



# Deep Purple

Empowering ocean energy systems with green hydrogen

Deep Wind  
Power-to-X Subgroup

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*Together we accelerate energy transition*



# TechnipFMC - Driving sustainable change, delivering real opportunity



Meeting our commitments

Positive impact on our Company,  
industry and communities

Driving sustainable change

50% reduction in CO<sub>2</sub>  
equivalent emissions by 2030

Delivering real opportunity

Play a material role in the  
energy transition today

# Hydrogen

## Ready for the hydrogen wave

- **Proprietary** technologies and **proven** capabilities to engineer and deliver hydrogen plants
- **Blue hydrogen** is a cost-effective method to produce hydrogen while removing CO<sub>2</sub>; **leader in CCUS** enables robust blue hydrogen offering
- Positioning to be a **leading technology** and **EPC supplier** in green hydrogen; **strategic** partnership with **McPhy** to develop large-scale solutions
- **Complete portfolio of services** include feasibility studies, EPC projects and measurement; both **greenfield** and **retro-fit** opportunities



Structural growth with spend that may exceed \$50 billion through 2030<sup>1</sup>

270+

Plants using proprietary steam reforming technology

35%<sup>2</sup>

Market share leader in grey hydrogen

50+

References for hydrogen plants with CO<sub>2</sub> capture

# Offshore is the next frontier in the Energy Transition

## TechnipFMC's subsea expertise and ecosystem position us well for the next frontier

- Offshore and subsea will provide significant opportunities in the Energy Transition
- Offshore technologies will require further innovation and greater collaboration to meet decarbonization goals
- Our core competencies and integration capabilities can transform new technologies into commercially viable alternatives

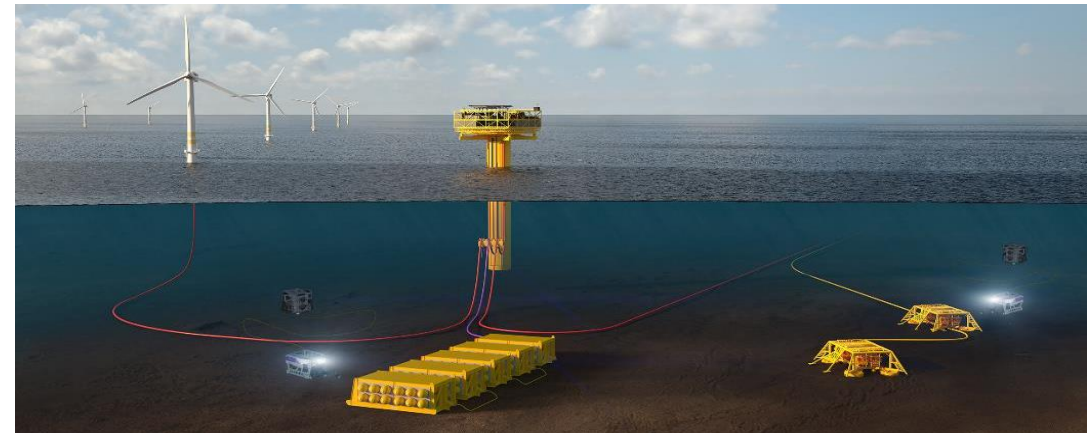
### Core competencies throughout the water column

