Self-Generation Incentive Program
Renewable Generation Workshop

November 12, 2020
Workshop Logistics

• Today’s presentations (.pdf) and agenda are available on the WebEx link under “Event Material”

• Please submit questions for speakers in the Chat box or raise your hand to be unmuted by staff

• Questions will be read aloud by staff (Reminder: Mute back!)
Workshop Objective and Next Steps

**Objective:** To explore in more detail options for developing rules to ensure proper tracking of renewable fuel sources and optimize the GHG reductions of renewable generation technologies under SGIP.

**Next Steps:**
- **Comments Due November 18, 2020** on Assigned Commissioner’s Ruling Seeking Party Comment on Renewable Generation Fuels and Technologies.
- **Q1 2021** - Proposed decision on renewable generation technologies.
Legislative and Procedural Background

PU Code 379.6(a)(1) and Decision (D.)16-06-055 codify three main SGIP goals:

- **Environmental goals** – reduce GHGs/criteria air pollutants and integrate renewables
- **Grid Support goals** – reduce or shift peak demand, reduce grid costs, provide ancillary services
- **Market transformation**

PU Code 379.6(m) requires that, as of January 1, 2020, **all SGIP generation technologies use only renewable fuels**.

D.20-01-021 (issued January 2020):

- Continues the requirement for a minimum 10-year biogas contract for all generation projects using directed biogas.
- Pauses acceptance of incentive applications for generation technologies using collect/use/destroy (flared) - baseline renewable fuels.
- Ordering Paragraph 16: All new renewable generation projects receiving SGIP incentives must use only renewable fuels on an ongoing basis and **for as long as the equipment is in use**.
The draft report suggests that, for the first time since 2010, SGIP projects resulted in a net GHG increase: over 42 thousand metric tons of CO$_2$eq in both 2018 and 2019.

In general, once directed biogas projects fulfill their 5-year (pre-2011) or 10-year (post-2011) directed biogas contract requirement, they no longer procure directed biogas due to the high cost relative to natural gas.

Source: Verdant Associates, November 2020
### Number of Installed and Reserved Generation Projects in SGIP

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Cell CHP</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>6</td>
<td>18</td>
<td>63</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>126</td>
</tr>
<tr>
<td>Fuel Cell Electric</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>82</td>
<td>23</td>
<td>37</td>
<td>32</td>
<td>87</td>
<td>50</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>326</td>
</tr>
<tr>
<td>Gas Turbine</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Internal Combustion</td>
<td>27</td>
<td>54</td>
<td>53</td>
<td>49</td>
<td>29</td>
<td>17</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>14</td>
<td>3</td>
<td>13</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Microturbine</td>
<td>21</td>
<td>17</td>
<td>41</td>
<td>30</td>
<td>15</td>
<td>12</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pressure Reduction Turbine</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Waste Heat to Power</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Wind Turbine</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49</strong></td>
<td><strong>73</strong></td>
<td><strong>98</strong></td>
<td><strong>53</strong></td>
<td><strong>40</strong></td>
<td><strong>37</strong></td>
<td><strong>7</strong></td>
<td><strong>29</strong></td>
<td><strong>152</strong></td>
<td><strong>37</strong></td>
<td><strong>72</strong></td>
<td><strong>43</strong></td>
<td><strong>114</strong></td>
<td><strong>67</strong></td>
<td><strong>13</strong></td>
<td><strong>9</strong></td>
<td><strong>2</strong></td>
<td><strong>6</strong></td>
<td><strong>1</strong></td>
<td><strong>985</strong></td>
</tr>
</tbody>
</table>
Installed and Reserved Generation Projects in SGIP - MWs

- Wind Turbine
- Waste Heat to Power
- Pressure Reduction Turbine
- Microturbine
- Internal Combustion
- Gas Turbine
- Fuel Cell Electric
- Fuel Cell CHP
Workshop on Self-Generation Incentive Program Renewable Generation

Sierra Club Concerns with Public Subsidy of Directed Biogas Projects under SGIP
Biomethane Potential is a Small Fraction of Total Gas Demand

FIGURE 5: AMERICAN GAS FOUNDATION AND NRDC HIGH AND LOW ESTIMATES OF BIOMETHANE AND SYNTHETIC GAS POTENTIAL

* NRDC estimates are based on the AGF results, adjusted for our biogas resource policy recommendations given in Figure 2. We use the AGF high and low estimates for synthetic methane produced with renewable electricity.

