External Communication & Outreach

HTAC Subcommittee Report
Charlie Freese
May 5, 2017

Subcommittee Membership

- Charlie Freese – **GM** (Sub-Com Chair, HTAC member)
- Katherine Ayers – **Proton Onsite** (HTAC member)
- Gary Stottler – **GM** (Fuel Cell Codes/Standards & Infrastructure)
- Joan Ogden – **University of California Irvine**
- Margo Oge – **US EPA**
- Morry Markowitz – **FCHEA** (HTAC member)
- Levi Thompson – **University of Michigan**
- Margarita Mann – **GM** (Fuel Cell Business Manager)

Special thanks to Vanessa Trejos & Kristen Nawoj – FCTO, Greg Kleen & Deanna Schenk – NREL, & FCHEA staff for their valuable work on this project

Background

The purpose of this subcommittee is to establish a standard communications package that consolidates a vision, clear objective, and supporting messages for implementing hydrogen & fuel cell technology.

It shall begin with a concise “elevator speech,” to identify roles that these technologies serve within future energy & transportation economies.

These messages shall be supported with well vetted proof points and will be targeted toward external audiences, with varied levels of technical understanding & hydrogen related background.

HTAC Charter

This work falls within the HTAC charter to:

"…review & make recommendations to the Secretary on … the safety, economical & environmental consequences of technologies for the production, distribution, delivery, storage, or use of hydrogen energy & fuel cells."

Subcommittee Charter

The product of this subcommittee shall serve as a resource for individuals that are communicating externally and require consistent, accurate data to form their messages. Focus areas will target the following topics:

- Concise elevator speech for "why hydrogen & fuel cells" – where does hydrogen fit?
- Unlocking the value equation in the broader "hydrogen ecosystem"
- Dispel the myths and folklore
- Future vision "hydrogen ecosystem"
- Context for large energy and transportation economy changes
- Current status, accomplishments, & remaining challenges
- Pathway forward with measurable assessment points
- Hydrogen safety
- What is required to address the hydrogen refueling network
- Where to find additional resources and tools
- Connections with Stationary Systems

These communications resources will be vetted with recognized experts. Sources and assumptions shall be clearly documented. The intent is to make this resource into the gold standard for defining accepted hydrogen and fuel cell strengths, weaknesses, future role within the energy/transportation economy, and consolidating status to future targets.

