Next Generation Hydrogen Station Composite Data Products: Retail Stations

Data through Quarter 3 of 2019

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Hydrogen Station Project Partners

- Air Liquide
- Air Products
- California Air Resources Board
- California Energy Commission
- California State University Los Angeles
- Equilon
- FirstElement Fuel
- Gas Technology Institute
- H2 Frontier
- IPHE and HySUT
- ITM Power
- Iwatani
- Linde
- Messer
- Proton OnSite
- Shell
Analysis Categories
Deployment
CDP-INFR-11
Hydrogen Stations by Type
CDP-INFR-27
Hydrogen Station Timeline

Hydrogen Station Timeline - Retail Stations

- Design
- Permit
- Construction
- Commission

Stations Sorted by Opening Date

- Stations

Duration [days]

Created: Jan-13-20 8:07 PM | Data Range: 2014Q3-2019Q3
Safety
An Incident is an event that results in:
- a lost time accident and/or injury to personnel
- damage/unplanned downtime for project equipment, facilities or property
- impact to the public or environment
- any hydrogen release that unintentionally ignites
- release of any volatile, hydrogen containing compound (including the hydrocarbons used as common fuels)

A Near Miss is:
- an event that under slightly different circumstances could have become an incident
- any hydrogen release sufficient to sustain a flame if ignited

A Minor H2 Leak is:
- an unplanned hydrogen release insufficient to sustain a flame, and does not accumulate in sufficient quantity to ignite
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A Minor H2 Leak is:
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Mean Fills per $H_2$ Leak - Retail Stations

Station Average: 890 Fills per $H_2$ Leak.

10 of 35 stations did not report leaks.
CDP-INFR-54
Mean Hydrogen Dispensed per Hydrogen Leak

Mean $H_2$ Dispensed (kg) per Leak - Retail Stations

Station Average: 2653 kg $H_2$ Dispensed per $H_2$ Leak.

10 of 35 stations did not report leaks.
Maintenance and Reliability
Maintenance by Known Equipment Type - Retail Stations

Total Events\(^1\) = 10,074
65% unscheduled

Total Hours\(^1\) = 22,807
77% unscheduled

Classified Events
- Dispenser: 7%
- Compressor: 12%
- Chiller: 26%
- Gas mgmt panel: 55%
- MISC: 8%

Event Count
- Classified events: 7000
- Multiple systems: 1541
- Entire: 1141
- Entire system: 392

1. Total includes classified events (plotted) and unclassified events.
2. Maintenance events with unknown equipment type excluded from plot.
Maintenance by Equipment Type by Quarter - Retail Stations

Number at bottom of bars is number of stations reporting for that quarter.

"OTHER" includes items for which equipment type could not be determined from the data.
Infrastructure Maintenance Labor Hours per Event - Retail Stations

Maximum and Mean Event Labor Hours for each site.

66% of repairs require less than the mean of 3.4 hours of labor. Median labor hours: 2.3
Failure Modes for Top Equipment Categories

Failure Modes for Top Equipment Categories - Retail Stations

- **GAS MGMT PANEL**: 7%
- **CHILLER**: 12%
- **COMPRESSOR**: 26%
- **DISPENSER**: 55%

- **Gas MGMT Panel**: 8%
- **Chiller**: 24%
- **Compressor**: 22%
- **Dispenser**: 46%

*Percentage of total events or hours.

Miscellaneous includes the following failure modes: collision, communication error, contamination, debris, design flaw, electrical breaker, end of life, environmental factors, fluid temp, freezing, installation error, low flow, loose electrical, loose mechanical, lost signal, maintenance error, manufacturing defect, mechanical deflection, mechanical fatigue, metal fatigue, moisture, no, operator error, out of calibration, overtemperature, power outage, quality, pressure loss, software bug, stress outside design limit, theft, vandalism, vibration, other.
Overall Averages
5.6 hours per station per month.
2738.8 kg dispensed per maintenance hour.

Overall Averages
2.8 events per station per month.
2357.8 kg dispensed per maintenance event.

*Trendlines connect continuous months of operation for a single station. Gaps in trendlines represent quarters in which a station was offline or missing data. Each station is represented by a unique color.
CDP-INFR-28
Maintenance Labor Hours by Quarter

Maintenance Labor Hours By Quarter - Retail Stations

Overall Average: 81 hours per station per quarter.

