California Industrial Existing Construction
Energy Efficiency Potential Study

CALMAC Study ID:  PGE0252.02

Volume 2 of 2 – Appendices

Final Report to
Pacific Gas and Electric Company
San Francisco, California

Prepared by
KEMA, Inc.
Oakland, CA

With assistance from
Lawrence Berkeley Nation Laboratory (LBNL) and Quantum Consulting

May 2006
# TABLE OF CONTENTS

## VOLUME 1  MAIN REPORT

### SECTION E  EXECUTIVE SUMMARY ................................................................. E–1

- E.1 Scope and Approach ..................................................................................... E–1
- E.2 Results........................................................................................................... E–2
- E.3 Conclusions................................................................................................... E–6

### SECTION 1  INTRODUCTION .......................................................................................1–1

- 1.1 Overview........................................................................................................1–1
- 1.2 Approach........................................................................................................1–1
- 1.3 Study Scope ...................................................................................................1–2
- 1.4 Report Organization.......................................................................................1–3

### SECTION 2  METHODS AND SCENARIOS.................................................................2–1

- 2.1 Characterizing the Energy Efficiency Resource ............................................2–1
  
  - 2.1.1 Defining Energy Efficiency Potential................................................2–1
- 2.2 Summary of Analytical Steps Used in this Study..........................................2–2
- 2.3 Program Scenario Analysis............................................................................2–4

### SECTION 3  ELECTRIC ENERGY EFFICIENCY POTENTIAL RESULTS ...................3–1

- 3.1 Introduction....................................................................................................3–1
- 3.2 Electric Technical and Economic Potential ...................................................3–1
  
  - 3.2.1 Aggregate Electric Technical and Economic Savings Potential by Utility ............................................................................................3–2
  
  - 3.2.2 Electric Technical and Economic Savings Potential by End Use and Measure .......................................................................................3–3
  
  - 3.2.3 Electric Energy-Efficiency Supply Curves........................................3–5
- 3.3 Achievable Potential ......................................................................................3–9
  
  - 3.3.1 Breakdown of Achievable Potential ................................................3–13
  
  - 3.3.2 Summary of Potentials.....................................................................3–14
  
  - 3.3.3 Differences from the Previous Study ...............................................3–18
- 3.4 Summary and Conclusions ..........................................................................3–19

### SECTION 4  NATURAL GAS ENERGY EFFICIENCY POTENTIAL RESULTS ........4–1

- 4.1 Introduction .................................................................................................4–1
- 4.2 Natural Gas Technical and Economic Potential ............................................4–1
  
  - 4.2.1 Aggregate Natural Gas Technical and Economic Savings Potential by Utility ..........................................................4–1
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.2</td>
<td>Natural Gas Technical and Economic Savings Potential by End Use &amp; Measure</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Natural Gas Energy-Efficiency Supply Curve</td>
</tr>
<tr>
<td>4.3</td>
<td>Achievable Potential</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Breakdown of Achievable Potential</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Summary of Potentials</td>
</tr>
<tr>
<td>4.4</td>
<td>Summary and Conclusions</td>
</tr>
<tr>
<td>5–1</td>
<td>SECTION 5 SOURCES</td>
</tr>
</tbody>
</table>

### VOLUME 2 APPENDIXES

#### APPENDIX A DETAILED METHODOLOGY AND MODEL DESCRIPTION ............ A–1

A.1 Overview of DSM Forecasting Method ........................................ A–1
   A.1.1 Estimate Technical Potential and Develop Energy-Efficiency
         Supply Curves ................................................................. A–2
   A.1.2 Estimation of Economic Potential .................................. A–6
   A.1.3 Estimation of Maximum Achievable, Program, and Naturally
         occurring Potentials ..................................................... A–11
   A.1.4 Scenario Analyses ....................................................... A–17
   A.1.5 Measure “Bundles” for Complex End Uses ............................ A–18

A.2 DSM ASSYST™ Model Description .................................................. A–19
   A.2.1 Basic Module ............................................................... A–20
   A.2.2 Supply Module ................................................................ A–22
   A.2.3 Penetration Module ....................................................... A–22

#### APPENDIX B DATA DEVELOPMENT ............................................... B–1

B.1 Baseline Data ................................................................................ B–1
   B.1.1 Total Baseline Consumption ............................................ B–1
   B.1.2 Baseline Consumption by Utility ....................................... B–5

B.2 Avoided-Cost Data ........................................................................ B–7