Adopted July, 2016

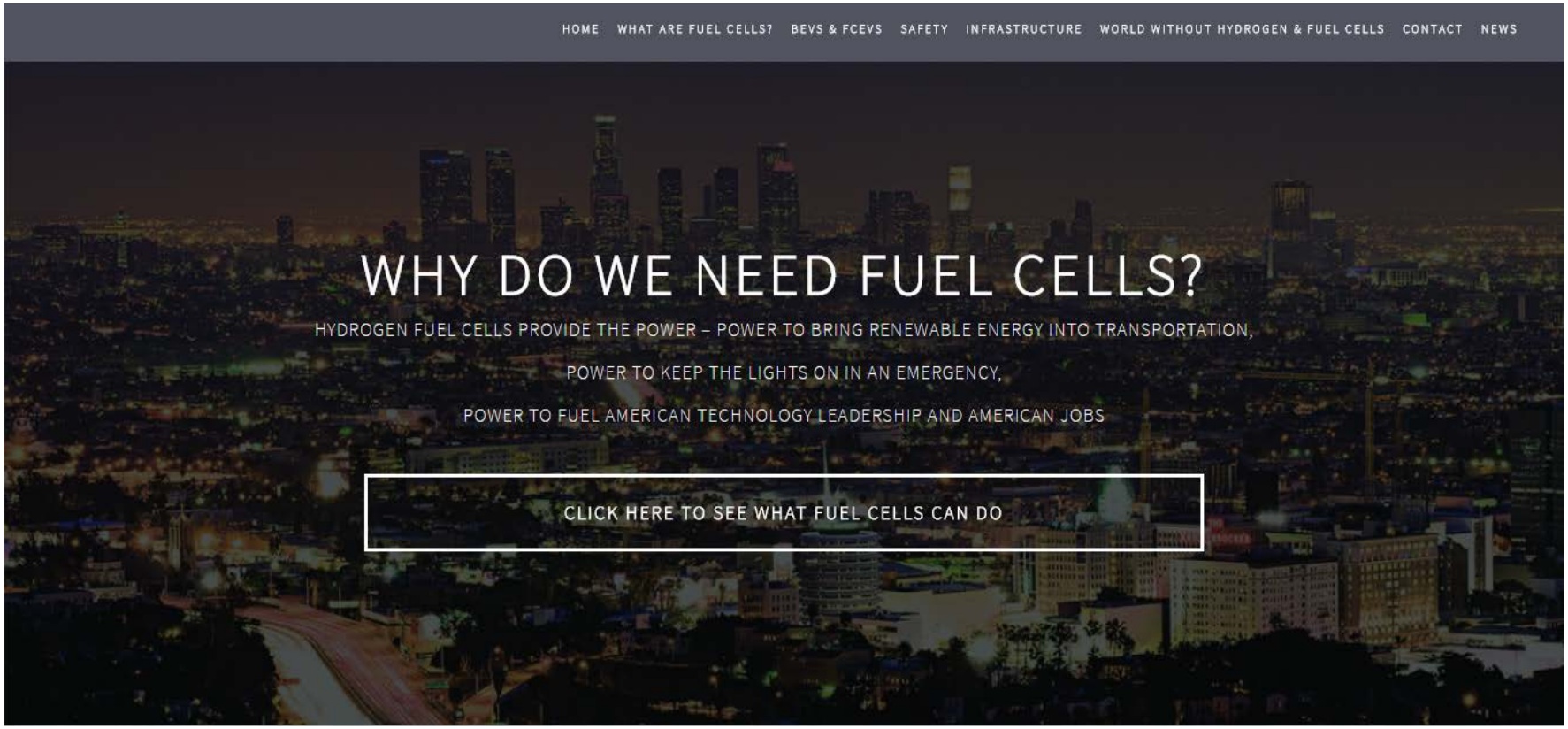
Status

- Message/material drafted by the Subcommittee in 2016
- Reviewed with full HTAC December, 2016
- Feedback from review implemented January–April 2017

Focus Areas for Narrative

- Portfolio Approach is Required (**AND** not **OR**)
  - H_2 Fuel Cells provide **unique solutions to real-world problems**
- Hydrogen is the **Universal Energy Translator**
  - Energy Storage – High Density for Long Time Periods
  - **Grid Modernization Enabler**
- Fuel Cells Provide the Only **"Fast Charging Electric Vehicle Solution"**
  - **Over 300 miles** in **Under 3 minutes**
  - Zero Emissions
- Hydrogen & Fuel Cells are **Safe Technologies**
- Rapidly Accelerating Progress, but this is a marathon

Importance & Presence (Reality)



WHY FUEL CELLS

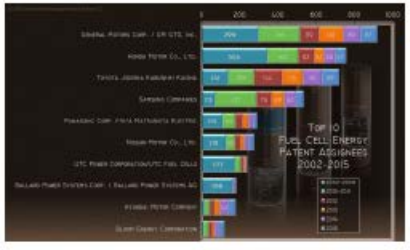
WHY DO WE NEED FUEL CELLS?

FUEL CELLS BRING AMERICAN JOBS AND AMERICAN TECHNOLOGY LEADERSHIP

- There are more than XX US-based companies in the Fuel Cell, Electrolyzer, and FCEV sectors.

- According to the US Department of Energy 2017 Energy and Jobs report, there are currently over 16,500 US employees in the FCEV sector and over 1,500 in the stationary fuel cell sector.

  https://www.energy.gov/sites/prod/-files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf



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  http://www.cepgi.com/2016/10/cep-gi_2015_year_in_review.html

IC POWER GRID
ON SECTOR

o vehicles and industry

Cell

2.8MW Fuel Cell Energy CHP system
example of a clean, efficient fuel cell
rating power for a large industrial site
r a utility to use on the electric grid.

es-to-position-itself-for-future-growth/2/#28bfd5927e10

CKUP POWER

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power
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as validated by NREL

s Backup Power in the United States"
NREL/TP-5400-60730

tations, and public
east Blackout (at right)

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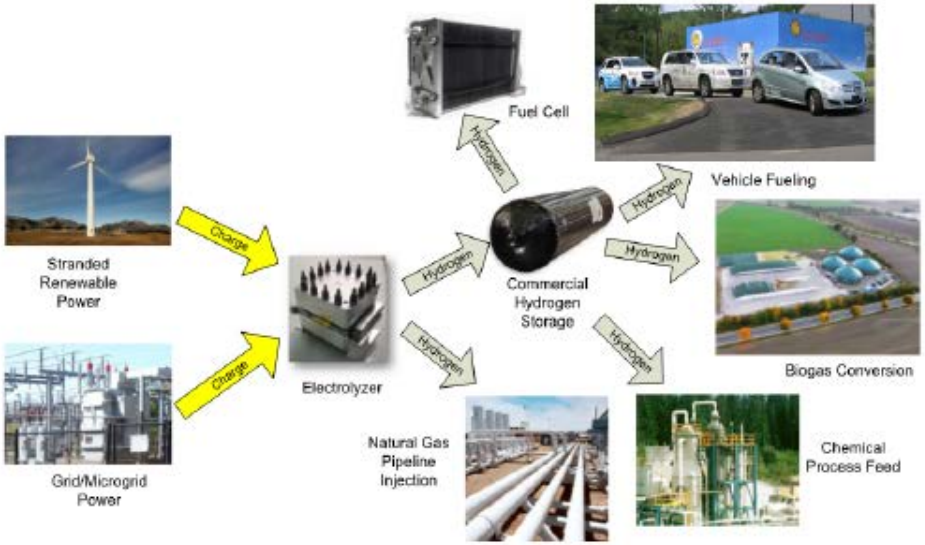
FUEL CELLS IN ELECTRIC POWER GRID & TRANSPORTATION SECTOR

From renewable power to hydrogen to vehicles and industry



- This 2.8MW Fuel Cell Energy CHP system is an example of a clean, efficient fuel cell generating power for a large industrial site or for a utility to use on the electric grid.

