

# Maritime Hydrogen Panel

## *Hydrogen Role in Ocean Energy*

Ken Dragoon, Renewable Hydrogen Alliance

September 2018



[www.RenewableH2.org](http://www.RenewableH2.org)

# Agenda

- Introductions
- Renewable Hydrogen Basics
- Markets and Economics

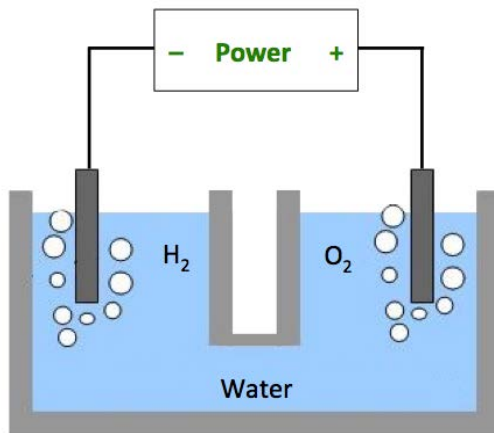
# Brief Introductions

- Ken Dragoon, Renewable Hydrogen Alliance, Facilitator
- David Hume, US Dept. of Energy
- Shanna Brownstein, NW Natural
- Gareth Davies, Aquatera
- Vladimir Shepsis, Coast & Harbor Engineering

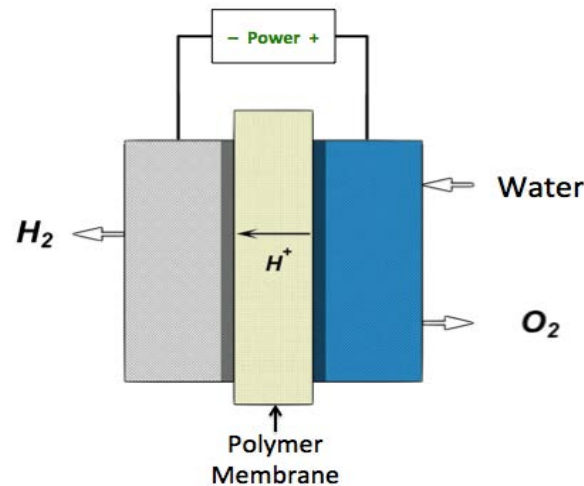
# Technology Basics

- Electricity + water = hydrogen, oxygen and heat
  - 200 year old technology
  - Gases created with this technology are called electrofuels
- Three technologies exist to create electrofuels

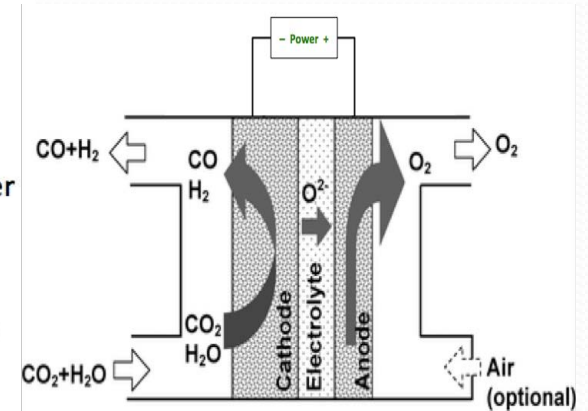
Alkaline



Proton Exchange Membrane (PEM)



Solid Oxide Electrolysis (SOE)



