HYDROGEN AND HYDROGEN BLENDING

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Research, Development and Demonstration

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SoCalGas™

SHAPING THE FUTURE:
SoCalGas Overview

In business for over 100 years and headquartered in Los Angeles, SoCalGas® is North America's **largest gas distribution utility.**

Serving 22 million consumers across **24,000 square miles** of Central and Southern California with affordable, reliable, and increasingly renewable gas service.

SoCalGas's mission is to build the **cleanest, safest and most innovative energy company in America**.

SoCalGas has committed to the goal of achieving **net zero greenhouse gas emissions** in its operations and delivery of energy by 2045 while keeping bills affordable for customers.

SoCalGas's recent **economy-wide technical analysis** shows how clean fuels like green hydrogen can help California achieve its net zero goals more affordably and with less risk than other energy pathways.

Journey to Become the Cleanest, Safest, Most Innovative Energy Company in America

Climate Goal

- Announced goal to be net zero by 2045
- Became the largest gas distribution utility in the nation to include scopes 1,2, and 3
- Aligned with California's statewide decarbonization goals and the global Paris Agreement climate emissions

ESG Financing Framework

- Aligns our investments/activities with our sustainability goals to help drive our environmental, social and governance (ESG) commitments to support long-term, sustainable value for all shareholders and our other stakeholders

Angeles Link

- Announced proposal to develop the nation's largest green hydrogen energy infrastructure system to deliver clean, reliable energy to the Los Angeles basin
- Goal to drive deep decarbonization in hard-to-electrify sectors of the Southern California economy

MARCH 2021 | OCT 2021 | NOV 2021 | JAN 2022 | FEB 2022

Clean Fuels White Paper

- Published a California economy-wide assessment of an integrated energy system
- Key study findings note the importance and requirement of a clean fuels network to achieve an affordable, resilient, and risk mitigating solution that supports electrification

ASPIRE 2045 – Sustainability Strategy

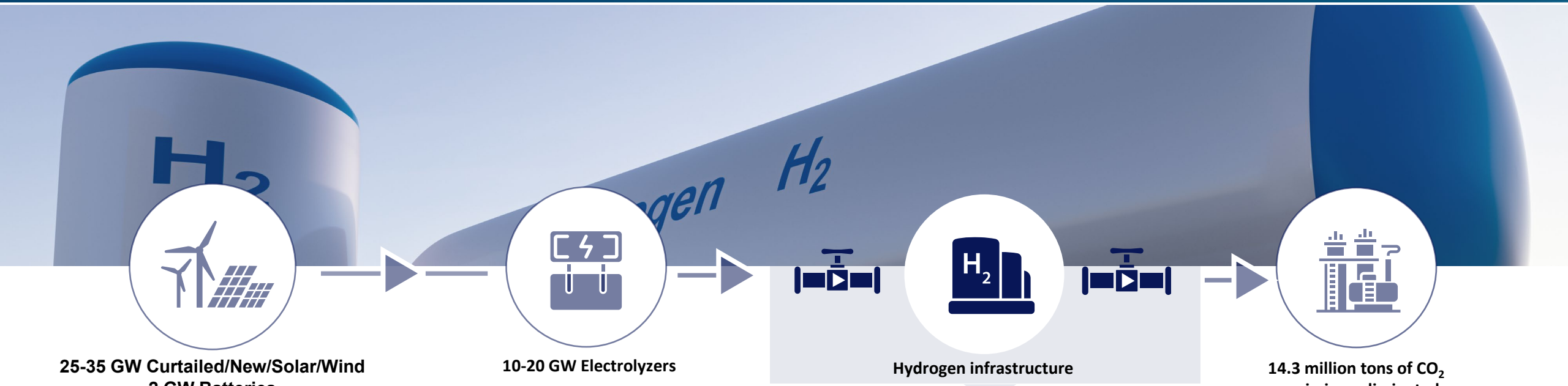
- Holistic approach to integrating sustainability across entire business to create positive impact and strengthen business outcomes
- Five strategic areas to support our business in being the cleanest, safest, most innovative energy company in America as we advance our climate objectives

