POWER-TO-GAS

Achieving California's Renewable Energy Goals
SoCalGas RD&D
RESEARCH, DEVELOPMENT, & DEMONSTRATION
Low Carbon Resources RD&D

- Natural Gas w/ CCUS
- Organics Conversion
- Power-to-Gas
- Artificial Photosynthesis

- Anaerobic Digestion
- Thermo-chemical
- Electrolysis

- Renewable Natural Gas
- Hydrogen

- CO₂
- Methanation
- Reformation

"Glad to be of service."
Power-to-Gas

ACHIEVING CALIFORNIA’S RENEWABLE ENERGY GOALS
Renewable Energy Goals

33% by 2020
50% by 2030
100% by 2050?

California is a Solar State:
• 32% of California’s renewable power came from solar
• 460 of the 490MW of pending renewable projects are solar

Source: California Energy Commission – Tracking Progress, 2016
Supply / Demand Mismatch

The Famous California “Duck Curve”

CAISO Net Load --- 2012 through 2020

- Typical March Day – significant change starting in 2015
- Potential Over-generation

Over-generation can lead to grid congestion or “curtailment”
Curtailment of Renewable Power is Here Today

Source: California Independent System Operator (CAISO)
CA Needs Energy Storage
What is Power-to-Gas (P2G)

» P2G is the process of converting excess renewable energy to a gaseous fuel (hydrogen or methane).
» P2G allows for storing large amounts of energy for long durations.
» P2G can help California reach its Renewable Energy goals.

Excess renewable energy goes through electrolysis which splits water molecules to produce hydrogen. Hydrogen & carbon combine through methanation and methane can be stored or transported on the pipeline. Hydrogen can also be stored directly in the pipeline.
P2G Provides Seasonal Storage
P2G Creates Flexibility

- From Grid, Wind or Solar
- Electrolyser
- H₂ Storage
- Methanation
- Natural Gas Grid
- Gas

- Electric Grid
- Power
- Industrial Use
- To power grid
- DG or Central Power Plant
- Fuel-cell Vehicle
- Natural Gas Vehicle
- Filling Station
- Home Heating
- H₂
- CO₂
- CH₄
GERMANY’S RENEWABLE ENERGY STORAGE

Potential for electrolysis is estimated at up to 170 GW which could power 114 million homes.

Source: Commercialisation of Energy Storage in Europe, 2014
SoCalGas RD&D
OUR WORK ON P2G
Simulation shows dramatic increase in solar utilization

Today: 3.5% Renewable Energy Integration

With P2G: 35.31% Renewable Energy Integration

UC Irvine P2G Simulation

34.16 MW of Solar Power
Max H₂ allowed: 15%
Electrolyzer size: 26.67 MW
February 11 and 12, 2015
UC Irvine P2G Demo

» 60kW Proton OnSite Electrolyzer
» On-campus Pipeline Blending
» NGCC Power Production
Biomethanation

Water Electrolysis → Renewable Hydrogen

CO₂ → Archaea

H₂ → Renewable Methane

Renewable Hydrogen

Carbon Dioxide

Renewable Methane

SoCalGas

Glad to be of service.
Co-electrolysis Cell

OPUS\textsuperscript{12}

CH\textsubscript{4} \rightarrow \text{H}_2\text{O} + \text{CO}_2 + \text{H}^+ + \text{O}_2

H\textsubscript{2}O + \text{CO}_2 \rightarrow \text{H}_2\text{O}
THANK YOU

Matt Gregori
mgregori@semprautilities.com