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Witness	:	Renaghan

DIVISION OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

Report on Total Factor Productivity for Pacific Gas and Electric Company

General Rate Case
Test Year 2007

San Francisco, California
April 14, 2006

REPORT ON TOTAL FACTOR PRODUCTIVITY

I. INTRODUCTION

This report analyzes Pacific Gas and Electric's (PG&E) productivity performance for its electric and gas departments over the period 1986 through test year 2007. Since 1986 (D.86-12-095), the California energy utilities (PG&E, San Diego Gas & Electric Company, Southern California Edison, and the Southern California Gas Company) have been required to file reports on historic and forecast firm-specific productivity growth. PG&E's Report on Total Factor Productivity fulfills this requirement.

Section II presents DRA's recommendations. Section III discusses the concept of total factor productivity. Section IV includes a detailed analysis of DRA's and PG&E's findings. Conclusions are summarized in Section V.

II. SUMMARY AND RECOMMENDATIONS

Productivity is simply a measure of how efficiently a firm, industry, or an economy transforms inputs into output. There are various measures of productivity. A commonly cited measure of productivity is labor productivity growth. Labor productivity shows a how well a firm, industry, or an entire economy utilizes its labor inputs to produce a unit of output. This measure of productivity, while useful, ignores the fact that a firm uses more than labor to produce a unit of output. An electric utility, for example, utilizes labor, capital (plant-in-service), fuel, and materials (O&M) to produce and distribute electricity. A common method to gauge how well a firm utilizes all its inputs to produce output is to construct measures of total factor productivity (TFP).

Total factor productivity is measured as the ratio of a firm's output to its entire set of inputs. Often the term multi-factor productivity is substituted for TFP. The concept, however, is the same: "Multi-factor productivity describes the

relationship between output in real terms and the inputs involved in its production. They do not measure the specific contributions of labor, capital, or any other factor of production. Rather, multi-factor productivity is designed to capture the joint influence on economic growth of technological change, efficiency improvements, returns to scale, reallocation of resources due to shifts in factor inputs across industries and other factors."[1] While the focus of this report is on TFP, partial productivity measures are not neglected. DRA discusses several measures of partial productivity, specifically, labor, and combined O&M and capital productivity.

PG&E presents separate estimates of TFP growth for the electric department, the gas department, and the combined electric and gas departments. For each measure of TFP growth, PG&E reports results with output defined as total sales adjusted for conservation and as total customers. Inputs are defined as the cost weighted sum of labor, capital, fuel, and materials expenses. PG&E concludes that: "For the historical period, 1987 – 2004, the combined electric and gas distribution department average productivity growth is 1.1 percent using gigawatt-hours (GWh) as the output measure, or 0.9 percent if one uses customers as the measure of output. If the forecast period is included then the combined electric and gas distribution department average productivity is estimated at 1.1 percent and the estimate is 1.4 percent if customers are used as the measure of output."[2]

DRA first replicated PG&E's TFP growth rates. DRA then compared PG&E's historic TFP growth rates to national TFP growth rates taken from the Bureau of Labor Statistics (BLS). Specifically, DRA compared PG&E's total factor productivity growth rates to the BLS' measures of productivity growth for the Electric, Gas, and Sanitary Services sector and the Private Non-Farm Business sector. Based on these comparisons, DRA concludes that PG&E's TFP growth

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[1] United States Department of Labor, Bureau of Labor Statistics, "Summary of Methods", July 23, 2002, p. 1.

[2] Pacific Gas and Electric Company, 2007 General Rate Case, Exhibit PG&E-8, "Report on Total Factor Productivity", December 2, 2005, pp. 8-1, 8-2.

rates are reasonable. Furthermore, DRA recommends no additional adjustments to PG&E's Results of Operations beyond those recommended by DRA's Results of Operations witnesses.

III. MEASURING TOTAL FACTOR PRODUCTIVITY

Total factor productivity is defined as the ratio of output to all inputs. The usefulness of TFP analysis is that it allows one to gauge "the company's dynamic efficiency, or the extent to which the company has lowered costs over time through innovation."[3] The focus of TFP studies is on the long-run, the time period over which inputs can be varied. A long-run focus is preferred because "it is costly for firms to adjust the level of important inputs – particularly capital and skilled labor – in the very short run and so their utilization rates very directly with the level of business activity…It is standard practice to "smooth" the annual series to reveal secular changes."[4] As a result, TFP studies typically focus on the results for a set of years rather than a particular year. The number of years should "be long enough to reflect the long-run TFP trend. We generally desire a sample period of at least 10 years to fulfill this goal."[5] PG&E's historic sample period of 1986 through 2004 clearly meets this criterion.