Angeles Link:
Green Hydrogen Pipeline Project

https://www.socalgas.com/regulatory/angeleslink

- Proposal to develop what would be the nation's largest green hydrogen energy infrastructure system to deliver clean, reliable energy to the Los Angeles region.
- When built, the Angeles Link green hydrogen system could reduce greenhouse gas emissions, improve local air quality, and help SoCalGas serve California's energy needs for generations to come.
- Angeles Link can drive deep decarbonization of heavy-duty transportation, dispatchable electric generation, industrial processes and other hard-to-electrify sectors of the Southern California economy.
- SoCalGas is directed by CPUC to join the State in its application for federal funding, and to study as part of Phase 1 the feasibility of a localized clean hydrogen hub solution in the Los Angeles Basin.

Angeles Link:
How Could It Work



25-35 GW Curtailed/New/Solar/Wind
2 GW Batteries

10-20 GW Electrolyzers

Hydrogen infrastructure

14.3 million tons of CO_2 emissions eliminated

Start with 100% renewable electricity

Utilize renewable electricity that is on the grid or being curtailed to provide power to electrolyzer

Convert it into green hydrogen with advanced electrolyzers

Electrolysis splits water into hydrogen and oxygen -- with virtually zero greenhouse gas and criteria pollutant emissions

*Deliver it into LA Basin by pipeline

SoCalGas will use its expertise in pipeline infrastructure and potential rights-of-way to safely deliver hydrogen from outside of LA Basin to industries that need it most

Use it to decarbonize sectors that can't be plugged in

Dispatchable electric generation and hard-to-electrify sectors like manufacturing and heavy-duty transportation are the missing links to solving the most challenging aspect of decarbonization; green hydrogen offers the solution

Project's Impact:

Angeles Link Benefits of One Potential End-Use Scenario

Could provide **zero-carbon green hydrogen** to assist LADWP's conversion of its natural gas electric generation facilities

+

Displace **3 million gallons of diesel per day** reducing NOx **(24,721 tons per year)**, $PM_{2.5}$ and other hazardous air pollutants associated with diesel emissions

=

Could significantly reduce regional natural gas demand to potentially remove **14.3 million metric tons of CO_2**

→

Equivalent to eliminating 57% of LA County's large stationary source CO_2 emissions

