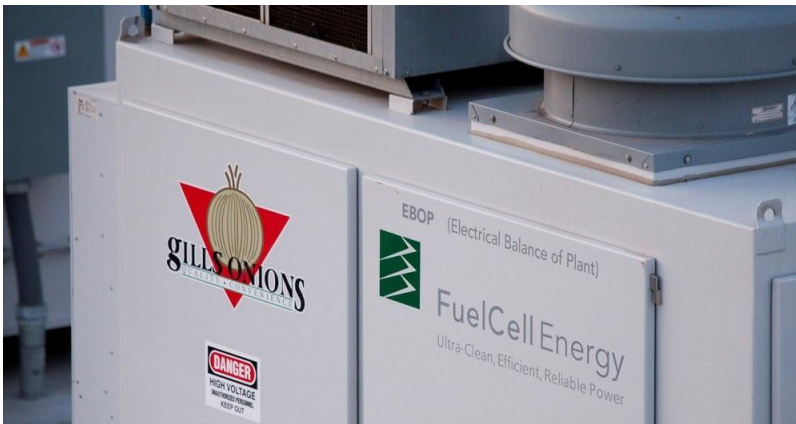


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# Fuel Cells and Power Generation

**August 31, 2011**

**Ryan Cornett, MPA, Virginia Clean Cities**

[www.vacleancities.org](http://www.vacleancities.org)



**Co-hosted by Clean Energy States Alliance**

[www.cleanenergystates.org](http://www.cleanenergystates.org)



**Funding Support from US DOE**



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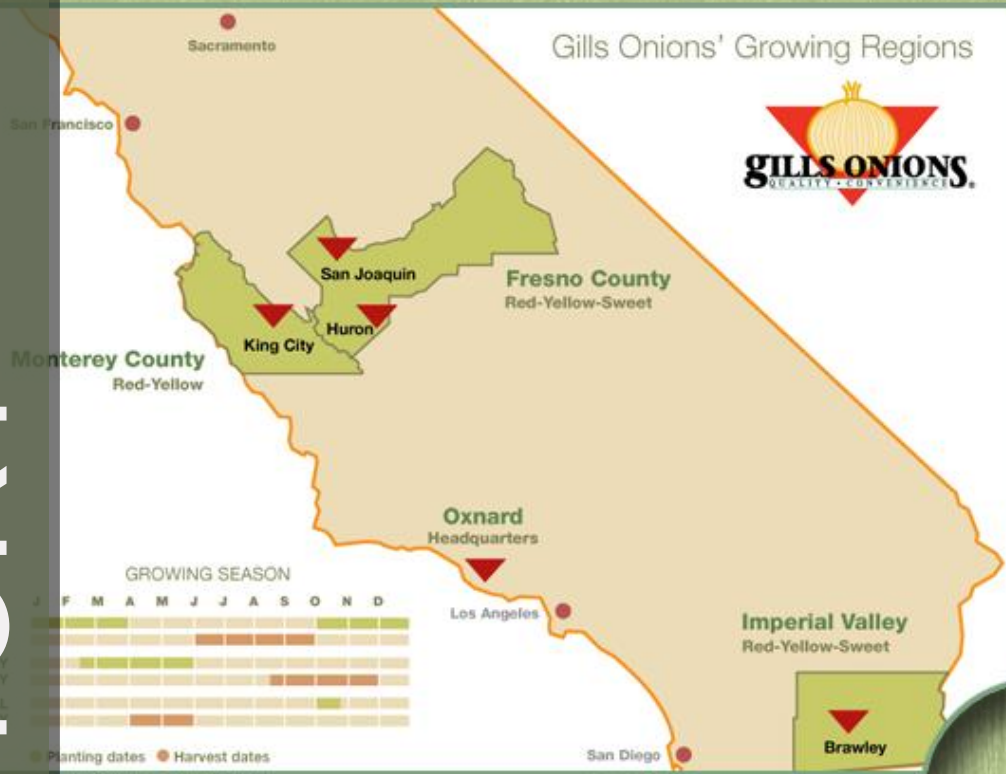
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# FUEL CELLS AND POWER GENERATION



# GILLS STORY



- INDUSTRIAL
- FOODSERVICE
- RETAIL





- GENERATED UP TO 300,000 LBS OF ONION WASTE PER DAY (TOP, TAIL AND PEEL)
- WASTE BECAME UNMANAGEABLE AND COST-PROHIBITIVE
- CREATED ODOR PROBLEMS, POTENTIAL GROUND WATER CONTAMINATION





# SOLUTION

## ONION WASTE TO ENERGY

ADVANCED ENERGY RECOVERY SYSTEM (AERS)