There are two approaches to measuring TFP growth: parametric and non-parametric. The non-parametric approach relies upon constructing indexes of inputs and outputs. In this report PG&E and DRA have adopted the index or non-parametric approach to TFP measurement. Parametric measures of TFP growth rely upon econometrically estimated cost or production functions.

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[3] Pacific Gas and Electric Company, 2007 General Rate Case, Exhibit PG&E-8, "Report on Total Factor Productivity", December 2, 2005, p. 8 -2.

[4] Pacific Gas and Electric Company, Direct Prepared Direct Testimony of Dr. Mark Schankerman, "Electric Distribution Performance Based Ratemaking Proposal", February 28, 1999, p. 3-2.

[5] Prepared Direct Testimony of Mark Newton Lowry, On Behalf of San Diego Gas & Electric, "X Factor Calibration for San Diego Gas & Electric", 13 December 2002, p. 13.

In past General Rate Cases (GRCs), DRA and the utilities have presented econometrically (parametric) measures of TFP growth. Recently, the shift is away from the parametric approach to the index number approach to measuring TFP growth. In its last GRC, Southern California Edison (SCE) noted that: "Our previous experience with productivity models indicates that they generally produce imprecise estimates of productivity growth… For example, in SCE's 1995 General Rate Case, in SCE's econometric productivity model, long-run productivity growth was estimated to be 1.0 percent, and the annual econometric productivity estimates were generally positive, ranging from 0.72 percent to 1.93 percent for years between 1982 and 1993. But the confidence intervals around these point estimates were so large that in some cases, the model could not reject the hypothesis that true productivity growth had been zero."[6] Others share SCE's concerns: "[T]here is the question of the econometric procedures used to obtain the estimates. The highly complicated structure of the models usually requires non-linear estimation techniques which are valid only under special assumptions, and there are questions about the statistical properties of the resulting estimates."[7] In their last GRC filings both PG&E and SCE used the index number approach to TFP measurement. **[1]**

[6] Southern California Edison, 2006 General Rate Case, "Productivity", SCE-10, December 2004, p. 12.

[7] Hulten, C. R., "Total Factor Productivity: A Short Biography" Working Paper No**.** 7471, National Bureau of Economic Research, January 2003, p. 23.

IV. DISCUSSION/ANALYSIS

A.1. Electric TFP Growth

Table 1 reports PG&E's annual electric TFP growth rates under three different output definitions. The results in column (1) of Table 1 report electric TFP growth rates with output defined as total electric sales. Column (2) of Table shows TFP growth rates when output is defined as total electric sales adjusted for the impact of conservation. Finally, column (3) reports electric TFP growth rates when output is defined as total electric department customers.

Table 1
Pacific Gas and Electric Company
Electric Total Factor Productivity Growth
1987 – 2007
(Percent Change)

Year	TFP1	TFP2	TFP3
	Output Measure	Output Measure	Output Measure
	Total Electric Sales	Conservation Adjusted Electric Sales	Total Electric Customers
1987	-2.56	-1.69	-5.29
1988	0.19	-1.08	-0.48
1989	4.15	4.23	4.83
1990	-3.29	-3.79	-6.04
1991	-1.26	-0.76	-0.08
1992	-1.36	-1.28	-1.93
1993	4.82	4.89	7.47
1994	-3.89	-3.96	-4.52
1995	11.06	10.37	13.64
1996	2.02	0.91	-0.47
1997	-2.10	-2.78	-4.18
1998	-9.01	-8.98	-7.83
1999	13.70	13.52	10.71
2000	29.14	29.38	26.65
2001	-34.33	-33.53	-30.00
2002	11.27	11.45	12.31
2003	-4.21	-4.00	-3.81
2004	5.99	6.33	4.43
2005	3.20	2.85	3.39
2006	-0.06	-0.38	0.14
2007	-2.15	-2.41	-1.85
Average 1987-2004	**1.12**	**1.07**	**0.86**
Average 2005-2007	**0.33**	**0.02**	**0.56**
Average 1987 – 2007	**1.01**	**0.92**	**0.81**

Source: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.

