Workpaper WPSCGREHC180723A

**Revision 00**

**SoCalGas**

**Wall Furnace Intermittent Pilot Light (IPL)**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | TBD |
| **Measure Description** | Intermittent Pilot Light (IPL), will turn off the gravity wall furnace pilot light during times of no heat demand. |
| **Base Case Description** | A furnace with continuous pilot light. |
| **Units** | Each |
| **Energy Savings** | SFM REA Kit: CZ9: 12.08 Therms |
| **Full Measure Cost ($/unit)** | SFM REA kit: CZ9: $309.96 |
| **Incremental Measure Cost ($/unit)** | SFM REA kit: CZ9: $309.96 |
| **Effective Useful Life** | REA: 6.67 years  ROB/NC: HV-EffFurn (20 years) |
| **Measure Installation Type** | Retrofit Add-on (REA)  Replacement on Burn Our (ROB)  New Construction (NC) |
| **Net-to-Gross Ratio** | ET-Default: 0.85 |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 8/16/2018 | Carlos Pineda(SCG) | * Initial Release |
|  |  |  |  |

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# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

The measures in this workpaper allow for energy to be saved from the installation of Intermittent pilot light (IPL) controls to existing wall furnaces (including but not limited to gravity, direct vented, top vented, fan assisted), fireplace inserts and from new gravity wall furnaces manufactured with integrated intermittent pilot light controls. These control valves turn off the pilot light when the furnace burners are off due to the furnace not calling for heat. During heat demand, the pilot control, turns ON the pilot light which turns the furnace burner ON. Allowing the pilot light to only operate during times of heat demand reduces the energy consumption, thus providing energy savings. SocalGas’ study “High Efficiency Natural Gas Wall Furnace Field Evaluation”, [***Attachment A***](#_Attachments), notes that pilot lights consume approximately 3.7 Therms/month to 7.2 Therm/month depending on the unit’s efficiency, 71% AFUE and (63% – 70%) AFUE for measure and baseline respectively. It further states the pilot energy intensity accounts for 62% of the annual energy consumed by baseline furnaces. This report shows there is ample opportunity for energy savings from the elimination of standing pilot lights in wall furnaces and fireplaces (Title 24 fireplace definition: is a hearth and fire chamber, or similar prepared place, in which a fire may be made and which is built in conjunction with a flue or chimney, including but not limited to factory-built fireplaces, masonry fireplaces, and masonry heaters as further clarified in the CBC.).

Table I: Base, Standard, and Measure Cases

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Furnaces/Fireplace retrofitted or manufactured with intermittent pilot light. |
| Existing Condition | Furnaces with continuously operating pilot light. |
| Code/Standard | Title 20 Section 1605.1(e)(1) |
| Industry Standard Practice | N/A |

Table II: Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
| TBD |  |  |  | Wall furnace/Fireplace Intermittent pilot light (IPL) |
| TBD |  |  |  | Gravity wall furnaces manufactured with integrated intermittent pilot light (IPL) |

These measures are available for the residential sector, single-family and multifamily building types.

**Eligibility requirements:**

* 1. The measures described herein are only available to California Investor-Owned Utility (IOU) Customers whom are paying the Public Goods Charge and are Customers of the IOU for which the measure (or measures) described herein are being offered through the IOU’s Energy Efficiency program.
  2. Participants in the program must be in good standing with the administering IOU.
  3. The applicable market segments allowed to participate are single-family and multi-family residential markets.
  4. For wall gravity furnaces manufactured with integrated intermittent pilot light the purchase invoice must be provided as proof of purchase.
  5. Customer agrees that the IOU will conduct a post measure implementation inspection.
  6. These measures only apply to gravity wall furnaces manufactured with integrated IPL controls, furnaces with a standing pilot light and any fireplace with standing pilot light.
  7. The Intermittent pilot light shall be powered by batteries or a wall voltage line.