Source: NRDC, A Pipe Dream or Climate Solution: The Opportunities and Limits of Biogas and Synthetic Gas to Replace Fossil Gas
Use of Directed Biogas for Self-Generation is a Poor Use Case

The Challenge of Retail Gas in California’s Low-Carbon Future

Renewable natural gas is found to be a valuable, but relatively expensive from a carbon reduction perspective. Relatively low-cost biomass feedstocks are limited in quantity, so lower-cost PATHWAYS scenarios allocate these limited feedstocks to sectors that are difficult to electrify, like aviation, industry, and trucking. The limited supply of and competing uses for biofuels mean that scenarios that maintain high volumes of gas throughput in buildings require hydrogen and synthetic natural gas to reduce emissions.
Use of Directed Biogas for Self-Generation is a Poor Use Case

Any GHG Benefits are Rapidly Diminishing as Grid Decarbonizes

### Benchmarking Greenhouse Gas Emissions for Delivered Electricity
(Pounds of CO₂ per MWh)

<table>
<thead>
<tr>
<th>U.S. Average¹</th>
<th>947</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Gas and Electric Company²</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>206</td>
</tr>
<tr>
<td>2017</td>
<td>210</td>
</tr>
<tr>
<td>2016</td>
<td>294</td>
</tr>
<tr>
<td>2015</td>
<td>405</td>
</tr>
<tr>
<td>2014</td>
<td>435</td>
</tr>
<tr>
<td>2013</td>
<td>427</td>
</tr>
<tr>
<td>2012</td>
<td>445</td>
</tr>
<tr>
<td>2011</td>
<td>393</td>
</tr>
<tr>
<td>2010</td>
<td>445</td>
</tr>
</tbody>
</table>
Use of Directed Biogas for Self-Generation is a Poor Use Case

GHGs Will Increase When Projects Revert to Fossil Gas Use Once Incentive Payments End

One final consideration regarding directed biogas projects is their limited term as renewable projects. SGIP rules require that directed biogas projects meet minimum renewable fuel use requirements for five years. After this five-year term, directed biogas projects are no longer required to procure directed biogas and can operate on non-renewable fuel. During this reporting period we find that most directed biogas projects have fulfilled their five-year terms and will likely continue operating on 100% natural gas.
Other Issues With Directed Biogas Projects Under SGIP

• No relationship between incentive level and carbon intensity of source fuel
• Lack of alignment with RPS standards allowing contracting with far away biomethane sources
• Lack of robust verification protocols
  • No onsite visits
  • A “concerning level of missing or inaccurate record” – RFUR Report
• Risks of double counting environmental benefits – still no tracking system despite 2016 decision
Fuel Cells at Wastewater Treatment Plants

How Renewable Gas Powered Fuel Cells Reduce Air and Methane Emissions

Paul Fukumoto
Director Business Development

November 14, 2020
Merits of Fuel Cells with Biogas

- Effective conversion of anaerobic digester gas (ADG)
  - Multiple Sources available
    - Wastewater treatment, food or agricultural digesters
    - Avoids clean air permitting challenges
    - Additional GHG reduction benefits with CHP

- Multiple uses of power generated
  - Utilized On-Site
  - Delivered to Grid via BioMAT or other available Tariff

- Enhances site’s energy resiliency with continuous supply of power
  - Not dependent on weather or time of day
  - Can be a core resource for a indefinite islanding during power outages

Resilient Clean Renewable Energy Resource for These Critical Facilities
Example: Fuel Cell for Compliance and CHP