PG&E suggests that electric TFP growth is influenced by exogenous factors such as mandated conservation. Since utilities in California are required to undertake conservation efforts on the part of their energy customers this results in lower energy consumption. Lower energy consumption coupled with no corresponding reduction in input growth yields lower reported energy TFP growth rates than if these conservation impacts had not been undertaken. PG&E explains that: "this is especially problematic for the most recent time period 2001 onward where conservation efforts have been strongly advocated and adopted in response to the energy crises… If output growth is suppressed due to successful conservation efforts and input growth does not decline in the same proportion (due to growing customer base, growing maximum demand, and growing conservation efforts which employ inputs) then measured productivity growth will decline."[8] The impact of conservation is clearly evident in the results reported in Table 1. When output is defined as total electric sales, electric TFP growth averaged 1.12 percent per year over the historic 1987 – 2004 period while with the conservation adjusted sales measure electric TFP grew, on average, at the slightly lower rate of 1.07 percent. Comparing the growth of unadjusted electric sales to conservation adjusted electric sales reveals that over the period 1987 – 2004 total electric sales grew, on average, by 1.5 percent per year while conservation adjusted sales grew, on average, by 1.1 percent**. [2]**

TFP growth is influenced by input growth as well as output growth. Total input growth is defined as the cost share weighted sum of labor, capital, fuel, and materials (O&M) inputs**.[3]** As a result, inputs with a relatively large cost share will exert a large influence on total input growth. PG&E's relative cost shares for the period 1986 through 2004 are shown in Table 2. Table 2 shows that for most years in the 1986 – 2004 period, fuel costs accounted for over 50 percent of

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[8] Pacific Gas and Electric, 2007 General Rate Case, Exhibit PG&E-8, "Report on Total Factor Productivity", December 2, 2005, p. 8-5.

PG&E's total electric costs. Over the period 1987 – 2004 fuel inputs rose by 2.74 percent. The rise in input growth reinforces the impact of fuel's relatively high cost share. By contrast, labor inputs declined, on average, by 2.40 percent over the 1987 – 2004 period. The growth in capital and materials quantities averaged less than one percent over this same period. As a result, fuel costs explain a large percent of the variation in PG&E's total input growth and therefore have a large effect on TFP growth. Later in section D of this report, DRA reports the results of a productivity analysis which excludes the impact of fuel costs.

Table 2
Pacific Gas and Electric Company
Electric Cost Shares
1986 – 2004
(Percent)

Year	Labor	Fuel	Capital	O&M
1986	19.10	48.81	17.08	15.01
1987	18.47	50.35	17.79	13.40
1988	19.15	48.58	17.88	14.39
1989	13.71	60.75	13.95	12.08
1990	13.26	64.05	11.89	10.78
1991	13.36	62.52	11.76	12.36
1992	13.60	63.65	10.84	11.91
1993	14.15	62.79	10.82	12.23
1994	11.95	65.31	10.06	12.67
1995	13.80	62.87	11.96	11.37
1996	13.63	62.57	11.88	11.96
1997	14.02	61.94	11.85	12.19
1998	17.35	49.74	14.98	17.93
1999	19.91	47.99	15.46	16.64
2000	15.91	54.48	13.02	16.59
2001	12.34	64.96	9.93	12.77
2002	11.63	65.81	10.76	11.80
2003	12.87	62.78	11.12	13.16
2004	14.87	58.06	11.68	15.38
Average	**14.15**	**55.90**	**12.24**	**12.73**

Source: Pacific Gas and Electric, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.