- CONVERTS ONION WASTE TO RENEWABLE ENERGY, ULTRA-CLEAN BIOGAS AND CATTLE FEED
- MEETS OUR GOALS FOR AIR QUALITY, ZERO WASTE AND RENEWABLE ENERGY
- WASTE NOW BECOMES A RESOURCE VS. LIABILITY



# SIMPLIFIED PROCESS SCHEMATIC

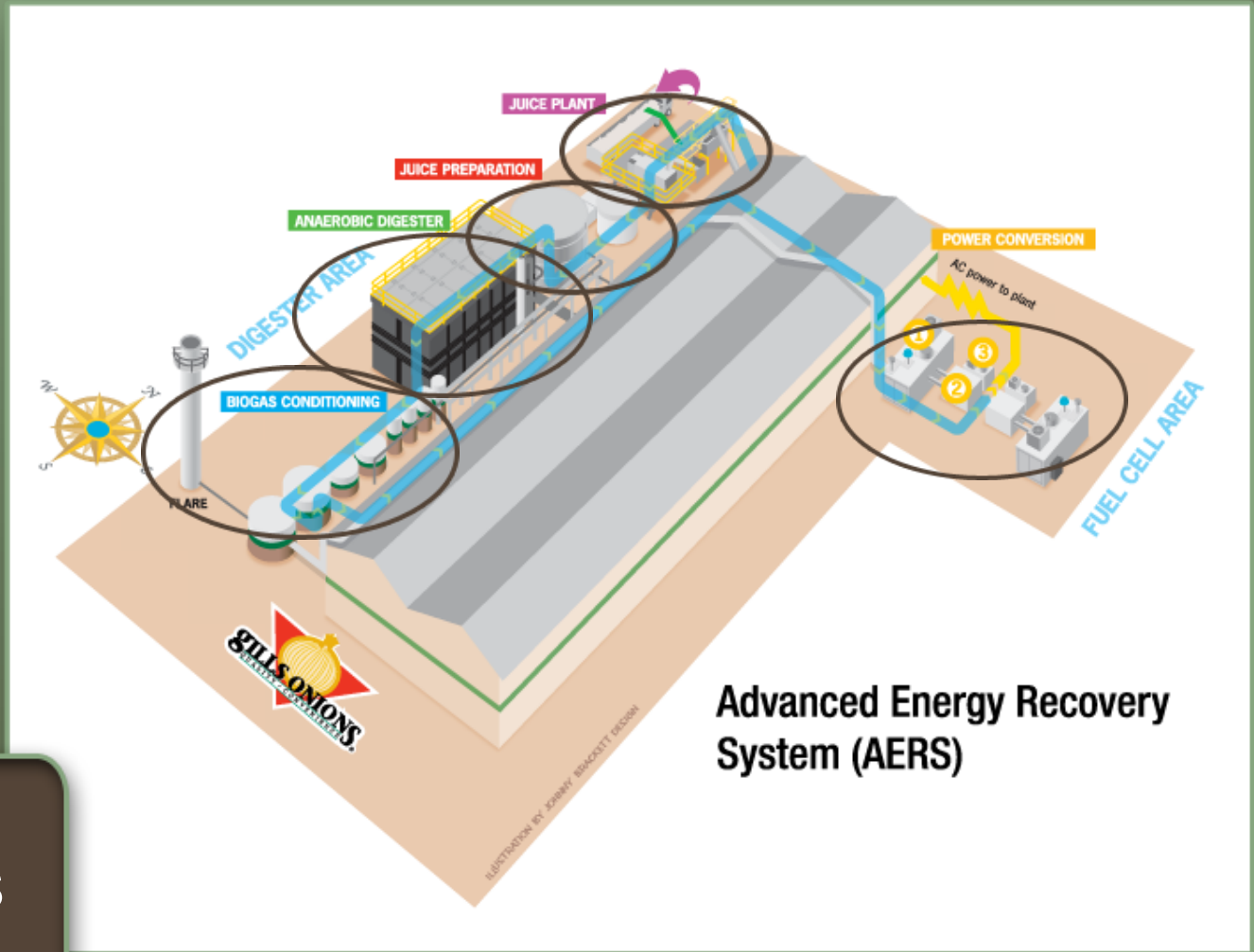
JUICE  
EXTRACTION

JUICE  
PREPARATION

UASB

BIOGAS  
PREPARATION

FUEL CELLS





# CHALLENGES

- HIGH SULFUR CONTENT - REMOVE IMPURITIES AND MOISTURE FROM BIOGAS

- PERMITTING OF NEW TECHNOLOGY – NO STANDARDS EXISTED FOR REFERENCE

- FIRE & SAFETY - EXTRA ALARMS, LIABILITY WAIVER

- FINANCING – HAD TO DEVELOP A GOOD ECONOMIC MODEL





# FUEL CELLS BECOME THE MOST INNOVATIVE PRACTICAL SOLUTION TO FULFILL OUR NEEDS



- MEETS OUR GOALS FOR AIR QUALITY, ZERO WASTE, AND RENEWABLE ENERGY
- HIGH FUEL-TO-ELECTRICITY CONVERSION RATE: 47-50% EFFICIENCY
- ELIMINATION OF 40,000 GALLONS DIESEL FUEL TO HAUL ONION WASTE TO FIELDS
- REDUCES GHG AND KEEPS US AHEAD OF AB 32 REGULATIONS