**Implementation and installation requirements**:

1. For direct install applications, the wall furnace or fireplace insert shall be functional prior to been retrofitted with the intermittent pilot light (IPL).
2. For direct install applications, this IPL control cannot replace an existing functional or non- functional pilot light control on a furnace or fireplace insert.
3. The technology shall be capable of either using a battery or voltage line to effectively operate as intended.
4. Any technology manufacturer qualifies to be used in this program if safety and all other regulations are met and the technology is commercially available.
5. For furnaces manufactured with integrated IPL, the furnace shall be a gravity vented type.

**Other program restrictions and guidelines:**

* 1. This measure is applicable to all California climate zones.

## 1.2 Technical Description

Intermittent Pilot Light (IPL) controls can turn the pilot light ON and OFF depending on the furnace or fireplace insert heat demand status. During heat demand, the ignition module opens the pilot valve and initiates a spark at the pilot head, this spark then turns on the pilot light. Once on, the pilot light ensues with the normal operation of turning on the burners. Once the heat demand is satisfied, the pilot light valve will close and wait for the next cycle. The spark used to turn on the pilot light is created from a voltage delivered by the modules battery or voltage line from the wall. Eliminating the continuous pilot light provides a great opportunity for savings which are summarized in [**Section 2**](#_Section_2._Calculation).

## 1.3 Installation Types and Delivery Mechanisms

Table III: Installation Type Descriptions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Retrofit Add-on (REA) | Above Customer Existing | N/A | EUL | N/A |
| Replace on Burnout (ROB) | Above Code or Standard | N/A | EUL | N/A |
| New Construction (NC) | Above Code or Standard | N/A | EUL | N/A |

The IPL measure will be REA for direct install applications in which the controller will be installed onto an existing furnace or fireplace insert. For ROB and NC measures a furnace shall be purchased with the IPL controller integrated onto it by the manufacturer.

Table IV: Delivery Method Descriptions

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |

Table V: Incentive Method Descriptions

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

DEER does not have this type of measure.

Table VI: DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | No |
| DEER Version | DEER READI v.2.4.8 |
| Reason for Deviation from DEER | DEER does not contain this type of measure. |
| DEER Measure IDs Used | N/A |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below. This measure was developed through the help of SoCal gas’ Emerging Technologies department therefore the ET default NTG will be used.

Table VII: NTGR

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| ET-Default | Emerging Technologies approved by ED through work paper review | Any | Any | Any | 0.85 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

Table VIII: GSIA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an REA measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

Table IX: EUL ID

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| HV-EffFurn | High Efficiency Furnace | Res | HVAC | 20 | 6.7 |

REA measures in this workpaper will claim savings over the RUL period of 6.7 years. New construction and replacement on burnout measures will claims savings over the EUL period of 20 years.

1.4.2 Codes and Standards Analysis Table X: Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 20 (2017) | Title 20 Section 1605.1(e)(1) | April 16, 2013 |
| Title 24 (2016) | Title 24 Section 150.0 (e)(2) | 2016 |

California Code of Regulation Title 20 requires wall furnaces to meet certain efficiencies, however it does not require pilot light controls. The following figure summarizes Title 20 requirements.

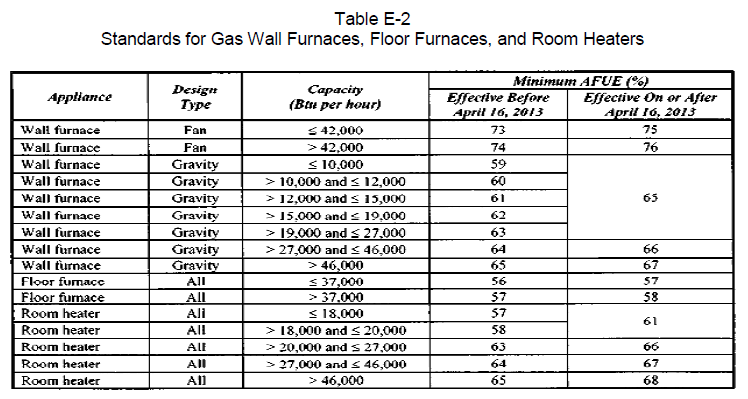


Figure I: Title 20 Wall Furnace Requirements

California Code of Regulations Title 24 has stringent requirements for furnace pilot lights, however the requirements do not apply to wall furnaces.