A.2. Comparison to Other Studies

DRA compared PG&E's historic electric TFP growth rates to national estimates of TFP growth drawn from the Bureau of Labor Statistics (BLS). Table 3 reports the results of a comparison of PG&E's electric TFP growth rates to the BLS estimates of TFP growth for the Electric, Gas, and Sanitary Services sector and the Private Non-Farm Business sector. The results reported in Table 3 show that PG&E's electric TFP growth rates are very similar to the BLS estimates of economy-wide TFP growth. For example, over the period 1987 – 2002 the BLS found that Private Non-Farm Business sector TFP grew, on average, by 0.78 percent per year. Over this same period PG&E's conservation adjusted sales measure of TFP grew, on average, by one percent per year. PG&E's customer-based measure of TFP grew, on average, by slightly less than one percent. Finally, DRA notes that PG&E's results are consistent with a 2000 study of nationwide electric TFP growth by the Pacific Economics Group (PEG). PEG concluded that over the period 1990 – 2000, "the trend in the TFP of the industry was 0.52 % annual growth."[9]

[9] Direct Prepared Testimony of Mark Newton Lowry, On Behalf of San Diego Gas & Electric Company, "X Factor Calibration for SDG&E", December 20, 2002, Revised May 1, 2003, p. 10.

Table 3
Measures of Electric TFP Growth
1987 – 2004
(Percent Change)

Year	Bureau Of Labor Statistics	Bureau Of Labor Statistics	Pacific Gas and Electric	Pacific Gas and Electric
	Electric Gas & Sanitary Services	Private Non-Farm Business	Conservation Adjusted Sales	Electric Customers
1987	0.11	0.00	-1.69	-5.29
1988	3.83	0.96	-1.08	-0.48
1989	0.41	0.22	4.23	4.83
1990	1.51	0.44	-3.79	-6.04
1991	-0.20	-0.55	-0.76	-0.08
1992	-0.20	2.39	-1.28	-1.93
1993	2.57	0.43	4.89	7.47
1994	0.58	0.96	-3.91	-4.52
1995	2.30	0.11	10.37	13.64
1996	1.22	1.47	0.91	-0.47
1997	0.00	0.62	-2.78	-4.18
1998	0.09	1.13	-8.98	-7.83
1999	NA	1.12	13.52	10.71
2000	NA	1.21	29.38	26.65
2001	NA	0.00	-33.53	-30.00
2002	NA	1.98	11.45	12.31
2003	NA	NA	-4.00	-3.81
2004	NA	NA	6.33	4.43
Average 1987-1998	**1.02**	**0.68**	**-0.32**	**-0.41**
Average 1987-2002	**NA**	**0.78**	**1.02**	**0.92**
Average 1987-2004	**NA**	**NA**	**1.04**	**0.86**

Sources: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.
United States Department of Labor, Bureau of Labor Statistics, Washington D.C. (http://data.bls.gov/cgi-bin/dsrv.)

B.1. Gas TFP Growth

PG&E's gas department TFP growth rates are reported in Table 4. Paralleling the approach taken for the electric department, PG&E developed three measures of gas TFP growth. With output measured as total gas sales historic TFP growth averaged 1.72 percent per year. When gas sales are adjusted for conservation impacts historic gas department TFP growth averaged 1.14 percent per year. Over the entire historic and forecast period, 1987 – 2004, this measure of gas TFP growth average 0.56 percent per year. Defining output as total gas customers, gas TFP growth averages 1.13 percent over the historic period. If the forecast period is included gas TFP growth declines to 0.77 percent per year.

Table 4
Pacific Gas and Electric Company
Gas Total Factor Productivity Growth
1987 – 2007
(Percent Change)

Year	TFP1	TFP2	TFP3
	Output Measure	**Output Measure**	**Output Measure**
	Total Electric Sales	**Conservation Adjusted Electric Sales**	**Total Electric Customers**
1987	25.51	22.21	6.70
1988	4.68	3.74	-2.34
1989	20.15	19.34	10.59
1990	5.17	5.12	4.77
1991	-2.72	-2.47	2.65
1992	4.29	-4.12	-1.52
1993	-14.82	-14.70	-2.96
1994	-4.64	-6.18	-17.34
1995	-36.90	-36.23	-20.84
1996	24.82	24.31	25.39
1997	-4.22	-6.45	-8.45
1998	30.00	29.04	21.66
1999	14.85	14.43	13.69
2000	-18.17	-18.43	-23.06
2001	15.08	14.65	16.58
2002	-13.07	-13.20	-5.89
2003	-15.20	-15.12	-2.97
2004	4.89	4.76	3.77
2005	3.00	3.05	9.40
2006	1.25	1.08	-1.89
2007	-12.59	-12.72	-11.66
Average 1987-2004	**1.72**	**1.14**	**1.13**
Average 2005-2007	**-2.78**	**-2.86**	**-1.39**
Average 1987 – 2007	**1.08**	**0.56**	**0.77**

Source: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.