B.3 Measure Data ................................................................................ B–8
   B.3.1 Electric Measure Descriptions ......................................... B–8
   B.3.2 Natural Gas Measure Descriptions .................................... B–17
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Economic Inputs</td>
</tr>
<tr>
<td>D</td>
<td>Building and TOU Factor Inputs</td>
</tr>
<tr>
<td>E</td>
<td>Electric Measure Inputs</td>
</tr>
<tr>
<td>F</td>
<td>Natural Gas Measure Inputs</td>
</tr>
<tr>
<td>G</td>
<td>Non-Additive Measure Level Electric Results</td>
</tr>
<tr>
<td>H</td>
<td>Non-Additive Measure Level Natural Gas Results</td>
</tr>
<tr>
<td>I</td>
<td>Supply Curve Data</td>
</tr>
<tr>
<td>J</td>
<td>Achievable Potential Summary</td>
</tr>
<tr>
<td>K</td>
<td>Electric End Use Results</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table E-1  Scenario Spending During the 2005–2016 Forecast Period
(Average Expenditures Over the 12-Year Analysis Period in
Millions of $ per Year) ........................................................................... E–2
Table E-2  Estimated Energy Efficiency Potential—Cumulative Through
2016............................................................................................................... E–2
Table 3-1  Industrial Electric Economic Savings Potential by End Use and
Utility, 2005 ................................................................................................. 3–5
Table 3-2  Aggregated Measure Values for Electric Energy-Efficiency
Supply Curves, 2005.................................................................................... 3–7
Table 3-3  Summary of Industrial Electric 12-Year Net Program Potential
Results* ........................................................................................................... 3–12
Table 3-4  Summary of Industrial Electric Energy Potentials by Utility –
Cumulative 2005 to 2016........................................................................... 3–15
Table 4-1  Industrial Natural Gas Economic Savings Potential by End Use
and Utility—Mth, 2005 ................................................................................ 4–3
Table 4-2  Aggregated Measure Values for Natural Gas Energy-Efficiency
Supply Curves, 2005.................................................................................... 4–6
Table 4-3  Summary of Industrial Natural Gas 12-Year Net Program
Potential Results* ............................................................................................ 4–9
Table 4-4  Summary of Industrial Natural Gas Potentials by Utility—
Cumulative 2005 to 2016.............................................................................. 4–11
Table 4-5  Summary of Industrial Natural Gas Potentials by End Use—
Cumulative 2005 to 2016 ............................................................................. 4–12
Table 4-6  Summary of Industrial Natural Gas Potentials by Industry—
Cumulative 2005 to 2016 ............................................................................. 4–12
Table A-1  Example of Technical Potential Calculation—Replace 75-W
Incandescent with 18-W CFL in the Office Segment of a
Utility Service Territory.............................................................................. A–4
Table A-2  Sample Technical Potential Supply Curve Calculation for
Commercial Lighting  (Note: Data are illustrative only)......................... A–6
Table A-3  Summary of Benefits and Costs of California Standard Practice
Manual Tests................................................................................................ A–8
Table A-4  Sample Use of Supply Curve Framework to Estimate
Economic Potential  (Note: Data are illustrative only).............................. A–11
Table A-5  Summary Description of Market Barriers from Eto, Prahl,
Schlegel 1997............................................................................................. A–16
Table A-6  Example Format of DSM ASSYST Achievable Potential
Outputs.......................................................................................................... A–18
Table A-7  Example of Industrial Efficiency Levels Developed for a
Recent California Potential Study............................................................. A–20
Table B-1 Mapping of Two-Digit SIC Codes to Three-Digit NAICS Codes for Manufacturing....................................................... B–2
Table B-2 Industrial Electricity Usage by Industry Type, 2003—by Utility..... B–6
Table B-3 Industrial Electricity Usage by End Use, 2003—by Utility .......... B–6
Table B-4 Industrial Natural Gas Usage by Industry Type, 2003—by Utility ........................................................................ B–7
Table B-5 Industrial Natural Gas Usage by End Use, 2003—by Utility........ B–7