Stars represent individual station maintenance hours in a given quarter.
Maintenance Costs Over Time - Retail Stations

Overall Average: $9,573 per station per quarter.

*Each color represents a unique station.
CDP-INFR-49
Mean Fills Between Failures

Mean Fills Between Failures - Retail Stations

- Median Site
- Lowest Site
Overall Site Reliability Growth By Fills - Retail Stations

Instantaneous MTBF improved for 22 of 35 sites for the last 20% of events.

Sites sorted by Increasing Age
Fills

2. % change in instantaneous mean Fills between failures
CDP-INFR-51
Mean Amount Dispensed Between Failures

Mean $H_2$ Dispensed Between Failures (kg) - Retail Stations

- Median Site
- Lowest Site
Instantaneous MTBF improved for 20 of 35 sites for the last 20% of events.

Sites sorted by increasing age

2. % change in instantaneous mean \( H_2 \) Dispensed (kg) between failures.
Historical Failure Rate (bathtub curve) by Fills - Retail Stations

\[ \rho = \lambda \beta \text{Fills}^{(\beta-1)} \]

\[ \lambda = 1.736 \]

\[ \beta = 0.577 \]

18 Mean Fills per Failure at 1000 Fills
Historical Failure Rate (bathtub curve) by kg H₂ Dispensed - Retail Stations

\[ \rho = \lambda \beta \text{ kg H}_2 \text{ Dispensed}^{(\beta-1)} \]

\[ \lambda = 1.269 \]
\[ \beta = 0.584 \]

47 Mean kg H₂ Dispensed per Failure at 5000 kg H₂ Dispensed
Maintenance Causes and Effects - Retail Stations

Subsystem: CHILLER
Component: VALVE

Causes

Effects
Maintenance Causes and Effects

Subsystem: CHILLER
Component: REFRIGERANT

Causes

Effects
Maintenance Causes and Effects - Retail Stations

Subsystem: DISPENSER
Component: ENTIRE
Maintenance Causes and Effects - Retail Stations

Subsystem: DISPENSER
Component: NOZZLE

Preventative Maintenance accounted for 5% of all events. Suppressed in the plot to show detail for other causes.
Maintenance Causes and Effects - Retail Stations

Subsystem: DISPENSER
Component: FITTING

Causes

Effects
Maintenance Causes and Effects: Compressor (Entire)

Subsystem: COMPRESSOR
Component: ENTIRE

Preventative Maintenance accounted for 31% of all events. Suppressed in the plot to show detail for other causes.

Causes:
- FAILED PART
- LOOSE MECHANICAL
- OUT OF CALIBRATION
- UNDETERMINED
- COMMUNICATION ERROR
- DESIGN FLAW
- ELECTRICAL BREAKER
- NA
- OPERATOR ERROR
- OVERTEMPERATURE
- PRESSURE LOSS
- UPGRADE
- POWER OUTAGE/QUALITY
- VIBRATION

Effects:
- ALARM
- FAILED TO START
- FLUID LEAK NON-H2
- FUNCTIONALITY LOST
- H2 LEAK
- NA
- SHUTDOWN HIGH
- SHUTDOWN LOW
- UNDETERMINED
- WARNING HIGH
- WARNING LOW
- DATA ERROR

NREL cdpRETAIL_infreq_70
Created: July-14-20 2:00 PM | Data Range: 2014Q3-2019Q3
Maintenance Causes and Effects - Retail Stations
Subsystem: COMPRESSOR
Component: PISTON

Preventive Maintenance accounted for 6% of all events. Suppressed in the plot to show detail for other causes.
Maintenance Causes and Effects - Retail Stations
Subsystem: COMPRESSOR
Component: VALVE

Preventative Maintenance accounted for 2% of all events.
Suppressed in the plot to show detail for other causes.
Performance
CDP-INFR-01
Hydrogen Dispensed by Quarter

Hydrogen Dispensed By Quarter - Retail Stations

By Year

- 2019 thru Q3: 636,944 kg
- 2018: 913,570 kg
- 2017: 449,725 kg
- 2016: 104,891 kg
- 2015: 2,341 kg

Note: Colors represent individual stations. Station count is number at bottom of bar.
Hydrogen Fills by Quarter - Retail Stations

