IEc

On-Bill Energy Savings Calculator

November 19, 2020

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- Objective: estimate energy cost savings from projects that produce savings via one or more pathways:
  - Reduce fuel usage (natural gas, oil, etc.)
  - Install new on-site electricity generation (i.e., solar PV) and employ net metering
  - Reduce electricity usage
  - Shift the timing of electricity usage (peak load reduction)
- Calculates savings to ratepayers, not utilities or the public at large
- Relevant for virtually any on-site energy efficiency and/or renewable energy project in California

Methodology: Pathways to on-bill savings

1. Fuel use reduction:

$$\text{Annual savings}_i = \Delta \text{ Fuel usage} * \text{Fuel price}_i$$

$$\text{Total savings} = \sum_{i=1}^{P} \text{Annual savings}_i$$

i = savings year index
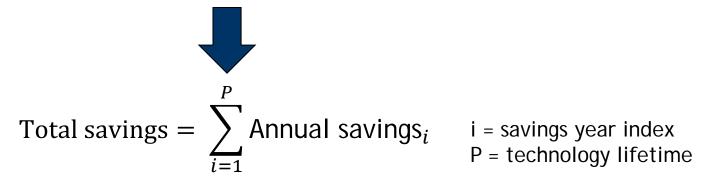P = technology lifetime

2. Electricity reduction: same as above, but accounts for:
   - Variation in electricity rate based on time-of-use (peak vs. off-peak hours, summer vs. winter)
   - Seasonality of energy savings (e.g., more efficient A/C yields savings in summer but not winter)

3. On-site Generation (mostly solar with net metering): essentially identical to electricity reduction
   - Assumes annual electricity generation ≤ annual consumption

4. Peak load reduction/load shifting:

$$\text{Annual savings}_i = \Delta \text{ Peak demand} * \text{Demand charge}_i$$

$$\text{Total savings} = \sum_{i=1}^{P} \text{Annual savings}_i$$

i = savings year index
P = technology lifetime

Similar to net metering and electricity reduction, accounts for:
- Different types of demand charges based on timing (peak vs. off-peak hours → facility-related vs. time-related charges)
- Timing of energy savings

Savings are calculated on a monthly basis

Calculator modules

- Calculator has three modules that correspond to the pathways to savings noted above:

  1. Reduce fuel usage → Fuel Reduction module

  2. Install new on-site generation → Net Metering module

  3. Reduce electricity usage and/or shift timing of electricity consumption → Electricity Reduction/Load Shifting module

- Modules can be used individually or in combination with each other

Key inputs

- Calculator is designed to be used with a limited number of project-level inputs, including:

  - Estimated annual energy savings/generation

  - Cost and lifespan of energy-saving technology

  - Gas/electric utility

  - End-use sector (residential, commercial, industrial)

- Default values are available for other data requirements (e.g., projected fuel/electricity prices)

  - Users can easily bypass defaults and enter data manually if desired

Fuel Reduction Module

General Inputs

	← *yellow highlight = user input required*
	← *orange highlight = user input completed*

GENERAL

	Input	Source notes
Project name/ID	FR Example Project	Applicant/grantee
Gas utility (N/A for projects not affecting gas consumption)	PG&E	Applicant/grantee
Customer end-use sector	Residential	Applicant/grantee
Technology lifespan (years)	20	Applicant/grantee
Start year for fuel savings (also used as base year for present value calculations)	2020	Applicant/grantee
Dollar year	2020	User input
Savings calculated from: 1) project, or 2) market penetration scenario	Project	User input
First cost per unit (enter 0 if none)	$250	Applicant/grantee

General Inputs

		← *yellow highlight = user input required*
		← *orange highlight = user input completed*

GENERAL

	Input	Source notes
Project name/ID	FR Example Project	Applicant/grantee
Gas utility (N/A for projects not affecting gas consumption)	PG&E	Applicant/grantee
Customer end-use sector	Residential	Applicant/grantee
Technology lifespan (years)	20	Applicant/grantee
Start year for fuel savings (also used as base year for present value calculations)	2020	Applicant/grantee
Dollar year	2020	User input
Savings calculated from: 1) project, or 2) market penetration scenario	Market Penetration scenario	User input
First cost per unit (enter 0 if none)	$1,000	Applicant/grantee

For a market penetration scenario, you must enter year-by-year fuel savings in the 'mkt penetration scenario inputs' worksheet. Be sure to enter the fuel type and units in the 'fuel use inputs' worksheet.

