System-Level Savings Calculator

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Objective: measure avoided costs at the system level associated with EPIC projects that cause modifications to electric load

Cost components: generation capacity, energy including losses, T&D capacity, ancillary services (regulation, operating reserve, reactive power/voltage support)

Load modifications can result from **discrete events** such as demand response, or **sustaining interventions** such as energy efficiency applications

Calculator can be used to measure impact on load from integration of RE generation, but with additional steps that must be conducted outside of the tool

Supplement to Avoided Cost Calculator

The Avoided Cost Calculator ("ACC"), developed under the direction of the California PUC and updated annually, provides standardized, consistent inputs for IRP modeling.

The ACC is not intended to analyze DSM, DR, or DER programs. It is not an analytical tool. But it provides California-specific data required as inputs for analyses of interest to EPIC

Data Sources

The System-Level model uses:

- Hourly avoided cost data from the ACC to measure program impacts
- Load profiles from the CPUC *Database for Energy Efficiency Resources* ("DEER") for six end-uses, plus residential, commercial & industrial average loads from PG&E
- 2018 PG&E demand-response event history associated with Capacity Bidding Program
- Consumer Price Index deflators

Model Structure

Data Inputs

ACC

Hourly avoided costs

DEER, PG&E

Load profiles for 6 end-use applications
Average profiles by PG&E rate class
P&E demand response events

User Inputs

Program timing & scale/scope
End-use (default) or load reduction timing (manual)
Program impact by MWh (sustained) or MW (event-based)

Analysis

Hourly calculation of avoided costs associated with the change in load (baseline v. modified)

Estimate of annual avoided costs by component, in total $ and $/MWh

Initial Input Screen

GENERAL INPUTS

	User selection	Source notes
Project name/ID	Treau Window-Mounted Heat Pump (EPC-18-019)	Applicant/ grantee
Dollar year	2020	User input
Load reduction type	Sustained	Applicant/ grantee
Savings calculated from: 1) single-year project inputs, or 2) multi-year market penetration scenario	Project	User input
Year of load reduction	2021	Applicant/ grantee

AVOIDED COST CATEGORY

Energy procurement	Energy	Include
	Ancillary Services	Include
Peak load reduction	Capacity	Include
	Transmission	Include
	Distribution	Include

Load Reduction Type:
Sustained – energy efficiency applications
Event-based – short-term, in response to real-time system conditions

User can decide which avoided cost components to include in analysis, or use defaults

← *yellow highlight = user input required*
← *orange highlight = user input completed*
← *gray highlight = user input not applicable*

Formatting convention for all screens

Detailed Input Screen

1

LOAD REDUCTION INPUTS

	User selection	Source notes
Hourly load shape	Heat pump	Applicant/ grantee
Usage reduction timing data	Use default data	User input

2

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)	1	Applicant/ grantee
Building profile #1: Number of individual pieces of technology installed per building	1	Applicant/ grantee
Building profile #1: Number of buildings	70000	Applicant/ grantee

Since "Sustained" was selected in the initial input screen, the user is provided with a dropdown menu of 6 loads profiles:

Indoor lighting
Refrigerator/freezer
Air conditioning
Heat pump
Clothes or dishwasher
Building shell insulation

The next step is to specify program application & **Intervention Scale**, for which there are 3 choices:

Single Unit of Technology
Single Building
Multiple Buildings

Intervention Scale

Options for intervention scale give the user flexibility

- Individual unit of technology – user reports the full extent of load reduction
- Single building – allows user to report full extent of load reduction, or per-unit load reduction
- Multiple buildings – allows user to report full extent of load reduction, per-unit load reduction, or per-building load reduction for up to three building types

Detailed Input Screen – Final Step

3

USAGE REDUCTION

	Input	Source notes
Scale of reported usage reduction	Building_Level	Applicant/ grantee
Baseline (pre-intervention) electricity use, annual (MWh)	2.0	Applicant/ grantee
Post-intervention electricity use, annual (MWh)	1.0	Applicant/ grantee

Pre- and post-intervention MWh are entered by user

*The Baseline & Post-Intervention values shown here were derived from estimates for the **Treau** window-mounted heat pump*

DEFAULT USAGE REDUCTION TIMING

	% of annual electricity usage reduction during:	
Season	Peak hours	Off-peak hours
Summer	7%	13%
Winter	9%	71%

These cells populate automatically from whichever end-use has been specified (shown: heat pump usage distribution)

Annual Avoided Cost Results

RESULTS SUMMARY:
EPC-18-019 System-Level Savings

General project characteristics	Result
Load reduction type	Sustained
Year of savings	2021
Days per year of load reduction	365
Annual usage avoided (MWh)	70273.6

Avoided cost, 2020 nominal $	Result
Total savings	$5,769,696
$/MWh	$82

Avoided component costs, 2020 nominal $	Result
Energy	$2,992,837
Losses	$208,704
Ancillary Services	$32,523
Capacity	$1,309,605
Transmission	$140,731
Distribution	$1,085,295