By Year

2019 thru Q3: 229,284
2018: 306,774
2017: 150,196
2016: 37,313
2015: 1,204

Cumulative Fuelings = 724,771

Note: Colors represent individual stations. Station count is number at bottom of bar.
CDP-INFR-81
Hydrogen Dispensed by Region

Hydrogen Dispensed By Region - Retail Stations

- Northern California
- Southern California
- Connector California

By Year

2019 thru Q3
2018
2017
2016
2015

Cumulative Hydrogen Dispensed
Northern California = 733,125 kg
Southern California = 1,287,176 kg
Connector California = 87,170 kg

H2 Dispensed [1,000 kg]
Histogram of Fueling Rates

633,333 Events
Average = 0.9 kg/min
1.0% > 1.51 kg/min
0.2% > 2 kg/min

2.5 minute fill of 5 kg
Histogram of Fueling Times

- 633,333 Events
- Average = 3.51 min
- 43% <3.3 min
- 18% <2.5 min

Legend:
- Green line: 2020 MYRDD Target for 5kg
- Red dotted line: Ultimate MYRDD Target (5 kg in 2.5 min)
- Triangle: Average
Histogram of Fueling Amounts

Average = 3.10 kg

Number of Fueling Events [1,000]

Amount Fueled (kg)
CDP-INFR-08
Time Between Fueling

Histogram of Time Between Fuelings - Retail Stations

25% of fills are within 0-5 minutes of each other
47% of fills have more than 20 minutes between them
634916 Total Fills

Final Pressures for Fills with <5 Minutes in Between

*Time is from end of fill to start of next fill.
Fueling Final Pressures - Retail Stations

- 350 bar Fills (200 to 450 bar)
  - Avg Final Pressure = 351 bar
  - % of Fills > 350 bar = 53%
  - Number of Fills = 21064

- 700 bar Fills (> 450 bar)
  - Avg Final Pressure = 763 bar
  - % of Fills > 700 bar = 88%
  - Number of Fills = 575955

*The line at 450 bar separates 350 bar fills from 700 bar fills. It is slightly over the allowable 125% of nominal pressure (437.5 bar) from SAE J2601.
CDP-INFR-12
Fueling Rates 350 bar vs. 700 bar

Histogram of Fueling Rates
350 vs 700 bar Fills

Fill Type | Avg | % > 1.51 | % > 2 | Count
----------|-----|---------|------|------
350 bar   | 0.85| 2.9%    | 0.7% | 31660
700 bar   | 0.92| 0.6%    | 0.3% | 602685

2.5 minute fill of 5 kg
CDP-INFR-90
Hydrogen Dispensed by Quarter and Pressure

Hydrogen Dispensed by Quarter and Pressure - Retail Stations

H2 Amount Dispensed [1000 kg]

Year Quarter

Amount Dispensed (H70)
Amount Dispensed (H35)
Number of Fueling Events per Hour

Average: 3.8 per hour
Median: 3.0 per hour
Max: 31.0 per hour
CDP-INFR-14
Hydrogen Dispensed per Hour

Hydrogen Dispensed Per Hour - Retail Stations

- Average: 11.4 kgs per hour
- Median: 10.5 kgs per hour
- Max: 115.2 kgs per hour
CDP-INFR-15
Number of Fills by Time of Day

Number of Fueling Events per Time of Day - Retail Stations

Number Included
675,105 fills

H2 Fueling
Gasoline Profile

Fueling Amounts per Time of Day - Retail Stations

Amount Included
2,095,835 kg
Fueling Profile by Day and Hour: Connector/Destination Stations

Fueling Amounts by Day and Hour - Retail Stations - Connector/Destination California

- Sun
- Mon
- Tue
- Wed
- Thu
- Fri
- Sat

[Graphs showing fueling amounts by day and hour for retail stations with hydrogen and gasoline data]

Fueling Profile by Day and Hour: Southern California

Fueling Amounts by Day and Hour - Retail Stations - Southern California

CDP-INFR-91
Missed Fuel Opportunity (Q1 2019)
CDP-INFR-91
Missed Fuel Opportunity (Q2 2019)
Missed Fuel Opportunity for June of Q2 of 2019 for 30 stations (50,537 kg)

- The minute fill profile was taken as an average from an hourly total.
Missed Fuel Opportunity during Q3 of 2019 for 26 stations (60,447 kg)

*The minute fill profile was taken as an average from an hourly total.*
CDP-INFR-95
Station Unavailability: Northern California