B.2. Comparison to Other Studies

Similar to its analysis of PG&E electric department TFP results, DRA compared PG&E's gas department TFP growth to the BLS' estimates of economy wide TFP growth for the Electric, Gas, and Sanitary Services sector and the Private Non-Farm Business sector. Table 5 reports a comparison of PG&E's gas TFP growth rates to the BLS estimates of TFP growth for the Electric, Gas, and Sanitary Services sector and the Private Non-Farm Business sector. The results reported in Table 5 show that PG&E's gas TFP growth rates are slightly higher than the growth rates reported by the BLS. Over the period 1987 through 2002, for example, TFP growth in the Private Non-Farm Business sector averaged 0.78 percent per year. Over this same period, when output is measured as conservation adjusted sales, PG&E's gas department TFP growth averaged 1.94 percent per year. With customers defined as the appropriate output measure, PG&E's gas department achieved a 1.23 percent annual average growth rate.

A recent study by PEG of nationwide gas industry TFP growth also confirms the reasonableness of PG&E's gas TFP estimates. PEG found that over the period 1990 – 2000, "the trend in the TFP of the industry was 0.93 %."[10]

[10] Direct Prepared Testimony of Mark Newton Lowry, On Behalf of San Diego Gas & Electric Company, "X Factor Calibration for San Diego Gas & Electric", December 13, 2002, Revised May 1, 2003, p. 17.

Table 5
Measures of Gas TFP Growth
1987 – 2004
(Percent Change)

Year	Bureau Of Labor Statistics	Bureau Of Labor Statistics	Pacific Gas and Electric	Pacific Gas and Electric
	Electric Gas & Sanitary Services	Private Non-Farm Business	Conservation Adjusted Sales	Electric Customers
1987	0.11	0.00	22.21	6.70
1988	3.83	0.96	3.74	-2.34
1989	0.41	0.22	19.34	10.59
1990	1.51	-0.55	5.12	4.77
1991	-0.20	2.39	-2.47	2.65
1992	-0.20	0.43	-4.12	-1.52
1993	2.57	0.96	-14.70	-2.96
1994	0.58	0.11	-6.18	-17.34
1995	2.30	1.47	-36.23	-20.84
1996	1.22	0.62	24.31	25.39
1997	0.00	1.13	-6.45	-8.45
1998	0.09	1.12	29.04	21.66
1999	NA	1.21	14.43	13.69
2000	NA	0.00	-18.43	-23.06
2001	NA	1.98	14.65	16.58
2002	NA	NA	-13.20	-5.89
2003	NA	NA	-15.12	-2.97
2004	NA	NA	4.76	3.77
Average 1987-1998	**1.02**	**0.68**	**3.14**	**1.52**
1987-2002	**NA**	**0.78**	**1.94**	**1.23**
Average 1987-2004	**NA**	**NA**	**1.14**	**1.13**

Sources: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.
United States Department of Labor, Bureau of Labor Statistics, Washington D.C. (http://data.bls.gov/cgi-bin/dsrv.)

C. Labor Productivity

Labor productivity growth is defined as output growth less the rate of growth of labor inputs. With data taken from PG&E's TFP workpapers DRA constructed historic measures of labor productivity for the electric and gas departments. Table 6 provides a comparison of PG&E electric labor productivity growth rates with BLS estimates of labor productivity growth for the electric industry. Table 6 shows that over the period 1988 through 2003, PG&E's electric labor productivity growth rates exceed the BLS estimates of labor productivity growth for the United States electric utility industry. For example, over the period 1988 – 2003, the BLS estimates that electric industry labor productivity growth averaged 2.95 percent per year. Regardless of the output measure chosen, Table 6 shows that PG&E's electric labor productivity growth exceeded 3 percent per year.