Load delta associated with 70,000* installations of high-efficiency heat pump

Unit avoided cost ($82/MWh) can be used to compare with program costs to determine standalone economic efficiency and v. alternatives

Behind the scenes, the hourly heat pump load delta has been multiplied by hourly marginal cost by component and rolled up into annual results

*Estimated # of CA households with central A/C and resistance heat (source: *2009 California Residential Appliance Saturation Survey*)

Overriding Seasonal/Time Bucket Defaults

LOAD REDUCTION INPUTS

	User selection	Source notes
Hourly load shape	Heat pump	Applicant/ grantee
Usage reduction timing data	Manual input	User input

Select "Manual input" from dropdown menu

MANUAL INPUT FOR USAGE REDUCTION TIMING

	% of annual electricity usage reduction during:	
Season	Peak hours	Off-peak hours
Summer	12%	20%
Winter	8%	60%

Enter alternative estimates for usage reduction timing

The resulting total avoided cost estimate is about 3.5% higher due to the specification of higher on-peak usage during the summer compared with the default value

12x24 Default Override for Load-Shifting

Choosing **Detailed Manual Input** opens up a 12x24 matrix:

DETAILED MANUAL INPUT FOR USAGE REDUCTION TIMING

% of Annual Electricity Usage Reduction	Error: these values must sum to 100%	
Hour	JAN	FEB
0:00		
1:00		
2:00		
3:00		
4:00		
5:00		
6:00		
7:00		
8:00		
9:00		
10:00		
11:00		
12:00		
13:00		
14:00		
15:00		
16:00		
17:00		
18:00		
19:00		
20:00		
21:00		
22:00		
23:00		

etc.

LOAD REDUCTION INPUTS

	User selection	Source notes
Hourly load shape	Heat pump	Applicant/ grantee
Usage reduction timing data	Detailed manual input	User input

User estimates two 12x24 matrices (in average MW/hour) pre- & post-intervention, and then compares results

Event-Based Intervention

GENERAL INPUTS

	User selection	Source notes
Project name/ID	Residential Price-Responsive Demand	Applicant/ grantee
Base year for conversion of price projections	2020	User input
Load reduction type	Event-based	Applicant/ grantee
Savings calculated from: 1) single-year project inputs, or 2) multi-year market penetration scenario	Project	User input
Year of load reduction	2021	Applicant/ grantee

Illustrative (PRD: price-responsive demand)

Load Reduction Type:
Sustained – energy efficiency applications
Event-based – short-term, in response to real-time system conditions

AVOIDED COST CATEGORY	COMPONENTS	
Energy procurement	Energy	Include
Peak load reduction	Capacity	Include
	Transmission	Include
	Distribution	Include

Avoided cost of ancillary services and energy losses not applicable to Event-based interventions (based on CPUC guidance)

Second Input Screen

LOAD REDUCTION EVENT INPUTS

	User selection	Source notes
Load reduced (MW)	10.0	Applicant /grantee
Event timing data	Use default data	User input

Anticipated load reduction (MW) as a result of the intervention

DEFAULT EVENT TIMING

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Duration (hours)	N/A	N/A	N/A	N/A	N/A	1	3	4	2	N/A	N/A	N/A
Start time (24:00)	N/A	N/A	N/A	N/A	N/A	18:00	16:00	16:00	18:00	N/A	N/A	N/A
Events per month	0	0	0	0	0	2	15	8	6	0	0	0

Defaults are based on PG&E demand response event history; can be overridden by user

Annual Avoided Cost Results

RESULTS SUMMARY:
Residential PRD System-Level Savings

General project characteristics	Result
Load reduction type	Event-based
Year of savings	2021
Days per year of load reduction	31
Annual usage avoided (MWh)	910.0

Avoided cost, 2020 nominal $	Result
Total savings	$629,415
$/MWh	$692

Avoided component costs, 2020 nominal $	Result
Energy	$125,996
Capacity	$233,980
Transmission	$29,680
Distribution	$228,886

Unit avoided cost ($692/MWh) can be used to compare with program costs to determine standalone economic efficiency and v. alternatives

ACC Assumptions

The ACC gives users a choice of IOU-specific avoided cost data & climate zone. The cost data in the System-Level model is specific to PG&E, CZ 4

- The calculator can be modified to use alternative ACC assumptions for SCE or SDG&E, but the output data would have to be stored in additional copies of the model

Also specified in the ACC:

- Include Reserve Margin = 1 (“yes”)
- Start Year = 2019
- Levelization Period = 1

Updating Data Inputs

When the ACC is updated (generally in late spring), **hourly marginal cost curves** for each cost component should be copied & pasted into the System-Level model

Demand response events can be updated when PG&E publishes new dates, times and durations (current version incorporates 2018 DR history – most recent available), or DR event history in SCE zone can be used

Detailed instructions for updating are in model documentation