



# General project presentation

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MULTIFUEL SOFC SYSTEM WITH MARITIME ENERGY VECTORS



# Brief gist of the project

FuelSOME = Multifuel SOFC system with maritime energy vectors

4 year project, Sept 2022 to Aug 2026

Total project budget €2.5 Million

The broad call from the EU is 'Emerging technologies for a climate neutral Europe' CL5-2021-D2-01-08.

Within this call the consortium prepared a proposal for 'Multifuel to power'

The end application is ocean going vessels

The different fuels that we are considering within the project are: Ammonia, Methanol and Hydrogen.

The power conversion aspect is via Solid Oxide Fuel Cells

- Fuels processed from waste streams
- Green fuel production supply chain

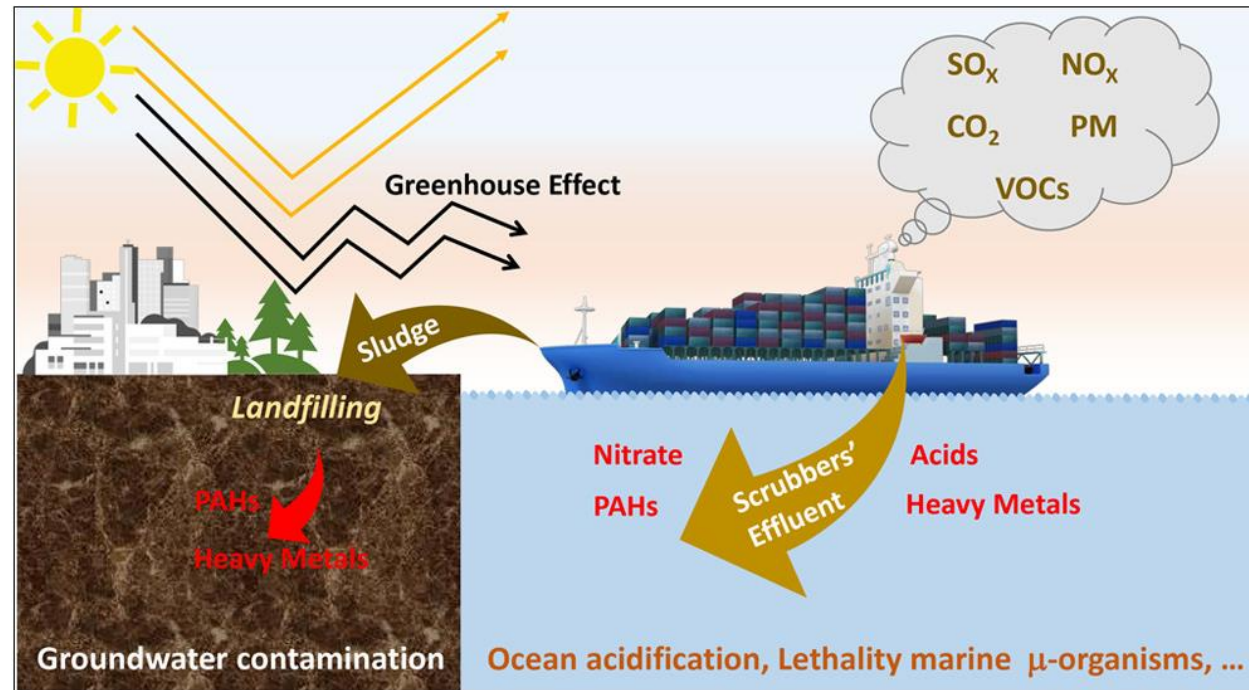
# Shipping and Green House Gas

1. Shipping is responsible for around 1 billion tons of carbon dioxide emissions, making up about **2.5% of total global greenhouse gas emissions**.
2. Within the transportation sector, shipping claims the third position in terms of carbon dioxide emissions, **comprising 11% of the total**.
3. Shipping is reported to produce **16.14 grams of CO<sub>2</sub> per kilometer** for each metric ton of cargo they carry.