- **Project with the City of San Bernardino Municipal Water Department (SBMWD)**
  - Compliance with SCAQMD requirement for alternative to gas engines
  - SBMWD receives electricity through a 20-year Power Purchase Agreement (PPA)

- **1.4 MW SureSource 1500™ Platform**
  - Operation on anaerobic digester gas and, as needed, natural gas
  - Electricity and thermal energy will support the SBMWD water reclamation plant (WRP)
  - Will utilize all WRP biogas; provide 65% of site power needs

- **Platform will use proprietary SureSource Treatment™ system**
  - Digester gas treatment
  - Fuel blending
  - Quality monitoring

- **Project under construction**

*City decided to avoid flaring and use digester gas for onsite energy*
- Project at City of Riverside Water Quality Control Plant (WQCP)
- 1.4 MW SureSource 1500™ Platform
  - In Service in 2016
  - 20-year Power Purchase Agreement (PPA)
  - No capital expense up front
  - Proprietary SureSource Treatment™ system
  - Complete turn-key solution
- Generates carbon-neutral power and heat for anaerobic digesters
  - Uses two thirds of the WQCP biogas
  - Provides one third of WQCP facility’s total power needs

*City decided to avoid flaring and use digester gas for onsite energy*
Example: Biogas Fuel Purchase

Project at City of Tulare Wastewater Treatment Facility (WWTF)

Digester gas purchase agreement and site lease
- Biogas supply from WWTF & backup directed biogas
- 2.8 MW SureSource 3000™ fuel cell platform
- Largest facility under the California Bioenergy Market Adjustment Tariff (BioMAT).
- 20-year BioMAT PPA provides renewable and carbon neutral power to the SCE grid.

City of Tulare benefits from biogas revenue
- Allows focus on core activity of WWTF operation

City decided to avoid flaring and use digester gas for revenue source
Significant Reduction of Air Pollution with SureSource Platform

SureSource Platform gives these facilities in Disadvantaged Communities long term savings/revenues while reducing the air pollution burden

*SCAQMD Rule 1118.1 (adopted January 2019)
**SureSource Platform is CARB DG Certified for Biogas (DG-046 & DG-048)

SureSource Platform

Criteria Air Emissions Comparison
Flare BACT and SureSource Fuel Cell Platform

Estimated Resulting Air Emissions Benefits

<table>
<thead>
<tr>
<th></th>
<th>SureSource 1500 Emissions Reductions lb/yr</th>
<th>SureSource 3000 Emissions Reductions lb/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx Avoided</td>
<td>2,147</td>
<td>4,294</td>
</tr>
<tr>
<td>VOC Avoided</td>
<td>3,226</td>
<td>6,452</td>
</tr>
<tr>
<td>CO Avoided</td>
<td>4,554</td>
<td>9,109</td>
</tr>
</tbody>
</table>

*SCAQMD Rule 1118.1 (adopted January 2019)
**SureSource Platform is CARB DG Certified for Biogas (DG-046 & DG-048)
Flaring Methane Emissions Using EPA AP-42 Emissions Factors

- Properly operated flares achieve at least 98% percent combustion efficiency in the flare plume, meaning that hydrocarbon and CO emissions amount to less than 2 percent of hydrocarbons in the gas stream.

Table 13.5-1 (English Units). EMISSION FACTORS FOR FLARE OPERATIONS

<table>
<thead>
<tr>
<th>Component</th>
<th>Emission Factor (lb/10^6 Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hydrocarbons</td>
<td>0.14</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>0.37</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>0.068</td>
</tr>
<tr>
<td>Soot^</td>
<td>0 - 274</td>
</tr>
</tbody>
</table>

EMISSION FACTOR RATING: B

Flare Hydrocarbon Emissions as CH₄ with EPA EF

<table>
<thead>
<tr>
<th>Biogas Flow MMBtu/hr</th>
<th>Flaring CH₄ Equivalent Emissions lb/hr</th>
<th>Flaring CO₂e mT/yr using 20 year GWP factor of 84 for CH₄ as SLCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.3¹</td>
<td>1.58</td>
<td>475</td>
</tr>
<tr>
<td>22.6²</td>
<td>3.12</td>
<td>938</td>
</tr>
</tbody>
</table>

