

**Short Form Work Paper PGECOPRO108**  
**Revision 0**

**Pacific Gas & Electric**

---

**Pipe Insulation (Non-Space  
Conditioning)**

**April 1, 2018**

# PG&E PIPE INSULATION

## INTRODUCTION

This short form workpaper (WP) documents the values adopted from SCG’s WP entitled “Pipe Insulation (Non-Space Conditioning)” (WPSCGWP110812A\_Rev4\_Pipe Insulation.docx). PG&E adopts all SCG measures.

## DOCUMENT REVISION HISTORY

Rev	Date	Author	Summary of Changes
0	4/1/2018	Linda Wan (PG&E)	Adopted all lead IOU workpaper measures from SCG’s workpaper “WPSCGWP110812A_Rev4_Pipe Insulation” dated December 26, 2017.

# MEASURE SUMMARY

**Table 1: Measure Summary Table**

Section	Value		
<b>Summary &amp; Purpose</b>	This short form workpaper documents ex-ante load impacts for SCG’s “Pipe Insulation (Non-space Conditioning)”. The base energy consumption and measure energy consumption values are from SCG’s workpaper, WPCSGWP110812A, Revision 4. Please note that the measures for Large Commercial and Small Commercial have been combined and the savings are weighted 70% and 30%, respectively.		
<b>1.1 Measure &amp; Baseline Data</b>	Measures:		
	PG&E Measure Code	SCG Measure Code	Description
	PR051	TBD	1 inch Insulation layer, <= 1 inch pipe, <=15 psig steam, Outdoor
	PR052	TBD	1 inch Insulation layer, <= 1 inch pipe, >15 psig steam, Outdoor
	PR053	TBD	1 inch Insulation layer, <= 1 inch pipe, Hot Water, Outdoor
	PR054	TBD	1 inch Insulation layer, > 4 inch pipe, <=15 psig steam, Outdoor
	PR055	TBD	1 inch Insulation layer, > 4 inch pipe, >15 psig steam, Outdoor
	PR056	TBD	1 inch Insulation layer, > 4 inch pipe, Hot Water, Outdoor
	PR057	TBD	1 inch Insulation layer, 1 inch < pipe <= 4 inch, <=15 psig steam, Outdoor
	PR058	TBD	1 inch Insulation layer, 1 inch < pipe <= 4 inch, >15 psig steam, Outdoor
	PR059	TBD	1 inch Insulation layer, 1 inch < pipe <= 4 inch, Hot Water, Outdoor
	PR069	TBD	Fitting Insulation <= 1 inch pipe, <= 15 psig steam, Indoor
	PR070	TBD	Fitting Insulation <= 1 inch pipe, >15 psig steam, Indoor
	PR071	TBD	Fitting Insulation <= 1 inch pipe, Hot Water, Indoor
	PR072	TBD	Fitting Insulation > 4 inch pipe, <=15 psig steam, Indoor
	PR073	TBD	Fitting Insulation > 4 inch pipe, >15 psig steam, Indoor
	PR074	TBD	Fitting Insulation > 4 inch pipe, Hot Water, Indoor
	PR075	TBD	Fitting Insulation 1 inch < pipe <= 4 inch, <=15 psig steam, Indoor
	PR076	TBD	Fitting Insulation 1 inch < pipe <= 4 inch, >15 psig steam, Indoor
	PR077	TBD	Fitting Insulation 1 inch < pipe <= 4 inch, Hot Water, Indoor
	PR078	TBD	Fitting Insulation, <= 1 inch pipe, <=15 psig steam, Outdoor
	PR079	TBD	Fitting Insulation, <= 1 inch pipe, >15 psig steam, Outdoor
	PR080	TBD	Fitting Insulation, <= 1 inch pipe, Hot Water, Outdoor
	PR081	TBD	Fitting Insulation, > 4 inch pipe, <=15 psig steam, Outdoor
	PR082	TBD	Fitting Insulation, > 4 inch pipe, >15 psig steam, Outdoor
	PR083	TBD	Fitting Insulation, > 4 inch pipe, Hot Water, Outdoor
	PR084	TBD	Fitting Insulation, 1 inch < pipe <= 4 inch, <=15 psig steam, Outdoor
PR085	TBD	Fitting Insulation, 1 inch < pipe <= 4 inch, >15 psig steam, Outdoor	
PR086	TBD	Fitting Insulation, 1 inch < pipe <= 4 inch, Hot Water, Outdoor	

