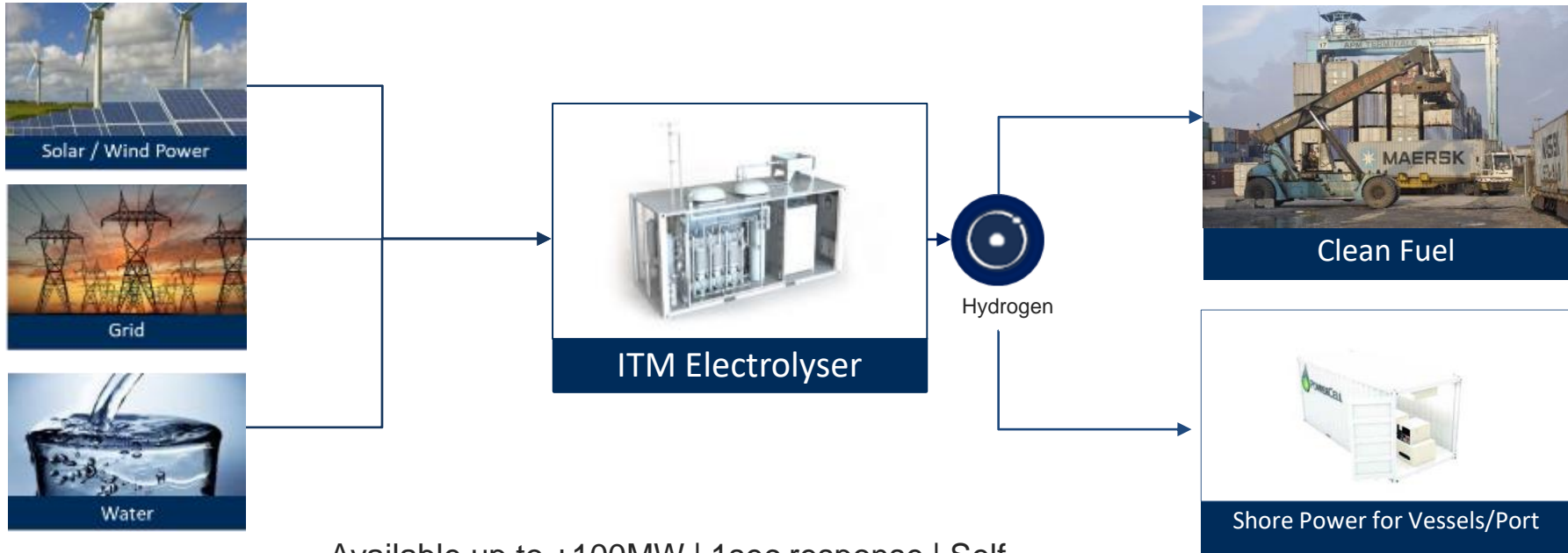


# SECTOR COUPLING AND HYDROGEN IN THE MARINE INDUSTRY AND PORTS

CHBC OCT 2018



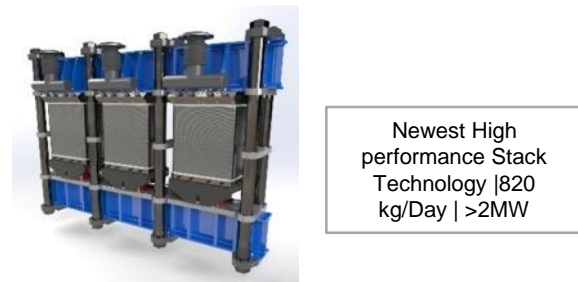
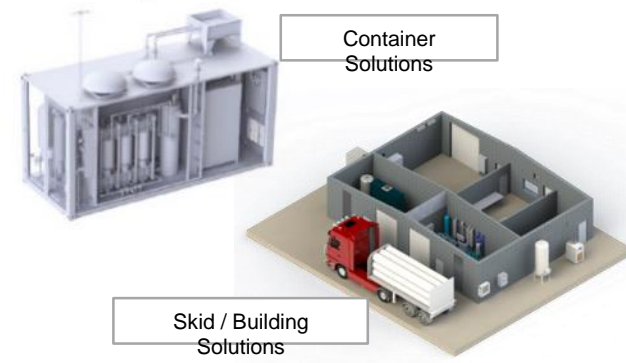
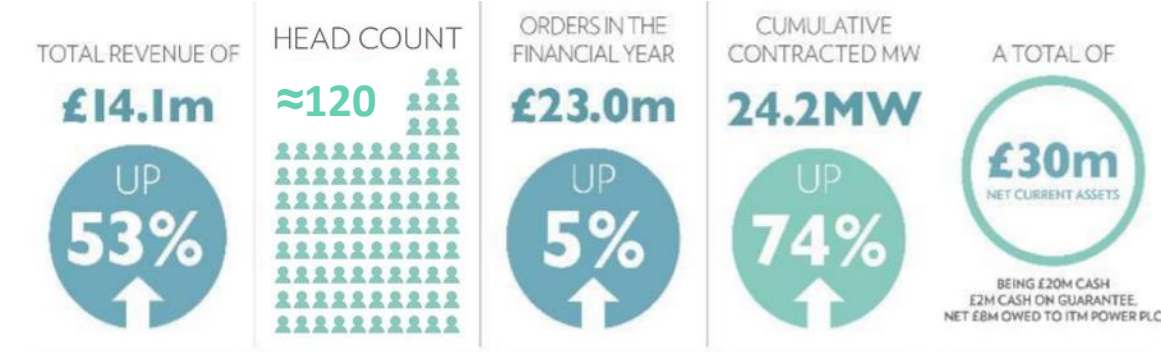
# PROTON EXCHANGE MEMBRANE ELECTROLYSERS – WHAT ITM DO