Automation and Control

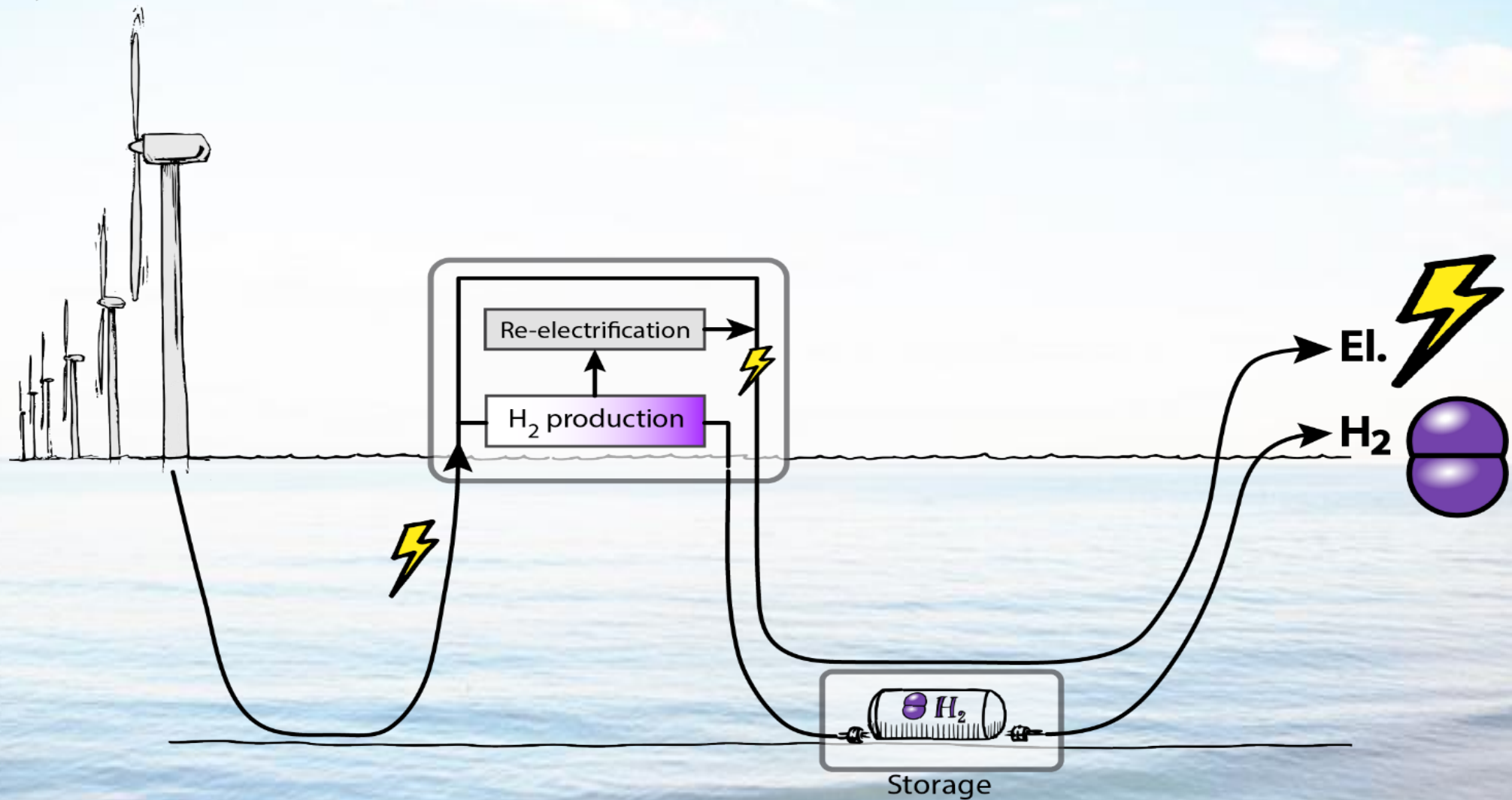
EPCI Execution

Digital and Robotics

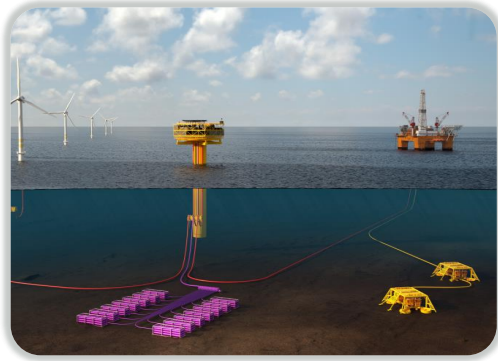
Subsea Infrastructure



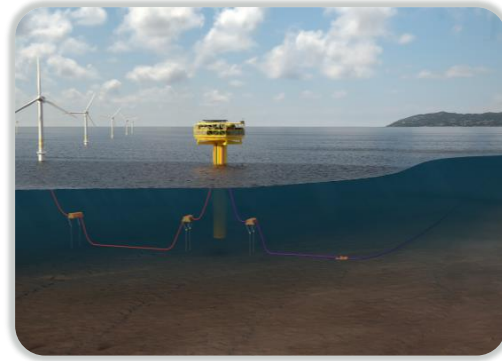
# The Deep Purple system



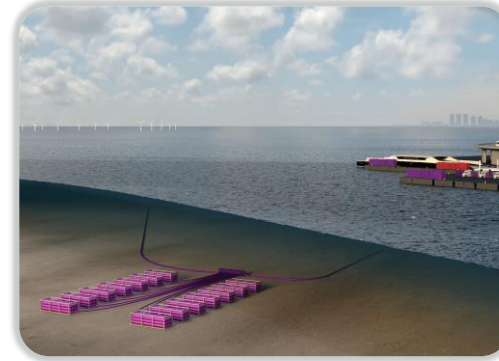
# Deep Purple – several applications in the Ocean Space