2019 Station Unavailability for 19 stations
Northern California

Time of Day

2am 4am 6am 8am 10am 12pm 2pm 4pm 6pm 8pm 10pm 12am

Day of the Year

Feb 01 Mar 01 Apr 01 May 01 Jun 01 Jul 01 Aug 01 Sep 01 Oct 01 Nov 01 Dec 01

# of Stations Unavailable

0 5 10 15

* y-axis resolution - minutes | x-axis resolution - days
2019 Station Unavailability for 23 stations
Southern California

Day of the Year

# of Stations Unavailable

Time of Day

*Y-axis resolution - minutes | X-axis resolution - days
CDP-INFR-18
Fueling Amount vs. Time to Fill

Histogram of Fueling Amount Vs Time - Retail Stations

Number of Fills

Amount [kg]

Fill Time [min]

01/01/2015 Through 07/01/2015
07/01/2015 Through 01/01/2016
01/01/2016 Through 07/01/2016
07/01/2016 Through 01/01/2017
01/01/2017 Through 07/01/2017
07/01/2017 Through 01/01/2018
01/01/2018 Through 07/01/2018
07/01/2018 Through 01/01/2019
01/01/2019 Through 07/01/2019
07/01/2019 Through 01/01/2020
Histogram of Fueling Rates By Year

- 2015
- 2016
- 2017
- 2018
- 2019
- 2020 MYRDD Target
- Ultimate MYRDD Target

<table>
<thead>
<tr>
<th>Year</th>
<th>Avg (kg/min)</th>
<th>%&gt;1.51</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0.69</td>
<td>0.2%</td>
</tr>
<tr>
<td>2016</td>
<td>0.83</td>
<td>0.9%</td>
</tr>
<tr>
<td>2017</td>
<td>0.88</td>
<td>0.5%</td>
</tr>
<tr>
<td>2018</td>
<td>0.96</td>
<td>1.4%</td>
</tr>
<tr>
<td>2019</td>
<td>0.91</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

3.3 minute fill of 5 kg
2.5 minute fill of 5 kg
CDP-INFR-55
Monthly Averages: All Fills

Monthly Averages for All Fills - Retail Stations

- Rate [kg/min]
  - Overall Avg
  - Individual Station Avg
  - Avg: 0.93

- Time [min]
  - Overall Avg
  - Individual Station Avg
  - Avg: 3.6

- Amount [kg]
  - Overall Avg
  - Individual Station Avg
  - Avg: 3.2
CDP-INFR-57
Monthly Averages: 700 bar Fills >1 kg with Pre-Cool of -40°C
Cost
CDP-INFR-53
Maintenance Cost per kg of Hydrogen Dispensed

Overall Average: $16 per kg.

*Each color represents a unique station. 0 data points excluded that were over $1000/kg
CDP-INFR-89
Hydrogen Price by Quarter

Hydrogen Price by Quarter - Retail Stations

H2 Price [$/kg]


Note: Data points above $20/kg have been filtered due to a data reporting error.
CDP-INFR-05
Dispensed Hydrogen per Day of Week

Dispensed Hydrogen per Day of Week - Retail Stations

1. Chevron weekly demand profile "Hydrogen Delivery Infrastructure Options Analysis", T. Chen.
Station Capacity Utilization

- Maximum Daily Utilization
- Maximum Quarterly Utilization
- Average Daily Utilization

Note: The focus for early stations is geographic coverage.

1. Station nameplate capacity reflects a variety of system design considerations including system capacity, throughput, system reliability and durability, and maintenance. Actual daily usage may exceed nameplate capacity.

2. Maximum quarterly utilization considers all days; average daily utilization considers only days when at least one filling occurs.
Station Usage - Retail Stations

- Maximum Daily Fills
- Average Daily Fills

Note: The focus for early stations is geographic coverage.