# OVERALL PROJECT COSTS



- AERS TOTAL COST INSTALLED:  
\$10.8 M
- SEMPRA ENERGY SELF GENERATION INCENTIVE \$2.7 M
- ARRA (AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009) \$3.2 M
- CEC (TO WORK WITH GTI FOR THE STUDY OF THE GAS CLEAN UP) (GRANT) \$499,000



- \$10.8 MILLION PROJECTION ANTICIPATED PAYBACK BETWEEN 5-6 YEARS
- IMMEDIATE SAVINGS IN HAULING AND ENERGY COSTS OF \$1.1 MILION ANNUALLY
- GILLS' GENERATES UP TO 300,000 LBS/DAY OF ONION WASTE – CONVERTED TO BIOGAS
- 2 FUEL CELL ENERGY FUEL CELLS – 600 KW
- PROVIDES 100% OF BASE-LOADED ELECTRICITY REQUIREMENT



**BOTTOM LINE FOR GILLS**

# NEXT STEP

## INSTALLATION OF A CLEAN ENERGY STORAGE SYSTEM BY FALL 2011

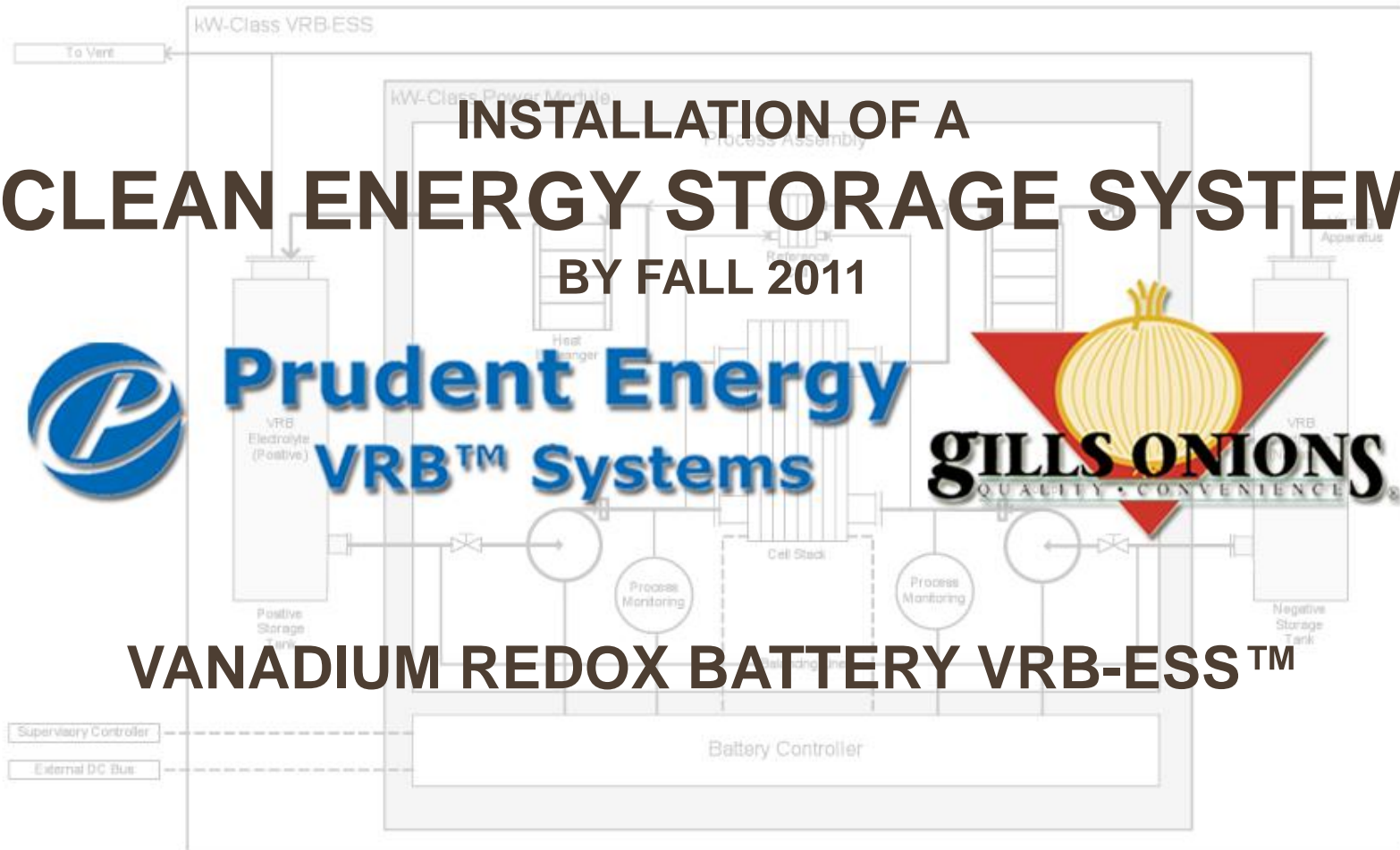


**Prudent Energy**  
**VRB™ Systems**



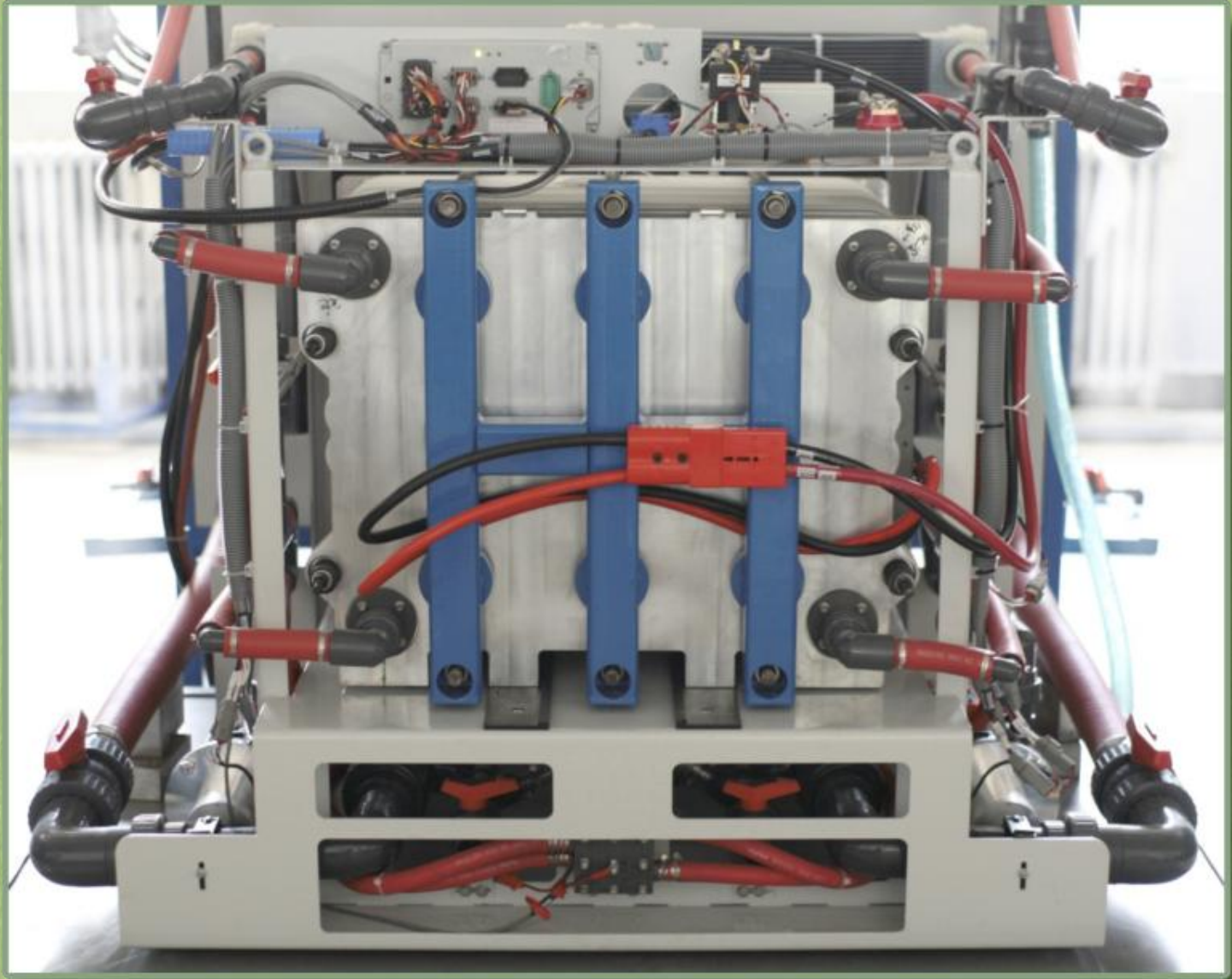
**GILLS ONIONS**  
QUALITY • CONVENIENCE®

**VANADIUM REDOX BATTERY VRB-ESS™**





# WHAT IS A FLOW BATTERY?



- LIKE A RECHARGEABLE FUEL CELL - BUT FOR INDUSTRIAL USE.