Section	Value															
<b>1.2 Technical Description</b>																
Measures	<p>As cited per SCG workpaper</p> <p>Table I: Base, Standard, and Measure Cases</p> <table border="1" data-bbox="383 436 1419 800"> <thead> <tr> <th data-bbox="383 436 695 472">Case</th> <th data-bbox="695 436 1419 472">Description of Typical Scenario</th> </tr> </thead> <tbody> <tr> <td data-bbox="383 472 695 569">Measure</td> <td data-bbox="695 472 1419 569">Adding a minimum of one inch of insulation to existing bare pipe used to transport a hot fluid ranging from half-inch to four inches in diameter either in the commercial or industrial sector.</td> </tr> <tr> <td data-bbox="383 569 695 636">Existing Condition</td> <td data-bbox="695 569 1419 636">Uninsulated commercial or industrial pipe used to transport hot fluids</td> </tr> <tr> <td data-bbox="383 636 695 732">Code/Standard</td> <td data-bbox="695 636 1419 732">-Title 24: Section 120.3 -Occupational Safety and Health Administration (OSHA) applicable requirements.</td> </tr> <tr> <td data-bbox="383 732 695 800">Industry Standard Practice</td> <td data-bbox="695 732 1419 800">Minimally insulating to comply with applicable code.</td> </tr> </tbody> </table>	Case	Description of Typical Scenario	Measure	Adding a minimum of one inch of insulation to existing bare pipe used to transport a hot fluid ranging from half-inch to four inches in diameter either in the commercial or industrial sector.	Existing Condition	Uninsulated commercial or industrial pipe used to transport hot fluids	Code/Standard	-Title 24: Section 120.3 -Occupational Safety and Health Administration (OSHA) applicable requirements.	Industry Standard Practice	Minimally insulating to comply with applicable code.					
Case	Description of Typical Scenario															
Measure	Adding a minimum of one inch of insulation to existing bare pipe used to transport a hot fluid ranging from half-inch to four inches in diameter either in the commercial or industrial sector.															
Existing Condition	Uninsulated commercial or industrial pipe used to transport hot fluids															
Code/Standard	-Title 24: Section 120.3 -Occupational Safety and Health Administration (OSHA) applicable requirements.															
Industry Standard Practice	Minimally insulating to comply with applicable code.															
Code for All Measures	<p>As cited per SCG workpaper</p> <p>Table XII: Code Summary</p> <table border="1" data-bbox="383 898 1419 1066"> <thead> <tr> <th data-bbox="383 898 623 934">Code</th> <th data-bbox="623 898 1182 934">Reference</th> <th data-bbox="1182 898 1419 934">Effective Dates</th> </tr> </thead> <tbody> <tr> <td data-bbox="383 934 623 970">Title 24 (2016)</td> <td data-bbox="623 934 1182 970">Section 120.3 Pages 131-133</td> <td data-bbox="1182 934 1419 970">January 1<sup>st</sup>, 2017</td> </tr> <tr> <td data-bbox="383 970 623 1005">Title 20 (2014)</td> <td data-bbox="623 970 1182 1005">N/A</td> <td data-bbox="1182 970 1419 1005">N/A</td> </tr> <tr> <td data-bbox="383 1005 623 1041">DOE</td> <td data-bbox="623 1005 1182 1041">N/A</td> <td data-bbox="1182 1005 1419 1041">N/A</td> </tr> <tr> <td data-bbox="383 1041 623 1066">OSHA</td> <td data-bbox="623 1041 1182 1066">1910.261(k)(11)</td> <td data-bbox="1182 1041 1419 1066">August 19, 1998</td> </tr> </tbody> </table>	Code	Reference	Effective Dates	Title 24 (2016)	Section 120.3 Pages 131-133	January 1 <sup>st</sup> , 2017	Title 20 (2014)	N/A	N/A	DOE	N/A	N/A	OSHA	1910.261(k)(11)	August 19, 1998
Code	Reference	Effective Dates														
Title 24 (2016)	Section 120.3 Pages 131-133	January 1 <sup>st</sup> , 2017														
Title 20 (2014)	N/A	N/A														
DOE	N/A	N/A														
OSHA	1910.261(k)(11)	August 19, 1998														