Available up to +100MW | 1sec response | Self  
pressurising

FACILITATING SECTOR COUPLING  
ENERGY STORAGE | CLEAN FUEL

# ITM – SNAPSHOT OVERVIEW



ITM POWER AT A GLANCE  
ENERGY STORAGE | CLEAN FUEL

# HYDROGEN IN PORTS

## Background

- Many Ports are in cities/towns
- The marine industry as a whole is looking to reduce emissions
- Causing investigation into new fuels and approach changes
- Many options foreseeable – some more challenging than others!
- In-Port diesel GenSet (APU) not a sustainable option
- Installation of shore-to-vessel electrical power = Potentially significant and prolonged interruption
  - Electrical grid limitations call for storage
- Interest in Hydrogen as a fuel and energy carrier growing



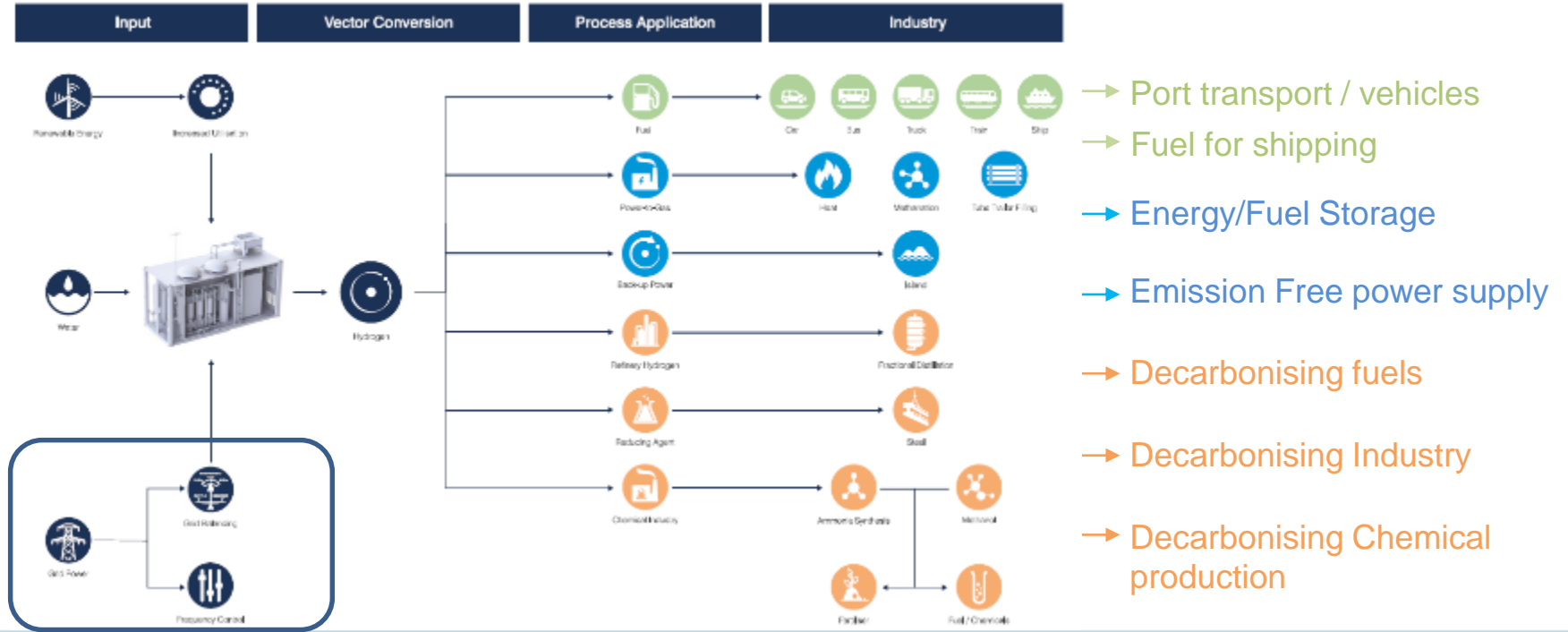
Picture source and full credit: Nikolaos Diakidis