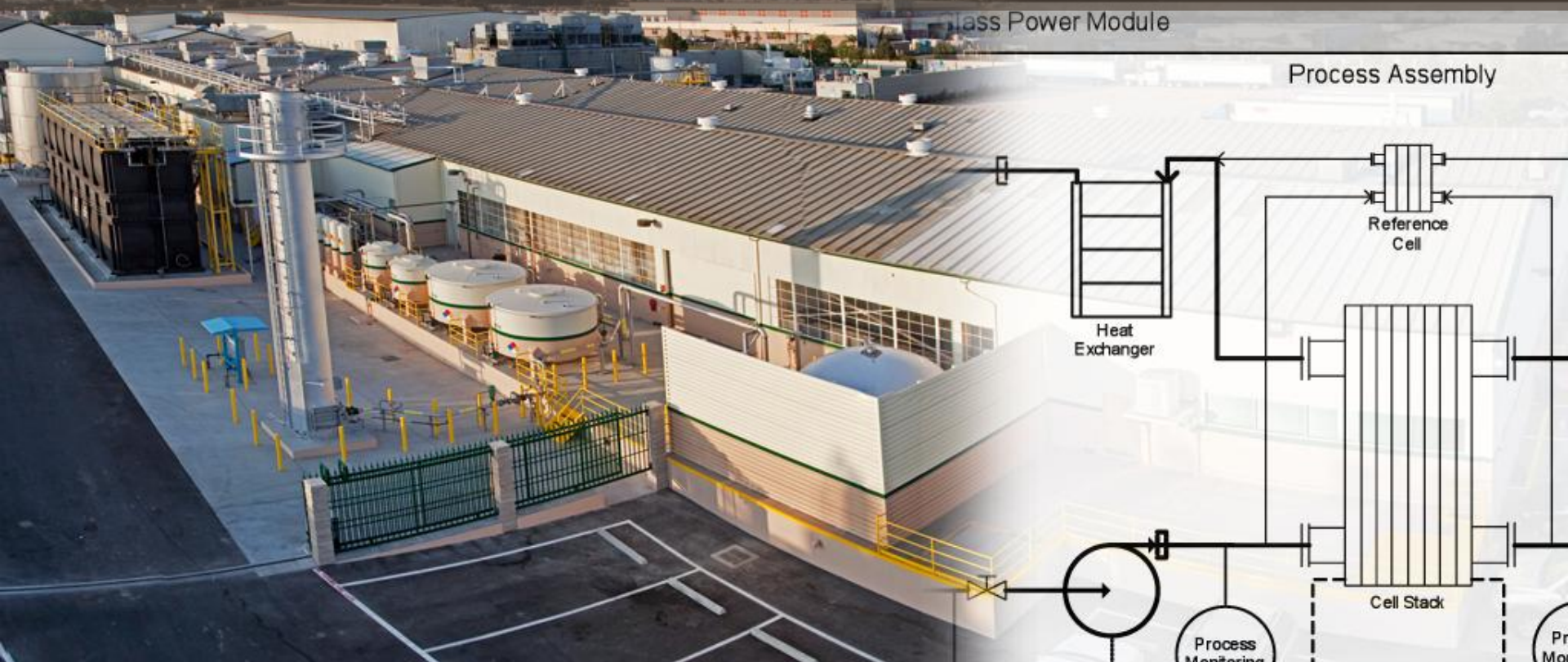
- YOU STORE AND PRODUCE CLEAN, EMISSION FREE ELECTRICITY FROM IT.

- BUT YOU CAN ALSO FORCE ELECTRIC CURRENT THE OTHER WAY, BACK INTO THE SYSTEM, WHERE THE ENERGY IS STORED IN BENIGN, ELECTRO-CHEMICAL LIQUIDS.