Electrification by renewable and stable power to oil&gas installations



Offshore, large-scale renewable hydrogen production

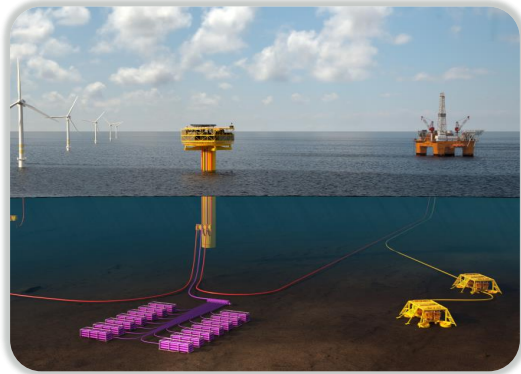


Coastal subsea hydrogen infrastructure and storage

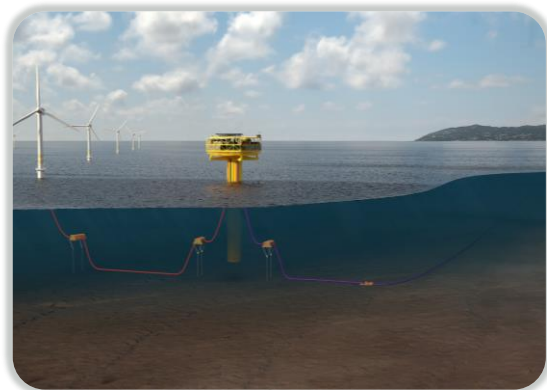


Renewable and stable power to remote islands

# Deep Purple innovation project



Electrification by renewable and stable power to oil&gas



Offshore, large scale renewable hydrogen production

## Partners:



## Engineering support:

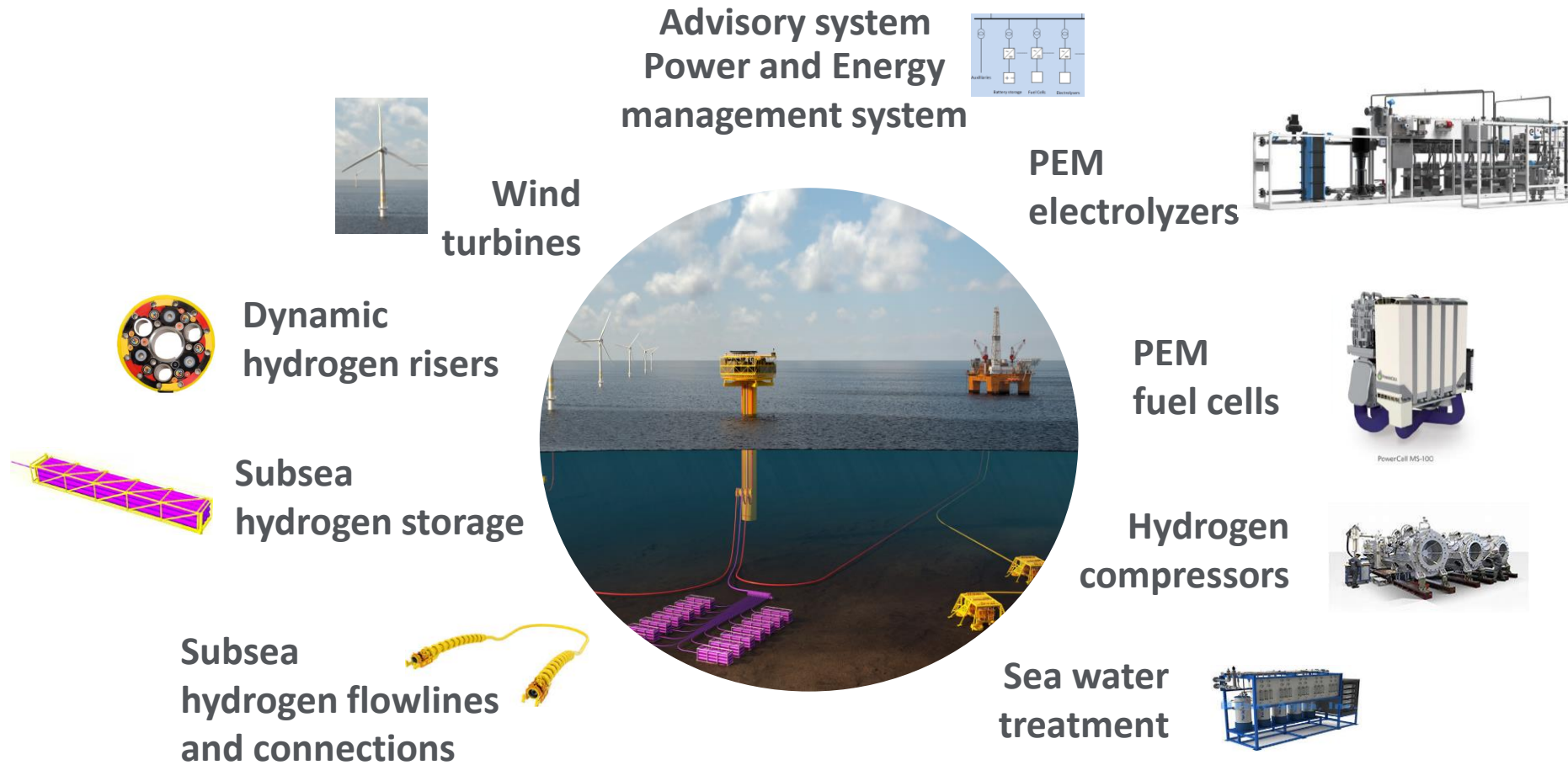
## Project setup:

- ▶ Duration: 2016-2020 (Ph1+Ph2)
- ▶ Total budget: 3 MEUR
- ▶ Funding: 50% TechnipFMC, 50% Research Council of Norway

## Objectives:

- ▶ Develop robust business cases and technical solutions for offshore renewable energy systems with offshore wind and hydrogen technologies
- ▶ Develop key hydrogen and subsea technologies for offshore hydrogen use to TRL5 (EU-scale)
- ▶ Develop partnerships with key suppliers and clients

# Deep Purple building blocks – scalable and modularized



## Deep Purple engineering tools:

- HyOpt – techno-economical optimization tool
- FlowManager – hydrogen process simulator
- NowiCob – availability and reliability simulator



# Optimized operation of energy production and storage



Parameters

- CO<sub>2</sub> and NO<sub>x</sub> taxes
- Unit costs
- Wind and power profiles
- Efficiencies



Targets and constraints

- CO<sub>2</sub> reduction target
- Availability
- Minimum cost



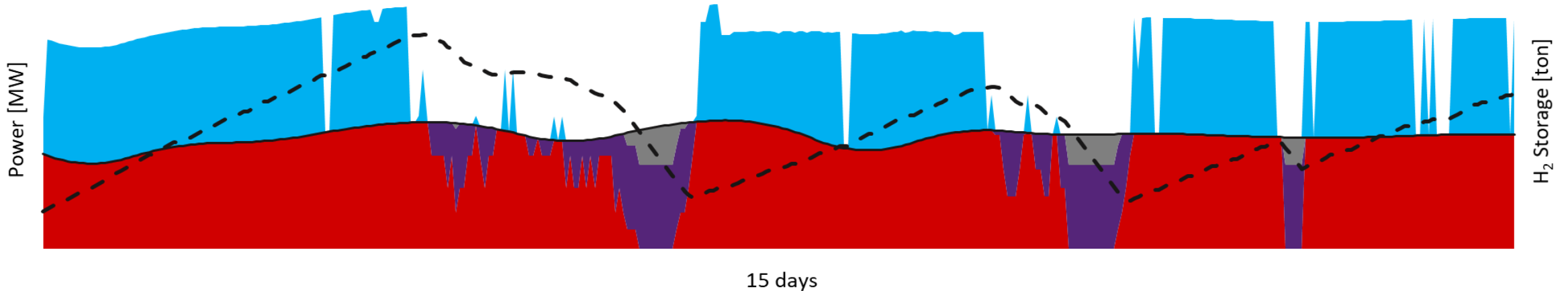
Variables

- Filling of storage