1 Excludes hydrogen fills of < 0.5 kg
2 Average daily fills considers only days when at least one fill occurred.
CDP-INFR-19
Hydrogen Dispensed by Month

Hydrogen Dispensed By Month - Retail Stations

- Individual station
- Average of all stations

Monthly Amount [kg]
CDP-INFR-20
Number of Fills by Month
Station Capacity Utilization Trends by Quarter - Retail Stations

Number of Stations = 37 Total
Total H2 Dispensed = 2,107,466 kg

Range of Station Capacities

Average Utilization (%) vs. Maximum Daily Fueling Capacity (kg)


1 Trendlines connect continuous quarters of operation for a single station. Gaps in trendlines represent quarters in which a station was offline or missing data. Each station is represented by a unique color.
2 Average quarterly utilization only considers quarters when at least one fill occurred.
3 Station nameplate capacity is as reported to NREL and reflects a variety of system design considerations including: system capacity, throughput, system reliability, and maintenance. Actual daily usage may exceed nameplate capacity.
Station Amount Dispensed by Quarter - Retail Stations

Number of Stations = 37 Total
Total H2 Dispensed = 2,107,486 kg

1 Trendlines connect continuous quarters of operation for a single station. Gaps in trendlines represent quarters in which a station was offline or missing data. Each station is represented by a unique color.

2 Average quarterly amount only considers quarters when at least one fill occurred.
Days with Fills by Quarter - Retail Stations

% Of Days With At Least One Fill

Quarters

- Trendlines connect continuous quarters of operation for a single station. Gaps in trendlines represent quarters in which a station had no fills or was missing data. Each station is represented by a unique color.
- The average percent of days with fills only considers quarters in which at least one fill occurred. Stations with no filling days in a quarter are excluded from the average for that quarter. All stations with at least one fill in a quarter are given equal weight when calculating the average for the quarter.

Number of Stations = 37 Total
Summary of Station Usage Statistics - Retail Stations

1. Station nameplate capacity is as reported to NREL and reflects a variety of system design considerations including: system capacity, throughput, system reliability, and maintenance. Actual daily usage may exceed nameplate capacity.
2. Average quarterly utilization only considers days when at least one fill occurred.
3. Utilization is calculated by dividing the quarterly amount dispensed by the stations nameplate capacity.
4. Only quarters with fills are included.
CDP-INFR-80
Daily Fueling Amounts by Station

Daily Fueling Amounts - Retail Stations

Daily Avg. 62.3 kg

Daily Avg. 7.4 kg

Daily Avg. 63.9 kg

Stations
Daily Fueling Amounts by Month

Daily Fueling Amounts Over Time - Retail Stations

*Daily Average per Month

*Daily average only includes days with fills.
Hydrogen Quality
CDP-INFR-79
Impurities—Argon

Impurities (Retail Stations) - Argon

- Delivered Compressed
- Delivered Liquid
- Delivered Pipeline
- Onsite Electrolysis
- Delivered Compressed; Onsite Electrolysis
- Onsite SMR

Number of Samples

Measured Impurity [ppm]

nd det. lim = 0.4 ppm
nd det. lim = 0.5 ppm
nd det. lim = 1 ppm
nd det. lim = 4 ppm
nd det. lim = 25 ppm

SAE J2719 Limit = 100 ppm
Impurities—Formaldehyde

Impurities (Retail Stations) - Formaldehyde

206 Total Samples
- Not Detected Summary:
  - Delivered Compressed 175 Sample(s)
  - Delivered Liquid 7 Sample(s)
  - Delivered Pipeline 1 Sample(s)
  - Onsite Electrolysis 7 Sample(s)
  - Delivered Compressed; Onsite Electrolysis 2 Sample(s)
  - Onsite SMR 5 Sample(s)
- Not Measured Summary:
  - Delivered Compressed 1 Sample(s)
  - Delivered Compressed; Onsite Electrolysis 2 Sample(s)

SAEJ2719 Limit = 10 ppb

Measured Impurity [ppb]

Number of Samples

0 20 40 60 80 100 120 140 160 180 200

nd det. lim = 1 ppb
nd det. lim = 2 ppb
nd det. lim = 5 ppb
Impurities—Helium

Graph showing the distribution of impurities measured in零售 stations. The x-axis represents measured impurity in parts per million (ppm), and the y-axis represents the number of samples. Different colors indicate different delivery methods:

- Delivered Compressed
- Delivered Liquid
- Delivered Pipeline
- Onsite Electrolysis
- Delivered Compressed; Onsite Electrolysis
- Onsite SMR

The graph includes a limit of 300 ppm as indicated by SAEJ2719. A nd det. limit of 10 ppm and a nd det. limit of 40 ppm are also noted.
Impurities (Retail Stations) - Nitrogen

