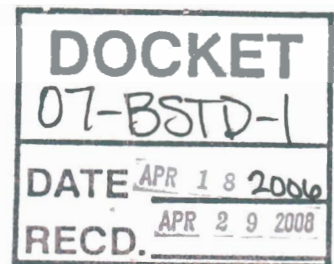

***Time Dependent Valuation of Energy
for Developing Building Efficiency Standards
2008 Time Dependent Valuation (TDV)***

***Data Sources and Inputs
APRIL 18, 2006***

*Submitted to:
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Contents Overview

This report describes data sources, results, and provides links to spreadsheets containing the input data and calculations used in the 2008 TDV update to include demand response. There is an accompanying report that describes the methodology used to develop the 2008 TDV values for each energy type; electricity, natural gas, and propane.

Acknowledgements

We would like to acknowledge the contributions and hard work of the following individuals at the California Energy Commission for developing the input data described in this report.

Jairam Gopal
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Ruben Tavares

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I. DATA SOURCES

Table 1 below shows the data types and sources used in the TDV calculations, and indicates whether separate data streams are provided according to climate zone, utility, or location relative to Path 15.

Table 1. Data Sources for 2008 TDV Calculations

Data	Source	Location Dependent?
Weather data	Climate zone data used for standards evaluation	Yes - each climate zone has its own weather
Electricity class load shapes	1999 utility statistical load profiles used in billing	Yes - varies by utility
Electricity retail rates forecast	CEC IEPR forecast 2008 to 2037 for each IOU, updated to reflect new natural gas price forecast residential and non-residential	Yes - varies by utility
Electricity annual wholesale price forecast	Constructed from CPUC Market Price Referent (R04-04-025, MPR) plant and financing assumptions, along with natural gas forecast (see below)	No.
Electricity hourly wholesale price shape	CEC (shape based on recorded market prices from CALPX, 1998-99)	Yes - varies for NP-15 and SP-15
Simple cycle combustion turbine (CT) capacity shortfall cost	CPUC MPR plant and financing assumptions	Yes. CT cost is the same, but shortfall varies by NP-15 and SP-15
Emission rates by power plant type	CPUC avoided costs for energy efficiency (E3 avoided cost methodology)	No
Emission costs by pollutant	CPUC avoided costs for energy efficiency (E3 avoided cost methodology)	No
Natural gas TDV streams	CEC IEPR 2005 – November 3 rd revision, retail natural gas rate forecast, extended from 2023 with straight-line trend to 2037, residential and commercial	No
Natural gas monthly price shape	NYMEX Henry Hub price shape through 2010	No
Natural gas monthly consumption shape	Utility monthly sales data, residential and non-residential	No
Propane monthly price shape	DOE EIA Petroleum Marketing Monthly publication	No

Propane monthly consumption shape	DOE EIA Petroleum Marketing Monthly publication	No
Propane annual price forecast	DOE EIA Petroleum Marketing Monthly publication	No
Customer partial outage costs (productivity and discomfort etc)	Constructed from data in academic study (see below)	No
Customer full outage costs	Constructed from data in 1999 and 2000 outage studies in utility CPUC filings, plus academic study (see below)	No

II. INPUT DATA STRUCTURE

The flow diagrams in Figures 1-3 below describe the major components used to construct the 2008 TDV curves for electricity, natural gas, and propane. The description of each component refers to the data sources and/or spreadsheet used to compute that component.