Market Penetration Scenario

Input fuel savings in this worksheet <u>only</u> if you selected 'market penetration scenario' in the 'general inputs' worksheet.

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fuel savings, by year:													
Natural_Gas, MMBtu					1,000	1,050	1,103	1,158	1,216	1,276	1,340	1,407	1,477

First cost:

Same total cost in all years (yes/no):	No

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Total cost, by year					$100,000	$105,000	$110,250	$115,763	$121,551	$127,628	$134,010	$140,710	$147,746

Fuel Price Data Source Inputs

DATA SOURCE FOR FUEL PRICES

	Input	Source notes
Fuel price in start year	Manual Input	User input
Price escalation in future years	Use default data	User input

Enter fuel prices manually in the 'manual price input_optional' worksheet.

Manual Price Inputs

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fuel price, by year:													
Natural_Gas, 2020 $/MMBtu					$10.00	$10.30	$10.61	$10.93	$11.26	$11.59	$11.94	$12.30	$12.67

Intervention Scale Inputs

INTERVENTION SCALE

	Input	Source notes
Intervention scale	Multiple_Buildings	Applicant/grantee
# of different building profiles (with different # of units of technology and/or fuel savings results) (up to 3)	2	Applicant/ grantee
Building profile #1: Number of individual pieces of technology installed per building	5	Applicant/ grantee
Building profile #1: Number of buildings	10	Applicant/ grantee
Building profile #2: Number of individual pieces of technology installed per building	100	Applicant/ grantee
Building profile #2: Number of buildings	1	Applicant/ grantee

Fuel Use Inputs

FUEL TYPE

	Input	Unit	Source notes
Fuel type	Natural_Gas	MMBtu	Applicant/ grantee

REPORTED FUEL REDUCTION

	Input	Source notes
Scale of reported fuel reduction	Building_Level	Applicant/ grantee
Fuel reduction reported as:	Known (absolute) quantity	Applicant/ grantee

FUEL REDUCTION

Option 1: known quantity

	Input	Unit	Source notes
Building Type 1: Baseline (pre-intervention) fuel use, annual	30	MMBtu	Applicant/ grantee
Building Type 1: Post-intervention fuel use, annual	25	MMBtu	Applicant/ grantee
Building Type 2: Baseline (pre-intervention) fuel use, annual	500	MMBtu	Applicant/ grantee
Building Type 2: Post-intervention fuel use, annual	425	MMBtu	Applicant/ grantee
Total project level fuel savings, annual (original units)	125	MMBtu	Calculated
Total project-level fuel savings, annual (MMBtu)	125	MMBtu	Calculated

Results

RESULTS SUMMARY:

FR Example Project, Reduced Fuel Use

General Project Characteristics	Result
Fuel type	Natural_Gas
Gas utility	PG&E
Total number of individual number of units of technology installed	150
Total number of buildings	11
Project lifespan (years)	20

Fuel savings, MMBtu	Result
Annual (1st year)	125
Total	2,500

Financial results	Result
First cost	$ 37,500
Total gross on-bill fuel savings through 2039, 2020 nominal $	$ 81,623
Total net on-bill fuel savings through 2039, 2020 nominal $	$ 44,123
Total net on-bill fuel savings through 2039, NPV at 3% discount rate	$ 22,138
Total net on-bill fuel savings through 2039, NPV at 7% discount rate	$ 3,998
Payback period, years	10.16

Net Metering Module

Overview

- Applicable to on-site (non-utility scale) renewable energy projects with net metering

- Technology options include solar and 'all other'

  - For solar, calculator requires project ZIP code to determine annual profile of solar power generation

  - For other technologies, calculator has limited selection of default options for generation timing (continuous or business hours)

- Inputs and user interface are generally similar to Fuel Reduction module

- Net Metering module also requires user input on system capacity

  - Annual generation (kWh/year) is optional for solar, required for other technologies

Time-of-Use Schedule, Annual Generation Profile

- Key difference in interface from Fuel Reduction module relates to data sources for timing of generation, ratepayer's Time-of-Use electricity rate schedule (peak vs. off-peak pricing)