¹ Equivalent biogas usage by FCE SureSource 1500 (1.4 MW)
² Equivalent biogas usage by FCE SureSource 3000 (2.8 MW)

https://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s05.pdf

Avoiding Flaring Reduces Methane Pollution from Combustion Inefficiency

https://www.epa.gov/ghgemissions/understanding-global-warming-potentials#Learn%20why
Using Otherwise Flared Biogas in Fuel Cells Supports 24/7 Critical Facility Infrastructure

Waste and Organics from Everyday Life are the Sources of Biogas

Local Communities Benefit Environmentally and Financially by Using Biogas in Fuel Cells

COMPANY OVERVIEW

- Deliver clean and affordable fuel cell solutions for the supply, recovery and storage of energy
- SureSource fuel cell systems provide continuous baseload power and are deployed with utility, municipality, university and industrial and commercial enterprise customers
- Turn-key solutions from design and installation of a project to long-term operation and maintenance of fuel cell system

COMPANY HIGHLIGHTS

<table>
<thead>
<tr>
<th>Company Highlight</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headquarters</td>
<td>Danbury, CT</td>
</tr>
<tr>
<td>Listing: NASDAQ</td>
<td>FCEL</td>
</tr>
<tr>
<td>Employees</td>
<td>~300</td>
</tr>
<tr>
<td>Continents</td>
<td>3</td>
</tr>
<tr>
<td>Global Plant Installations</td>
<td>59</td>
</tr>
<tr>
<td>Capacity in Field</td>
<td>&gt;260 MW</td>
</tr>
</tbody>
</table>

GLOBAL CUSTOMERS

Over 10 Million MWh generated by SureSource™ plants around the world

Enable The World To Live A Life Empowered By Clean Energy

1 As of the quarter ended April 30, 2020.
FuelCell Energy Technology: Addressing The 4 Major Energy Opportunities

**Carbon Capture**
- Most efficient Carbon Capture technology – Produces MW while capturing carbon
- Increases output of host plant, providing additional generation / ancillary revenue
- Power revenue stream reduces cost of CO₂ capture

**Electrolysis**

**Hydrogen Energy Storage**
- ≥ 8hr Energy Storage “Virtual-Battery”
- > 100% electrical efficiency when utilizing excess thermal energy
- Fully scalable energy storage (caverns, etc.)
- Provides efficient, dispatchable, zero emissions power while avoiding the raw material and disposal issues of batteries

**Hydrogen Power Generation**
- Multi-Fuel
- Microgrid
- CHP
- Carbon Capture and Separation
- Sub-MW through Large MW Scale
- Grid Resiliency | Reliability
- Limited Space Requirements
- Avoid transmission upgrade and infrastructure costs
IPCC: We have 12 years left to reduce climate pollution or face catastrophic changes

ARB: SLCP Reduction and carbon sequestration are the only ways to immediately reverse climate change and its impacts

SLCP’s are tens to thousands of times more damaging to the climate than CO₂
More than one-third of CA’s Climate Strategy Depends on SLCP Reductions
California’s Climate Change Scoping Plan

- “Organic matter can provide a clean, renewable energy source in the form of bioenergy, biofuels, or renewable natural gas.”
- Need to increase production of renewable transportation fuels and energy from organic waste
- Need to remove barriers to pipeline biogas and electricity interconnection
CA’s Short-Lived Climate Pollutant Strategy

• The State's organic waste should be put to beneficial use for electricity generation, transportation fuel, and pipeline biogas

• Building organic waste to energy facilities and infrastructure would lead to billions of dollars of investment and thousands of jobs in the State
# California’s Technically Available Organic Waste Feedstocks