Table 6
Measures of Electric Labor Productivity Growth
1988 – 2003
(Percent Change)

Year	Bureau of Labor Statistics	Pacific Gas and Electric	Pacific Gas and Electric
	Electric Utility Industry	Conservation Adjusted Sales	Total Electric Customers
1988	4.91	0.97	1.56
1989	1.15	8.79	9.37
1990	1.99	2.11	-4.48
1991	3.59	1.21	-0.53
1992	1.08	-2.50	-3.15
1993	5.10	-3.61	-1.17
1994	5.82	18.45	17.80
1995	6.30	-4.77	-1.84
1996	7.30	5.03	3.65
1997	4.92	1.85	0.38
1998	3.63	5.77	7.02
1999	-0.20	9.83	7.32
2000	3.32	19.97	17.83
2001	-0.56	-7.14	-1.97
2002	-3.34	12.17	12.95
2003	2.12	-4.88	-4.72
Average 1988-2003	**2.95**	**3.95**	**3.75**

Sources: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.
United States Department of Labor, Bureau of Labor Statistics, Washington D.C. (http://data.bls.gov/cgi-bin/dsrv.)

Table 7 compares PG&E's gas department labor productivity growth rates to the BLS estimates of gas industry labor productivity growth. Unlike the results for the electric department, PG&E's gas labor productivity growth rates are below those reported for the gas industry.

Table 7
Measures of Gas Labor Productivity Growth
1988 – 2003
(Percent Change)

Year	Bureau of Labor Statistics	Pacific Gas and Electric	Pacific Gas and Electric
	Gas Utility Industry	Conservation Adjusted Sales	Total Gas Customers
1988	7.11	7.07	0.98
1989	1.50	16.14	8.53
1990	-3.94	0.53	0.20
1991	1.94	-1.69	3.43
1992	4.43	-4.73	-2.02
1993	4.50	-15.29	-2.39
1994	3.33	17.05	4.39
1995	7.83	-45.31	-23.69
1996	7.57	21.76	22.62
1997	4.08	0.65	-1.52
1998	-1.00	25.32	19.43
1999	3.67	7.52	6.88
2000	9.73	-0.74	-6.59
2001	-2.78	-3.29	-1.62
2002	4.70	2.87	10.96
2003	-0.96	-13.77	-0.40
Average 1988 – 2003	**3.26**	**0.88**	**2.45**

Sources: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.
United States Department of Labor, Bureau of Labor Statistics, Washington D.C. (http://data.bls.gov/cgi-bin/dsrv.)

D. O&M and Capital Productivity

For the electric department, DRA constructed a partial productivity measure which captures the joint influence of labor, capital, and O&M. This index is similar to the electric department TFP index with the important exception that it excludes the impact of fuel inputs. Table 8 reports a comparison between PG&E's non-fuel productivity growth with non-fuel productivity growth for the Electric, Gas, and Sanitary services sector. PG&E's non-fuel electric TFP growth rates compare favorably to the estimates derived from the BLS data. Over the period 1987 through 1998, non-fuel productivity growth for the Electric, Gas, and Sanitary Services sector averaged one percent per year. Depending on the output measure chosen PG&E's non-fuel electric productivity growth ranged from 1.34 to 1.49 percent per year.

Table 8
Measures of Non-Fuel Productivity Growth
1987 – 2007
(Percent Change)

Year	Bureau of Labor Statistics	Pacific Gas and Electric	Pacific Gas and Electric
		Conservation Adjusted Sales	Total Electric Customers
1987	-0.27	9.99	6.27
1988	4.40	0.00	0.60
1989	0.40	0.43	3.01
1990	1.04	1.84	-0.53
1991	-0.63	-5.05	-4.38
1992	-0.71	-0.24	-0.90
1993	2.64	-2.72	-0.29
1994	0.90	7.03	6.38
1995	2.08	5.06	7.98
1996	1.35	1.89	0.51
1997	0.49	1.49	0.02
1998	0.67	-3.84	-2.59
1999	NA	16.02	13.52
2000	NA	8.44	6.31
2001	NA	-5.83	-0.67
2002	NA	8.76	9.53
2003	NA	-3.79	-3.62
2004	NA	1.28	-0.54
2005	NA	5.99	6.52
2006	NA	-2.63	-2.11
2007	NA	-7.61	-7.04
Average 1987 – 1998	**1.03**	**1.49**	**1.34**
Average 1987 – 2004	**NA**	**2.37**	**2.26**

Sources: Pacific Gas and Electric Company, Exhibit PG&E-8, Report on Total Factor Productivity Workpapers, December 2, 2005.
United States Department of Labor, Bureau of Labor Statistics, Washington D.C. (http://data.bls.gov/cgi-bin/dsrv.)