Section	Value
Requirement S	<p>As cited per SCG workpaper</p> <p>Eligibility Requirements: This measure is applicable to small, large commercial and industrial buildings with existing uninsulated pipe systems. These buildings must be within the IOU territory and shall use natural gas provided by an IOU.</p> <p>Implementation Requirements:</p> <ul style="list-style-type: none"> <li>• These measures are applicable to any small, large commercial and industrial pipe insulation retrofit (i.e., non-new construction) application. They cannot be used for residential purposes.</li> <li>• Insulation required by California Building Code (Title 24) or employee safety laws (Occupational Safety and Health Administration: OSHA) is not eligible for a rebate.</li> <li>• The pipes must transfer hot water, low-pressure steam, or medium-pressure steam directly from gas-fired equipment. The fluid type must be indicated. If the fluid is steam, the pressure of the steam must also be indicated.</li> <li>• Maximum qualifying pipe diameter is four inches, and minimum qualifying pipe diameter is half-inch.</li> <li>• The length of insulation to be installed at each pipe size must be indicated.</li> <li>• A minimum of one inch of pipe insulation must be added to existing bare commercial or industrial steel or copper pipe.</li> <li>• The hours of operation must be indicated on the top of the application.</li> <li>• Acceptable types of insulation for hot water pipes include: elastomeric foam rubber, polyethylene foam, UV-resistant polyethylene foam and rigid polyurethane foam.</li> <li>• Acceptable types of insulation for steam pipes include silicone foam rubber, melamine foam, rigid urethane-based foam, cellular glass, rigid fiberglass and rigid mineral wool.</li> <li>• Replacement of damaged (existing) insulation is not eligible for a rebate.</li> <li>• The manufacturer’s specification sheet must be submitted with the application.</li> </ul>
<b>1.3 Installation Type and Delivery Mechanism s</b>	
Installation Type	Retrofit Add-on (REA)
Delivery Mechanisms	Downstream Rebate – Deemed Direct Install
<b>1.4.1 DEER Data</b>	