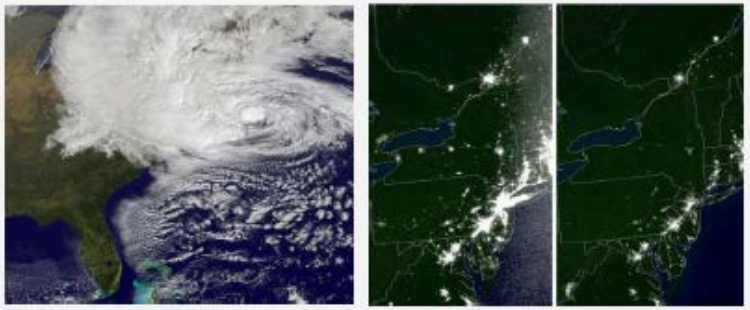
https://www.forbes.com/sites/peterdetwiler/2016/03/11/fuelcell-energy-continues-to-position-itself-for-future-growth/2/#28bfd5927e10

FUEL CELLS BRING BACKUP POWER

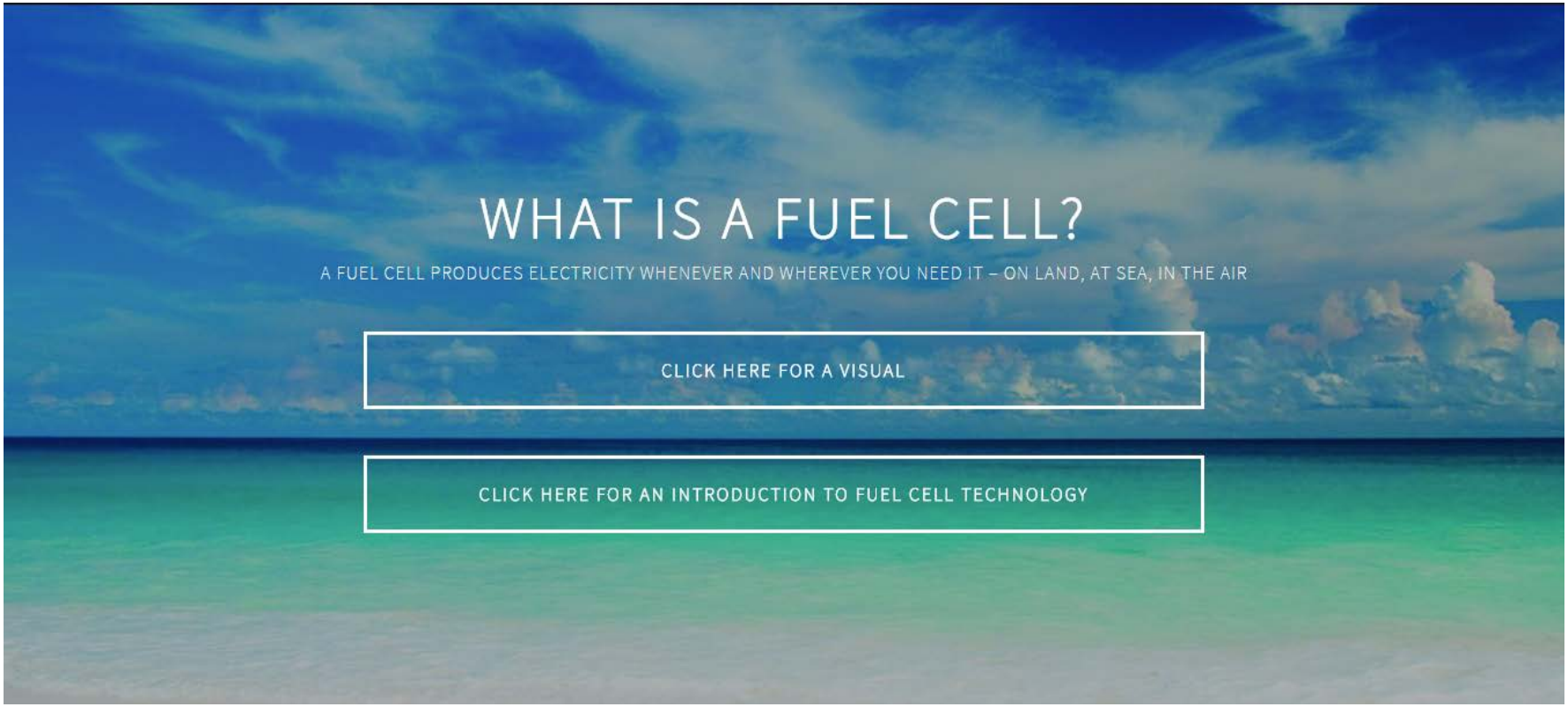
- To business, homes, emergency services, and critical infrastructure
- Clean, quiet power wherever it's needed

Source: *"Hydrogen Fuel Cell Performance as Telecommunications Backup Power in the United States"*
NREL/TP-5400-60730

- Fuel Cells provide power to homes, hospitals, police stations, and public buildings during grid failures such as the 2003 Northeast Blackout (at right) or Hurricane Sandy (left)