# STATUS OF THE PROJECT



## ANALYSIS, DESIGN AND CONSTRUCTION PHASE

- ON-SITE ASSESSMENT OF OUR STORAGE NEEDS
- DESIGNED THE SYSTEM BASED ON OUR STORAGE NEEDS USING THE LATEST TECHNOLOGIES AND MATERIALS
- HIRED LOCAL CONTRACTOR TO MANAGE THE ENTIRE CONSTRUCTION PROCESS INCLUDING PERMITTING, LOGISTICS AND THE UTILITY INTERCONNECT PROCESS

WHAT DOES THIS MEANS FOR

# GILLS ONIONS?



- THIS PROJECT, AS AN EXPANSION OF THE AERS IS ANTICIPATED TO REDUCE ELECTRICITY COSTS BY AS MUCH AS \$80% AND OUR COMMITMENT TO SUSTAINABILITY - THIS SYSTEM IS VIRTUALLY EMISSIONS FREE, THERE IS NO COMBUSTION OR BURNING OF FUEL WITH THE NEW TECHNOLOGY
- THIS WILL NOT ONLY PROVIDE US WITH ELECTRICITY DURING THE HIGHEST DEMAND AND EXPENSIVE PERIODS OF EACH DAY BUT WE WILL HAVE EMERGENCY BACKUP POWER WHENEVER WE NEED IT.



# QUESTIONS & COMMENTS



Nikki Rodoni  
Gills Onions, LLC  
Director of  
Sustainability





est. 1980



Blackwood Canyon

# Brewing with Fuel Cells



Cheri Chastain

Sierra Nevada Brewing Co.  
Sustainability Coordinator

SIERRA NEVADA  
BREWING CO.





Sierra Nevada was founded in 1980 using recycled dairy equipment and an old soda bottling line and was founded with efficiency and conservation at the forefront.

We are now the 7<sup>th</sup> largest brewer in the United States but have maintained the early philosophies of conservation and efficiency.







est. 1980

With energy prices on the rise and the California grid loosing stability, we started looking into onsite power generation options in 2003.

Looking for consistent source of power *(largely eliminates solar and wind).*

Looked into sterling engines, but the technology was not yet cost effective.





est. 1980

Blackwood Canyon



Purchased four Fuel Cell Energy DFC 300 units for a total of 1.2 MW potential in 2004.

Each system was coupled with a heat recovery system to add 15% efficiency.

Original installation was designed to run on natural gas with potential for biogas feed.

Installation was commissioned in May 2005.

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BREWING CO.**

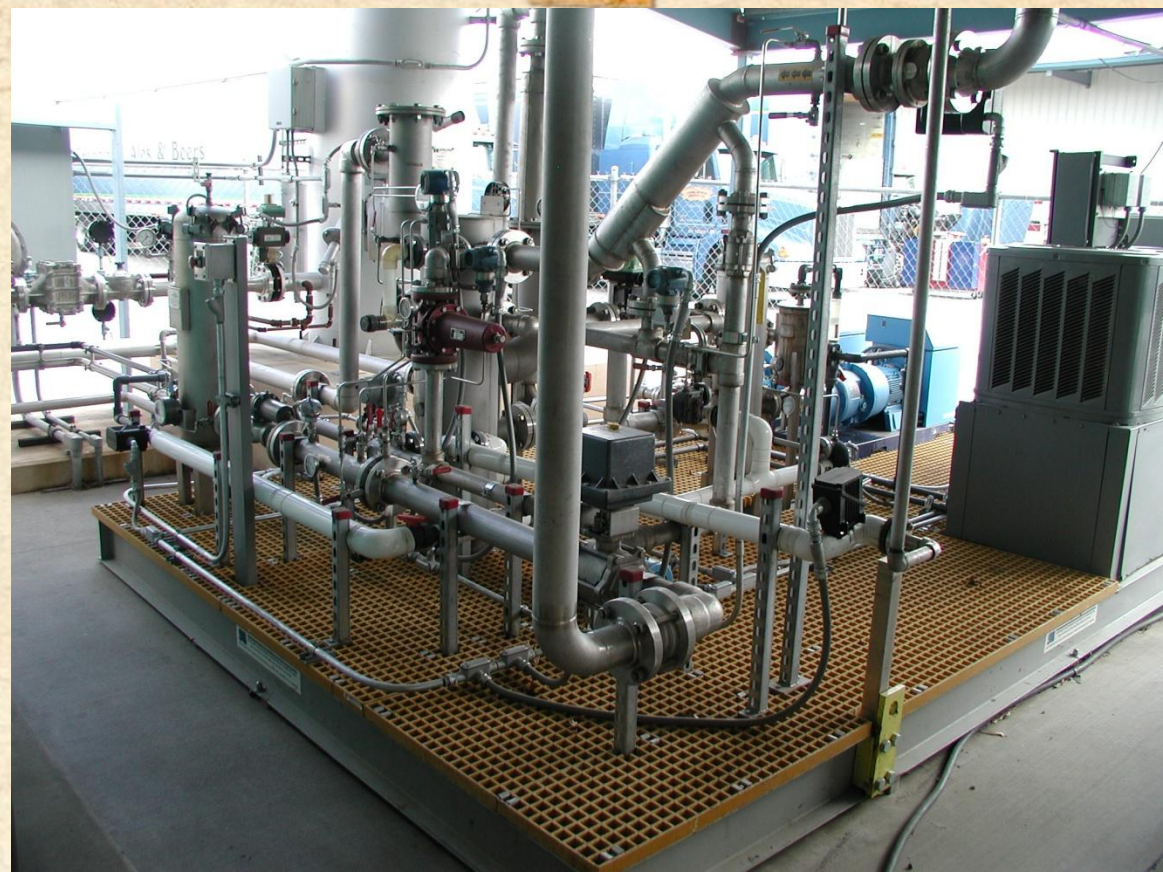
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Wilderness





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Our system was intended to run on biogas generated at our waste water treatment facility.