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Amount Technically Available</th>
<th>Billion Cubic Feet Methane</th>
<th>Million Gasoline Gallon Equivalents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill Gas</td>
<td>106 BCF</td>
<td>53</td>
<td>457</td>
</tr>
<tr>
<td>Animal Manure</td>
<td>3.4 M BDT</td>
<td>19.5</td>
<td>168</td>
</tr>
<tr>
<td>Waste Water Treatment Gas</td>
<td>11.8 BCF</td>
<td>7.7</td>
<td>66</td>
</tr>
<tr>
<td>Fats, Oils and Greases</td>
<td>207,000 tons</td>
<td>1.9</td>
<td>16</td>
</tr>
<tr>
<td>Municipal Solid Waste (food, leaves, grass)</td>
<td>1.2 M BDT</td>
<td>12.7</td>
<td>109</td>
</tr>
<tr>
<td>Municipal Solid Waste lignocellulosic fraction)</td>
<td>6.7 BDT</td>
<td>65.9</td>
<td>568</td>
</tr>
<tr>
<td>Agricultural Residue (Lignocellulosic)</td>
<td>5.3 M BDT</td>
<td>51.8</td>
<td>446</td>
</tr>
<tr>
<td>Forest, Sawmill, Shrub &amp; Chaparral Residues</td>
<td>26.2 M BDT</td>
<td>256</td>
<td>2,214</td>
</tr>
<tr>
<td><strong>BIOGAS POTENTIAL</strong></td>
<td><strong>468.5</strong></td>
<td><strong>4,044</strong></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Rob Williams and Stephen Kaffka, UC Davis, presentation to the California Energy Commission on January 30, 2017; Lawrence Livermore National Lab assessment of forest, sawmill, shrub & chaparral residues
Biogas can Provide Locally Sourced, Carbon Negative Generation and Storage
## Carbon Intensity of Fuels (grams CO₂e / MJ)

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Carbon Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>102</td>
</tr>
<tr>
<td>Gasoline</td>
<td>100</td>
</tr>
<tr>
<td>Corn ethanol</td>
<td>34-75</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>68</td>
</tr>
<tr>
<td>Fuel Cell (non-renewable hydrogen)</td>
<td>39</td>
</tr>
<tr>
<td>Electric vehicles (CA power grid)</td>
<td>31</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>9 to 50</td>
</tr>
<tr>
<td>Landfill Biogas</td>
<td>11 to 40</td>
</tr>
<tr>
<td>Biogas from forest waste</td>
<td>14</td>
</tr>
<tr>
<td>Wastewater Biogas (large facilities)</td>
<td>8 - 30</td>
</tr>
<tr>
<td>Biogas from Diverted Food and Green Waste</td>
<td>-15 to -100</td>
</tr>
<tr>
<td>Dairy Biogas</td>
<td>-276 to -330</td>
</tr>
</tbody>
</table>

[www.arb.ca.gov/fuels/lcfs/lcfs.htm](http://www.arb.ca.gov/fuels/lcfs/lcfs.htm)
How can California achieve 125 MT/year of negative emissions by mid-century?

- Natural and Working Lands: 25 MT/year
- Waste Biomass Conversion to Fuels with CO₂ Storage: 83 MT/year
- Direct Air Capture with CO₂ Storage: 17 MT/year

Technological readiness: mid-to-high – no new breakthroughs required
The least-cost path to 125 MT/year uses natural solutions, gasification of biomass to $\text{H}_2$, and some direct air capture.
University of California

• UC has set biomethane procurement goal to meet the UC’s carbon neutrality goal
• Recent procurement agreement with landfill in San Bernardino County to supply enough biomethane to meet all of UCSB’s gas needs
• Biomethane fuels existing UC power plants, provides CHP and renewable hydrogen
• Keeps essential services operating, including UC hospitals and labs
Miramar Marine Corps Air Station

- 20 MW microgrid in San Diego County
- Includes 3.2 MW of landfill gas powered flexible generation
- The microgrid uses solar energy and biomethane to keep mission-critical buildings operational during power shut-offs.
Altamont Pass Landfill

• CEC helped fund landfill gas to energy project
• Landfill produces enough biogas to generate 6 MW of RPS power and 13,000 gge/day of vehicle fuel that has replaced diesel in WM garbage trucks
• GHG and NOx reductions compared to flaring the landfill gas
Why Landfill and Wastewater Biogas?

