

Appendix G. Distributed Generation

G.1 Overview

Distributed Generation (DG) is a concept of installing and operating small-scale electric generators, typically less than 20 megawatts MW, at or near an electrical load and interconnected to the electric utility distribution system. The most common technologies used today for DG are turbines and internal combustion engines (ICEs). However, new technologies including fuel cells, microturbines, and solar PVs are now being developed. The promise of DG is to provide electricity to customers at a reduced cost and more efficiently than the traditional utility central generating plant with transmission and distribution wire losses. Other benefits that DG could potentially provide, depending on the technology, include reduced emissions, utilization of waste heat, improved power quality and reliability and deferral of transmission or distribution upgrades.

DG can be customer installed or utility installed. The benefits for customer installed DG include waste heat recovery, backup power and power quality. The benefits for utility installed DG include generation, transmission and distribution infrastructure deferral, and reduction of delivery losses.

This Appendix describes DG on the grid, ICE technologies, fuel cells, and PV technologies.

G.2 Distributed Generation on the Grid

The introduction of competition into the electric marketplace has driven the development of new electrical generation technologies. Most technologies being developed for DG applications are more costly than traditional generating resources. However, it is anticipated that, with advances in the technologies and a greater demand for DG, costs will be reduced, and more systems will be installed.

LADWP currently has approximately 350 MW of customer installed DG on its electrical grid, producing approximately 1,700 Gigawatt hours (GWh) annually, most of which is consumed on-site, although some (approximately 40 MWh/h) is exported back to LADWP. Most of the customer installed DG (approximately 300 MW) is made up of 20 MW or larger natural gas combustion engines. The amount of customer DG installed in the future will depend on several factors including reliability, cost of the technologies, and natural gas and electricity prices. With stable electricity prices and high natural gas prices, customer generation becomes less attractive. Additionally, more than 700 LADWP customers have installed over 17 MW of solar PV energy systems with the help of LADWP's Solar Incentive Program.

LADWP has installed nearly 1 MW of solar PV energy systems on LADWP and City of Los Angeles (City) facilities to generate clean, renewable energy for the LADWP grid. LADWP has also installed various other DG technologies for demonstration purposes to understand the operating issues and benefits associated with various equipment and to promote the

development of new clean, efficient technologies. Future DG installations for demonstration purposes will showcase new technologies and should add approximately 1 MW in capacity every three years. These projects will be funded with Public Benefits funds, described in Section 2 of the IRP.

Utility installed DG may also play a role in meeting capacity needs in the future that have very low energy production requirements (low capacity factors). It is estimated that approximately 1 MW of DG will be installed annually beginning in 2010. Tables G-1 and G-2 provide projections of DG and Solar PV capacity and energy. The projections are summarized in Table G-3.

Table G-1: Projected Distributed Generation Capacity and Energy - Cumulative

Calendar Year		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Customer generated	MW	290	280	290	300	302	304	306	308	310	312	314	316
	GWh	1650	1600	1650	1700	1720	1730	1740	1760	1770	1780	1790	1800
Utility generated	MW	1	1	1	2	3	4	6	7	8	10	11	12
	GWh	4	4	4	8	9	10	15	16	17	22	23	24

Table G-2: Projected Solar Photovoltaic Generation Capacity and Energy - Cumulative

Calendar Year		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Customer generated	MW	9	11	13	18	25	33	43	57	75	95	115	135
	GWh	15	18	21	30	35	48	63	83	109	140	173	206
Utility generated	MW	1	1	1	1	1	3	25	85	145	205	270	295
	GWh	2	2	2	2	2	4	25	109	237	365	498	589

NOTE: The LADWP Solar Program is set to encourage the installation of 280 MW of customer-installed PV by 2016 with a budget of \$313 million over 10 years.