# Hydrogen Uses

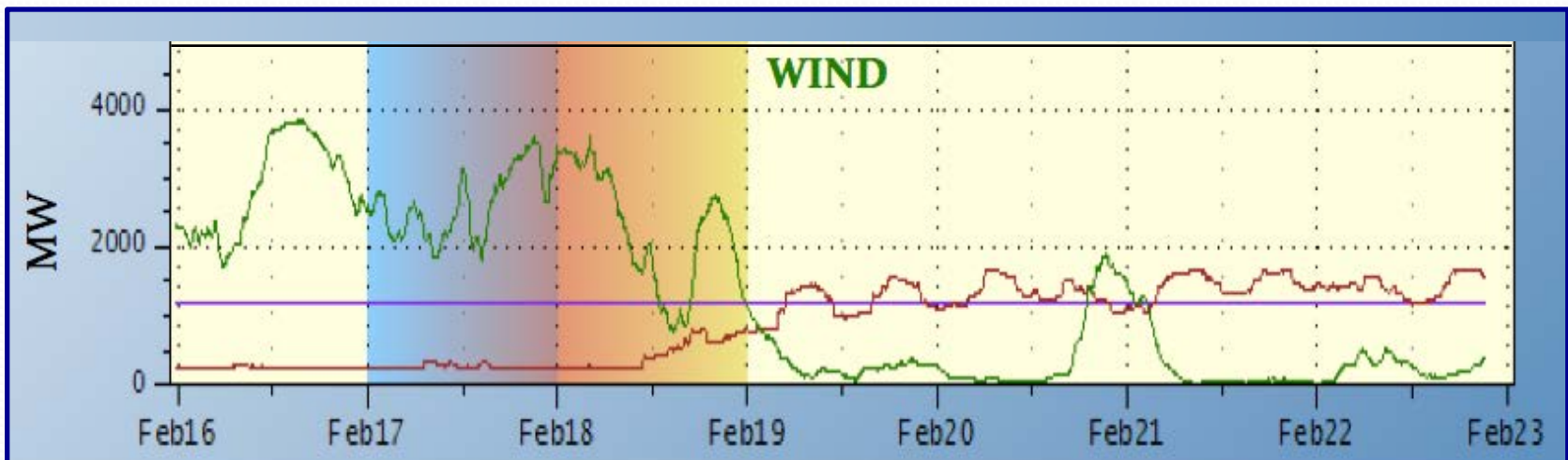
- Hydrogen can be used as a fuel directly
  - New hydrogen vehicles.
  - Can be substituted for natural gas in gas pipeline systems
- About 10 billion kg of hydrogen are produced in the US annually from methane, leaving a large carbon footprint.
- Combines with carbon dioxide to form methane
  - Methane is completely interchangeable in the gas system



Audi Car Company 6 MW e-gas plant in Germany, begun in 2013.

# Renewable Power

- Renewable electricity is the key to reducing carbon emissions
- Future will increasingly rely on renewables
- Issues with relying entirely on renewable electricity
  - Variability
  - Sometimes way too much
  - Sometimes not enough