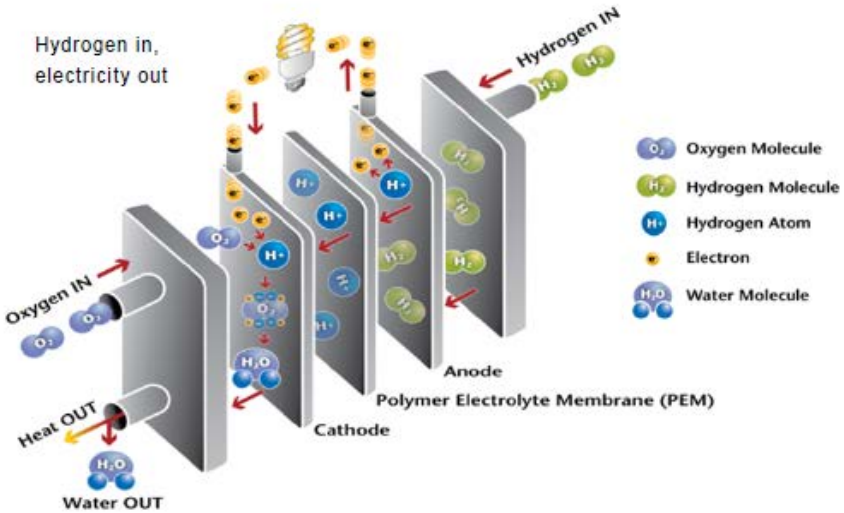


Basic Introduction



FC101

FUEL CELLS - WHAT AND HOW?



For a video showing how a fuel cell works, click here
https://player.vimeo.com/video/194293086?wmode=opaque&api=1&autoplay=1

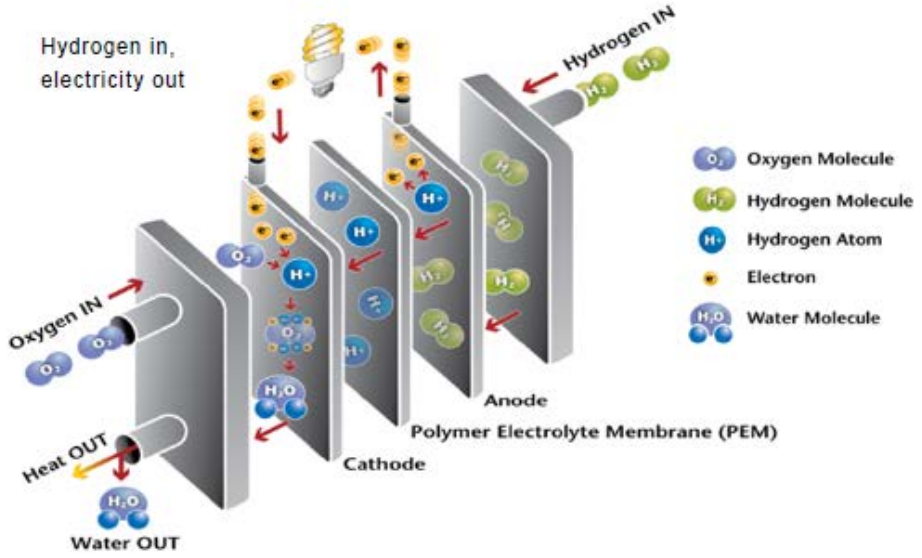
- Electricity produced directly as needed
- No combustion involved
- No pollution in tailpipe emissions
- Twice as efficient as today's combustion engines
- Water and Heat only byproducts

OR FUEL CELLS

ating to more products

FOR HYDROGEN

FUEL CELLS - WHAT AND HOW?



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MANY APPLICATIONS FOR FUEL CELLS