Section	Value																						
<p>Net-to-Gross Ratio</p>	<p>Per SCG Workpaper For all measures in this Workpaper, the NTGR found in the “ESPI Pipe Insulation Reports” was used.</p> <p>Table VII: NTGR ID</p> <table border="1" data-bbox="386 394 1416 653"> <thead> <tr> <th data-bbox="386 394 618 457">NTGR ID</th> <th data-bbox="618 394 886 457">Description</th> <th data-bbox="886 394 1024 457">Sector</th> <th data-bbox="1024 394 1154 457">BldgType</th> <th data-bbox="1154 394 1341 457">Measure Delivery</th> <th data-bbox="1341 394 1416 457">NTGR</th> </tr> </thead> <tbody> <tr> <td data-bbox="386 457 618 653">NonRes-sAll-mPipeIns-deemed</td> <td data-bbox="618 457 886 653">Pipe insulation: non-HVAC or DHW applications; deemed; all delivery mechanisms except upstream</td> <td data-bbox="886 457 1024 653">Ind</td> <td data-bbox="1024 457 1154 653">Any</td> <td data-bbox="1154 457 1341 653">NonUpStrm</td> <td data-bbox="1341 457 1416 653">0.6</td> </tr> </tbody> </table>	NTGR ID	Description	Sector	BldgType	Measure Delivery	NTGR	NonRes-sAll-mPipeIns-deemed	Pipe insulation: non-HVAC or DHW applications; deemed; all delivery mechanisms except upstream	Ind	Any	NonUpStrm	0.6										
NTGR ID	Description	Sector	BldgType	Measure Delivery	NTGR																		
NonRes-sAll-mPipeIns-deemed	Pipe insulation: non-HVAC or DHW applications; deemed; all delivery mechanisms except upstream	Ind	Any	NonUpStrm	0.6																		
<p>Effective and Remaining Useful Life</p>	<p>Per SCG Workpaper</p> <p>Table XI: EUL ID</p> <table border="1" data-bbox="386 751 1416 919"> <thead> <tr> <th data-bbox="386 751 548 814">EUL ID</th> <th data-bbox="548 751 837 814">Description</th> <th data-bbox="837 751 935 814">Sector</th> <th data-bbox="935 751 1101 814">UseCategory</th> <th data-bbox="1101 751 1263 814">EUL (Years)</th> <th data-bbox="1263 751 1416 814">RUL (Years)</th> </tr> </thead> <tbody> <tr> <td data-bbox="386 814 548 919">WtrHt-PipeIns-Gas-2017</td> <td data-bbox="548 814 837 919">Pipe Insulation</td> <td data-bbox="837 814 935 919">Com Ind</td> <td data-bbox="935 814 1101 919">SHW</td> <td data-bbox="1101 814 1263 919">20</td> <td data-bbox="1263 814 1416 919">6.67</td> </tr> </tbody> </table>	EUL ID	Description	Sector	UseCategory	EUL (Years)	RUL (Years)	WtrHt-PipeIns-Gas-2017	Pipe Insulation	Com Ind	SHW	20	6.67										
EUL ID	Description	Sector	UseCategory	EUL (Years)	RUL (Years)																		
WtrHt-PipeIns-Gas-2017	Pipe Insulation	Com Ind	SHW	20	6.67																		
<p>Section 2. Calculation Methodology</p>	<p>Per SCG Workpaper</p> <p>Table VI: DEER Difference Summary</p> <table border="1" data-bbox="386 1014 1416 1451"> <thead> <tr> <th data-bbox="386 1014 711 1056">DEER Item</th> <th data-bbox="711 1014 1416 1056">Used for Workpaper?</th> </tr> </thead> <tbody> <tr> <td data-bbox="386 1056 711 1119">Modified DEER methodology</td> <td data-bbox="711 1056 1416 1119">Yes</td> </tr> <tr> <td data-bbox="386 1119 711 1161">Scaled DEER measure</td> <td data-bbox="711 1119 1416 1161">No</td> </tr> <tr> <td data-bbox="386 1161 711 1203">DEER Base Case</td> <td data-bbox="711 1161 1416 1203">No</td> </tr> <tr> <td data-bbox="386 1203 711 1245">DEER Measure Case</td> <td data-bbox="711 1203 1416 1245">No</td> </tr> <tr> <td data-bbox="386 1245 711 1287">DEER Building Types</td> <td data-bbox="711 1245 1416 1287">Yes</td> </tr> <tr> <td data-bbox="386 1287 711 1329">DEER Operating Hours</td> <td data-bbox="711 1287 1416 1329">No</td> </tr> <tr> <td data-bbox="386 1329 711 1371">DEER eQUEST Prototypes</td> <td data-bbox="711 1329 1416 1371">No</td> </tr> <tr> <td data-bbox="386 1371 711 1413">DEER Version</td> <td data-bbox="711 1371 1416 1413">DEER 2017</td> </tr> <tr> <td data-bbox="386 1413 711 1451">Reason for Deviation from DEER</td> <td data-bbox="711 1413 1416 1451">DEER does not contain this type of measure</td> </tr> <tr> <td data-bbox="386 1451 711 1493">DEER Measure IDs Used</td> <td data-bbox="711 1451 1416 1493">N/A</td> </tr> </tbody> </table>	DEER Item	Used for Workpaper?	Modified DEER methodology	Yes	Scaled DEER measure	No	DEER Base Case	No	DEER Measure Case	No	DEER Building Types	Yes	DEER Operating Hours	No	DEER eQUEST Prototypes	No	DEER Version	DEER 2017	Reason for Deviation from DEER	DEER does not contain this type of measure	DEER Measure IDs Used	N/A
DEER Item	Used for Workpaper?																						
Modified DEER methodology	Yes																						
Scaled DEER measure	No																						
DEER Base Case	No																						
DEER Measure Case	No																						
DEER Building Types	Yes																						
DEER Operating Hours	No																						
DEER eQUEST Prototypes	No																						
DEER Version	DEER 2017																						
Reason for Deviation from DEER	DEER does not contain this type of measure																						
DEER Measure IDs Used	N/A																						
<p>Energy Savings/Peak Demand Reduction – All Measures</p>	<p>Please see refer to the SCG workpaper for energy savings values.</p> <p>The savings for Large Commercial and Small Commercial have been combined and uses a 70% and 30% weighting, per the Observations column in Table 4-2 Comparison of Ex Ante and Ex Post Annual Operating Hours by Customer Type. Please refer to the “SmallLargeCombinedCalculations” worksheet in the excel file, “SCG to PGE Measure Mapping.xlsx.”</p>																						