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BREWING CO.**





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## Some of the economics...

- Roughly 70% of the installation cost was covered through:
  - 30% Federal Investment Tax Credit
  - Rebate from local utility through the Self Generation Incentive Program
  - Joint grant from DOE/DOD
- Expected a 6 year payback and it

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## Things to consider...

- Did not need to be permitted through our Air Resources Board
- We did have to adjust our EPA hazardous waste generator status
- They are a significant source of our CO<sub>2</sub> emissions
- Are really good in situations where constant electricity is needed and there is a beneficial use for the heat



**SIERRA NEVADA  
BREWING CO.**





# Since the Fuel Cells...

## Solar Panels

- 503 kW Elevated, Tracking
- 1500 kW Roof Top System
- 14 kW at Rail Spur
- 5 kW at Day Care



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BREWING CO.

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Leger

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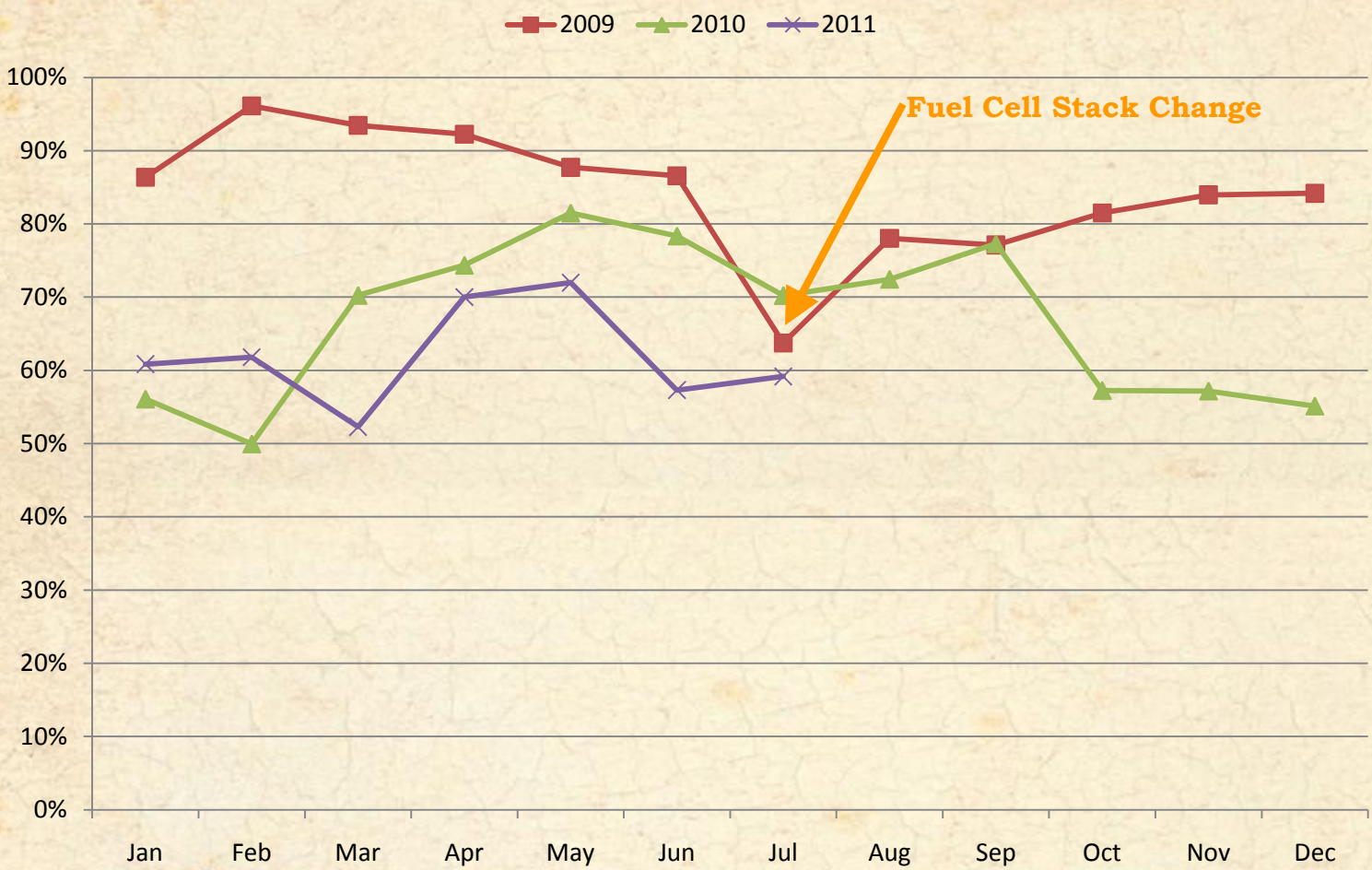
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# Sierra Nevada On-Site kWh Generation