Shaping the Future:
Industrial Hub

Green Hydrogen Could Enable Industrial & Hydrogen Hub in the L.A. Basin

Reliable and scalable delivery of green hydrogen as demand grows

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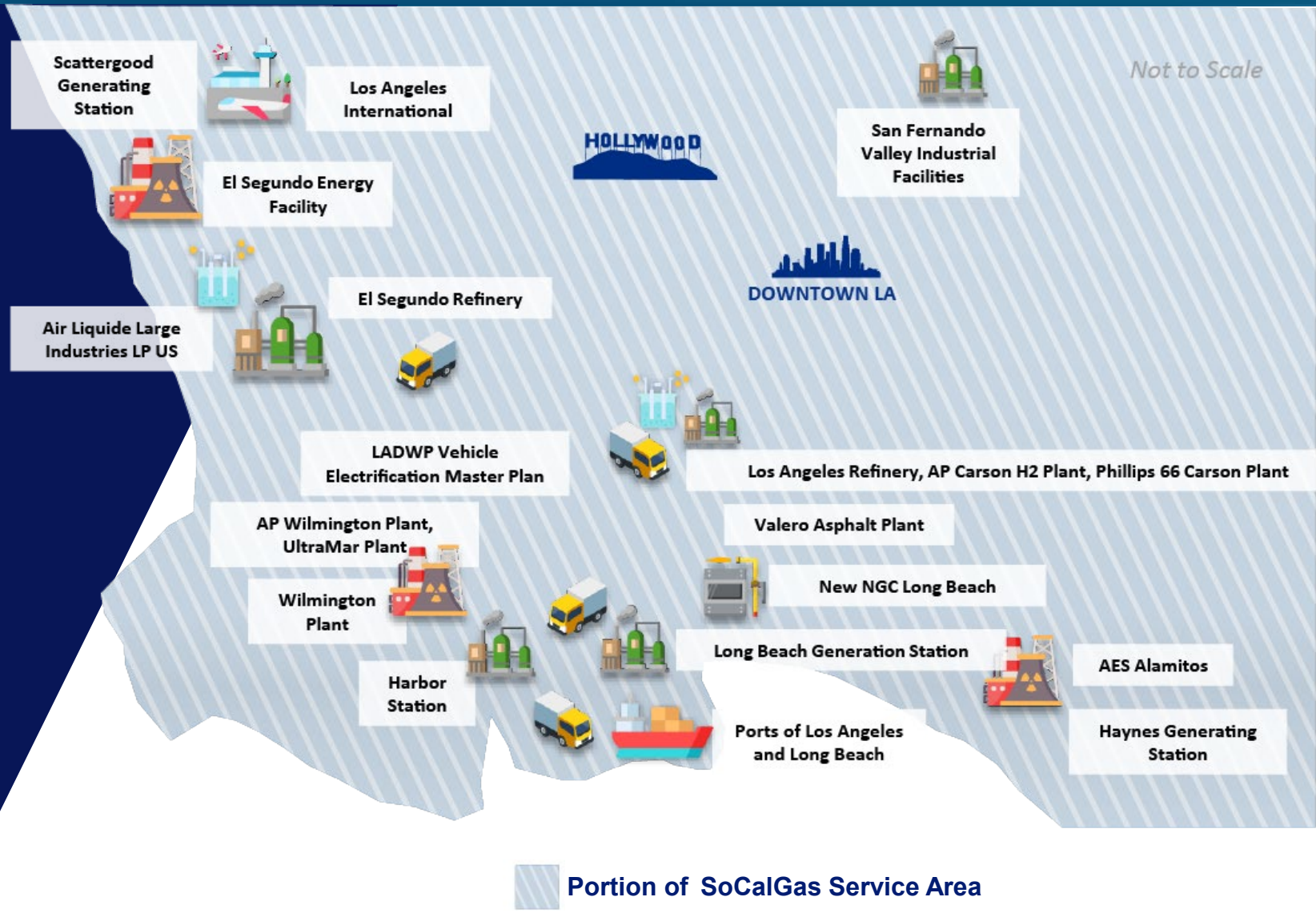
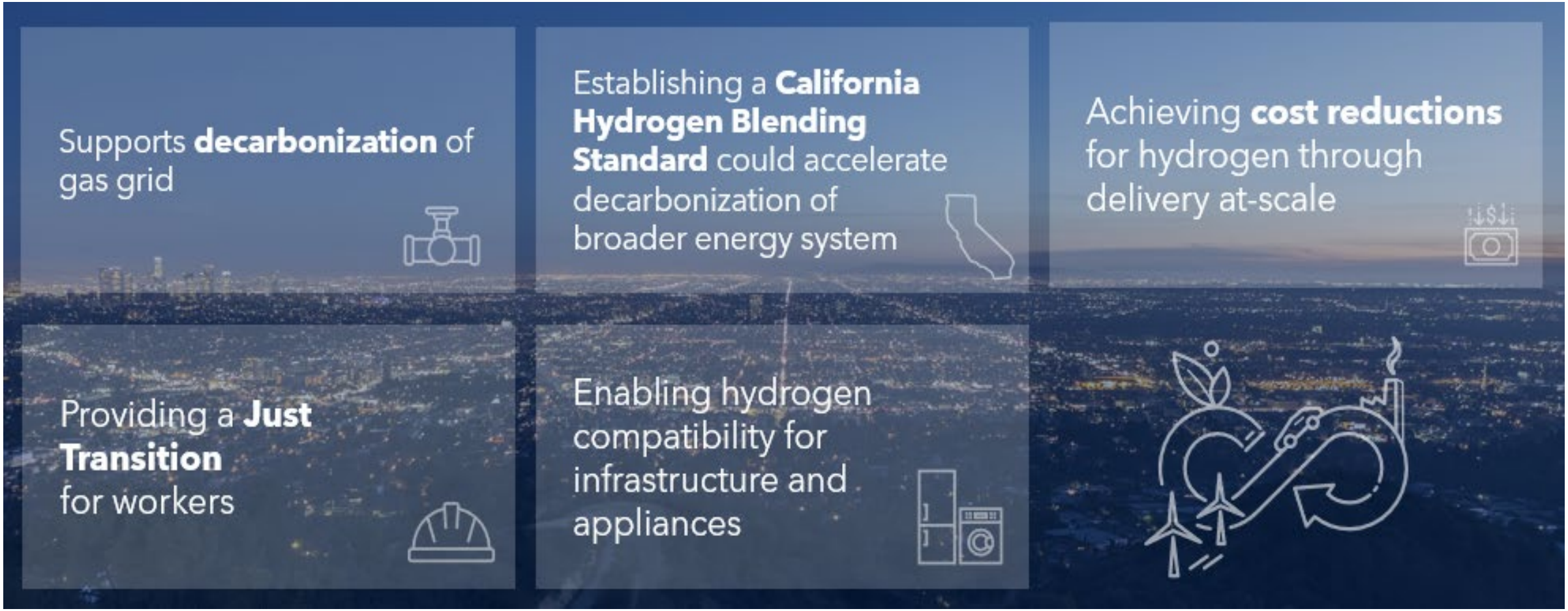
Focuses on large emitters such as electric generation, aviation, cement, chemical manufacturing, shipping and trucking