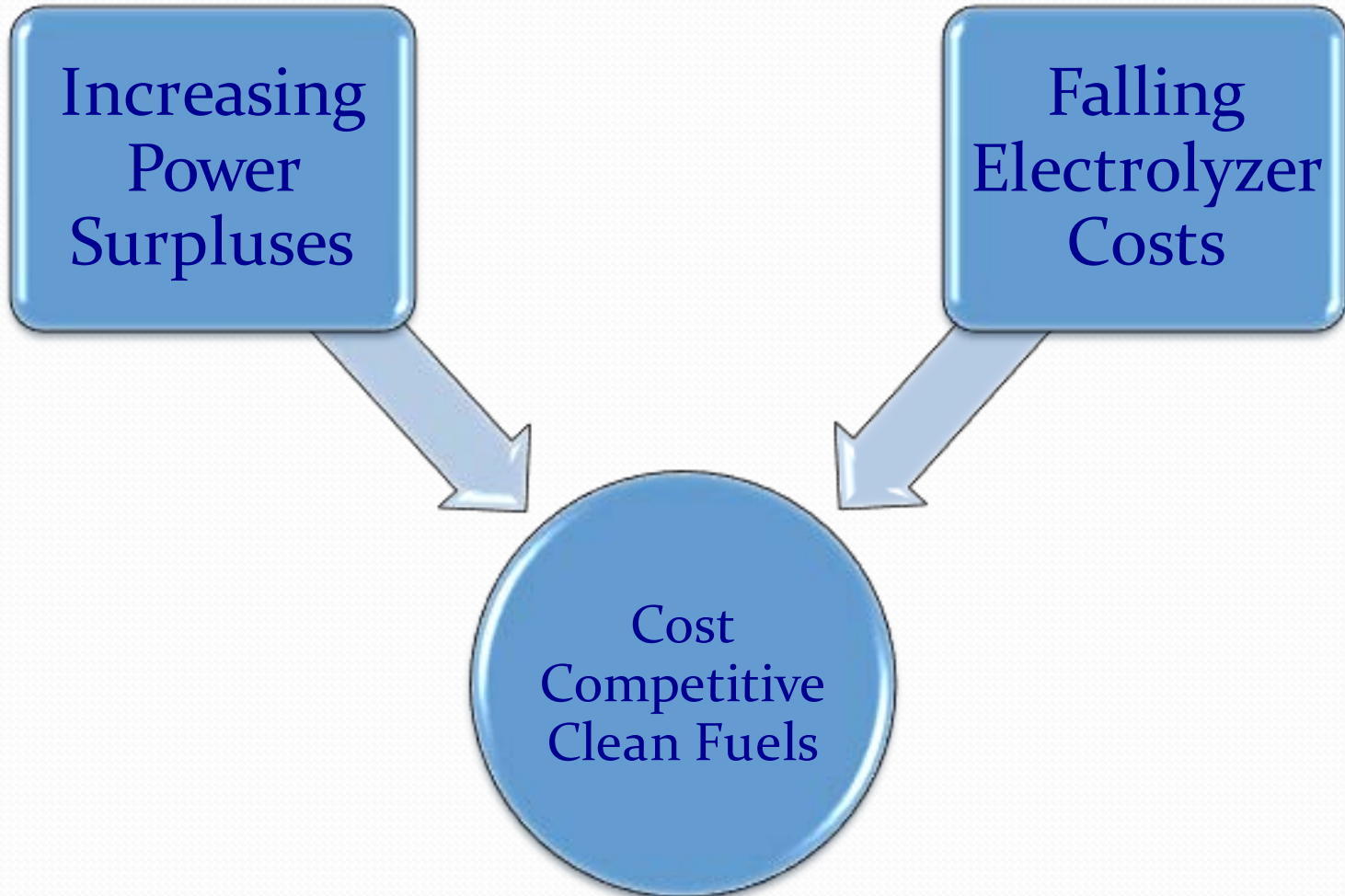


# Technology Costs Plummeting

- Dozens of power-to-gas demonstration projects have cropped up in Europe to absorb renewable power.
- Important result is that electrolyzer technology is experiencing economies of scale—costs are less than half of just a few years ago.



# Economic Convergence





# RHA Advocate for Renewable Hydrogen

- Education
  - Explain role of electrofuels in building electric markets, shoring up wholesale prices, grid balancing, and decarbonization.
  - Provide information clearinghouse and forums for cross pollination across diverse stakeholders.
- Outreach
  - Utilities and renewable energy community.
  - Regulators, legislators, and others that green power to hydrogen is a critical step to reaching climate goals.
- Policy Advocacy
  - Develop and promote effective policies to optimize the use of surplus power.

# Renewable Hydrogen Alliance

[www.RenewableH2.org](http://www.RenewableH2.org)

- New advocacy organization to educate, coordinate, and promote policies conducive to using surplus renewable electricity to produce hydrogen and derivative products.
- Institutions expressing interest to date:
  - American Wind Energy Association
  - **Barlow Strategies**
  - **Bonneville Environmental Foundation**
  - **CEERT**
  - **Eugene Water & Electric Board**
  - **Flink Energy Consulting**
  - **HydroStar USA**
  - **ITM Power**
  - K&L Gates Law Firm
  - **NW Natural**
  - **PERA**
  - **Phoenix Finance**
  - Portland General Electric
  - Proton Onsite/Nel Hydrogen
  - **Puget Sound Energy**
  - Renewable Northwest
  - **Research Strategy Content**
  - Tacoma Public Utilities

# RenewableH2.org for membership Information



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