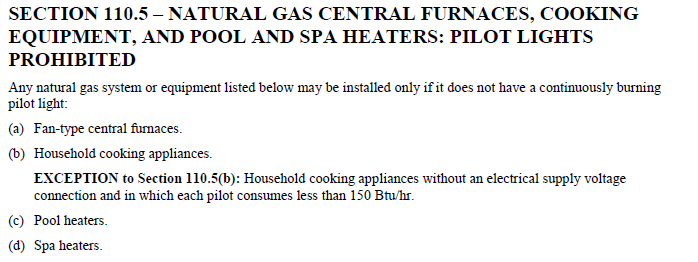


Figure II: Title 24 Pilot Light requirements

Fireplaces have their own requirements from Title 24 as shown in the figure below. However, the IPL control will be an REA application; therefore, it shall qualify for fireplace units in existing vintages that have a standing pilot light.

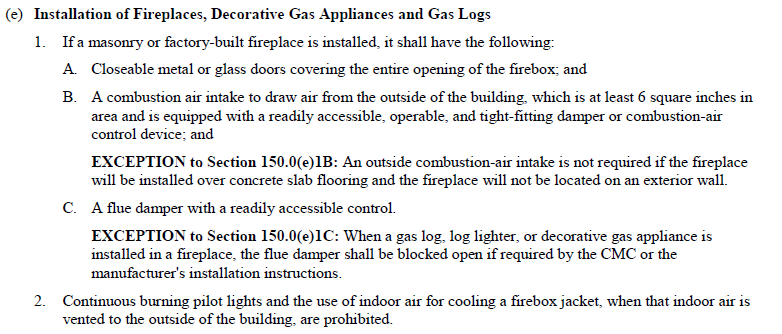


Figure III: Title 24 Fireplace Pilot Light Requirements

# 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

This workpaper refers to a study to understand the energy intensity of pilot lights. The study quantifies potential savings, however this workpaper uses its own methodology described in section 2 to estimate the actual savings presented in this document.

### 1.5.1 Southern California Gas Company Emerging Technologies Program Assessment Report Project ID E12SCG0018: High Efficiency Natural Gas Wall Furnace Field Evaluation

Field study replaced the wall furnace in three different studio housing type units and gathered empirical energy consumption data.

1. The high efficiency furnace units in the study have an input rating of 25,000 Btuh and 71% AFUE. Baseline furnaces are estimated to have a 63% AFUE.
2. Savings for the three replaced units varies from 15% to 55% based on annually extrapolated finding. Some of the units were observed to increase the energy consumption, but this is attributed to the convenience of new thermostat location affecting behavior.
3. Potential savings from the benefit of higher efficiency furnace in the SocalGas territory is estimated to be 169,750 Therms per year for multifamily residences. For single family residences that savings are estimated to be 162,750 Therms per year.

Study states the pilot light is the most significant consumer of gas. It further quantifies the pilot lights to account for half the savings mentioned on section (iii). The study recommends “*Utility programs may want to consider the elimination of standing pilots when developing rebate requirements.”*

1. The elimination of standing pilot lights could save SocalGas 121,000 Therms/Year.
2. With proper maintenance wall furnaces can work effectively for up to 20 years.
3. The average pilot light consumption from the furnace units was 7.2 Therms per month for baseline units and 3.7 Therms per month for efficient units. The baseline units pilot lights accounted for 62% of the annual energy consumed by the furnace.

