Calistoga Frequently Asked Questions

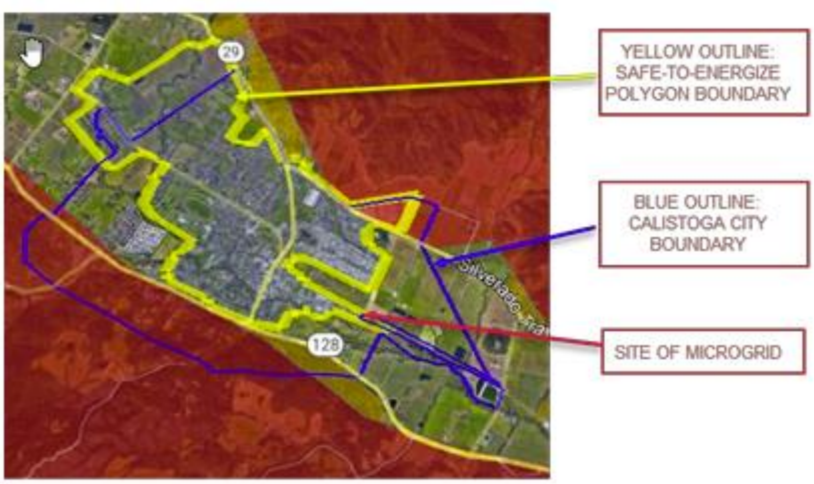
1. **How does the Calistoga Resiliency Center work?**

   Answer: The CRC is a hybrid energy storage and power generation facility utilizing lithium-ion battery and green hydrogen fuel cell technologies. It is a permanent stationary installation sited on land leased from the City of Calistoga.

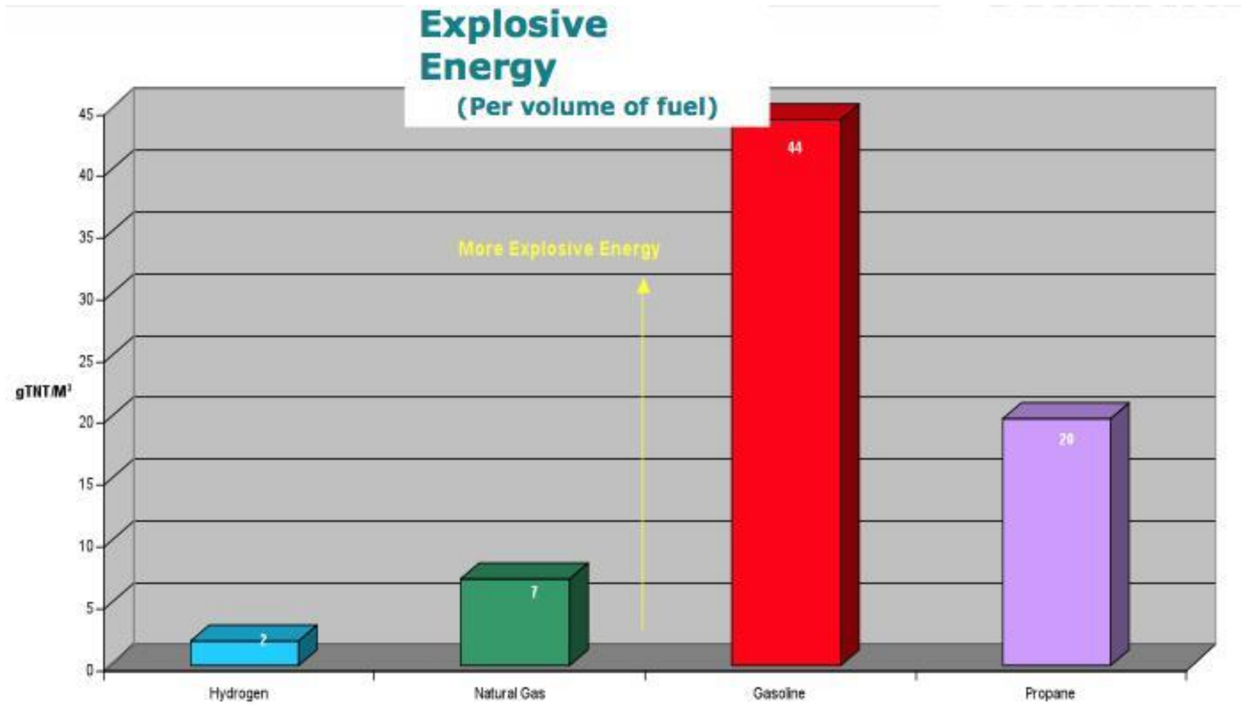
   The green hydrogen used at the CRC is produced via an electrolysis process powered by renewable energy or non-fossil feedstock resources compliant with California's Renewables Portfolio Standard (RPS). This renewably green hydrogen is produced and delivered to the CRC's onsite liquid hydrogen storage tank. During system operation, green hydrogen is fed into the CRC's fuel cell array, producing power for the Calistoga microgrid.

   The site maximizes operational efficiency by capturing the small amount of daily liquid hydrogen boil-off to power the standby power needs of the CRC, including auxiliary power for batteries and other installation power needs. While the onsite batteries will be primarily charged via this excess power from the fuel cells, the site can also utilize its interconnection to draw power if needed.