- Size of units

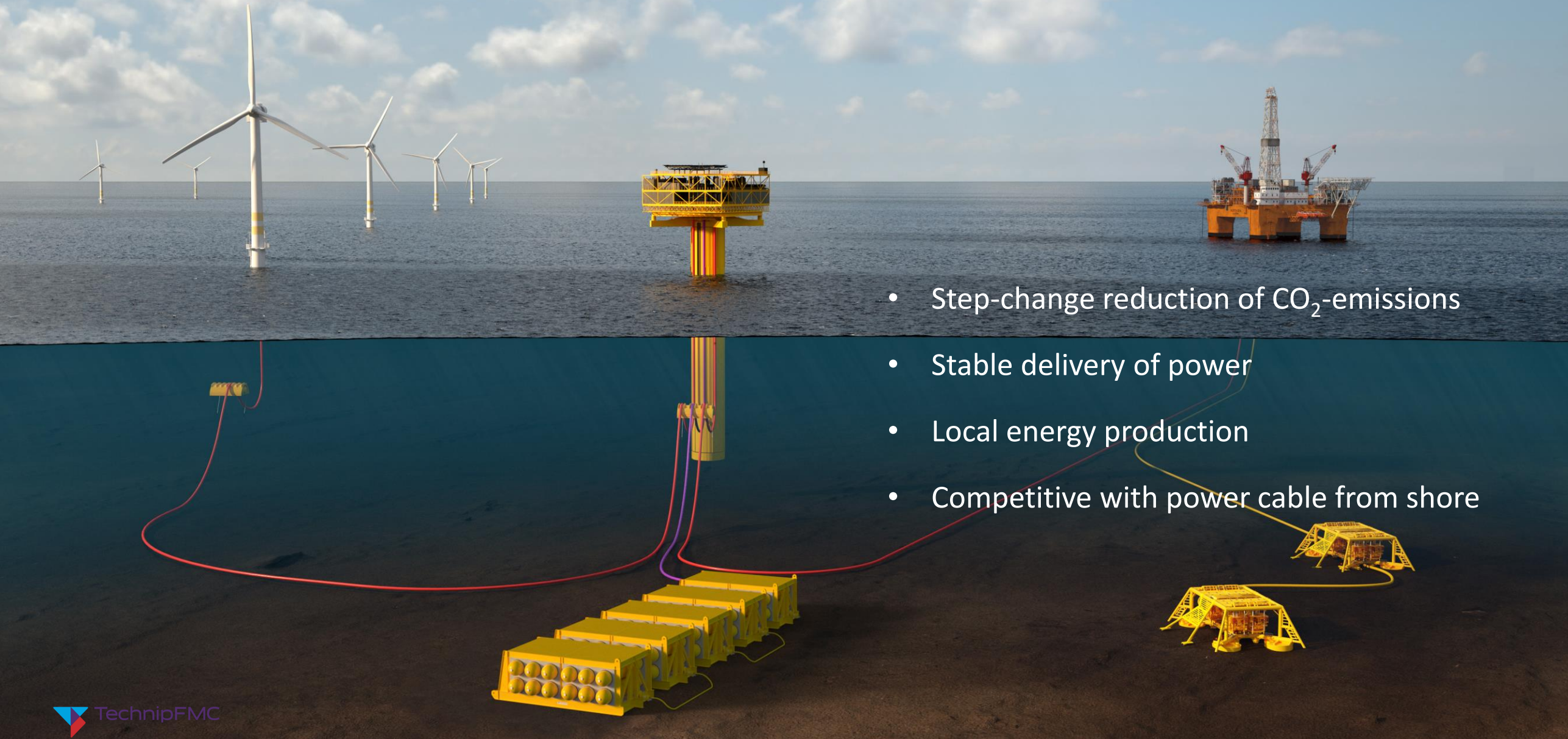


Results

- Lifetime costs
- Size of system

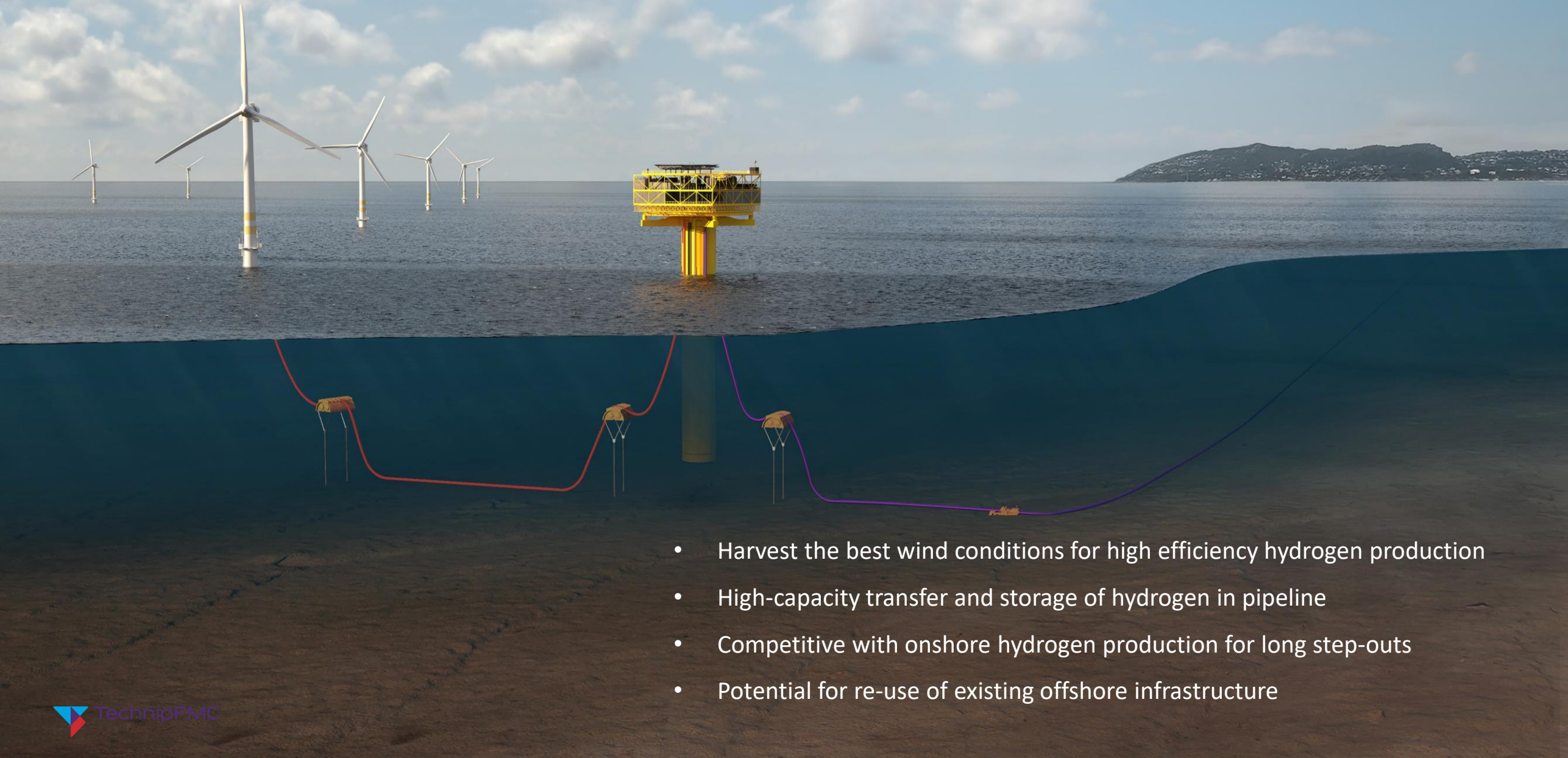


# Deep Purple - stable power from offshore wind to oil&gas installations



- Step-change reduction of CO<sub>2</sub>-emissions
- Stable delivery of power
- Local energy production
- Competitive with power cable from shore

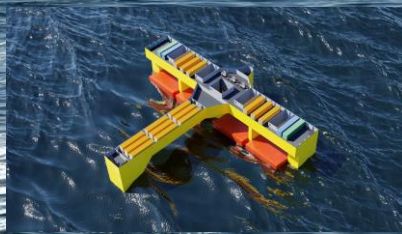
# Deep Purple – Offshore large-scale hydrogen production and distribution



