

# Hydrogen and the Law

## Safety and Liability

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# Road Map

- What do we mean by “safe?”
  - Experience with current fuels
    - Puts H<sub>2</sub> in perspective
    - shows what the public, regulators, and insurers deem “acceptable.”
- What about hydrogen?
- Theories of tort liability

# Road Map

## ➤ Bottom Line

- Hydrogen can be as safe or safer than current fuels
  - Many properties of hydrogen are favorable
  - Solid track record
  - Research and analysis suggests no unusual liability concerns
  - Technology, codes, and standards being developed now
- Liability will be directly proportional to success of technology, codes, and standards

# What is “Safe?”

## Natural Gas

### Pipeline Transmission and Distribution

- Between 1986 and 2003:
  - 2406 incidents involving gas distribution
    - 300 fatalities
    - 1364 injuries
    - \$302,540,095 property damage
  - 1467 incidents involving gas transmission
    - 60 fatalities
    - 232 injuries
    - \$365,433,478 property damage

Source: USDOT/OPS



Home service fire (NC)



Storage/distribution fire (PA, CNN)

# What is “Safe?”

## Gasoline Pipeline Transportation

- Between 1986 and 2003,
  - 3302 incidents
  - 37 fatalities
  - 254 injuries
  - \$857,432,100 property damage
  - 1,804,685 bbls net loss



Ruptured gasoline pipeline fire

Source: USDOT/OPS

# What is “Safe?”

## Gasoline Consumer Distribution

- Roughly 7,400 fires and explosions annually
  - two deaths and 70 injuries
  - \$18 million in property damage
  - Gasoline often first material ignited.
  - Static discharge accounted for 3.2 percent of fires that occurred outside vehicles or structures.

Source: NFPA



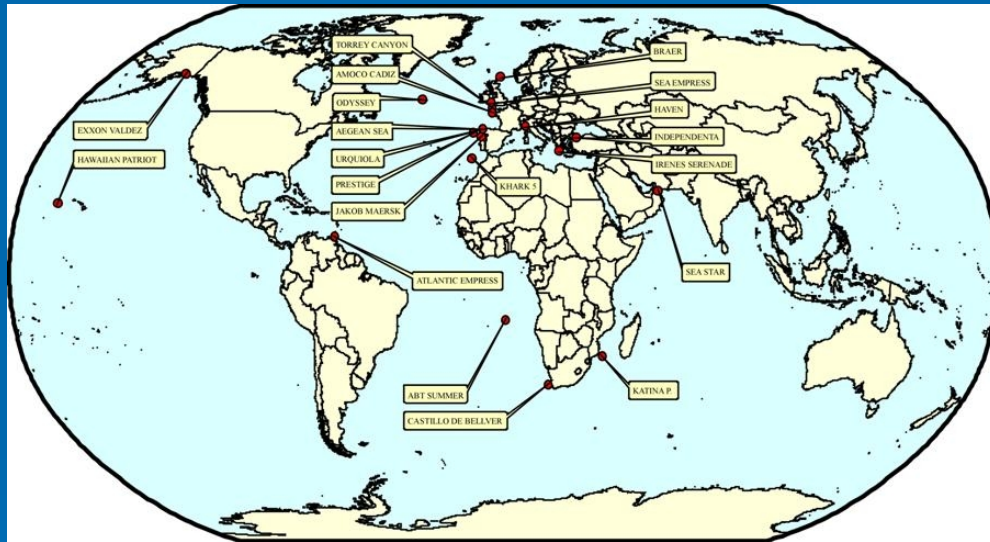
Gas station fire, Nevada



AP/CBS photo of cell phone suspected of igniting gasoline fire (NY)



# What is “Safe?” Oil Environmental Damage



Major Tanker Spills, 1970-Present (Source: ITOPF)



Oiled duck, Prince William Sound  
(Source: Exxon Valdez Oil Spill  
Trustee Council)



Beached oil (Source: FWS)

# What is “Safe?”

## Propane

- **1,600 LP-gas fires in U.S. homes (1998)**
  - 41 deaths,
  - 260 injuries,
  - \$30.8 million in direct property damage.
- **600 gas grill fires/explosions annually**
  - 30 injuries