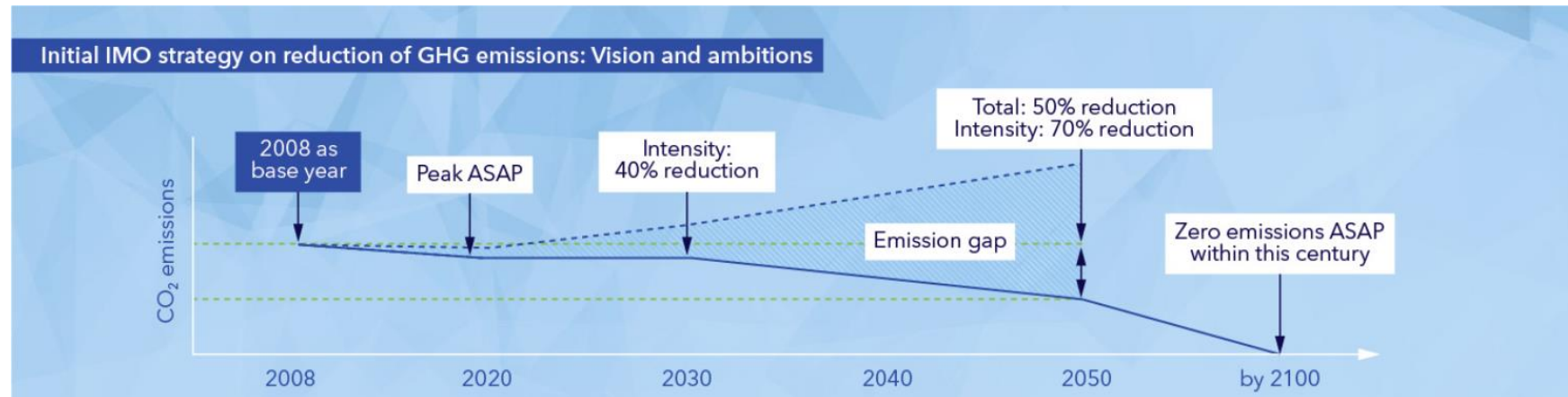
# Marine Vessels and heavy diesel oil

Marine vessels have **relied on heavy diesel oil**, a fossil fuel, as the primary propulsion source for over a century. As a consequence, greenhouse gas and air pollutants like carbon dioxide, nitrogen oxides, sulfur oxides, and particulate matter have become focal points of regulation at both EU and global levels.



Ref: *Industrial & Engineering Chemistry Research* ( IF 4.2 ) Pub Date: 2023-01-23 , DOI:10.1021/acs.iecr.2c03621

# International Maritime Organization (IMO) vision and ambitions



- The urgent need to significantly decrease GHG emissions from shipping - **a crucial objective within the EU Green Deal** framework.
- Internationally, in 2018, the International Maritime Organization (IMO) strongly emphasized the need to reduce CO<sub>2</sub> emissions from shipping by at least 50% by 2050 compared to 2008 levels.
- The maritime industry - **challenging sector for decarbonization**, is actively pursuing alternative technologies that improve environmental sustainability while maintaining current performance standards.
- Uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources – **at least 5% in international shipping by 2030**

# Current state-of-the-art technologies for both fuels and propulsion systems

- ❑ Existing state-of-the-art technologies for both fuels and propulsion systems do not meet the necessary emission standards established by global and EU regulations.
- ❑ Consequently, there is an urgent requirement to investigate transformative technologies, **thoroughly assessing their environmental, social, and economic implications**. This investigation is crucial for aligning with the EU's and the sector's goal of achieving climate neutrality.