Table G-3: Summary of Annual MW of EE, DSM and DG Additions

Summary of DG, Solar PV and Customer Electrification - Projected Annual Increases (MW)											
Row	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1 Excess Customer DG	10	10	10	2	2	2	2	2	2	2	2
2 Utility DG	1	0	1	1	1	2	1	1	2	1	1
3 Customer PV	2	4	5	7	8	10	14	18	20	20	20
4 LADWP PV	0	0	0	0	2	22	60	60	60	65	25
5 Customer Electrification Program	-3	-5	-6	-8	-10	-11	-13	-15	-16	-18	-20
Total Annual Projections	10	9	10	2	3	25	64	66	68	70	28
Total Cumulative Projections	10	19	29	31	34	59	123	189	257	327	355

Row Notes

- 1 See Table F-1. The October 2006 Load Forecast incorporates existing Customer DG. Future years are converted to annualized values.
- 2 See Table F-1. Converted to annualized values
- 3 See Table F-2. 10 MW of existing Customer PV is deducted. Future years are converted to annualized values.
- 4 See Table F-2. 1 MW of existing LADWP PV is deducted. Future years are converted to annualized values.
PV funding continues through 2011. This IRP assumes a continuation of the program for future years.
The October 2006 Load Forecast incorporates the existing 10 MW Customer PV and 1 MW LADWP PV
- 5 See Table E-1. 2 MW per year growth assumed for years 2018 - 2026. The values are negative as they act to add load.

G.3 Internal Combustion Engines

ICEs include reciprocating engines and combustion turbines. Improvements have been seen recently in the emissions and efficiencies of reciprocating engines and combustion turbines. Combustion turbines have typically been in the multi-MW size, but recently small-scale combustion turbines, or microturbines, have been developed.

Microturbines are machines ranging in size from 28 kilowatts (kW) to 500 kW, which include a compressor, combustor, turbine, alternator, recuperator, and generator. They have the potential to be located on sites that have space limitations to produce power. The advantages of microturbines are that there are a small number of moving parts, are compact in size, are lightweight, and can utilize waste fuels.

LADWP has installed nearly 2 MW of microturbines, the first of which was located at LADWP's Main Street Center in 1999. Additional microturbines have been installed at LADWP facilities and the Lopez Canyon landfill.

G.4 Fuel Cells

A fuel cell combines hydrogen and oxygen to produce electricity through an electrochemical process. Besides electricity, fuel cells produce water and heat. If the oxygen source is air, then small amounts of NO_x may also be emitted. Fuel cells produce energy at relatively higher efficiencies and emit far fewer air pollutants than combustion technologies. Fuel-cell power plants are now becoming commercially available for use by electric power producers, industrial facilities, and large commercial buildings. Smaller systems for residential, small commercial buildings and transportation applications are expected to be commercially available in the near future. The pricing for these products is expected to become competitive due to several factors:

- A fuel cell is a fairly simple technology with reasonably priced components.
- Significant recent investments in the technology are accelerating the development of fuel cells, and costs are being reduced.
- Integrating fuel processing and power conditioning equipment can be a significant cost with regard to fuel cells, but reductions are likely as more fuel cells are manufactured and installed.

LADWP has installed a total of four 200-250 kW fuel cell power plants in various locations in Los Angeles that have provided considerable experience and data. The existing fuel cell installations are being evaluated for viability of continued operation.

G.5 Photovoltaics

Solar energy is converted to electricity using two power technologies: PV systems and solar thermal power systems. PV systems convert sunlight directly into electricity. PV systems are modular, portable, highly reliable, and have low environmental impact, making them ideal for power applications of all sizes. Several large PV systems capable of powering hundreds of homes are now connected to utility grids throughout the United States. Many utilities are installing these systems on the rooftops of schools or customer's homes.

A typical 4 kW alternating current (AC) residential rooftop solar power system produces 6,600 kWh per year. Presently, LADWP has installed about 1 MW of PVs at LADWP facilities and other City facilities. LADWP incentives have supported the installation of about 23 MW on its customers' properties. In 2006 state legislation, SB1, required all utilities to offer incentives to customers to install solar energy systems through 2016. LADWP's solar incentive program has been developed with a goal of encouraging the installation of 280 MW of customer installed solar PV systems by 2016 with a budget of \$313 million over 10 years, however because of LADWP's lower electric rates, a higher incentive amount has been offered which will reduce the expected amount of customer installed solar to approximately 130MW. An additional 150MW of distributed solar is expected to be installed through a new feed-in tariff program.