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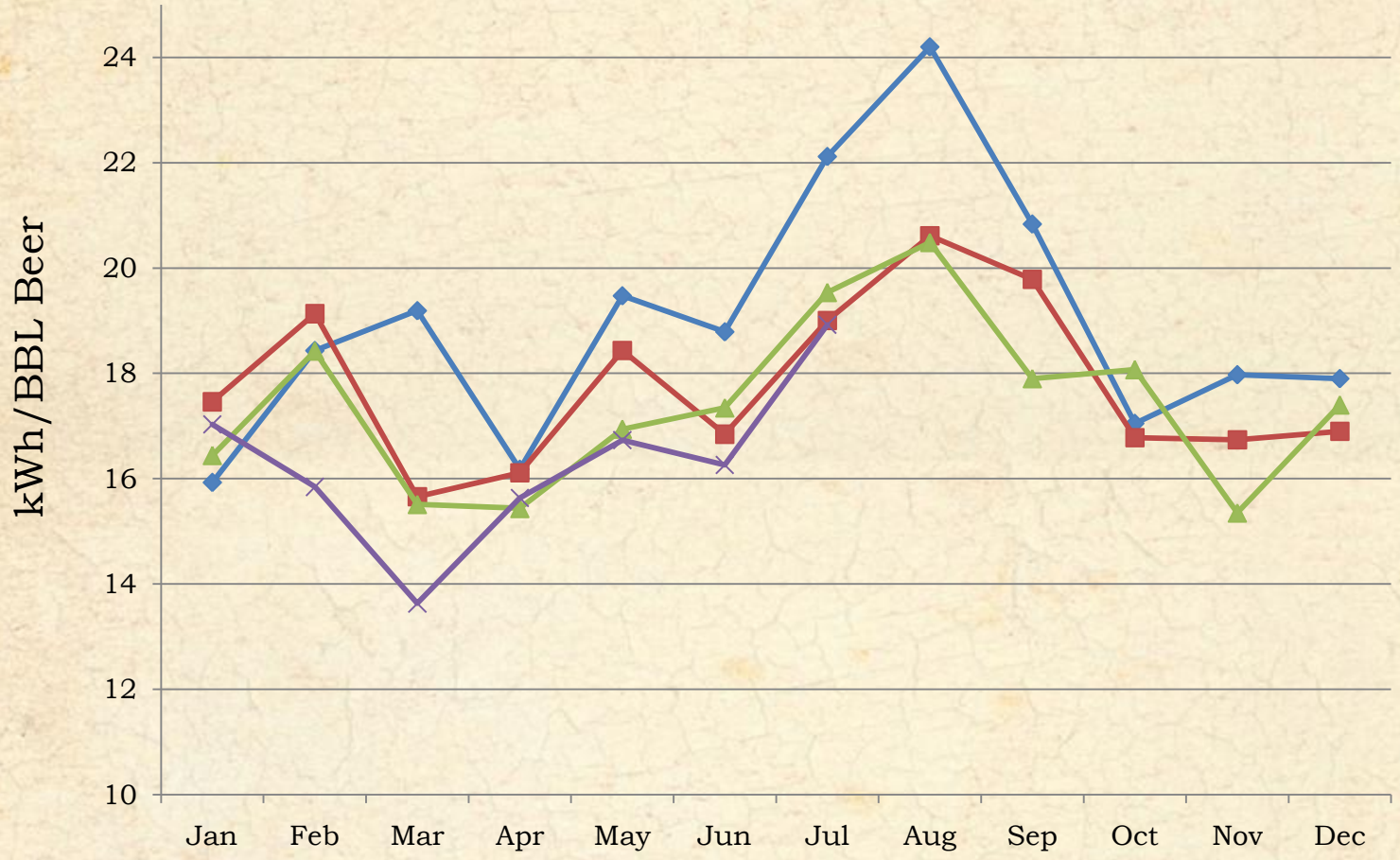




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# Sierra Nevada kWh per BBL Beer Produced

2008 2009 2010 2011



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BREWING CO.



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Blackwood Canyon

# Cheers,



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