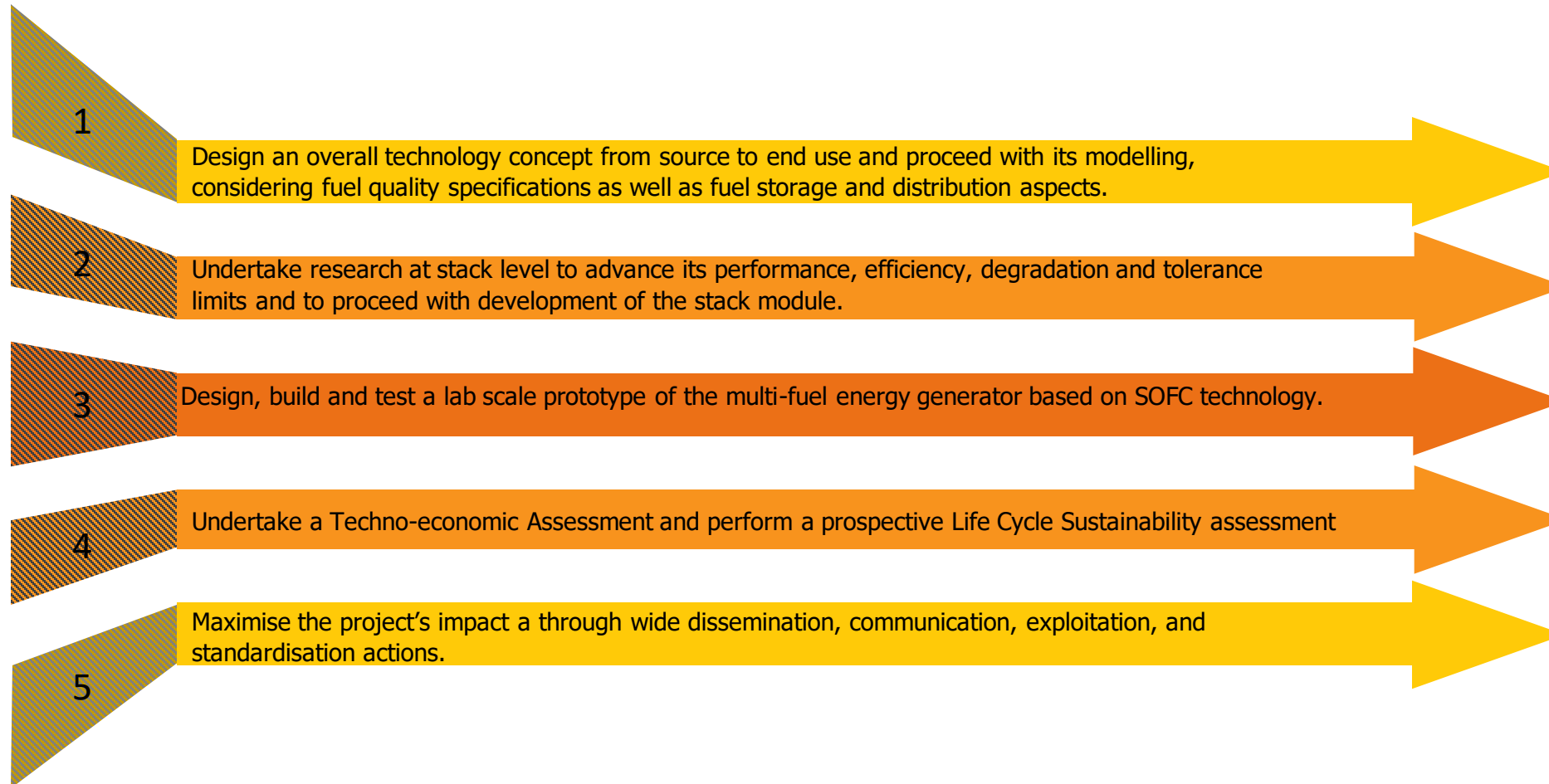


# Project Vision

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The **vision of the project** is to find a scalable and flexible path for supply of multi-fuels, viz. **ammonia and methanol** besides hydrogen, to act as key contenders in replacing marine diesel as fuel on ocean going vessels, coupled with their use in a **multi-fuel energy generation system** using **Solid Oxide Fuel Cell** technology