Section	Value																													
<b>Section 3. Load Shapes</b>	Per SCG Workpaper																													
	Table XIII: Building Types and Load Shapes																													
	<table border="1"> <thead> <tr> <th>Building Type</th> <th>Load Shape</th> <th>E3 Alternate Building Type</th> </tr> </thead> <tbody> <tr> <td>Commercial</td> <td>Misc. Commercial</td> <td>DHW HtPmp</td> </tr> <tr> <td>Industrial</td> <td>Industrial</td> <td>DHW HtPmp</td> </tr> </tbody> </table>	Building Type	Load Shape	E3 Alternate Building Type	Commercial	Misc. Commercial	DHW HtPmp	Industrial	Industrial	DHW HtPmp																				
	Building Type	Load Shape	E3 Alternate Building Type																											
Commercial	Misc. Commercial	DHW HtPmp																												
Industrial	Industrial	DHW HtPmp																												
<b>Section 4. Costs</b>	The Gross Measure Cost is obtained from costs documented by SCG work paper "WPCSGWP110812A_Rev4__Pipe Insulation.docx" Section 4- Cost.																													
<b>Section 4.1 Base and Measure Costs</b>																														
Base Cost	The base case cost is \$0.00, as this will be not doing anything to reduce the heat loss from a pipe.																													
Measure Cost																														
	As per SCG workpaper																													
	Table XIV: Pipe Insulation Cost																													
	<table border="1"> <thead> <tr> <th>Cost Case Description</th> <th>Program Delivery Strategies</th> <th>Material Cost</th> <th>Installation Labor Cost - Retrofit</th> <th>Unit</th> <th>Gross Measure Cost</th> </tr> </thead> <tbody> <tr> <td>Pipe Insulation Hot Water/Steam</td> <td>Downstream Prescriptive Rebates/Incentives</td> <td>\$3.49</td> <td>\$3.18</td> <td>Ln. Ft.</td> <td>\$6.68</td> </tr> </tbody> </table>	Cost Case Description	Program Delivery Strategies	Material Cost	Installation Labor Cost - Retrofit	Unit	Gross Measure Cost	Pipe Insulation Hot Water/Steam	Downstream Prescriptive Rebates/Incentives	\$3.49	\$3.18	Ln. Ft.	\$6.68																	
	Cost Case Description	Program Delivery Strategies	Material Cost	Installation Labor Cost - Retrofit	Unit	Gross Measure Cost																								
	Pipe Insulation Hot Water/Steam	Downstream Prescriptive Rebates/Incentives	\$3.49	\$3.18	Ln. Ft.	\$6.68																								
	Table XV: Fitting Insulation Costs (Material and Installation) Provided by Vendor																													
	<table border="1"> <thead> <tr> <th rowspan="2">Parameter</th> <th colspan="2">Hot Water</th> <th colspan="2">Low-pressure Steam (0-15 psig), High Pressure Steam ( &gt; 15 psig)</th> </tr> <tr> <th>0.75 &lt;= OD &lt;2</th> <th>2 &lt;= OD &lt;= 4</th> <th>0.75 &lt;= OD &lt;2</th> <th>2 &lt; OD &lt;= 4</th> </tr> </thead> <tbody> <tr> <td>Pipe Size (inch)</td> <td>0.75 &lt;= OD &lt;2</td> <td>2 &lt;= OD &lt;= 4</td> <td>0.75 &lt;= OD &lt;2</td> <td>2 &lt; OD &lt;= 4</td> </tr> <tr> <td>Insulation Thickness (inch)</td> <td>1</td> <td>1</td> <td>1.5</td> <td>1.5</td> </tr> <tr> <td>Indoors (\$/fitting)</td> <td>\$7.73</td> <td>\$7.87</td> <td>\$7.60</td> <td>\$9.47</td> </tr> <tr> <td>Outdoors (\$/fitting)</td> <td>\$7.87</td> <td>\$9.60</td> <td>\$8.67</td> <td>\$7.33</td> </tr> </tbody> </table>	Parameter	Hot Water		Low-pressure Steam (0-15 psig), High Pressure Steam ( > 15 psig)		0.75 <= OD <2	2 <= OD <= 4	0.75 <= OD <2	2 < OD <= 4	Pipe Size (inch)	0.75 <= OD <2	2 <= OD <= 4	0.75 <= OD <2	2 < OD <= 4	Insulation Thickness (inch)	1	1	1.5	1.5	Indoors (\$/fitting)	\$7.73	\$7.87	\$7.60	\$9.47	Outdoors (\$/fitting)	\$7.87	\$9.60	\$8.67	\$7.33
	Parameter		Hot Water		Low-pressure Steam (0-15 psig), High Pressure Steam ( > 15 psig)																									
		0.75 <= OD <2	2 <= OD <= 4	0.75 <= OD <2	2 < OD <= 4																									
	Pipe Size (inch)	0.75 <= OD <2	2 <= OD <= 4	0.75 <= OD <2	2 < OD <= 4																									
Insulation Thickness (inch)	1	1	1.5	1.5																										
Indoors (\$/fitting)	\$7.73	\$7.87	\$7.60	\$9.47																										
Outdoors (\$/fitting)	\$7.87	\$9.60	\$8.67	\$7.33																										