## 1.6 Data Quality and Future Data Needs

The quality of the data used in this workpaper is appropriate for computations purposes. Primarily the data is used to establish the precedent of energy loss from the use of a standing pilot light and the energy consumption of the pilot light. Future data needs could involve a thorough survey to more accurately compute an appropriate value for the annual hours the pilot is kept on throughout the service territory population.

# Section 2. Calculation Methodology

The savings for this measure are computed by assessing the hours per year the standing pilot is ON and OFF, this was accomplished by utilizing SocalGas’ data of customer calls for pilot ignition and pilot turn OFF inquiries. From [***Attachment B***](#_Attachments)*,* customers were found to call SocalGas to turn off pilot lights throughout the year, however the intensity of calls occurs yearly from April to July, with the maximum number of calls taking place in July. Due to July experiencing the highest calls, this workpaper will consider July as the month when pilot lights are turned OFF. For ON instances, the same process was taken and the months with the most intensity are from October to January, with December experiencing the highest number of calls. December is taken as the month when pilot lights are turned on. Since pilot lights are turned ON in December and Turned OFF in July, the pilot lights are ON for seven months and OFF for five. Using CPUC approved weather data, [***Attachment******C***](#_Attachments), the annual ON and OFF hours are identified from the 8760 annual hours available. The ON hours are found to be from 1-4344 and 8017-8760 hours, while hours 4345-8016 are found to be OFF hours. Naturally, savings will not occur during OFF hours. Energy savings occur during the annual ON hours, there are two instances for ON hours that yield savings, these instances depend on the hourly heating degree day (HDD) and are as follow.

1. During ON hours, if the HDD is equal to zero, the savings for this hour are the entire pilot light hourly rate.
2. During ON hours, if HDD is not zero, the fraction of the hour the furnace is ON is computed and the OFF fraction is multiplied by the pilot light hourly rate.
   1. This case will also consider a pilot light efficiency, a value that captures the amount of heat produced from the pilot light that is transferred to the conditioned space. Currently there are no studies assessing this value, however, the DEER water heater calculator [***Attachment D***](#_Attachments), uses a pilot light efficiency of 67%, this measure for this instance will only claim 33% of the energy as savings that would have otherwise been losses. 67% of the pilot heat rate is assumed to be transferred into the conditioned space.

Heating Degree Days are taken from [***Attachment C***](#_Attachments),with a base of 65° for each California climate zone. The pilot light hourly heat rate is found to be 501.4 Btuh from an Emerging Technologies effort to test the functionality of battery driven IPLs [***Attachment B***](#_Attachments).

The work performed by the furnace during ON hours with non-zero HDD is computed through the analysis performed in SoCalGas’ [***Attachment E***](#_Attachments)***:*** *“WPSCGREHC110603A: Gravity Wall Furnaces in Single-Family and Multi-Family Homes”*. The following equations compute the energy demand by the furnace.

Where,

= Fraction of the hour the furnace is ON due to HDD

= Energy saved by intermittently turning pilot light ON

HDD = Heating Degree Days, Source: [***Attachment C***](#_Attachments), CompareWeatherData-v4

P = Regression from [***Attachment E***](#_Attachments)***,*** (), Source: WPSCGREHC110603A

Area = Home area [***Attachment E***](#_Attachments)***,*** (), Source: WPSCGREHC110603A

C = Furnace input [***Attachment E***](#_Attachments)***,*** (), Source: WPSCGREHC110603A

A = Furnace capacity, ()

PI = Pilot light rate, (), Source: [***Attachment B***](#_Attachments)

= Pilot light loss = 33%, Source: DEER-WaterHeater-Calculator-v2.1

**Sample Calculation:** For climate zone 9, for hour 7 for a single-family dwelling with a wall furnace rated at 25 kBtuh, from Attachment C, the HDD has a value of 1.17. Hour 7 falls under ON hours as described above. First the fraction of the hour the furnace shall be ON to compensate for the HDD heat demand shall be estimated by equation 1.

