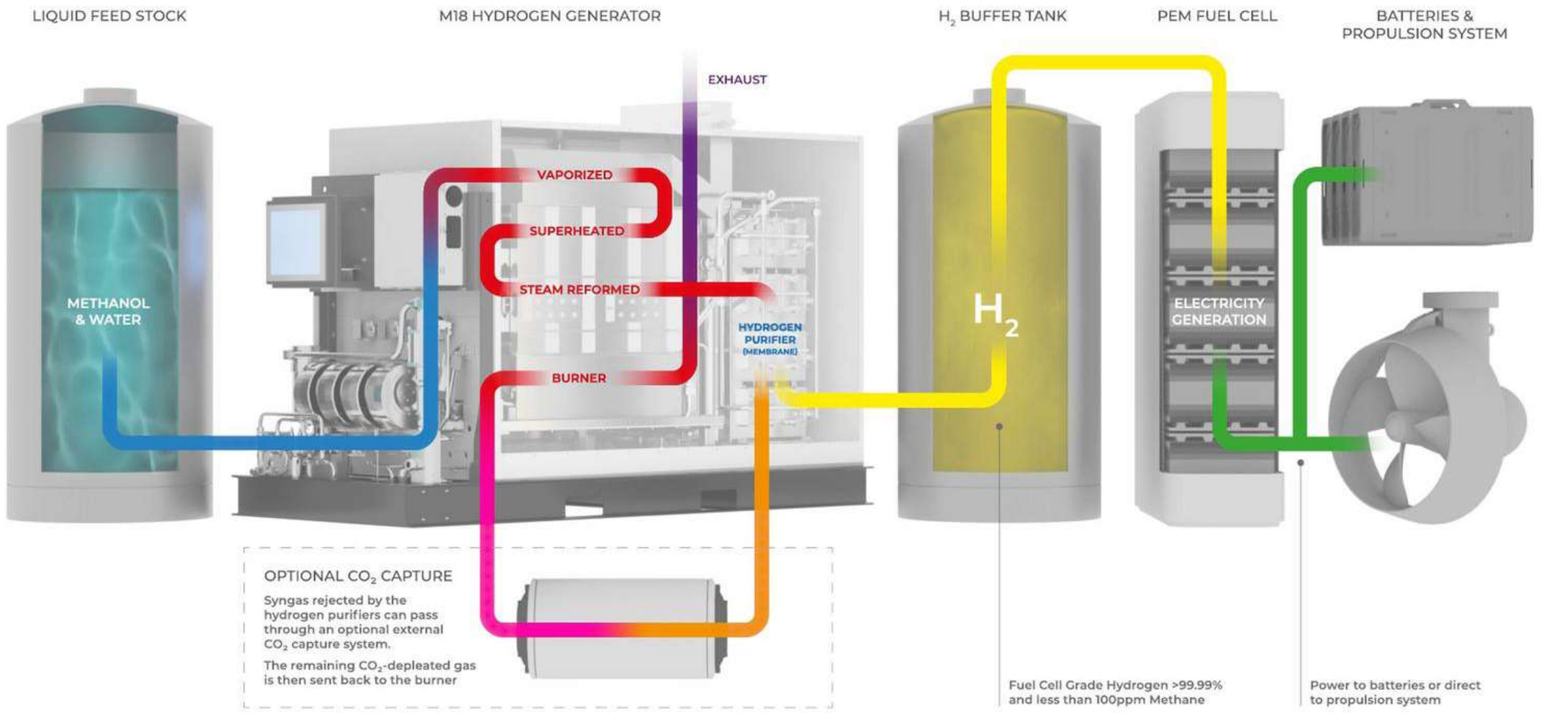
M⚡REFORMER

Outlook of methanol-reforming process

M18 / M30 & e-Nomad

Outlook of methanol-reforming process

M18 / M30 & e-Nomad



View diagram

Outlook of methanol-reforming process

REFORMER

$$\eta = \frac{172.45\ \left[\frac{g}{min}\right] * \frac{1\ kg}{1000\ g} * \left[\frac{120.21\ MJ}{kg}\right]}{1253.1\ \left[\frac{g}{min}\right] * \frac{1\ kg}{1000\ g} * \left[\frac{20.094\ MJ}{kg\ MeOH}\right]} = 0.823 = 82.3\%$$

→ **82,3 %**

REFORMER ENERGY POWER

- Methanol Reformer: 82 %
- Fuel Cell Generator: 50 % - 60 %

→ **42 % - 49 %**

Projects

YACHT PROJECT

Onboard power generation (M30) for maritime applications.

BALEÀRIA PROJECT

First autonomous e-methanol power container for ferries in Europe, producing renewable hydrogen on board to supply auxiliary power and support battery charging under real navigation conditions.