BLENDING INITIATIVES:

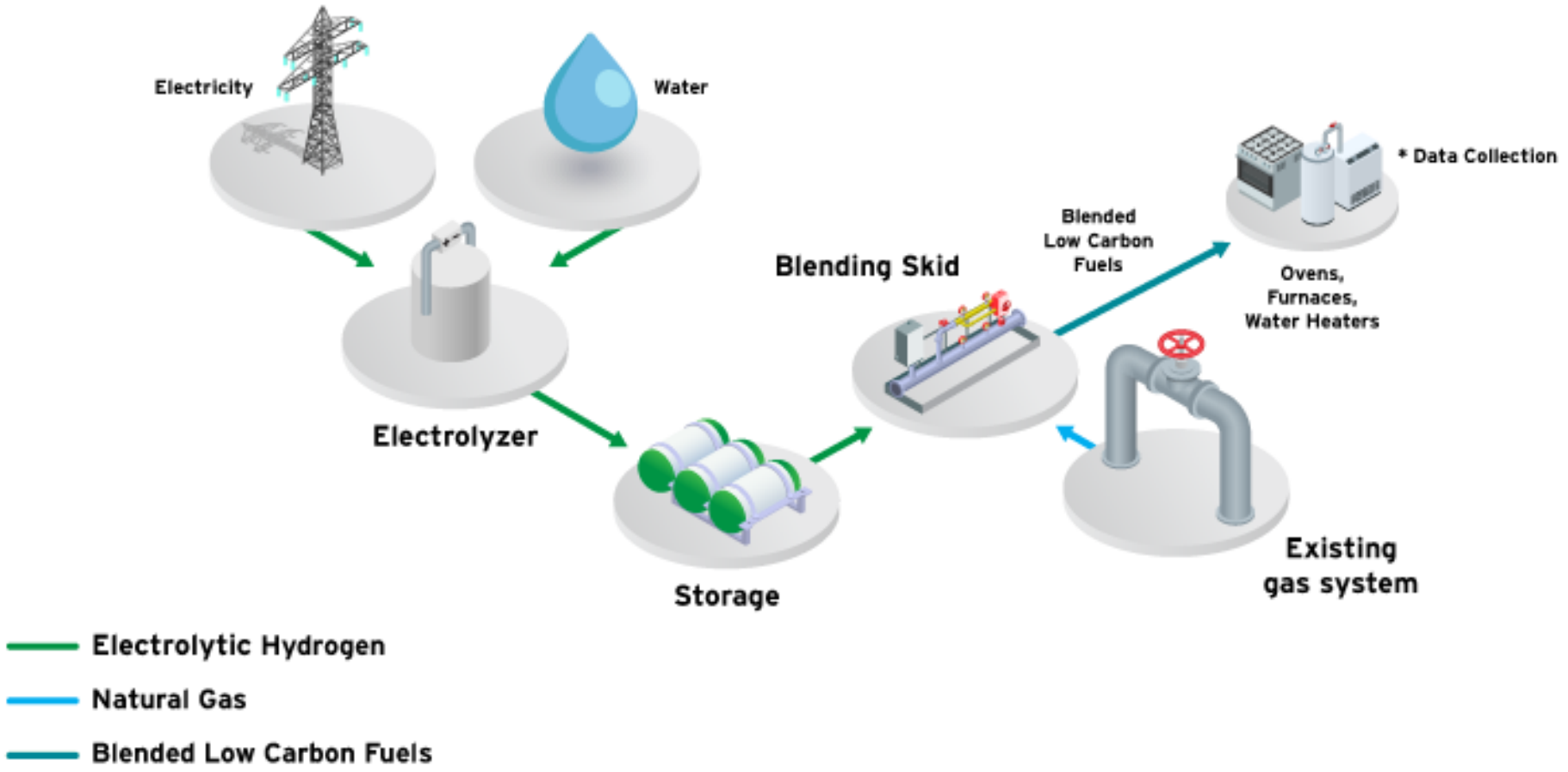
Why Blend Hydrogen into Natural Gas Infrastructure

