Fuel Cell Stationary Systems Deployed by Year

Cumulative Deployment Count by Year*

Total = 460 units  
Fuel Cell CHP = 122 units  
Fuel Cell Electric = 338 units

Cumulative Capacity by Year

Total = 178 MW  
Fuel Cell CHP = 40 MW  
Fuel Cell Electric = 139 MW

*Data from the CA SGIP.
Stationary Fuel Cell System Count by Status

Order of Project Phases:

1. Application Review includes CA SGIP projects in Reservation Request Form (RRF) phases.
2. Project Execution Review includes CA SGIP projects in Proof of Project Milestone (PPM) phases.
3. Incentive Claim Review includes projects in operation and pending confirmation of incentive claims, including CA SGIP Incentive Claim Form (ICF) phases.
4. Project In Operation includes projects that are receiving performance based incentives, includes CA SGIP Performance Based Incentives (PBI) In Progress.
5. Project Completed includes installed projects with unknown operation status, includes CA SGIP Payment Completed and Payment Recalled status.

73% of 460 projects have been installed [3-5].

*Data from the CA SGIP.

Order of Project Phases:
[1] Includes CA SGIP projects in Reservation Request Form (RRF) phases.
[2] Includes CA SGIP projects in Proof of Project Milestone (PPM) phases.
[3] Projects are in operation and pending confirmation of incentive claims, including CA SGIP Incentive Claim Form (ICF) phases.
[4] Includes projects that are receiving performance based incentives, includes CA SGIP Performance Based Incentives (PBI) In Progress.
[5] Includes installed projects with unknown operation status, includes CA SGIP Payment Completed and Payment Recalled status.

*Data from the CA SGIP.
Site Count by Fuel Type*
- Biomass [1]: 3%
- Digester Gas [1]: 7%
- Landfill Gas [1]: 8%
- Natural Gas: 82%

Total Sites: 460

Installed Capacity by Fuel Type
- Biomass [1]: 3%
- Digester Gas [1]: 15%
- Landfill Gas [1]: 10%
- Natural Gas: 73%

Total Capacity: 178 MW

*Data from the CA SGIP.

Definition of Included Status:
[1] The renewable fuels exclude those defined as conventional in Section 2805 of the California Public Utilities Code and are categorized here as gas derived from biomass, digester gas, or landfill gas.
[2] Includes CA SGIP projects in Reservation Request Form (RRF) phases.
[3] Includes CA SGIP projects in Proof of Project Milestone (PPM) phases.
[4] Projects are in operation and pending confirmation of incentive claims, including CA SGIP Incentive Claim Form (ICF) phases.
[5] Includes projects that are receiving performance based incentives, includes CA SGIP Performance Based Incentives (PBI) in Progress.
[6] Includes installed projects with unknown operation status, includes CA SGIP Payment Completed and Payment Recalled status.

Includes Status Categories:
- Application Review [2]
- Project Execution Review [3]
- Incentive Claim Review [4]
- Project In Operation [5]
- Project Completed [6]

NREL cdp_stat_04
Created: Nov-05-15 2:46 PM | Data Range: 2001Q2-2015Q3
Stationary Fuel Cell - Installation Capacity Statistics by Fuel Type[1]*

- Insufficient data to protect anonymity

Biomass: 75% Percentile
Digester Gas: Median
Landfill Gas: Mean
Natural Gas: 25% Percentile

[1] The renewable fuels exclude those defined as conventional in Section 2805 of the California Public Utilities Code and are categorized here as gas derived from biomass, digester gas, or landfill gas.