The furnace shall be ON for 0.37 fraction of one hour to compensate the heat demand by the 1.17 HDD of hour 7. Then, equation 2 will be used to estimate the amount of energy that will be saved from an intermittent pilot light in this scenario.

This process will be performed 8760 times for all annual hours for single-family and multi-family homes.

The following table shows a summary of savings.

Table XI: IPL Energy Savings

|  |  |  |  |
| --- | --- | --- | --- |
| CZ | MF Annual savings (Therm) | SF Annual savings (Therm) | Annual HDD Base 65 |
| 1 | 6.90 | 6.71 | 5094 |
| 2 | 9.99 | 9.84 | 3835 |
| 3 | 8.52 | 8.39 | 3257 |
| 4 | 10.37 | 10.23 | 3050 |
| 5 | 8.92 | 8.77 | 3715 |
| 6 | 11.14 | 11.04 | 2013 |
| 7 | 10.08 | 10.00 | 1478 |
| 8 | 12.20 | 12.12 | 1702 |
| 9 | 12.17 | 12.08 | 2000 |
| 10 | 12.39 | 12.28 | 2240 |
| 11 | 11.78 | 11.64 | 3027 |
| 12 | 11.02 | 10.88 | 3122 |
| 13 | 12.18 | 12.05 | 2794 |
| 14 | 11.76 | 11.60 | 3322 |
| 15 | 17.17 | 17.12 | 1102 |
| 16 | 8.31 | 8.05 | 5578 |

Savings in Table XI are applicable to REA measure applications in which the IPL kit is retrofitted into existing wall furnaces or fire places. For wall furnaces manufactured with integrated IPL, the savings (Table XII) will be a sum of table XI and the savings found in workpaper [***Attachment F***](#_Attachments).

Table XII: New Furnace Integrated with IPL Energy Savings

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | SF (Therms/year) | | | MF (Therms/year) | | |
| CZ | 25,000  Btu/h | 35,000  Btu/h | 50,000  Btu/h | 25,000  Btu/h | 35,000  Btu/h | 50,000  Btu/h |
| 1 | 32.51 | 33.41 | 39.71 | 34.70 | 35.70 | 42.50 |
| 2 | 23.54 | 24.04 | 27.34 | 23.79 | 24.29 | 27.69 |
| 3 | 22.49 | 22.99 | 26.39 | 25.32 | 25.92 | 30.02 |
| 4 | 22.13 | 22.53 | 25.43 | 23.17 | 23.67 | 26.77 |
| 5 | 23.27 | 23.87 | 27.37 | 24.92 | 25.52 | 29.32 |
| 6 | 19.74 | 20.14 | 22.24 | 22.24 | 22.64 | 25.34 |
| 7 | 14.00 | 14.20 | 15.10 | 18.88 | 19.18 | 21.38 |
| 8 | 17.82 | 18.02 | 19.32 | 19.90 | 20.20 | 22.10 |
| 9 | 20.28 | 20.58 | 22.58 | 22.17 | 22.47 | 24.87 |
| 10 | 20.48 | 20.68 | 22.68 | 21.49 | 21.89 | 24.09 |
| 11 | 25.14 | 25.64 | 28.94 | 24.68 | 25.18 | 28.28 |
| 12 | 24.18 | 24.68 | 27.98 | 23.92 | 24.42 | 27.62 |
| 13 | 24.55 | 24.95 | 27.95 | 24.68 | 25.18 | 28.18 |
| 14 | 26.50 | 27.10 | 30.70 | 23.96 | 24.36 | 27.36 |
| 15 | 21.92 | 22.12 | 23.22 | 22.07 | 22.17 | 23.37 |
| 16 | 26.65 | 27.35 | 31.85 | 28.01 | 28.71 | 33.61 |

**Table XIII** displays savings by building type and furnace input capacity, however by performing an AHRI query [***Attachment F***](#_Attachments)***,*** the only furnace sizes that currently are manufactured with an AFUE of 70 or greater are 25 kBtuh and 50 kBtuh. This workpaper will only provide savings and rebate opportunity for wall furnaces manufactured with integrated IPL units for furnace capacities of 25 and 50 kBtuh.