LIST OF FIGURES

Figure E-1 Achievable Energy Savings Potential by Program Funding Scenario.................................................................................... E–3
Figure E-2 Achievable Natural Gas Savings Potential by Program Funding Scenario .................................................................................... E–3
Figure E-3 Costs and Benefits of Industrial Electric Efficiency Savings— 2005 to 2016* .................................................................................. E–4
Figure E-4 Costs and Benefits of Industrial Natural Gas Efficiency Savings—2005 to 2016* ............................................................ E–5
Figure E-5 Industrial Achievable Savings Potential by End Use— Cumulative to 2016................................................................. E–5
Figure E-6 Industrial Achievable Savings Potential by Industry— Cumulative to 2016................................................................. E–5
Figure E-7 Industrial Achievable Savings Potential by IOU—Cumulative to 2016 ........................................................................ E–7
Figure 2-1 Conceptual Relationship Among Energy Efficiency Potential Definitions ...........................................................................2–2
Figure 2-2 Conceptual Overview of Study Process.................................2–3
Figure 3-1 Estimated Electric Technical and Economic Potential (Industrial Sector Existing Construction, PG&E/SCE/SDG&E, 2005) ............................................................................3–2
Figure 3-2 Industrial Electric Savings Potential by Utility, 2005 ............3–3
Figure 3-3 Industrial Electric Demand Savings Potential by Utility, 2005 ....3–3
Figure 3-4 Industrial Electric Savings Potential by End Use, 2005 ............3–4
Figure 3-5 Industrial Electric Savings Potential as Percent of Base End- Use Consumption, 2005 .................................................................3–4
Figure 3-6 Industrial Electric Savings Potential by Industrial Category, 2005.........................................................................................3–6
Figure 3-7 Industrial Electric Energy-Efficiency Supply Curve, 2005 – Energy .........................................................................................3–6
Figure 3-8 Industrial Electric Energy-Efficiency Supply Curve, 2005 – Demand .........................................................................................3–7
Figure 3-9 Achievable Energy Savings Potential by Program Funding Scenario.........................................................................................3–10
| Figure 3-10 | Achievable Peak Demand Savings Potential by Program Funding Scenario | 3–11 |
| Figure 3-11 | Costs and Benefits of Industrial Electric Efficiency Savings—2005 to 2016* | 3–12 |
| Figure 3-12 | Industrial Net Achievable Electric Savings Potential by Utility—Cumulative 2005 to 2016 | 3–13 |
| Figure 3-13 | Industrial Net Achievable Electric Savings Potential by End Use—Cumulative 2005 to 2016 | 3–14 |
| Figure 3-14 | Industrial Achievable Electric Savings Potential by Industry—Cumulative 2005 to 2016 | 3–15 |
| Figure 4-1 | Estimated Natural Gas Technical and Economic Potential (Industrial SectorExisting Construction, PG&E/SCG/SDG&E, 2005) | 4–2 |
| Figure 4-2 | Industrial Natural Gas Savings Potential by Utility, 2005 | 4–2 |
| Figure 4-3 | Industrial Natural Gas Savings Potential by End Use, 2005 | 4–3 |
| Figure 4-4 | Industrial Natural Gas Savings Potential as Percent of Base End-Use Consumption, 2005 | 4–3 |
| Figure 4-5 | Industrial Natural Gas Savings Potential by Industrial Category, 2005 | 4–4 |
| Figure 4-6 | Industrial Natural Gas Energy-Efficiency Supply Curve, 2005 | 4–5 |
| Figure 4-7 | Achievable Natural Gas Savings Potential by Program Funding Scenario | 4–7 |
| Figure 4-8 | Costs and Benefits of Industrial Natural Gas Efficiency Savings—2005 to 2016* | 4–8 |
| Figure 4-9 | Industrial Achievable Natural Gas Savings Potential by Utility—Cumulative 2005 to 2016 | 4–9 |
| Figure 4-10 | Industrial Achievable Natural Gas Savings Potential by End Use—Cumulative 2005 to 2016 | 4–10 |
| Figure 4-11 | Industrial Achievable Natural Gas Savings Potential by Industry—Cumulative 2005 to 2016 | 4–11 |
| Figure A-1 | Simplified Conceptual Overview of Modeling Process | A–1 |
| Figure A-2 | Generic Illustration of EE Supply Curve | A–5 |
| Figure A-3 | Primary Measure Implementation Curves Used in Adoption Model | A–15 |
| Figure A-4 | Illustration of Effect of Incentives on Adoption Level as Characterized in Implementation Curves | A–17 |
| Figure A-5 | Example of DSM Scenario Outputs | A–18 |
| Figure A-6 | DSM ASSYST Analytic Flow | A–21 |
| Figure B-1 | Industrial Electricity Usage by Industry Type, 2003—Overall | B–3 |
| Figure B-2 | Industrial Electricity Usage by End Use, 2003—Overall | B–3 |
| Figure B-3 | Industrial Natural Gas Usage by Industry Type, 2003 - Overall | B–4 |
| Figure B-4 | Industrial Natural Gas Usage by End Use, 2003—Overall | B–5 |