*Data from the CA SGIP.
Fuel Cell Stationary Capacity and Average Prices

Stationary Fuel Cell - Distribution of Capacity and Average Eligible Cost $2010/kW*

- % of systems vs. Capacity (kW)
- $/kW w/o Incentive
- $/kW w/ Incentive
- 2020 DOE Target†

Detailed Capacity Distribution

- % of systems vs. Capacity (kW)
- Number of systems


*Data from the CA SGIP.
†Installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
Price without incentives [$2010/kW]

Stationary Fuel Cell - Installed Eligible Cost Per kW*
Adjusted To 2010 Dollars

Avg** = $10,709 $/kW

Current
DOE 2020 Target†
Mean without Incentives

± 1 σ ($2,168)

Price with incentives [$2010/kW]

Avg** = $7,616 $/kW

Current
DOE 2020 Target†
Mean with Incentives

± 1 σ ($2,508)


*Data from the CA SGIP.
**Data bins with less than 2 projects filtered.
†installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
Stationary Fuel Cell - Average Eligible Cost $2010/W Trend for Overall Deployments*

- **Without Incentive**
- **With Incentive**
- **DOE 2020 Target†**

**Capacity < 500 kW**

**Capacity >= 1000 kW**


Data from the CA SGIP.

Note: Data points are omitted where only one system would be represented in a given year.

†Installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
CDP-STAT-09
Stationary Fuel Cell Install Price by Fuel Type with and without Incentives

Stationary Fuel Cell - Eligible Cost $2010/kW of Installed Capacity by Fuel Type*

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Avg. Without Incentive</th>
<th>Avg. With Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digester Gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landfill Gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


*Data from the CA SGIP.
Note: Refer to CA SGIP Handbook for on-site vs directed digester gas (biogas) qualifications.
Stationary Fuel Cell - Installed Capacity And Fuel Type*

- Biomass
- Digester Gas
- Landfill Gas
- Natural Gas

*Data from the CA SGIP.

Note: Refer to CA SGIP Handbook for on-site vs directed digester gas (biogas) qualifications.
In 2014 incentive rates for emerging technologies (including fuel cells) and biogas will decline 10% and all other technologies 5% annually. (2014 SGIP Handbook)
Stationary Fuel Cell - Average System Size Installed Per Year (kW)*

Overall Average Capacity = 452 kW

*Data from the CA SGP.
Stationary Fuel Cell - Installed Fuel Type By Year*

- Biomass
- Digester Gas
- Landfill Gas
- Natural Gas

Year

Total Annual Installed Capacity (MW)

2001Q2-2015Q3

*Data from the CA SGIP.

Note: Refer to CA SGIP Handbook for on-site vs directed digester gas (biogas) qualifications.
**Distribution of Capacity by Equipment Type**

*Data from the CA SGIP.*
Average Eligible Cost $2010/W Trend for Overall Deployments*
Without Incentives

Average Eligible Cost $2010/W Trend for Overall Deployments*
With Incentives


*Data from the CA SGP.
Stationary Fuel Cell - Average Eligible Cost $2010/kW Biogas Source

Without Incentives

System Size (kW)

<table>
<thead>
<tr>
<th>$2010/kW of Installed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>12000</td>
</tr>
<tr>
<td>10000</td>
</tr>
<tr>
<td>8000</td>
</tr>
<tr>
<td>6000</td>
</tr>
<tr>
<td>4000</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

System Size (kW) 0 200 400 600 800 1000 >1000 (max 4200)

Directed**

Onsite**

Stationary Fuel Cell - Average Eligible Cost $2010/kW Biogas Source

With Incentives

System Size (kW)

<table>
<thead>
<tr>
<th>$2010/kW of Installed Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
</tr>
<tr>
<td>6000</td>
</tr>
<tr>
<td>4000</td>
</tr>
<tr>
<td>2000</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

System Size (kW) 0 200 400 600 800 1000 >1000 (max 4200)

Directed**

Onsite**


*Data from the CA SGIP.

** Refer to CA SGIP Handbook for on-site vs directed digester gas (biogas) qualifications.
Installations By Fuel Type (CHP Fuel Cells)

Site Count by Fuel Type*

- Digester Gas [1]: 13%
- Landfill Gas [1]: 4%
- Natural Gas: 83%

Total Sites: 122

Installed Capacity by Fuel Type

- Digester Gas [1]: 40%
- Landfill Gas [1]: 9%
- Natural Gas: 51%

Total Capacity: 40 MW

*Data from the CA SGIP.