V. CONCLUSION

This report has analyzed PG&E's electric and gas department total factor productivity findings for the period 1986 through test year 2007. Depending upon the output measure chosen, PG&E's electric department historic TFP growth averaged from 0.86 percent to 1.12 percent per year. Including the forecast period results in slightly lower TFP growth rates. For example, with output defined as conservation adjusted sales PG&E's electric TFP growth averaged 0.92 percent per year. With total electric customers defined as output, PG&E's electric TFP averaged 0.81 percent per year. DRA compared PG&E's electric TFP growth rates to national estimates of TFP growth taken from the BLS. The BLS findings for the historic 1987 – 2004 period were close to PG&E's results. On the basis of this comparison, DRA concludes that PG&E's electric TFP growth rates are reasonable.

For the gas department, PG&E's historic, 1987 – 2004, TFP growth rates range from 1.13 percent per year to 1.72 percent per year. As in the case of the electric department, including the forecast period, results in slightly lower growth rates. With output defined as conservation adjusted sales, PG&E's historic and forecast gas TFP growth averages 0.56 percent per year. Defining total gas customers as the appropriate output measure, PG&E's gas department TFP growth averaged 0.77 percent per year. As in the case of the electric department, DRA compared PG&E's gas department TFP growth to national estimates of TFP growth drawn from the BLS. On the basis of these comparison's DRA concludes that PG&E's gas department TFP growth rates are reasonable.

With data obtained directly from PG&E, DRA constructed measures of labor productivity growth for the electric and gas departments. As in the case of DRA's TFP analysis these indexes of labor productivity growth were compared to the BLS estimates of nationwide labor productivity growth. DRA concludes that

PG&E's estimates of electric and gas labor productivity compare favorably to the BLS results.

Finally, for PG&E's electric department, DRA constructed a measure of productivity growth which excluded the impact of fuel. With output defined as conservation adjusted sales DRA found that over the historic period 1987 – 2004 PG&E's non-fuel productivity growth averaged 2.37 percent per year. With output defined as total customers the historic non-fuel average productivity growth averaged 2.26 percent per year. A similar non-fuel productivity index constructed from BLS data showed that over the period 1987 – 1998 the Electric, Gas, and Sanitary Services sector experienced a 1.03 percent productivity growth rate. Over this same period, with output defined as conservation adjusted sales, PG&E's non-fuel productivity growth rate averaged 1.49 percent per year. With total electric customers as the output measure, the growth rate for this index averaged 1.34 percent per year.

Endnotes

[1] Inputs and outputs are aggregated with the Divisia index. The Tornqvist approximation to the Divisia index is defined as:

Ln [It/It-1] = Σ .5 * [Wj,t + Wj,t-1] * Ln [Qj,t/Qj,t-1]

Where :

It = Total input or output index in period t

It-1 = Total input or output index in period t -1

W j,t = Cost or revenue share of input or output i in period t

W j,t-1 = Cost or revenue share of input or output i in period t-1

Qj,t = Quantity of input or output i in period t

Qj,t-1 = Quantity of input or output i in period t-1

Ln = Natural log operator

The BLS studies cited in this report also rely upon the Tornqvist approximation to the Divisia index. The BLS notes that: "In the literature on productivity measurement, the Tornqvist [1936] is the changing weight index that has been most frequently examined and used…." (**Dean, E.R., and Harper, M.J., "<u>The BLS Productivity Measurement Program</u>", United States Department of Labor, Bureau of Labor Statistics, February 28, 1998, p. 5).**

[2] An alternative method of measuring output growth is to construct a Divisia index of output growth as the revenue weighted sum of sales to the residential, commercial, industrial, and resale classes of service. DRA experimented with this approach and found that with output measured in this manner electric TFP growth averaged 0.24 percent per year over the 1987 – 2003 period. Data limitations prevented extending the results through the 2004 – 2007 period.

[3] The contribution of each input to total input growth is calculated as the growth in the input between periods t and t-1 times the average of the cost share of the input between periods t and t-1.