PROJECT HYDROGEN ONE

"We chose methanol as our fuel of choice due to its widespread availability in river systems and global ports, compatibility with existing distribution infrastructure, and safety."

EUROPE SHIPYARD PROJECT

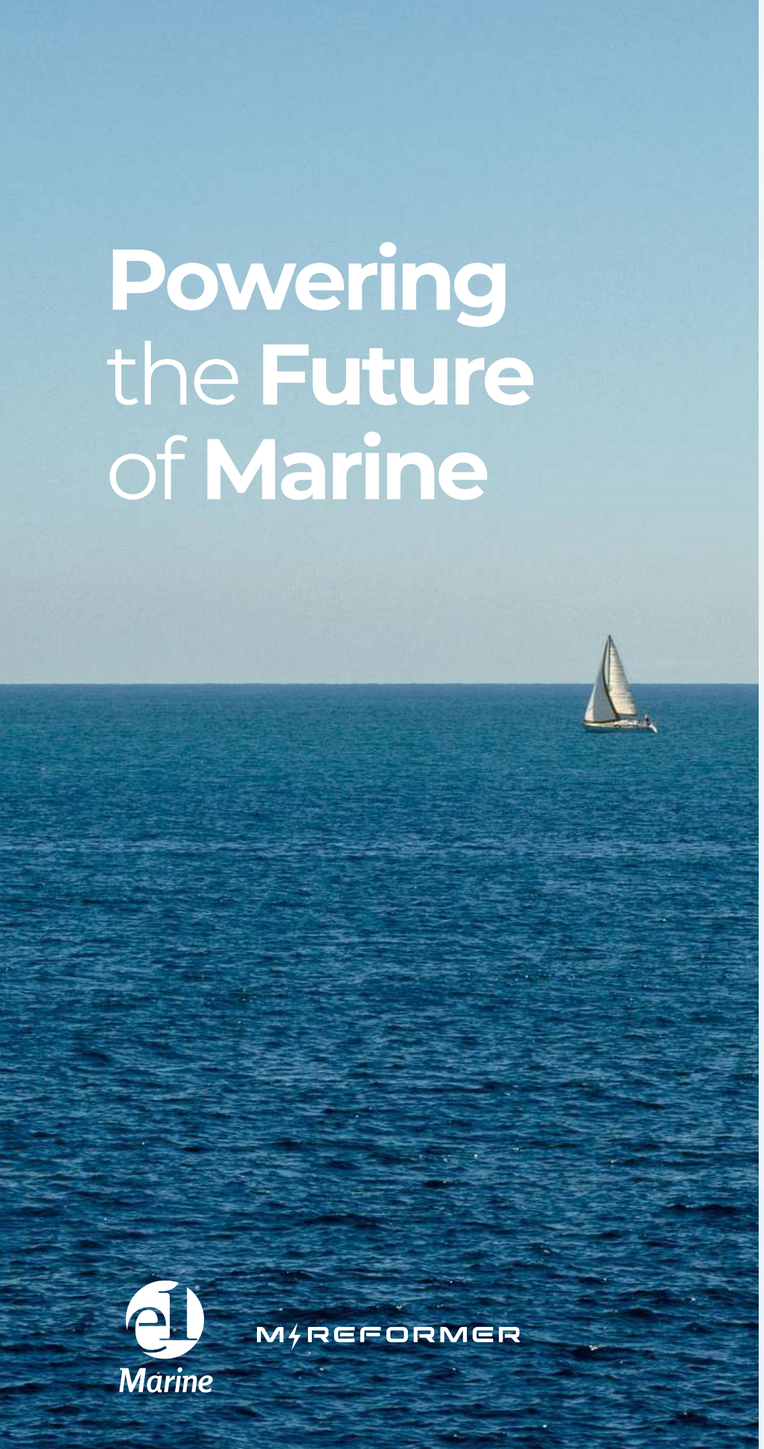
M30 CONTAINER + MIXING STATION FOR EFFICIENT ONBOARD OPERATIONS

S SERIES REFORMER YACHTBUILDER

COMPACT HYDROGEN GENERATION SYSTEM FOR YACHTS, ENABLING ONBOARD RENEWABLE POWER

M2POWER

Naval engineering for onboard integration up to 500 kW



Powering the Future of Marine

Clean & Efficient

Generates hydrogen and electricity with no harmful emissions (NOx, SOx, PM).

Flexible & Reliable

Mobile, off-grid solution operating 24/7. Fast start-up (<1 hour).

Cost-Effective

Low CAPEX & OPEX. Minimal maintenance and long service life.

Scalable & Versatile

For stationary and mobile applications. Adaptable to diverse energy demands.

FOR FURTHER INFORMATION, CONTACT US.

We are here to develop and produce unique solutions together.

www.methanolreformer.com

asancho@methanolreformer.es

WTC. Moll de Barcelona s/n
Edificio Este Planta 5. 08039 Barcelona (Spain)