[1] The renewable fuels exclude those defined as conventional in Section 2805 of the California Public Utilities Code and are
categorized here as gas derived from biomass, digester gas, or landfill gas.

Definition of Included Status:
[2] Includes CA SGIP projects in Reservation Request Form (RRF) phases.
[3] Includes CA SGIP projects in Proof of Project Milestone (PPM) phases.
[4] Projects are in operation and pending confirmation of incentive claims, including CA SGIP Incentive Claim Form (ICF) phases.
[5] Includes projects that are receiving performance based incentives, including CA SGIP Performance Based Incentives (PBI) In Progress.
[6] Includes installed projects with unknown operation status, includes CA SGIP Payment Completed and Payment Recalled status.

Includes Status Categories:
Application Review [2]
Project Execution Review [3]
Incentive Claim Review [4]
Project In Operation [5]
Project Completed [6]

*Data from the CA SGIP.
Installation Capacity Statistics by Fuel Type[1] (CHP Fuel Cell)*

The renewable fuels exclude those defined as conventional in Section 2805 of the California Public Utilities Code and are categorized here as gas derived from biomass, digester gas, or landfill gas.

*Data from the CA SGIP.

*Data from the CA SGIP, †installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
Price without incentives [$2010/kW]

- Mean without Incentives: $10,243 $/kW
- DOE 2020 Target†: ($3,036)

Price with incentives [$2010/kW]

- Mean with Incentives: $7,295 $/kW
- DOE 2020 Target†: ($3,280)


Avg** = $10,243 $/kW
Avg** = $7,295 $/kW

*Data from the CA SGIP.
**Data bins with less than 2 projects filtered.
†Installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
Eligible Cost $2010/kW of Installed Capacity by Fuel Type (CHP Fuel Cell)*


*Data from the CA SGIP. Note: Refer to CA SGIP Handbook for on-site vs directed digester gas (biogas) qualifications.
Cumulative Deployment Count by Category and Year

Total = 2169 units
- Fuel Cell CHP = 122 units
- Fuel Cell Electric = 338 units
- Gas Turbine = 17 units
- Internal Combustion = 293 units
- Microturbine = 158 units
- Pressure Reduction Turbine = 9 units
- Steam Turbine CHP = 1 units

Cumulative Capacity by Category and Year

Total = 666 MW
- Fuel Cell CHP = 40 MW
- Fuel Cell Electric = 139 MW
- Gas Turbine = 61 MW
- Internal Combustion = 195 MW
- Microturbine = 35 MW
- Pressure Reduction Turbine = 3 MW
- Steam Turbine CHP = 30 MW

*Data from the CA SGIP.
Stationary Fuel Cell - Installed Eligible Cost Per kW By Capacity*

*Data from the CA SGIP.


Average Prices No Incentive, Incentive

0-50 kW = $11,275/kW, $8,782/kW
51-200 kW = $10,927/kW, $6,715/kW
201-400 kW = $10,515/kW, $7,497/kW
401+ kW = $10,424/kW, $7,163/kW

Data points with less than 2 projects filtered.

†installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
Installed Eligible Cost per kW By Capacity (CHP Fuel Cell)

- Average Prices No Incentive, Incentive
  - 0-50 kW = $11,303/kW, $8,809/kW
  - 51-200 kW = $NaN/kW, $NaN/kW
  - 201-400 kW = $8,414/kW, $5,581/kW
  - 401+ kW = $8,043/kW, $4,197/kW

Data points with less than 2 projects filtered.


*Data from the CA SGIP.
†installed cost for the year 2020, operating on natural gas. May not include all costs reported in CA SGIP.
Stationary Fuel Cell - Range of Installed Eligible Cost Per kW Biogas Sources by Capacity*

- Biogas Sources with Incentive 25th/75th percentile
- Biogas Sources without Incentive 25th/75th percentile
- Mean with Incentive
- Median with Incentive
- Mean without Incentive
- Median without Incentive

*N Data from the CA SGIP.

Created: Oct-21-15  3:01 PM | Data Range: 2001Q2-2015Q3
Includes CA SGIP data as well as sites supplying voluntary data.