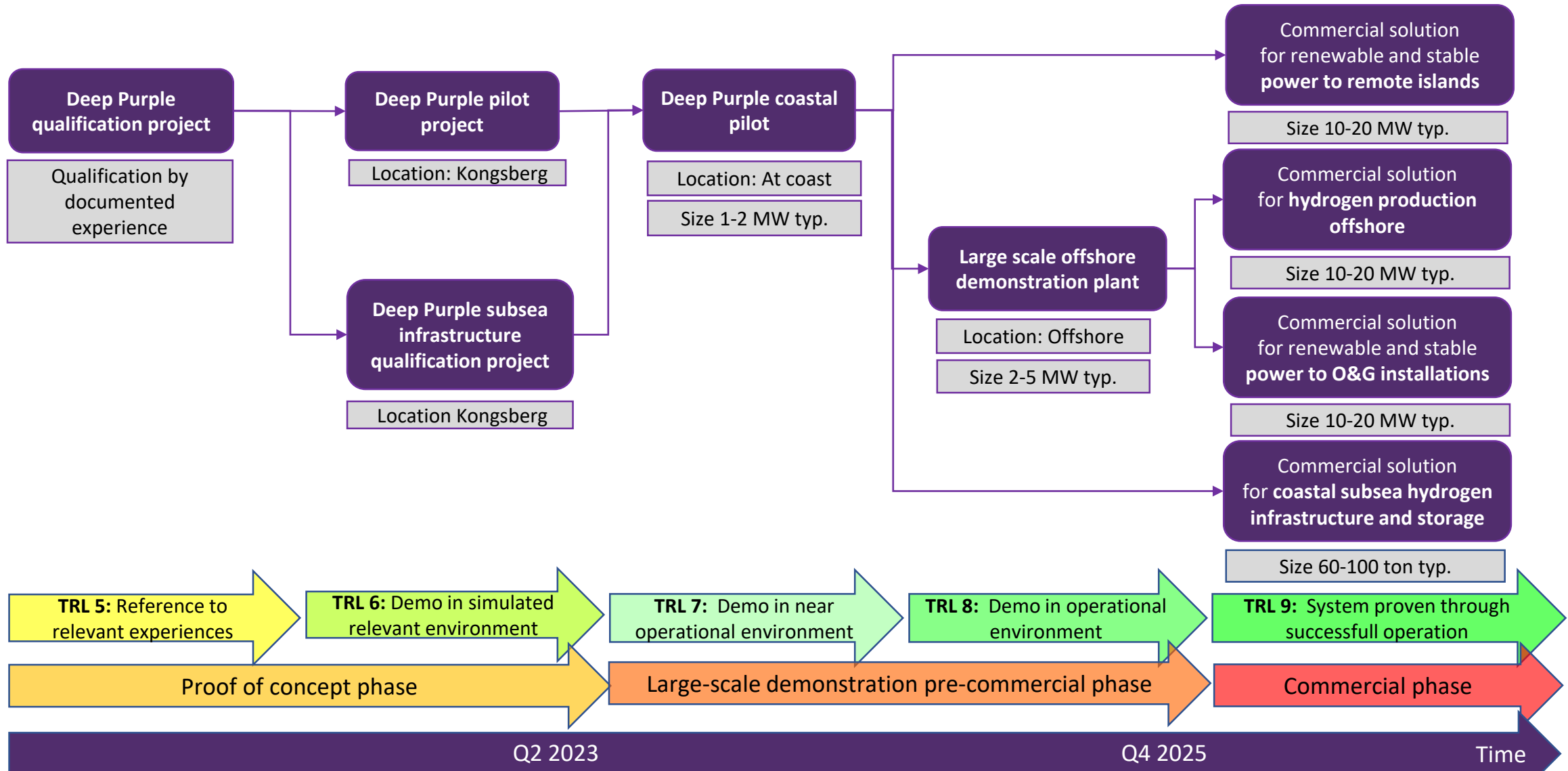
- Harvest the best wind conditions for high efficiency hydrogen production
- High-capacity transfer and storage of hydrogen in pipeline
- Competitive with onshore hydrogen production for long step-outs
- Potential for re-use of existing offshore infrastructure

# O/G Decarb innovation project

- ▶ Integrated wind, wave and hydrogen solution for baseload power to oil&gas installations and remote islands
- ▶ CO<sub>2</sub> reduction potential up to 90%
- ▶ 10 MW wind, 2 MW wave, 16 ton / 300 MWh hydrogen storage with electrolysers and fuel cells



# Deep Purple technology qualification roadmap



# Next step - Deep Purple pilot - for optimized control and operation of coupled offshore hydrogen and wind systems

- Building and operating a 100 kW version with electrolyser, storage, fuel cell, compressor, wind and load emulator
- Test program for optimized operation of offshore wind and hydrogen systems
- Development of advanced control and advisory systems for large scale piloting and commercial projects
- Development of dynamic model and digital twin