# Broad project objectives

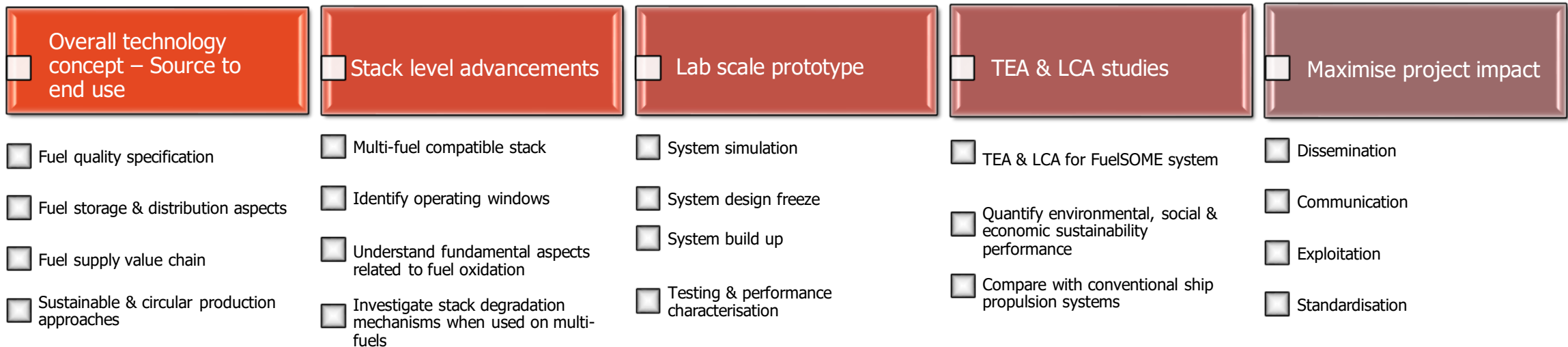




# Specific project Objective=s

"FuelSOME" will develop and validate, **up to TRL 4, a novel multifuel energy generation system based on Solid Oxide Fuel Cell Technology** – called the FuelSOME system which will be capable of operating on various fuels and fuel mixtures.

## Sub- Objectives



# Core pillars for project's success

## Fundamental Science

- Fuel supply value chain
  - **WP 1**
- Stack level improvements for use of ammonia & methanol as fuels
  - **WP 2**



## Systems Engineering

- System demonstration & testing
  - **WP 3**



## LCA & TEA analysis

- Technoeconomic Analysis and Life Cycle Analysis of the whole chain & system
  - **WP 4**



# FuelSOME project and the transformational technology

FuelSOME project is driving the advancement of ground-breaking technologies with a focus on two main areas

1

Prioritizing sustainable alternative fuels such as Ammonia, Methanol, and Hydrogen tailored for maritime use,

Ammonia and methanol, known for their liquid form and exceptional energy density, are prime candidates for decarbonizing deep-sea shipping. While hydrogen has shown satisfactory performance as a fuel.

2

Developing highly efficient multifuel energy conversion systems.

Fuel Cells, particularly Solid Oxide Fuel Cell (SOFC) systems, offer significantly high energy efficiencies compared to internal combustion engines. Among fuel cell options, SOFC systems are particularly promising for maritime applications, especially for long-distance voyages. Therefore, improving SOFC performance with above diverse fuels is essential for developing a reliable high-performance system.