2. **What area will be part of the Microgrid?**
   Answer:



3. **What makes hydrogen safe?**
   Answer: Hydrogen is less combustible: gasoline in the air is flammable at a lower concentration limit of 1.4%, compared to hydrogen's 4%. To put it another way, gasoline is two to three times more flammable in the air. The optimal mixture for hydrogen combustion is 29%—which in the real world is quite unusual, since hydrogen rises and will generally diffuse. Gasoline vapor's optimal mixture for combustion is only 2%—a ratio that is very easy to reach.



The worst-case explosion scenario for each fuel. Hydrogen gas does not have a lot of "bang-power" volume-wise compared to other common fuels.

Additionally, hydrogen in liquid form will quickly vaporize and dissipate, unlike gasoline which will continue to be present indefinitely as an explosive/combustible hazard and later as an environmental hazard.

4. **What is the impact of a hydrogen explosion?**
   Answer: The flames emit low radiant energy, which means they're less likely to move to surrounding areas and spread fire. It is 14 times lighter than air: if released, hydrogen disperses quickly, rising into the atmosphere at a rate of 20 meters per second (at normal ambient temperatures). In comparison, propane and gasoline vapor are heavier than air. If released, they pool at ground level, where any accidental ignition presents a clear danger to the surrounding area.

5. **What happens if someone shoots at the tank?**
   Answer: If a hunter shoots at a hydrogen tank, small caliber bullets will simply bounce off the outer tank. Larger caliber bullets will likely be slowed by the 0.5 inch mild steel of the outer tank, and will bounce off the much thicker inner tank with zero impact. In the unlikely event that the tank were to be penetrated, it would begin releasing hydrogen to the atmosphere through the hole. The hydrogen inside the tank is pure hydrogen, and without oxygen cannot combust. The venting hydrogen poses risks of small fires if an ignition source were present, though such fires would be small and localized. Under no circumstances can a bullet cause a Hollywood-style explosion.

6. **What is the difference between gas and liquid hydrogen?**
   Answer: There are two ways to store hydrogen, one is either as a highly compressed gas, or as a very cold/refrigerated liquid. If gas storage is utilized this is typically at ~3,000 psi. Note this is common for hydrogen powered cars. Larger installations (such as the proposed one at Calistoga) are typically liquid hydrogen. While these installations require extra insulation, they are typically safer as the liquid is stored near ambient pressure, not as a highly pressurized gas. This offers the benefits of:
   - Reduced hazard relative to gas stored under high pressure.
   - As liquid hydrogen must first vaporize to gas, and then mix with oxygen to be flammable, an extra degree of safety is afforded.

7. **How is there not going to be a Hindenburg-level explosion?**
   Answer: Airships have the challenges of needing to keep additional combustible materials and fuels(for propulsion engines, cooking and structure) in very close proximity to the hydrogen gas(on the same air ship). The liquid storage tank proposed at Calistoga is over 0.75" thick of steel designed to be 4 times stronger than it needs to be and inspected per a very stringent code required per the American Society of Mechanical Engineers(ASME). The steel is not flammable in hydrogen, and anything that could be potential combustible is geographically separated by requirements given by the National Fire Protection Association Code(NFPA)

8. **What is the largest hydrogen tank + fuel cell deployment in USA?**
   Answer: Liquid Hydrogen Storage tanks are installed extensively across the United States. Some of the largest installations would be the Space Shuttle Liquid Hydrogen tank at 1,250,000 gal. Common installations across the United States range from 10,000 for 240,000 gallons for domestic hydrogen usage, with 20,000 gallons being a common size situated behind Amazon/Walmart warehouses to support fuel cells driving forklifts.

9. **What makes this project unique? Understanding that hydrogen fuel cells + tank is common practice; is it just the batteries that are coupled?**
   Answer: Most existing fuel cell plants follow the grid's load and simply inject power as needed. As Calistoga will operate independent from the power grid, the fuel cells and batteries have to work together to form the sinusoid of the power grid and "react" to the load of the city. This is the largest reactive power deployment in the US yet, but the technology has been demonstrated to 2 MW and scaling is not a problem.

10. **How does a hydrogen fuel cell work?**
    Answer: A fuel, such as hydrogen, is fed to the anode, and the air is fed to the cathode. In a hydrogen fuel cell, a catalyst at the anode (water) separates hydrogen molecules into protons and electrons, which take different paths to the cathode. The electrons go through an external circuit, creating a flow of electricity.

11. **How is the green hydrogen produced for this project?**
    Answer: Green Hydrogen is produced through a process called electrolysis, which is powered by renewable electricity compared to fossil fuels. Green hydrogen has the potential to reduce fossil

fuels in hard-to-abate sectors like long-haul trucking, steel manufacturing, aviation and grid reliability.

12. **How does this project compare to the diesel onsite?**
Answer:

System Parameters	Existing Diesel Generators	Battery + Fuel Cell Microgrid
System Owner and Operator	PG&E	Calistoga Resiliency Center, LLC / Energy Vault
Generation Type	Temporary Level 4 Diesel	Stationary Hydrogen Fuel Cells and Lithium-Ion Batteries
Fuel Type	Diesel #4 (4-D)	Liquid renewable green hydrogen
Total Fuel Storage Capacity	10,220 gallons	80,000 gallons
Duration of Operation in islanding Mode	8-10 hours	48 hours
System Refueling Time	1-2 hours	3-4 hours
Point Source GHG Emissions	194 lb CO_2e/MWh	0
Particulate Emissions	0.1399 NO_x	0
Site Footprint	1/3 acre	2/3 acre
Noise	72dB at 10 meters	68dB at 10 meters