Lower costs, higher durability are translating to more products

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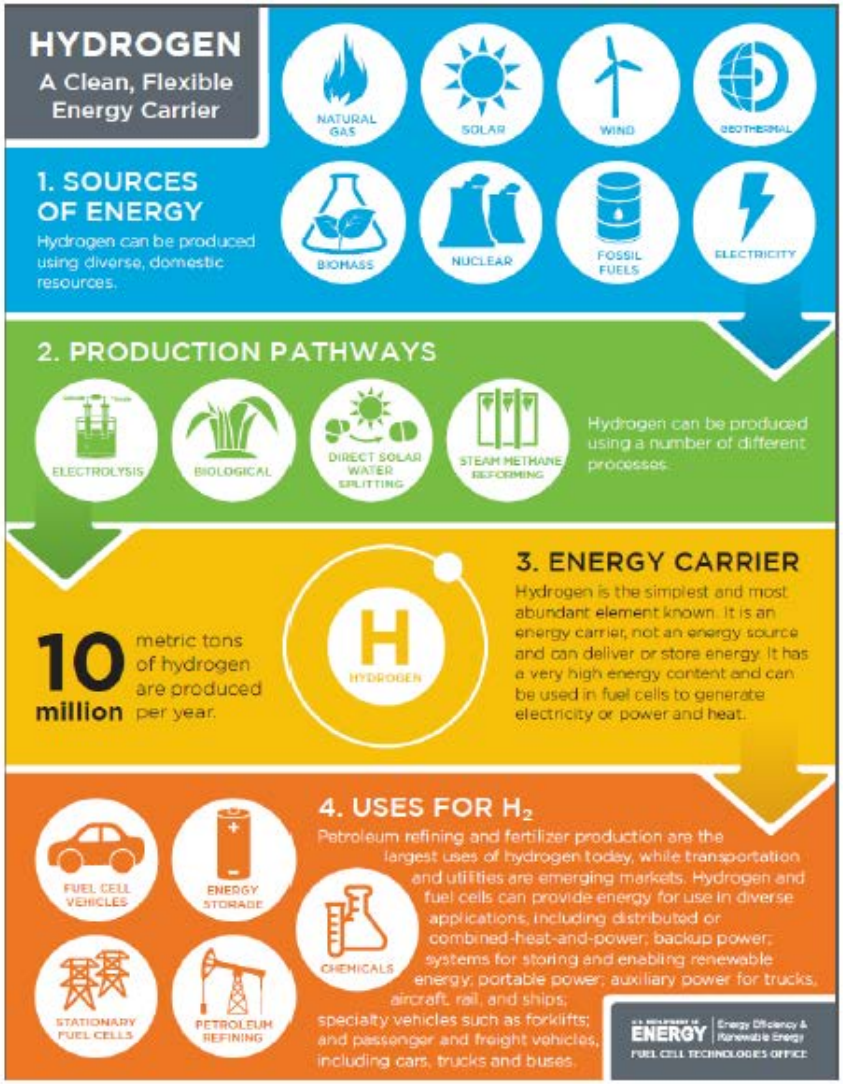
- No pollution in tailpipe emissions
- Twice as efficient as today's combustion engines
- Water and Heat only byproducts

MANY FUEL SOURCES FOR HYDROGEN



Why, When, Where (AND not OR)

BEV FCEV

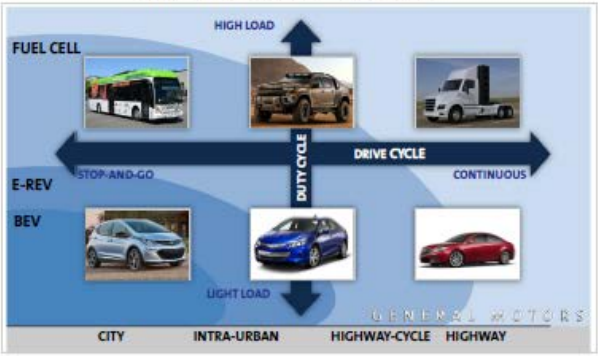
FCEVs & BEVs

HOW DO THEY PLAY TOGETHER?

When is it better to fill up and when is it better to plug in?
Both Fuel Cells and Batteries have a role in clean energy transportation

It is "and"
not "or"

PROPULSION APPLICATION MAP



- A BEV that's going a long distance requires a lot of charging time
- An FCEV that's going a long distance can fill up in 3-5 minutes and be back on the road. Daimler data 36,000 fills, 2.8 min average
- A larger vehicle or one with a heavy load needs more energy, so it has to carry more fuel.

FCEVs & BEVs

TIME

has a different range,
up that matters

r trip
lling

Filling up an FCEV with hydrogen is a lot like filling your current car with gasoline!

opportunity cost)
ctric motor is very efficient

40% efficient
big benefits
utes)
o fill a vehicle.
able electrons are available.

FCEVs & BEVs

ANGE, & EFFICIENCY

ou need it

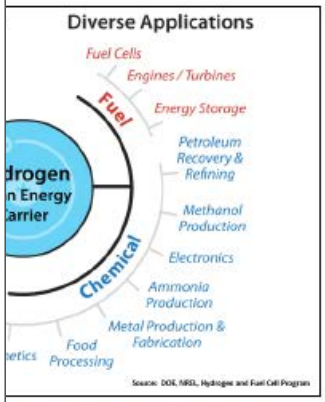
cle quickly with stored energy.

energy when the sun is not shining

le energy when the sun IS shining
t's not when you need to fill up your car
to generate.

ring renewable energy in the form of hydrogen.

wer now to use for transportation fuel later



about "H2@Scale" – the concept of connecting
sing hydrogen
s/h2-scale-potential-opportunity-webinar

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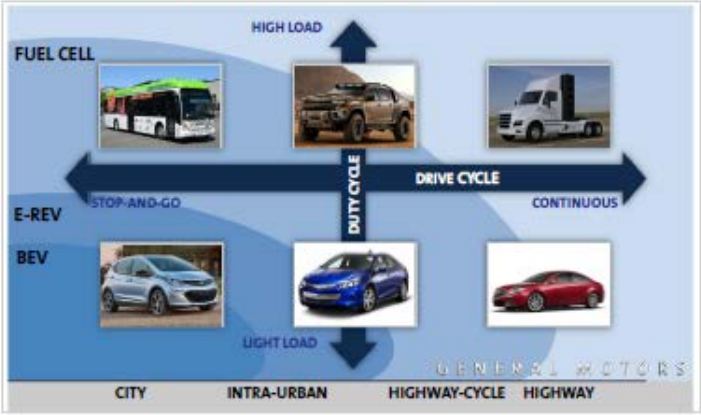

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FCEVs & BEVs

REFUELING TIME

Refueling Time – Since every vehicle has a different range, it is the rate at which you can fill up that matters

Energy Source	Rate (miles of travel per minute spent filling)	Percent of your trip you'll spend filling
Gasoline	150	1-2%
Hydrogen	100	<2%
EV Supercharger	6	15%

Filling up an FCEV with hydrogen is a lot like filling your current car with gasoline!