# Specific Novelties from WPs (Near term)

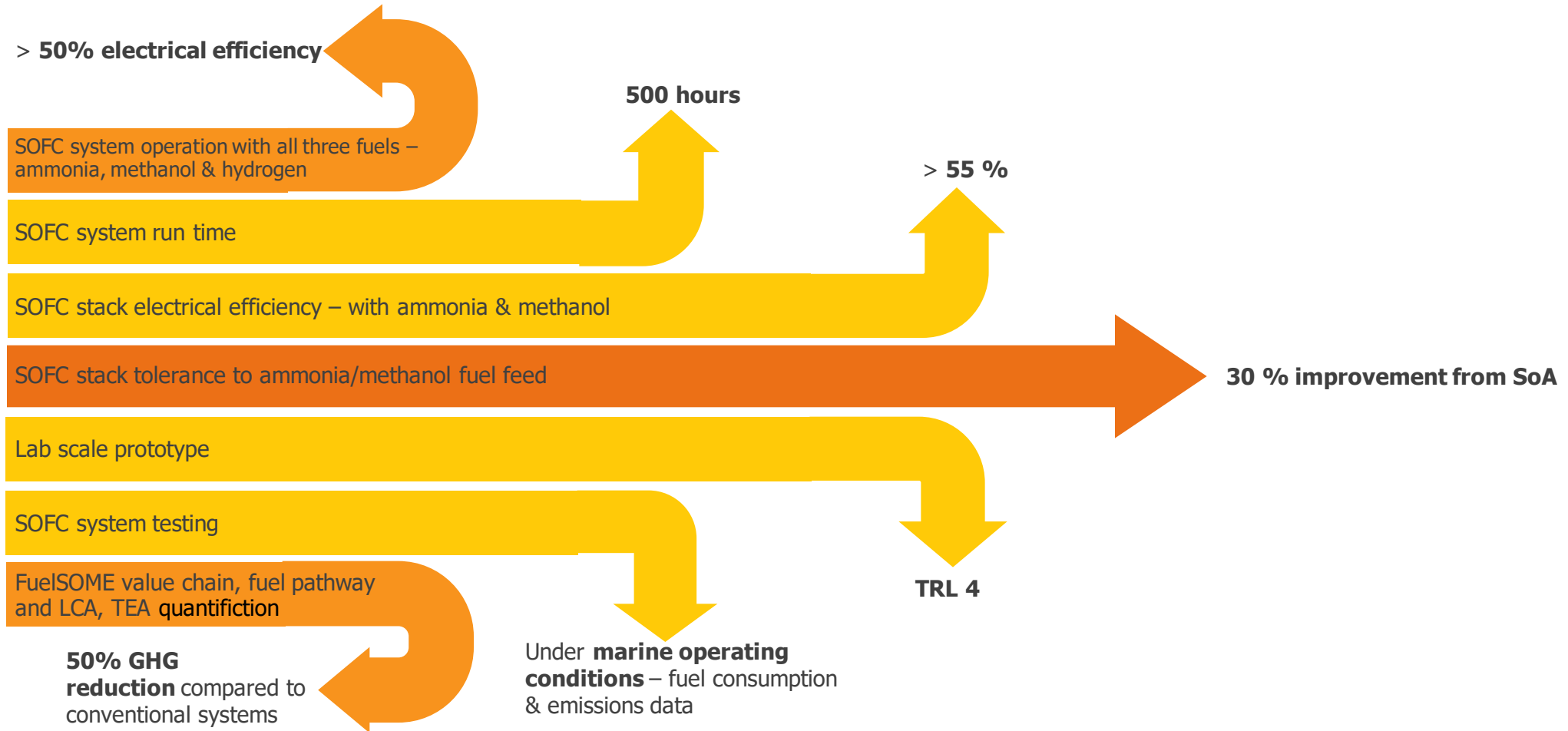
- Elcogen **SOFC stack adaptation** to operation with i) Ammonia, ii) Methanol
  - Specific operating strategies needed at stack level
  - Performance comparison with current state of the art
- Testing under **emulated marine conditions**
  - Equipment
  - Test protocols
- Establishing **emerging & flexible fuel supply pathways**
  - Raw fuel quality
  - Fuel quality requirements at i) System inlet, ii) stack inlet
  - Fuel pre-processing needed