SoCalGas™



BLENDING INITIATIVES:

H2/NG Blending Process Overview



BLENDING INITIATIVES:

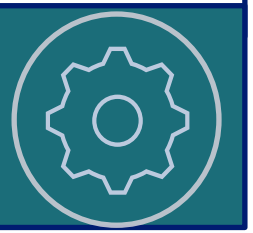
H2/NG Blending Areas of Focus

- Leakage rates
- Leak detection
- Odorant compatibility

Safety

- Plastic and steel compatibility
- AGS/UGS assessment
- End user considerations

System Integrity



- Operations and system impacts
- Pipeline Facilities
- Compressors, turbines & engines

System Reliability

Center For Hydrogen Safety (AIChE)

BLENDING INITIATIVES:

H2/NG Blending Proposed Demonstration Projects

Utility	Pilot Location	Material	Summary
SoCalGas	UC Irvine	Mixed (steel and plastic)	Project will gather and analyze field-testing data using increasing concentrations of blended hydrogen in a **medium-pressure steel and plastic distribution pipeline system**
SDG&E	UC San Diego	Polyethylene plastic (PE)	SDG&E's project will collect the same data as SoCalGas' project but will specifically help determine hydrogen blending standards applicable to **PE plastic distribution systems**
Southwest Gas	Truckee, CA	Polyethylene plastic (PE)	Southwest Gas' project will blend increasing concentrations of hydrogen into a **PE plastic distribution system** and will assess performance and safety at high elevation in **extreme weather conditions** such as those experienced in Northern California