Speed vs. Efficiency (timing and opportunity cost)

- Charging a battery and then using it to run an electric motor is very efficient
  – over 75% (gasoline/hybrid is 30% efficient)

- Making hydrogen and running a fuel cell is around 40% efficient
  – still almost twice as efficient as gasoline with 2 big benefits
  1. Fast fill-ups (300+ mile range in less than 5 minutes)
  2. Hydrogen can be made, stored, and used later to fill a vehicle.
     Timing is everything – make H2 when renewable electrons are available.

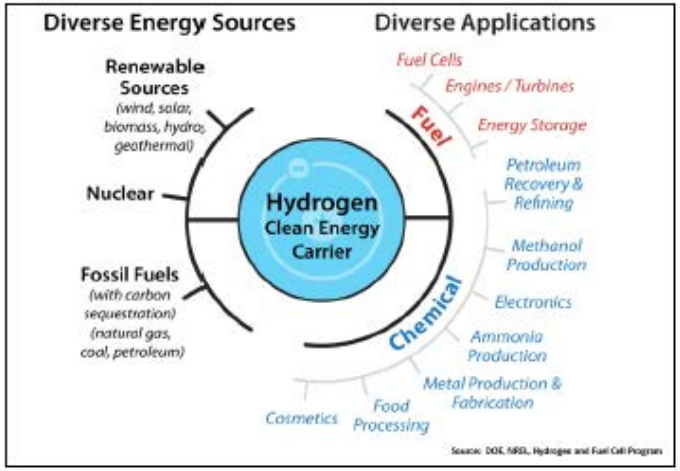
FUELING TIME, RANGE, & EFFICIENCY

In order to be able to use energy when you need it

- You need to be able to fuel your vehicle quickly with stored energy.
- You need to be able to use renewable energy when the sun is not shining and the wind is not blowing.
- You need to be able to store renewable energy when the sun IS shining and the wind IS blowing even if that's not when you need to fill up your car rather than pay windmills/solar not to generate.

FCEVs let you do all these things by storing renewable energy in the form of hydrogen.

Hydrogen lets us store renewable power now to use for transportation fuel later



- Click here for a webinar presentation about "H2@Scale" – the concept of connecting transportation to renewable power using hydrogen

  https://energy.gov/eere/fuelcells/downloads/h2-scale-potential-opportunity-webinar

Hydrogen Safety Emphasis

Safety

HOW DOES HYDROGEN FUEL COMPARE?

We know hydrogen vehicles are safe because

- Hydrogen tanks in vehicles are safe
- Hydrogen vehicles are tested for safety
- Hydrogen fuel dispensers are safe
- Hydrogen fuel is handled safely

Hydrogen fuel is an energy carrier used in a fuel cell to produce electricity for vehicles, buildings, and backup power systems.

Hydrogen fuel (a compressed gas) is produced and shipped all over the world for use in industry. Just like systems for handling natural gas, gasoline, and diesel fuel, modern hydrogen production, storage, transportation, and dispensing systems include multiple safety systems to guard against leakage and shut down if any problems occur.

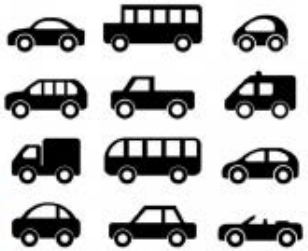
For more information, visit
https://www.hydrogen.energy.gov/advisory_htac.html

http://www.computerworld.com/article/2852323/heres-why-hydrogen-fueled-cars-arent-little-hindenburgs.html

Hydrogen fuel is in gaseous form and is measured in kilograms (kg). 1kg of Hydrogen has the same energy content as a gallon of gasoline

A typical FCEV carries about 5kg of fuel – the equivalent of a 5 gallon can of gasoline for your lawn mower

Hydrogen released into the air does not hang around – it rises at about 45mph (bonus, you can't get it on your hands or your shoes)



Hydrogen-fueled cars meet all of the same Federal Motor Vehicle Safety Standards (FMVSS) requirements and tests as gasoline or battery cars

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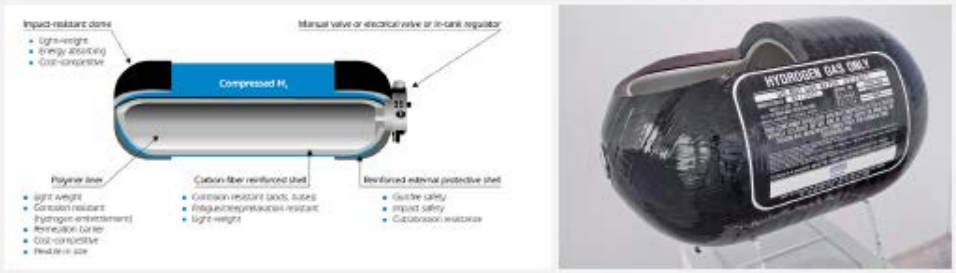
TAKE A LOOK AT THIS HYDROGEN TANK