WP 2

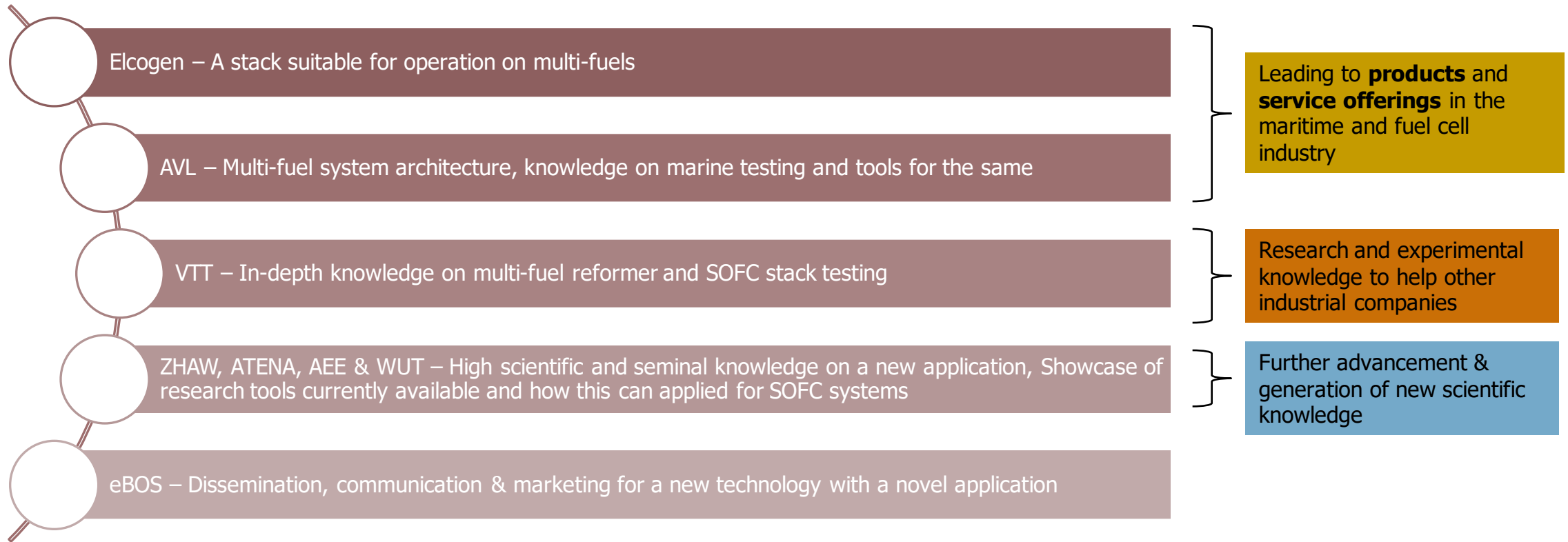
WP 3

WP 1

# FuelSOME ultimate targets



# Foreseeable benefits for partners



# FuelSOME project consortium

## 4 Academic and research technology organizations



Leading European institute of applied research in renewable energy and resource efficiency.



Institution of higher education. One of Poland's top centers for chemical engineering education and research.



One of Europe's leading research institutions and a visionary research and innovation partner for companies and society.



One of the leading universities of applied sciences in Switzerland, focusing on important societal challenges.

## 3 Small to medium enterprises



World's most advanced manufacturer of ceramic anode-supported solid oxide cells and stacks.



Research and Technology Hub comprising Italian universities, research institutes, and private companies collaborating on projects.



A leading research and development institution, is an innovative and client-focused SME providing technologically-advanced e-business software solutions.

## 1 Large industry



An experienced Project Coordinator with a proven track record of excellence, has led numerous successful collaborative projects throughout Europe. They bring their extensive expertise to the development, integration, and testing of Solid Oxide Fuel Cell systems.

# FuelS ME

Multifuel SOFC system  
with Maritime Energy  
vectors



## Thank you!



FUELSOME

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