[H2] PROQUAL AND LIVING LAB PROJECTS:
Phase 1 & 2 H2 Blending Testing

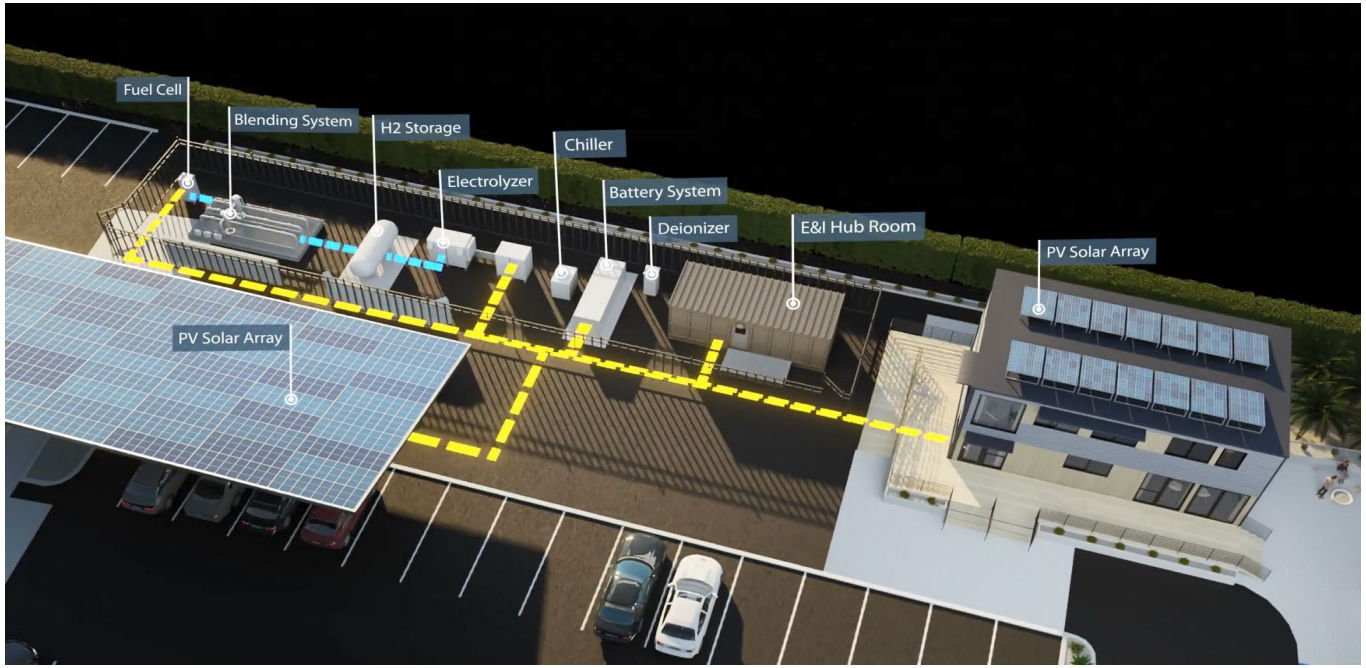
- **Phase 1 [H2] PROQUAL**: Blending up to 20 vol% H2
- Pipeline material impacts
- Common residential meter set
- Gas monitoring and leak detection tools/equipment
- Testing common residential appliances; focus on “vintage” equipment
- **Phase 2 H2 Living Lab**: collaboration with NYSEARCH
- 2-year demonstration project to simulate hydrogen blending in a high pressure and medium pressure system; blend 25 to 35 vol% H2
- Investigation on pipeline and pipeline equipment material and performance impacts on polyethylene pipe, steel pipe, gaskets, elastomers, fittings, regulators, valves, compressor
- Periodic removal of pipe and components to examine material changes
- Test new leak survey/detection/quantification technologies as they become available
- Assess the need and extent for new safety training

Demonstration Project:
[H2] Hydrogen Innovation Experience

- State-of-the-art demonstration home designed to show the resiliency and reliability of a hydrogen microgrid
- Features solar panels, a battery, an electrolyzer to convert solar energy to hydrogen, and a fuel cell to supply electricity for the home
- Hydrogen is blended up to 20% with natural gas and used in the home's tank-less water heater, clothes dryer, gas stove, fireplace and BBQ grill

[H2] INNOVATION EXPERIENCE

includes an ecosystem of hydrogen, natural gas and microgrid infrastructure



- Solar carport and rooftop solar panels
- Green hydrogen production using an electrolyzer
- Hydrogen blending skid
- Storage units: battery + hydrogen tank
- Hydrogen fuel cell
- Home appliances

RD&D Project:
[H2] PureComp

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- Testing new technology that can simultaneously separate and compress hydrogen from a blend of hydrogen & natural gas
- Potentially allow hydrogen to be easily and affordably transported via the existing natural gas system
- Hydrogen may be extracted and compressed at fueling stations for fuel cell electric vehicles

RD&D Project:
H2 SilverSTARS

- Developing first-of-its-kind advanced hydrogen generation system at SunLine Transit Agency in Thousand Palms, CA
- System will produce hydrogen from renewable natural gas and help fuel SunLine's fleet of 17 hydrogen fuel cell electric buses
- At scale, project could provide clean hydrogen at any location adjacent to a natural gas pipeline

Thank You!