Sources: NFPA, CPSC



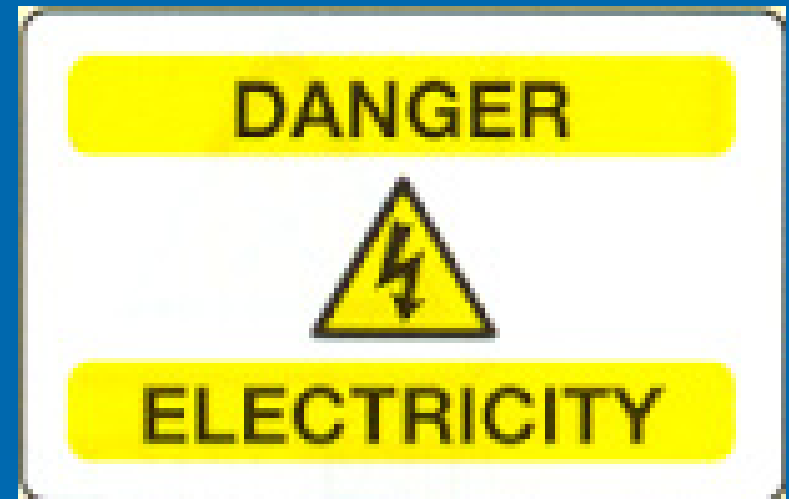
Propane Delivery Truck Fire



# What is “Safe?”

## Electricity

- 38,300 home electrical fires (1998)
  - 284 deaths
  - 1,184 injuries
  - \$668.8 million in direct property damage
- 400 deaths from electrocution (2000)



Sources: NFPA; CPSC

# So What About Hydrogen?

- To date, no widespread, established record in consumer applications
- We do know that:
  - H<sub>2</sub> produced extensively since WWII
    - 9 million tons annual production
    - Over 600 miles of pipelines
    - Routinely transported by truck
  - Some incidents, but not many
  - No reported cases
    - Many cases involving other fuels

# So What About Hydrogen?

- Hydrogen has many “safe” properties:
  - non-toxic.
  - dissipates quickly in open spaces.
    - 14.4 times lighter than air.
  - burns rapidly
  - emits one-tenth the radiant heat of a hydrocarbon fire
  - produces no smoke or emissions

# So What About Hydrogen?

- It is difficult to cause a mixture of air and hydrogen to explode
  - Requires a constrained volume
  - hydrogen/air mixture must be twice as rich as natural gas/air mixture and four times as rich as a gasoline/air mixture.
- explosive power is 22 times weaker than the explosive power of gasoline vapor.
- poses little if any threat to the environment.

# Hydrogen Testing

- Simultaneous hydrogen and gasoline fires
- No damage to hydrogen car
- Gasoline car completely destroyed





# Extensive Analysis

- “No safety issues are foreseen that would warrant cessation of hydrogen as a vehicle fuel.” Idaho National Engineering and Environmental Laboratory (1999)
- “Hydrogen is no more or less dangerous than any other energy carrier” and “has properties that in certain areas make it safer than other energy carriers.” Bellona Foundation (2002)

# Extensive Analysis

- “[H]ydrogen can be produced, stored and dispensed safely.” US Department of Energy
- “[t]he experience with hydrogen in NASA and AEC operations has been extremely gratifying in that relatively few accidents have occurred.” NASA

# Extensive Research



**Bonfire Test**



**Crash Tests**



**Assessment  
after Drop Test**



**Vibration Test**



**Permeation Test**

# Potential Areas for Tort Liability

- Transition to consumer use will create challenges, but no different than other fuels
  - Products liability
  - Negligence
  - Abnormally dangerous activity

# Potential Areas of Tort Liability

## ➤ Products Liability

- General rule: commercial seller or distributor only where product is *defective* and the defect *caused* harm to persons or property. (See Third Restatement of the Law, Torts: Products Liability, Section 1 (1998))
- Types of defects
  - Manufacture
  - Design
  - Failure to warn