- Delivered Compressed
- Delivered Liquid
- Delivered Pipeline
- Onsite Electrolysis
- Delivered Compressed; Onsite Electrolysis
- Onsite SMR

Number of Samples

Measured Impurity [ppm]

Notes for exceeding SAE J2719 Limits:
Commissioning

Created: Jan-14-20 4:36 PM | Data Range: 2015Q4-2019Q3
Impurities (Retail Stations) - Particulate Concentration

- Delivered Compressed
- Delivered Liquid
- Delivered Pipeline
- Onsite Electrolysis
- Delivered Compressed; Onsite Electrolysis
- Onsite SMR

Number of Samples

Measured Impurity [mg/kgH2]

nd det. lim. = 0.05 mg/kgH2
CDP-INFR-79
Impurities—Total Sulfur

Impurities (Retail Stations) - Total Sulfur

- Delivered Compressed
- Delivered Liquid
- Delivered Pipeline
- Onsite Electrolysis
- Delivered Compressed; Onsite Electrolysis
- Onsite SMR

Number of Samples

Measured Impurity [ppb]

SAEJ2719 Limit = 4 ppb
nd det. lim = 3 ppb

nd
CDP-INFR-79
Impurities—Water

Impurities (Retail Stations) - Water

- Delivered Compressed
- Delivered Liquid
- Delivered Pipeline
- Onsite Electrolysis
- Delivered Compressed; Onsite Electrolysis
- Onsite SMR

206 Total Samples
- Not Detected Summary:
  - Delivered Compressed: 1 Sample(s)
  - Not Measured Summary:
  - Delivered Compressed; Onsite Electrolysis: 1 Sample(s)

nd det. lim = 1 ppm

SAEJ2719 Limit = 5 ppm

Number of Samples

Measured Impurity [ppm]

nd 0-1 1-1.5 1.5-2 2-3 3-4 4-5 > 5

0 10 20 30 40 50 60 70 80 90 100
Component Energy
CDP-INFR-92
Dispenser Energy

Dispenser Efficiency - Retail Stations
Average (for >500kg) = 1.68 [kWh/kg]

Chiller Energy for 700bar
Average (for >500kg) = 1.48 [kWh/kg]
CDP-INFR-78
Station Energy per kg Dispensed

Electricity Usage - Retail Stations

- Compressed Delivery
- Delivered Pipeline
- Liquid Delivery
- Onsite Electrolysis; Compressed Delivery

Monthly Electricity Usage per kg

Monthly Amount of Hydrogen Dispensed [kg]
CDP-INFR-84
Station Electricity Cost per kWh

Electricity Cost per kWh - Retail Stations

- Compressed Delivery, Average: $0.29/kWh
- Compressed Delivery Average
- Delivered Pipeline, Average: $0.21/kWh
- Delivered Pipeline Average
- Liquid Delivery, Average: $0.24/kWh
- Liquid Delivery Average
- Onsite Electrolysis; Compressed Delivery, Average: $0.13/kWh
- Onsite Electrolysis; Compressed Delivery Average

*Some data has been filtered due to station reporting errors.
CDP-INFR-85
Station Electricity Cost per kg Over Time

Electricity Cost per kg Over Time - Retail Stations

- Compressed Delivery, Average: 3.34 $/kg
- Compressed Delivery Average
- Delivered Pipeline, Average: 1.33 $/kg
- Delivered Pipeline Average
- Liquid Delivery, Average: 4.36 $/kg
- Liquid Delivery Average
- Onsite Electrolysis; Compressed Delivery, Average: 3.65 $/kg
- Onsite Electrolysis; Compressed Delivery Average
- Onsite SMR; Compressed Delivery, Average: 5.97 $/kg
- Onsite SMR; Compressed Delivery Average

Monthly Electricity Cost per kg [$/kg]
Station Electricity Cost per kWh by Region

Electricity Cost per kWh by Region - Retail Stations

- **Connector California, Average: 0.36 $/kWh**
- **Northern California, Average: 0.27 $/kWh**
- **Southern California, Average: 0.28 $/kWh**

*Some data has been filtered due to station reporting errors.*
Electricity Cost per kWh by Utility - Retail Stations

- PG&E, Average: 0.30 $/kWh
- SCE, Average: 0.25 $/kWh
- SDG&E, Average: 0.37 $/kWh
- Unknown, Average: 0.27 $/kWh

*Some data has been filtered due to station reporting errors.*