- It is made of carbon fiber –some of the strongest stuff on Earth.
- It is a cylinder – the more hydrogen (the more pressure) in it, the stronger it gets



- Just look at the tests that get run – tanks are dropped, burned, crushed, even shot

Drop test | 2-ton drop impact test on pressurized tanks | Bonfire test | Gunfire penetration test

Environmental and chemical effects | Hydraulic crush test | Vehicle fire test | .50 BMG gunfire test

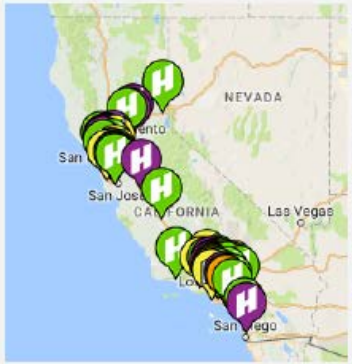
For more information, visit https://energy.gov/sites/prod/files/2014/03/f10/hydrogentank_testing_ostw.pdf

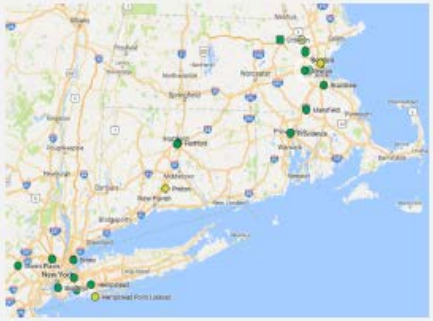
Infrastructure Education

Infrastructure

WHERE DO I GET HYDROGEN?

- Hydrogen for FCEVs is dispensed from a hydrogen pump that looks very much like a gas pump
- Hydrogen pumps are being installed now at gas stations in California and in the Northeast US



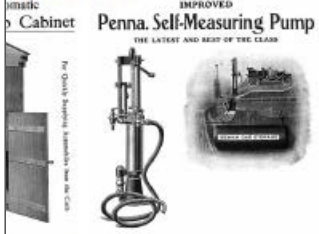


List of hydrogen stations
http://cafcp.org/stations#stations_refilling

Type in your zip code to find the nearest station
http://www.afdc.energy.gov/locator/stations/

HYDROGEN REFUELING
TURE

rly challenges



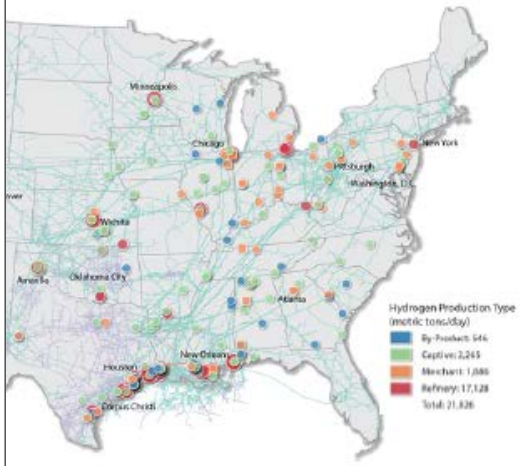
frastructure challenges

technology

WHAT'S THE BOTTOM LINE?

en production facilities in the US

s about 10 million tons of hydrogen per year
o power over 50 million FCEVs



ipelines distribute H2 from
on the Gulf coast and in California

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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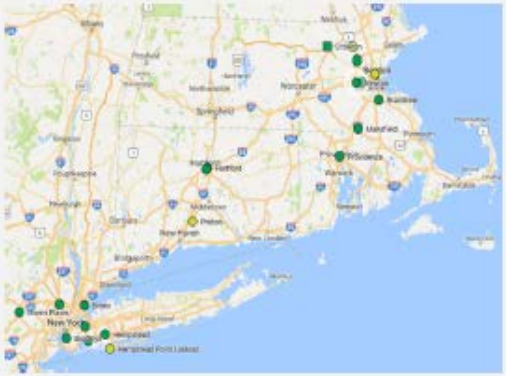

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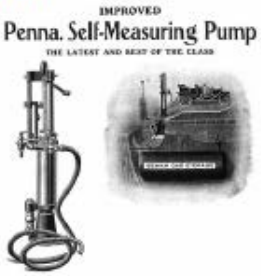
HYDROGEN REFUELING INFRASTRUCTURE

Gasoline was inevitable…despite early challenges



There were road challenges and refueling infrastructure challenges

The infrastructure followed the technology

Hydrogen fuel is inevitable because

- It has the appeal
  Renewable, fast fueling, long range electric driving
- It has the momentum
  More stations opening every month
- It has the demand
  More cars on the road every week
- It has the investment
  Corporate, International, Federal, State

WHAT'S THE BOTTOM LINE?