# Section 3. Load Shapes

Table XIII: Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Residential | Residential | SCG:RES:DEER:Res:HVAC\_Eff\_AC |

# Section 4. Costs

There are currently only a few manufacturers of intermittent pilot light technologies. The cost will consist of both voltage line and battery powered to estimate a more accurate equipment cost. Desktop research and talks with manufacturers were held to quantify the figures in section 4.1 and section 4.2.

## 4.1 Base Case Cost

For the REA IPL applications, the base case cost is zero dollars as this will be not applying any measure. For furnaces manufactured without IPL controls the cost breakdown can be found in [***Attachment B***](#_Attachments) and is as follow.

* + 1. 25,000 kBtuh base cost = $545.06
    2. 35,000 kBtuh base cost = $791.70
    3. 50,000 kBtuh base cost = $980.37

## 4.2 Measure Case Cost

Again, combining manufacturer talks and desktop research, the cost for the REA IPL control from [***Attachment B***](#_Attachments)***,*** is $264.71. Controller manufacturer discussions concluded that furnaces manufactured with integrated IPL controls have a cost increase of $100. The cost for these measures include the cost for furnaces meeting the efficiency requirements in [***Attachment E***](#_Attachments) plus the $100 for the IPL and is as follows.

1. 25,000 kBtuh base cost = $772.03
2. 35,000 kBtuh base cost = NA
3. 50,000 kBtuh base cost = $1,140.87

Currently there are no units that meet the efficiency requirements in [***Attachment E***](#_Attachments)for furnaces with input capacity of 35kBtuh. AHRI does not have units with 35 kBtuh with AFUE of 70 or greater [***Attachment F***](#_Attachments). For this reason, there will not be a measure case for furnaces manufactured with integrated IPLs with an input capacity of 35 kBtuh.

## 4.3 Full and Incremental Measure Cost

The labor cost for IPL REA applications was computed by multiplying a time factor for installation by the labor rate for the installation of HVAC package units found in READI v.2.4.8. The labor rate from READI is $67.88 per hour. Under Emerging Technologies functionality evaluations, the time to retrofit wall furnaces by highly trained and adept technicians was found to be 40 minutes, hence the labor cost will be . Labor to install furnaces with integrates IPL will use a time factor of 3 hour at a rate of $68.77, for a total of .

Table XIV: Full and Incremental Measure Cost

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC)   1. 25kBtuh   ($772.03+$203.6) - ($545.06+203.6) = $226.97   1. 35kBtuh: NA 2. 50kBtuh   ($1,140.87+$203.6) - ($980.37+203.6) = $160.49 | (MEC + MLC) – (BEC + BLC)   1. 25kBtuh   ($772.03+$203.6) - ($545.06+203.6) = $226.97   1. 35kBtuh: NA 2. 50kBtuh   ($1,140.87+$203.6) - ($980.37+203.6) = $160.49 | N/A |
| NC  (IPL+Furnace) |
| REA  (IPL) | MEC + MLC  $264.71 + $45.25 = $309.96 | MEC + MLC  $264.71 + $45.25 = $309.96 | N/A |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

# Attachments

Attachment A: Southern California Gas Company Emerging Technologies Program Assessment Report Project ID E12SCG0018: High Efficiency Natural Gas Wall Furnace Field Evaluation

Attachment B: Energy Savings Analysis

Attachment C: CompareWeatherData-v4

Attachment D: DEER-WaterHeater-Calculator-v2.1

Attachment E: WPSCGREHC110603A: Gravity Wall Furnaces in Single-Family and Multi-Family Homes

Attachment F: AHRI Search

# References

1. <https://howmuch.net/costs/HVAC-heating-furnace-gas-wal-install>
2. https://www.improvenet.com/r/costs-and-prices/wall-furnace