for ships and ports

## WHY HYDROGEN IN PORTS?

### ENERGY STORAGE | CLEAN FUEL

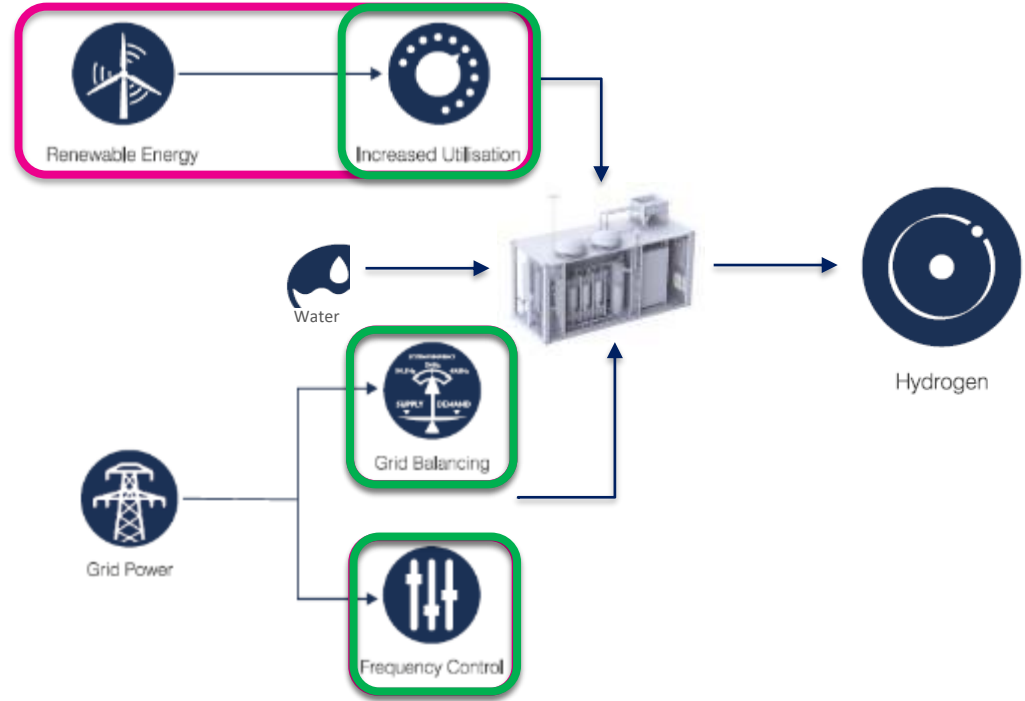
# PEM ELECTROLYSERS – MULTIPLE SECTOR COUPLING



AT THE CENTER IS HYDROGEN  
ENERGY STORAGE | CLEAN FUEL

# PEM ELECTROLYSERS – ADDITIONAL FEATURES

- Multiple cash flows – multiple uses
- Saving money and earning money



California specific:  
SB100 – will increase renewable energy availability and increase requirements for storage

IT'S NOT "JUST" AN ELECTROLYZER  
ENERGY STORAGE | CLEAN FUEL



# MOBILITY: HYDROGEN AS A DIRECT FUEL

## Infrastructure for Forklift trucks

- Small forklift trucks are available to day (USA >16,000)
  - Walmart, Amazon
- Fleets of smaller Fuel Cell Forklift Trucks can be commercially viable today without grants
- Larger Forklift Trucks:
  - Kalmar/Cargotec (Sweden/Finland): Medium-range 9-18 tonnes fuel cell forklift truck project with SSAB & PowerCell
  - Hyster-Yale: Developing 52-tonnes Fuel Cell electric hybrid top-loader



EMISSION FREE TRANSPORT  
ENERGY STORAGE | CLEAN FUEL

# SHORE POWER / MARITIME FC GENERATOR

## Clean Power

- Emission and noise free power !
- Potential uses of such unit;
  - Powering vessels whilst at port
  - Providing backup power and heat
  - Powering refrigerated containers in port