Hydrogen production facilities in the US

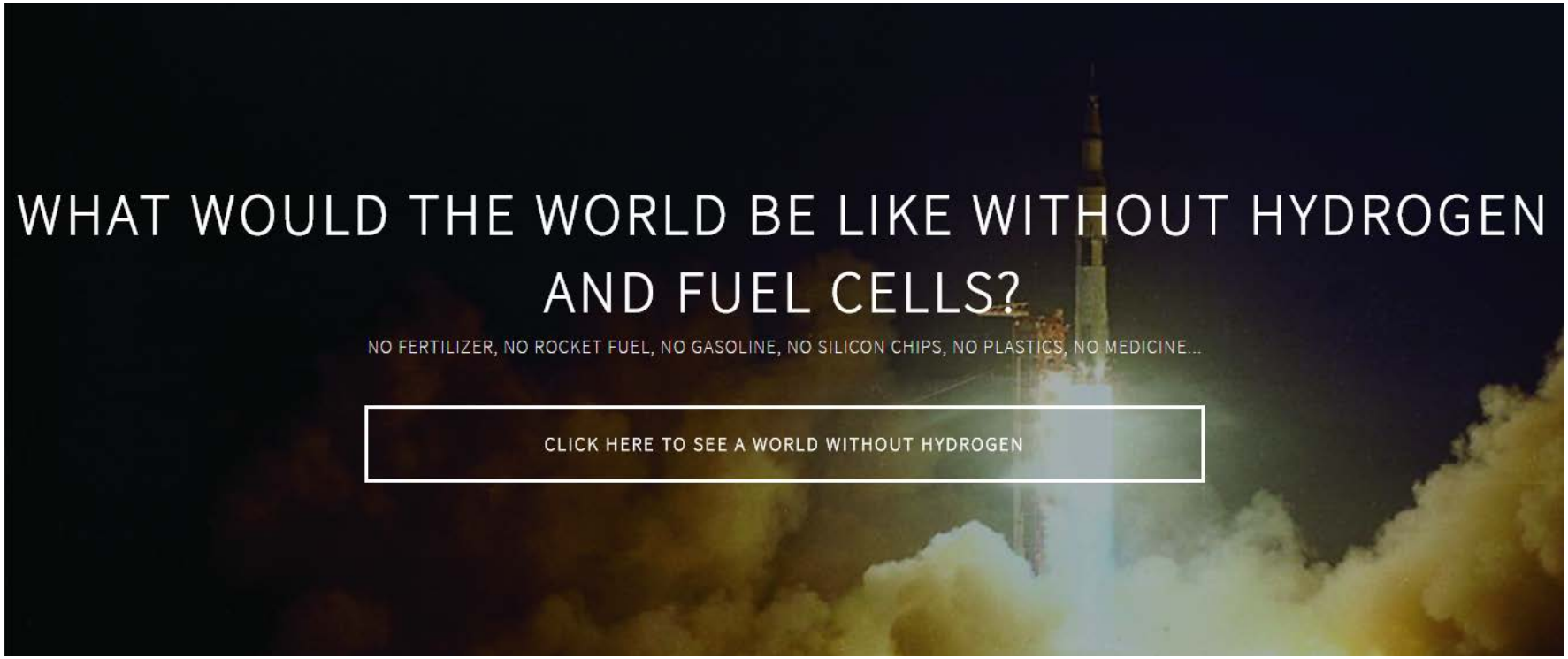
The USA already produces about **10 million tons of hydrogen per year**
Enough to power over 50 million FCEVs

About 1600 miles of Hydrogen pipelines distribute H2 from production sites to major users on the Gulf coast and in California

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

- Fueling is safe, easy, and available, just not everywhere…yet
- Today we're rapidly adding retail stations to the existing US hydrogen production and distribution system
- The H2@Scale concept brings renewable energy into transportation – it allows us to use with renewable power that's available when the electric grid doesn't need it
- United States Hydrogen retail infrastructure investment – at most $24B will deploy nearly 12,000 stations covering the largest 100 metro areas and 130,000 miles of our highway network – enough to put most people within 2 miles of a station

Emphasis on Technological Importance



Current Event Links & Contacts

ABOUT HTAC

TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXTTEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT

CONTACT US

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Summary & Links for Current Events

Challenges

- Uncertain Timing of
  - energy.gov/eere/fuelcells/education website update
  - Note: possible resolution 4/27/17 with opening of "sandbox" for website development
- Additional work needed to implement website from the demonstration materials
- Vetting process required to approve content

Strategic Questions

- How/who will vet materials for accuracy?
  - Initial Deployment
  - Ongoing Maintenance
- How should HTAC materials be linked to other sites?
  - FCHEA
  - H2USA
  - H2MOBILITY
  - CaFCP
  - etc.
- How will we evolve/maintain message & materials over time to ensure ongoing relevance?

Next Steps/Recommended Actions

- Implement HTAC External Communication & Outreach webpage, hosted at EERE Education site (https://energy.gov/eere/fuelcells/education)
- Ensure "mobile friendly" website implementation
- Ongoing materials refinement as deployed & approve external reference links
- Opportunity to redeploy short animated snapshots to educate about fuel cells & hydrogen in less than 5 minutes

THANK YOU