• Landfills and WWTF are essential services that protect public health
• They produce biogas whether it’s used or not
• Using for power generation reduces NOx, PM and carbon emissions compared to flaring
• California wastes ≈ 250 million gge worth of landfill gas / year
### Recommendations for SGIP

- Directed biogas should be allowed provided it meets requirements of PU Code 399.12.6
- Carbon negative fuels should receive additional incentives, but other GHG tests should not be required unless required for all SGIP sources
- Carbon intensity should be based on lifecycle emissions, including avoided emissions, using the GREET model
- Tracking should be consistent with BioMAT and other distributed generation programs
- Green hydrogen needs to include H₂ from biogas
THANK YOU

Julia Levin, Executive Director
jlevin@bioenergyca.org
510-610-1733

www.bioenergyca.org
Fuel Cells for Resilience and Decarbonization in California

November 12, 2020
California Policy Priorities

- Decarbonization
  - Zero emission transportation and goods movement
  - Community health risk mitigation
- Resilience and Public Safety Power Shutoffs
- Increased penetration of renewables
- GHG reduction & air quality improvement
Fuel Cell Emissions Reduction Quantified

**GHG Reductions**

By Technology Type and Year (A)

**Criteria Air Pollution Reductions**

Source: SGIP 2016-2017 Impact Report, Table ES-6: GHG Impacts by Technology Type and Year and Figure ES-4 Criteria Air Pollutant Impacts By Technology Type (2017)
Stationary Fuel Cells in Microgrids

- Increased resilience with local backup power and load management
- Connect or island from central grid
- High efficiency
- Balance intermittent resources
- No pollutant emissions
- Power purchase agreements eliminate end user risk
- Reduce operating costs and avoid T&D investment

Public Safety
Utilities
Data centers
Research Facilities
Industrial
Hospitals

Photo courtesy of FuelCell Energy
Demonstrated Resilience of Fuel Cells and Gas System

- San Diego Blackout, 9/28/11
- Winter Storm Alfred, 10/29/11
- Hurricane Sandy, 10/29/12
- CA Earthquake, 8/24/14

- Data Center Utility Outage, 4/16/15
- Hurricane Joaquin, 10/15/15
- Napa Fire, 10/9/17
- Japanese Super-Typhoon, 10/23/17

- Hurricane Michael, 10/15/18
- Ridgecrest Earthquakes, 7/4-5/19
- Manhattan Blackout, 7/13/19

> 99.999% reliability

Gas Technology Institute, Assessment of Natural Gas ... Service Reliability, 2018.
Fuel Cells for Dispatchable Load Following

- Coca-Cola bottling facility
- 5 day/week production facility
- 400 kW baseload weekdays
- Load-following with 100 kW minimum utility import on weekends

- Whole Foods Market
- Supermarket
- Continuous load-following
- Net-metering with zero utility power import
Fuel Cell use of Biogas is Better than Alternatives

- Beneficial use (power/heat) is always better than flaring
- Fuel cell use of biogas in SGIP reduces GHG
- Fuel cell use in SGIP eliminates pollutant emissions, esp. compared to the diesel/peaker alternatives
- Fuel cell GHG assessment in SGIP should be equally/fairly applied to all technologies in the program
- Fuel cell use in SGIP helps with PSPS and wildfire challenges
- Since biogas is scarce, CPUC should adopt the broadest definition(s) possible
- Electrolytic and biogenic hydrogen should be eligible in SGIP
Fuel Cells for Resilience and Decarbonization in California

November 12, 2020
Low Carbon Fuel Standard (LCFS)

California’s primary program to promote alternative fuel use in the transportation sector

- Reduce carbon intensity of transportation fuels
- Transform and diversify fuel pool
- Reduce petroleum dependency
- Reduce emissions of criteria pollutants and toxics

Transportation sector accounts for 50% of State’s GHG inventory when industrial emissions from refining and oil production are included
How Does LCFS Work?