Total Count of Sites in Continental US: 501
Stationary Fuel Cell - Cumulative Fuel Cell Energy Output*
Units >100 kW

Total MWh: 607,267

* Voluntarily supplied data for units > 100 kW
Histogram of Load Fractions for Base Load Units >100 kW

Load Fraction (%) [2]

Stationary Fuel Cell - Histogram of Load Fractions (Base Load Units) [1]

Units >100 kW

Operation Time (%)

[1] Voluntarily supplied data for units > 100 kW, fuel cells running as building base load generation

[2] Load fraction is the ratio of electrical output per rated capacity of the fuel cell unit.
Stationary Fuel Cell - Histogram of Load Fractions (Load Following Units) [1]

Units >100 kW

[1] Voluntarily supplied data for units > 100 kW, fuel cells running as building load following generation
[2] Load fraction is the ratio of electrical output per rated capacity of the fuel cell unit.
Stationary Fuel Cell - Electrical Efficiency by Load Fraction [1]

Units >100 kW

Mean Electrical Efficiency HHV (%) [3]

- Median
- 25/75th percentile
- Mean
- DOE Target Efficiency 2015 (HHV)

[1] Voluntarily supplied data for units > 100 kW
[2] Load fraction is the ratio of electrical output per rated capacity of the fuel cell unit. Efficiency data points for each load fraction are +/- 2% of the target load fraction.
[3] Mean efficiencies by unit are calculated as the percentage of electrical power output to higher heating value of fuel input. The natural gas higher heating value used is 48.956 MJ/kg and the lower heating value used is 44.294 MJ/kg.
CDP-STAT-34
Total Efficiency by Load Fraction for Units >100 kW

Stationary Fuel Cell - Total Efficiency by Load Fraction [1]
Units >100 kW

Mean Total Efficiency HHV (%) [3]
Load Fraction (%) [2]

Median
25/75th percentile
Mean

[1] Voluntarily supplied data for units > 100 kW
[2] Load fraction is the ratio of electrical output per rated capacity of the fuel cell unit. Efficiency data points for each load fraction are +/- 2% of the target load fraction.
[3] Mean total efficiencies by unit are calculated as the percentage of electrical plus heat outputs to higher heating value of fuel input. The natural gas higher heating value used is 48.956 MJ/kg and the lower heating value used is 44.294 MJ/kg.
Stationary Fuel Cell - Cumulative Fuel Cell Hours Accumulated* Units >100 kW

Total Hours: 1,713,872

* Voluntarily supplied data for units > 100 kW
Stationary Fuel Cell - Histogram of Capacity Factor (Load Following Units) [1]

Units >100 kW

[1] Voluntarily supplied data for units > 100 kW, fuel cells running as building load following generation

[2] Capacity Factor is defined as the ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period.
Stationary Fuel Cell - Histogram of Capacity Factor (Base Load Units) [1]

Units >100 kW

Capacity Factor
Mean Capacity Factor

[1] Voluntarily supplied data for units > 100 kW, fuel cells running as building base load generation
[2] Capacity Factor is defined as the ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period.
[3] Capacity Factor over 100% is possible when a unit operates above rated capacity.
Stationary Fuel Cell - Histogram of Availability (Load Following Units) [1]

Units >100 kW

Availability (%) [2]

Units (%)

90 91 92 93 94 95 96 97 98 99 100 >100

[1] Voluntarily supplied data for units > 100 kW, fuel cells running as building load following generation
[2] Downtime may include scheduled maintenance decreasing calculated availability.
Histogram of Availability for Base Load Units >100 kW

Stationary Fuel Cell - Histogram of Availability (Base Load Units) [1]
Units >100 kW

- Availability
- Mean Availability

Available: 80 82 84 86 88 90 92 94 96 98 100

Units (%)

- Max 100.0

Mean Availability: 98.3

Notes:
1. Voluntarily supplied data for units > 100 kW, fuel cells running as building base load generation
2. Downtime may include scheduled maintenance decreasing calculated availability.