The energy generation characteristics of a typical PV installation are that the output peaks around 1:00 p.m., and that 90 percent of a solar PV system's energy is produced from 10:00 a.m. to 4:00 p.m. during a typical summer day in California. Another point worth noting is that a solar PV system can be designed to coincide more closely to the system load profile by altering the module's orientation. While this will increase the energy produced during the peak load of the

utility, it will result in an overall lower amount of energy produced for the day. Cloud cover also affects the energy output of a solar photovoltaic installation. The type of clouds will either raise or lower the output of the PV system. Darker rain clouds will lower PV output, but a light marine layer may actually produce more energy than the nameplate rating of the modules due to light reflecting off of the modules, back to the atmosphere, and then back to the modules. This does not happen often but does cause design issues that must be taken into account.

G.6. Combined Heat and Power (CHP) Program

Combined heat and power (CHP) systems, or also known as thermal cogeneration, simply capture and utilize excess heat generated during the production of electric power. CHP systems offer economic, environmental and reliability-related advantages compared to power generation facilities that produce only electricity. Distributed power generation systems, which are frequently located near thermal loads, are particularly well suited for CHP applications.

Currently CHP installed in the LADWP Power System consists primarily of cogeneration projects of industrial and commercial customers. This totaled to approximately 265 MWs nameplate capacity operating in the LADWP's service area. Some cogeneration projects sell excess energy to the LADWP under interconnection agreements.

Current barriers to the expansion of CHP can be attributed to:

- Natural gas price volatility in recent years has caused uncertainty in the economic feasibility of CHP projects.
- Diminishing industrial customer base in recent years has reduced CHP developable potential.
- Reliability and economic issues made small systems infeasible.
- Added cost from utility replacement reserve requirements.
- Uncertain Green House Gas emission add costs to CHP electric generation.
- Air quality sitting restriction for new carbon-based CHP electric generation.

LADWP is developing CHP target goals to incorporate CHP generation in its future resource mix. LADWP is currently considering development of several self-owned CHP projects:

- Terminal Island Renewable Energy Project is a fuel cell plant to produce 4 MW of electricity and process heat using methane gas.
- Los Angeles Bureau of Sanitation Alternative Technologies Projects to convert waste to heat.

To encourage customer-developed CHP, shift demand from electric grid, and provide accurate price signals to customer, LADWP is currently offering a Standard Energy Credit (SEC) to its customers for excess energy they sell to LADWP. The SEC is based on LADWP marginal

generation cost, and is updated and posted monthly. In the future, for renewable CHP, LADWP will provide a renewable premium based on the energy market plus the SEC. For non-renewable CHP, LADWP will continue to purchase CHP excess energy at the SEC.

Current Net Metering Incentives offered to customers require:

- Customer must purchase electric services from LADWP to be eligible for interconnection
- Customer submits completed Standard Offer Agreement for interconnection and qualification for the CG Rate
- Customers pay for all costs associated with time-of-use metering, interconnection, and safe grid-parallel operation of the generation facilities
- For cogeneration facilities greater than one megawatt, the customer is required to install remote monitoring equipment for LADWP
- Customer maintains adequate insurance on generating facilities
- Excess power reimbursements are made to the customer at end of billing period at the CG Rate
- The interconnection agreement has a three year term and requires approval by the General Manager initially and for renewal and extension

Inclusion of the CHP goals under the IRP process will incorporate stakeholder feedback provided through the following activities:

- Present preliminary IRP at the review meetings of the City Council Energy and Environment Committee
- Create e-mail box for public comment use on all outreach materials and website
- Conduct workshops with Neighborhood Council Committee meetings
- Brief the Southern California Association of Governments
- Brief large customers
- Brief labor organizations
- Review all inputs and make final recommendations to City Council
- Place approved IRP (incorporating CHP Goals) on LADWP website