Fuels with CI above the benchmark generate deficits.

Fuels with CI below the benchmark generate credits.

Historical Compliance Targets

Future Compliance Targets

Percent Reduction in Carbon Intensity
Most Common Low Carbon Fuels

- Biodiesel
- Renewable Diesel
- Biomethane
- Ethanol
- Electricity
- Hydrogen
Diverse and Growing Alternative Fuel Pool

- Over 15 million metric tons of GHG reductions in 2019
- Rapid growth in electricity and renewable diesel as transportation fuels
- 240 parties generated credits in 2019

**VOLUMES**

- Fuels supported by the LCFS displaced about 2.5 billion gallons of petroleum fuel in 2019

**CREDITS**

- Over 15 million metric tons of GHG reductions in 2019
- Rapid growth in electricity and renewable diesel as transportation fuels
- 240 parties generated credits in 2019
“Well-to-Wheel” Life Cycle Analysis

- CI includes the “direct” effects of producing and using the fuel, as well as “indirect” effects that are primarily associated with crop-based biofuels.

- Modeling tools:
  - Oil Production Greenhouse Gas Emissions Estimator (OPGEE): Direct carbon intensity of crude production and transport to the refinery.
  - Global Trade Analysis Project (GTAP) + Agro-Ecological Zone Emissions Factor (AEZ-EF) model: Used to estimate indirect effects associated with crop-based biofuels.
LCA Example: Corn Ethanol

Corn Farming
34 g/MJ
Land Use Change

Bio-Refinery
27 g/MJ
-12 g/MJ
Co-products

Vehicle
< 1 g/MJ

Corn Ethanol
CI approx. 70-75 g/MJ
Energy Economy Ratio (EER)

• Energy Economy Ratio represents the efficiency of fuel use in alternative fuel vehicle compared to that of conventional vehicle (tank-to-wheel portion of life cycle).

• In simple terms, it compares the useful “output” derived from a unit of energy of alternative fuel vs. conventional baseline fuel in same application.

• For example, EER for battery electric light duty vehicle in comparison to gasoline powered internal combustion engine car is 3.4. This means, 1 MJ of energy will drive electric car 3.4 times more than gasoline car.
Reporting, Credit Generation and Verification

• Approved entities report fuel quantities sold in California to our Low Carbon Reporting Tool (LRT) on a quarterly basis
• Credits generated for fuel transactions in previous quarter based on the carbon intensity and quantity of the fuel reported and the end-use vehicle application
• Beginning in 2020, implementation of mandatory annual verification of operational data and fuel transactions reporting
Other Crediting Opportunities

- Project-based crediting:
  - Innovative crude production projects
  - Refinery-focused projects
- Carbon Capture and Sequestration (CCS)
  - Can be paired with crude oil production, refinery processing and biorefineries, or as a stand-alone direct air capture project
- Alternative Jet Fuel
- Zero Emission Vehicle Refueling Infrastructure
- Off-road electric transportation
CALIFORNIA PUBLIC UTILITIES COMMISSION

Workshop on Self-Generation Incentive Program
Renewable Generation

November 12, 2020
Foundation Windpower California Projects

- 35 MW at 20 Commercial, Industrial, Agricultural Customer Sites
- Diverse Geographies and Customer Types:
  - Aggregate Rock Mines
  - Cement Manufacturing Facilities
  - Winery
  - Brewery
  - Agricultural Processing Facilities
  - CA State Prisons
  - Tribal Travel Center & Gaming Facility
  - Bottling Facility
  - Municipal Wastewater Treatment Facilities
  - Large Commercial Distribution Centers
NATURALLY ALIGNED TO PRODUCE WHEN NEEDED MOST: Sun heats central CA, pulling cooler air in from the coast, resulting in strong and predictable late afternoon and evening winds, offering a natural solution to the “duck curve” problem. This alignment with peak 4-9PM hours occurs statewide, but is particularly pronounced in Salinas Valley:

Average Foundation Windpower Project Capacity Factor: 30-35%
Average Foundation Windpower Project Capacity Factor, 4-9PM Jun 1 –Sep 30: 40-85%*
*Alignment with peak 4-9PM hours occurs statewide, but is particularly pronounced in Salinas Valley

A typical behind-the-meter wind NEM customer exports to the grid during peak hours, and draws back from it in the early morning hours.