# Products Liability

## ➤ Manufacturing Defect

- Generally, must be a problem with the product itself
  - Contaminated gasoline, kerosene, natural gas, and propane cases
    - Contamination caused deviation from regulatory standard, usually resulting in a fire because of reduced flashpoint
- Hydrogen
  - Stringent purity standards under development
    - Potential liability for producing “substandard” hydrogen
  - Likely to see manufacturing defects in storage vessels (e.g., cylinders, tanks, valves, etc.)
  - No different than other fuels

# Products Liability

## ➤ Design Defect

- “the foreseeable risks of harm posed by the product could have been reduced or avoided by the adoption of a reasonable alternative design ... and the omission of the alternative design renders the product not reasonably safe.”

(See Third Restatement of the Law, Torts: Products Liability, Section 2(b) (1998)).

- H<sub>2</sub> is a natural element – can’t be redesigned
- Likely issues will be design of storage systems and devices, valves, piping, etc.

# Products Liability

## ➤ Failure to warn

- Significant research underway on leak detection sensors and odorization
- Potential issue: may be difficult or impossible to odorize H<sub>2</sub>
  - However, law only requires reasonable warnings under the circumstances
    - Third Restatement of the Law, Torts: Products Liability, Section 2, note (i) (1998).

# Products Liability

- Failure to warn
  - Hydrogen no different than other fuels




Natural Gas Pipeline  
Warning Sign



Hydrogen Gas  
Pipeline Warning Sign

# Negligence

## Elements:

- duty to conform to a standard of conduct designed to protect a reasonably foreseeable plaintiff against an unreasonable risk of injury;
  - breach
  - actual and proximate cause; and
  - damages.
- As with other fuels, full range of defenses:
- comparative/contributory negligence
  - compliance with industry standards, etc.
- 



# Abnormally Dangerous Activity

## ➤ Not a likely source of liability

- Usually requires really dangerous activity in an inappropriate location
  - Storing/transporting large quantities of gasoline in a residential neighborhood
  - High explosives
- Hydrogen not that dangerous
- H<sub>2</sub> will become mainstream in the community, just like other fuels are today

# Bottom Line

- Success of technology, codes, and standards will dictate extent of liability
- Training, use of warning labels, etc. will help limit liability

**GASOLINE DISPENSING WARNING**

**GASOLINE HEALTH & SAFETY WARNING**

- EXTREMELY FLAMMABLE, VAPORS MAY EXPLODE.
- HARMFUL OR FATAL IF SWALLOWED.
- LONG TERM EXPOSURE TO VAPORS HAS CAUSED CANCER IN LABORATORY ANIMALS.
- KEEP FACE AWAY FROM NOZZLE WHILE FILLING.
- KEEP NOZZLE AWAY FROM EYES AND SKIN.
- NEVER SIPHON BY MOUTH.
- DON'T OVERFILL TANK.

**FOR USE AS A MOTOR FUEL ONLY**

**STATIC ELECTRICITY/ SPARK EXPLOSION WARNING**

- DO NOT GET BACK IN YOUR VEHICLE WHILE REFUELING.
- REENTRY COULD CAUSE STATIC ELECTRICITY BUILD UP.

**ELECTRONIC DEVICES WARNING**

- KEEP CELLULAR PHONES OR OTHER ELECTRONIC DEVICES IN YOUR VEHICLE DURING REFUELING.

**PORTABLE CONTAINER WARNING**

- USE APPROVED CONTAINER.
- PUT CONTAINER ON GROUND (NEVER ON OR IN A VEHICLE).
- KEEP NOZZLE IN CONTACT WITH CONTAINER.



# Bottom Line

- Focus on the “negative” qualities of H<sub>2</sub> is a red herring
  - All fuels are potentially dangerous
  - “Safe” is a relative term – does not mean incident free
  - “Safe” is a function of the technology, codes, and standards surrounding the use of the fuel

# Bottom Line

- Strong public policy rationale also may lead to limited liability
  - Need exit strategy for Mid-East oil addiction
  - Need cleaner sources of energy