  - For most users, default data is the best option for these parameters

TIME-OF-USE RATES AND GENERATION SCHEDULE

Based on your utility and customer end-use sector, the default weekday time-of-use schedule for your project is as follows:

	Dates	Peak hours	Partial peak hours: pre-peak	Partial peak hours: post-peak	Off-peak hours
Summer	06-01 through 10-31	16:00 - 21:00			21:00 - 16:00
Winter	11-01 through 05-31	16:00 - 21:00			21:00 - 16:00

Based on your climate zone and the default time-of-use schedule above, your default annual generation profile is as follows:

% of Total Annual Generation

	Dates	Peak hours	Partial peak hours	Off-peak hours
Summer	06-01 through 10-31	0.87%	0.00%	51.25%
Winter	11-01 through 05-31	0.43%	0.00%	47.45%

Electricity Reduction/ Load Shifting Module

Overview

- Applicable to on-site projects that reduce electricity use and/or change timing of electricity use

- Technology options include A/C; building insulation; clothes or dishwasher; heat pump; indoor lighting; refrigerator/freezer; and other

    - Choice of technology affects seasonal & daily timing of electricity use reduction

- Generally similar inputs and interface as other modules

Demand charges

- Many industrial users face a monthly demand charge

  - $/kW charge based on maximum demand at any point during the month

  - Separate from $/kWh consumption charges on total electricity used

- Projects that reduce demand during this monthly peak, either by reducing or shifting timing of electricity use, will lower customers' demand charges

- Electricity reduction/load shifting module captures the savings from lower demand charges

DEMAND CHARGES

	Input	Source notes
Do electricity bills at project site include a demand charge?	Yes	Applicant/grantee
Data source for dollar value of demand charge	Use default data	User input
Data source for month-by-month reduction in maximum demand	Use default data	User input
Total annual site-level electricity consumption (kWh), pre-intervention	10,000	Applicant/grantee

Data Sources

- Default gas price projections are from CEC; projections for other fuels are from EIA (U.S. Pacific Region)

- Default electricity price projections are from CEC

  - For net metering, calculator assumes that annual generation ≤ consumption → all electricity transacted at retail rates

- Solar energy generation by climate zone is from Solar + Storage Tool developed by Environmental Energy Economics (E3) → originally sourced from CPUC Avoided Cost Calculator

- Hourly load shapes for each energy efficiency project type are from E3 Energy Efficiency Calculator → originally sourced from CPUC Database for Energy-Efficient Resources

- IEc identified representative rate structures for each IOU and customer class, based on:

  - Rates offered to customers by default

  - Highest number of customers enrolled

  - Simplest pricing structures

- For future electricity prices, available projections reflect flat rate structures

  - Thus, to project future TOU pricing schedules, we applied the same annual escalations shown for flat rates to current TOU rates for each period (peak, off-peak, partial peak)

IOU	END-USE SECTOR	TOU RATE SCHEDULE	JUSTIFICATION FOR SELECTION
PG&E	Residential	E-TOU-C3	Popular rate: 400,015 MWh and 64,638 customers according to 2018 FERC Form 1. Featured on PG&E website. No weekend/weekday distinction.
PG&E	Commercial	A-1	For <75 kW customers. Popular rate: 1,062,816 MWh and 46,613 customers according to FERC Form 1. Featured on PG&E website. No demand charges.
PG&E	Industrial	A-10	For 75-499 kW customers. Popular rate: 8,431,271 MWh and 43,336 customers according to FERC Form 1.
SDG&E	Residential	TOU-DR1	Default TOU rate. Featured on SDG&E website.
SDG&E	Commercial	TOU-A	Two periods (peak and off-peak). Seasonal differences consistent with standard summer/winter options.
SDG&E	Industrial	AL-TOU	Simplest rate structure available for industrial customers with demand charges.
SCE	Residential	TOU-D-4-9PM	Peak period hours more similar to other IOU rates. Featured on SCE website.
SCE	Commercial	TOU-GS-1E	For <20kW customers. No demand charges.
SCE	Industrial	TOU-GS-3D	For 200-500 kW customers. Lower rates than other options provide conservative estimate of savings.