Many deployed wind in part because of its unique ability to deliver peak heavy renewable power without requiring onsite storage.
Challenges of Behind-the-Meter Wind

- **Geographic**: Must deploy where the load is – cannot chase the strongest wind resource.

- **Economics**: Cannot benefit from economies of scale seen at wind farms (e.g., crane is constructed, used once, and disassembled).

- **Permitting**: Permitting simplicity does not scale down with project size (CEQA).

- **Interconnection**: Costs and timelines are increasing exponentially. Costs swamp small project economics.

- **Financing**: Uncertainty from the above factors + imminent expiration of federal tax credits for > 100kW wind.
Challenges: Permitting and CEQA

Wind projects require extended permitting timelines due to size and visibility.

Example: Most recently permitted project (2020) was well-positioned for straightforward environmental review and approval:

- Onsite wind facility within 5 miles of 5 other operating existing behind-the-meter wind projects.
- Ample biological study data available from previous permits
- Supportive community and permitting authority
- Permit issued with Mitigated Negative Declaration on 7-0 vote

Still, time from filing to issuance of permit was 18 months, excluding any time for appeals. Delay could be much more significant if extended biological monitoring is required.

The unique and visible nature of wind projects results in extended permitting timelines for even the simplest, best-sited projects.
Challenges: Interconnection Cost and Delays

- Over the last 10 years, the cost to interconnect behind-the-meter wind to the grid has increased exponentially, particularly in PG&E service territory, as a result of unique grid protection requirements.

- Utility upgrade timelines create a bottleneck that threatens projects’ viability by running out the clock on expiring federal tax credits and/or SGIP reservations.

- Most recent behind-the-meter wind project is requiring $6M in utility interconnection upgrades and approximately 30 months for upgrades to be completed.
T=0: Decision to Proceed

SGIP Deposit

System Impact Study

Posting of Interconnection Security

UTILITY INTERCONNECTION WORK (24-36 Months)

SGIP Reservation

CEQA Process (best case)

CEQA Process (typical 18-24M)

CEQA Process (with extended bio. surveys)

Extension

Extension

Extension

Twin “Long Poles” of Interconnection and Permitting drive the project schedule. Construction (6 months) timed to meet gating long pole. **SGIP deadline lapses prior to completion, requiring extension(s)**
SGIP Program Features Impacting Wind Energy Development

• First Come; First Serve Reservation Requests

• 5% Non-Refundable Deposit Due w/in 7 days of Reservation Request

• Reservation Expiration -- 18 mos. for 3-step reservations

• Up to three (3) 6-month extensions available at SGIP Working Group’s Discretion

• 12/31/2022 – Potential Advice Letters for Budget Shifts Between Technology
Potential Responses to Current Challenges

SGIP & Wind Energy – Potential Responses to Current Challenges

• Improve Coordination of Incentive Claim Deadline with CEQA
  • Require applicant to file permit application w/in 60 days of confirmed reservation
  • Pause incentive claim clock during pendency of CEQA process
  • Grant PA’s more authority to extend incentive claim deadline for CEQA

• Improve Coordination of Incentive Claim Deadline with Interconnection Process
  • Pause incentive claim clock during pendency of Utility’s interconnection build-out
  • Grant PA’s more authority to extend incentive claim deadline for interconnection

• SGIP deposit refundable if CEQA permit denied or cost-prohibitive interconnection, provided pursued in good faith