Example: PowerCell (Swedish fuel cell manufacturer) is developing a 3MW fuel cell system housed in a 40foot container;





# WHY ONSITE PRODUCTION / BUNKERING?

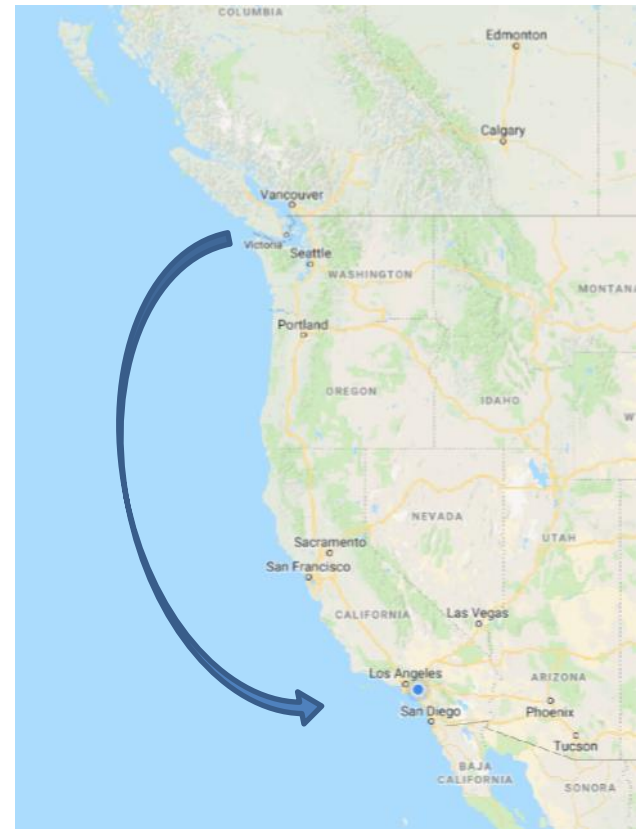
- No Transport costs / supply chain emissions
- Flexible production
  - Decoupling refuelling demand from production – grid stability
- CO<sub>2</sub> + NO<sub>x</sub> + SO<sub>x</sub> free fuel
- Electrical power often abundant (Offshore power)
- Good location for large scale production for other applications
  
- Could also be inland and transported.



VESSEL BUNKERING WITH ON-SITE  
ELECTROLYSIS  
ENERGY STORAGE | CLEAN FUEL

## LARGE SCALE IMPORT – BC TO CA

- Up to 300MW of electrolysis
- 50,000 tonnes per year
- Hydrogen from renewable sources (wind/solar/hydro)
- Transported in tankers as a liquid (LOHC)
- Product moves through port to stations in CA
- Could easily use some of this inside the port
- Removes space and power requirements
- Feasibility study concludes in Q2 2019



# ORKNEY ISLANDS – WIND TO HYDROGEN

Orkney's **challenges** of:

- High curtailment
- Inadequate grid – lots of power
- High fuel prices
- EMEC ITM 0.5MW electrolyser on Eday
- ITM 1MW electrolyser on Shapinsay
- 3+2x tube trailers
- >2000kg of Storage
- 75kW fuel cell powering Kirkwall harbour
- H<sub>2</sub> heating for council buildings
- H<sub>2</sub> refuelling station + 10 FC vehicles in Kirkwall



SECTOR COUPLING PORT PROJECT – WIND TO  
HYDROGEN ENERGY STORAGE | CLEAN FUEL




# BIG HIT

Building Innovative Green Hydrogen  
Systems in Isolated Territories

PARTNERS

 **ITM POWER**  
Energy Storage | Clean Fuel

 **AIRCOMINI**  
WATER SYSTEMS

This Electrolyser is part of a project that has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700092. This Joint Undertaking receives research and innovation funding from the European Union's Horizon 2020 research and innovation programme.





GLOBETROTTER  
ORKNEY

NORTHWA

VOLVO



MN17 VKD

BIC HIT

BIC HIT

17 PB

# SECTOR COUPLING AND HYDROGEN IN THE MARINE INDUSTRY AND PORTS

CHBC SEP 2018

## Summary:

- Sector Coupling an intelligent approach to decarbonising the marine landscape
- Multitude of applications in the ports / marine industry
- PEM electrolysers can provide cash-flows above and beyond the value of the hydrogen in a highly renewable grid environment
- Can be onsite or delivered



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THANK YOU