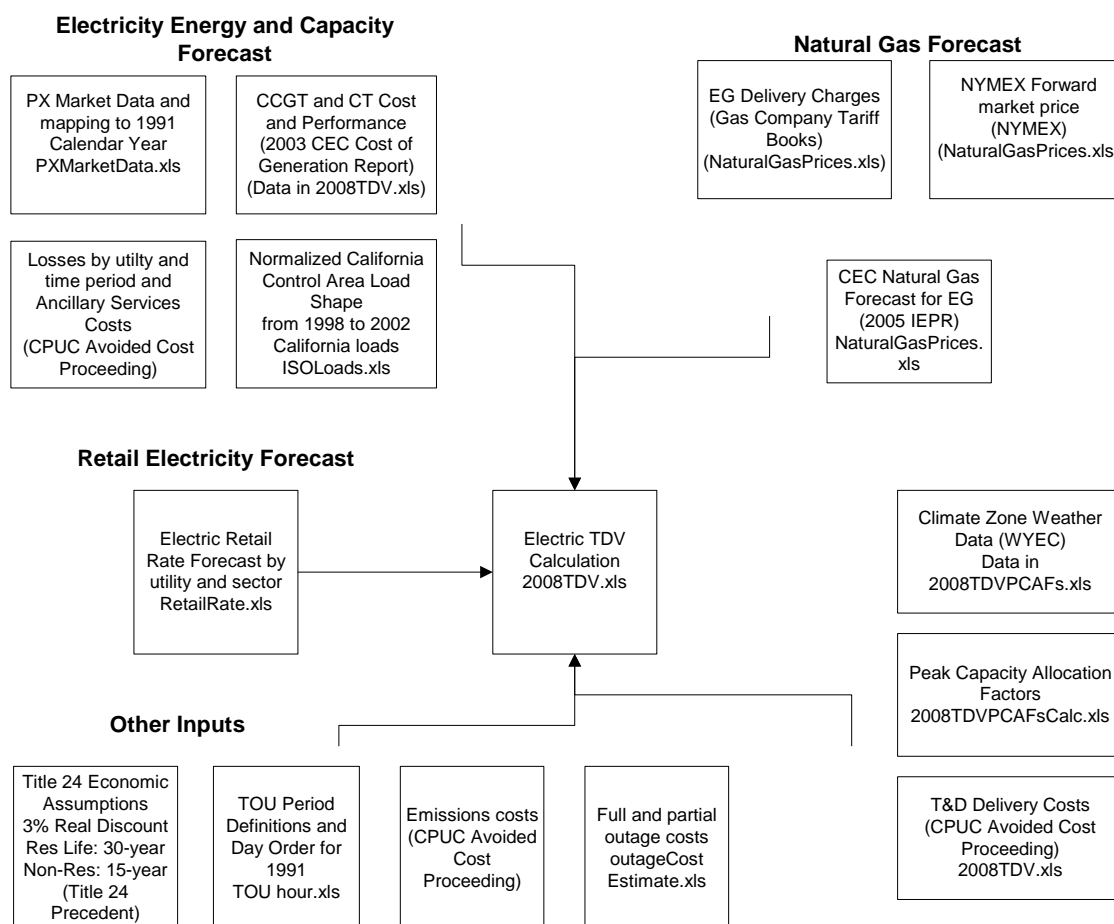


Figure 1. Data Structure for 2008 Electricity TDV Calculations

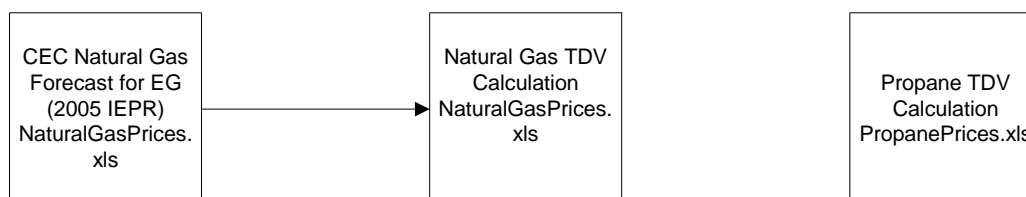


Figure 2. Data Structure for 2008 Natural Gas and Propane TDV Calculations

III. INPUT DATA AND CALCULATION SPREADSHEETS

1. *Electricity TDV Calculation*

The spreadsheet contains the main calculation of the 2008 TDV values for electricity including demand response.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/2008TDV10.xls>

2. *PX Market data*

This spreadsheet contains 1998-99 CALPX market data the constructed in 1991 day order. This data is shown in Figure 3.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/PXMarketData.xls>

Key Results:

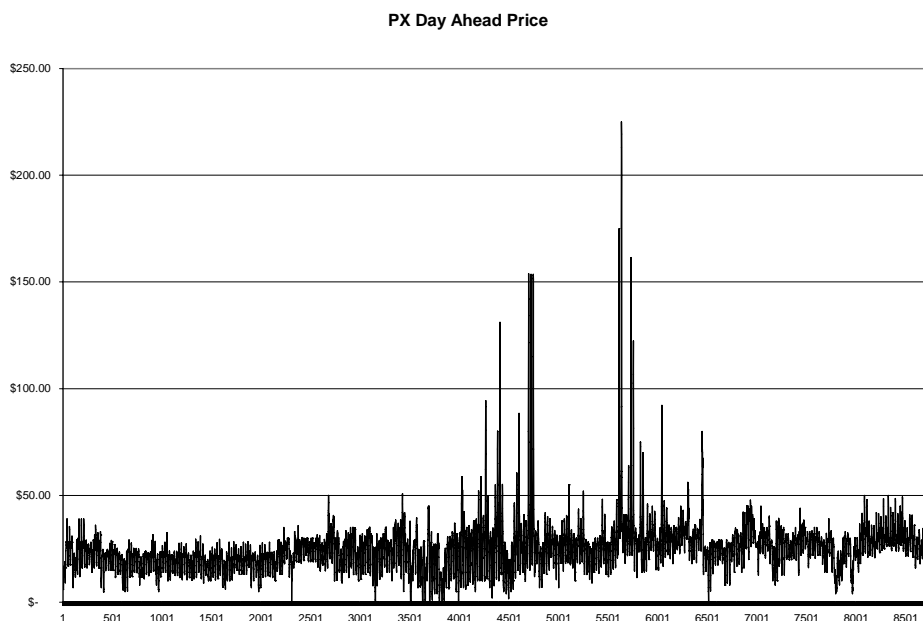


Figure 3. CALPX day-ahead prices 1998-1999

3. California Load Shape and Allocation of Residual Capacity

This spreadsheet contains CAISO Load data and calculation of the allocation factors of residual capacity.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/isoLoads.xls>

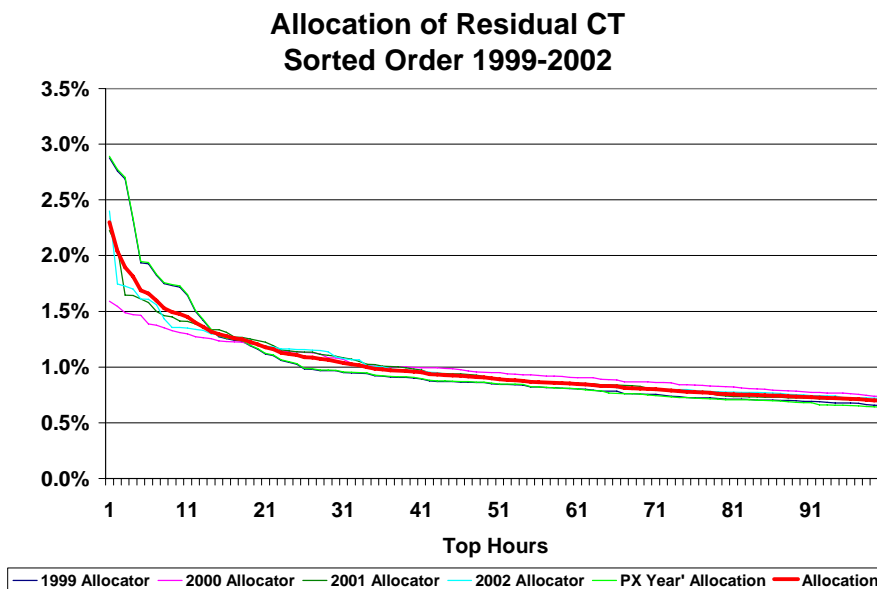


Figure 4. Proxy Loss of Load Probability Allocation Factors

4. Electric Retail Rate Forecast

This spreadsheet contains the retail rate forecast for the three investor-owned utilities from 2008 to 2037.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/retailRate4.xls>

Key Results:

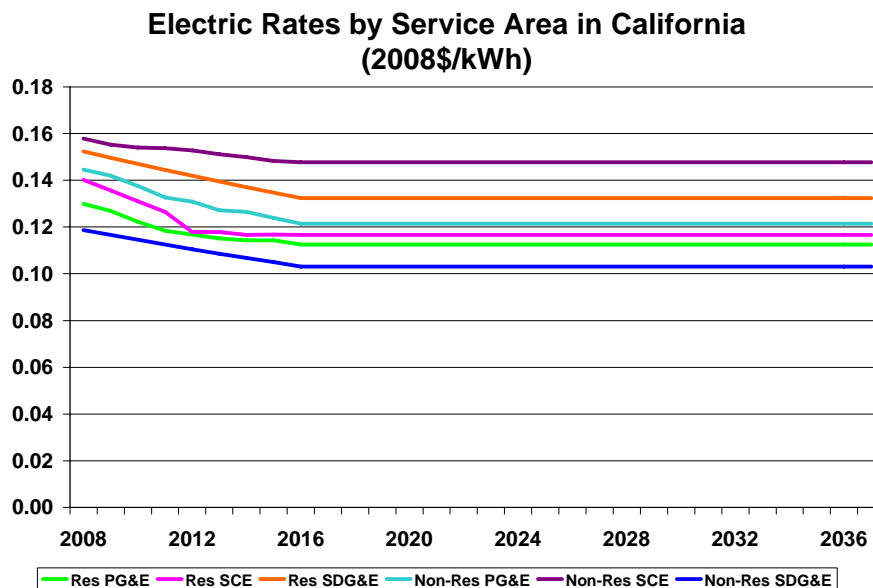


Figure 5. Electric Retail Rate Forecast – 2008 through 2037

5. Weather Data and Peak Capacity Allocation Factors

This spreadsheet contains climate zone weather data and calculation of the Peak Capacity Allocation Factors (PCAFs) to allocate electricity T&D costs.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/2008TDVpcafsCalc.xls>

6. Outage cost estimate

This spreadsheet contains estimates of full and partial outage costs used to calculate emergency and economic-dispatch DR values. Tables 5 and 6 show the outage costs.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/outageCostEstimate.xls>

Table 2. Summary of Average Summer Afternoon Outage Cost

Class	Average \$/kWh	Statewide Sales (%)
Residential	\$ 5.07	39%
Commercial	\$ 109.04	30%
Industrial	\$ 24.77	28%
Agriculture	\$ 11.50	3%
Weighted Average	\$ 42.02	

Data sources:

PG&E. 2003. *Supplemental Testimony Pursuant to Appendix A of Assigned Commissioner's Ruling Dated February 13, 2003. Reliability Performance Issues*. Application No. 02-11-017. San Francisco, California.

PG&E. 2000. *Value of Service (VOS) Studies: Presentation to ISO Grid Planning Standards Subcommittee*. San Francisco, California.

SCE. 1999. *Customer Value of Service Reliability Study*. Rosemead, California.

Woo, C. K., and R. L. Pupp. 1992. "Costs of service disruptions to electricity consumers." *Energy* 17(2): 109-126.

Table 3. Partial Outage Cost

Class	Partial Outage Cost	Source
Residential	\$2.60/kWh	Keane DM, McDonald D, Woo CK (1988) "Estimating residential partial outage cost with market research data," <i>Energy Journal-Reliability Special Issue</i> , 9: 151-172. Inflated to \$2004 using CA Dept of Finance CPI.

<http://www.ethree.com/Title24DR/calculation/partialOutageCost.xls>

7. Other Input Files for Electricity TDV Calculations

The spreadsheets below contains hourly consumption profiles to compute weighted average retail rates, TOU period definitions, and price deflators.

a. Consumption profiles

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/electricConsumptionProfile.xls>

Table 4. Electricity Consumption Shares

Electric consumption shares by utility, TOU period, and customer class

TOU period	PG&E		SCE		SDG&E	
	Res	Com	Res	Com	Res	Com
1	10%	13%	9%	9%	9%	12%
2	12%	12%	11%	11%	12%	13%
3	28%	22%	18%	16%	21%	20%
4	0%	0%	0%	0%	7%	6%
5	20%	26%	26%	32%	22%	25%
6	30%	26%	36%	31%	29%	25%
	100%	100%	100%	100%	100%	100%

	Residential			Non-residential		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
1	10%	9%	9%	13%	9%	12%
2	12%	11%	12%	12%	11%	13%
3	28%	18%	21%	22%	16%	20%
4	0%	0%	7%	0%	0%	6%
5	20%	26%	22%	26%	32%	25%
6	30%	36%	29%	26%	31%	25%

b. Price deflator series.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/priceDeflators.xls>

c. Time-of-use definitions for each of the investor-owned utilities.

Spreadsheet Link:

http://www.ethree.com/Title24DR/calculation/TOU_hour2.xls

6. Natural Gas Price Forecast

This spreadsheet contains the natural gas price forecast for 2008-2037 and its supporting data (NYMEX futures prices and EG delivery charges). This forecast is based on the November 3rd, 2005 CEC IEPR forecast that was adopted by the CEC.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/NaturalGasPrices9.xls>

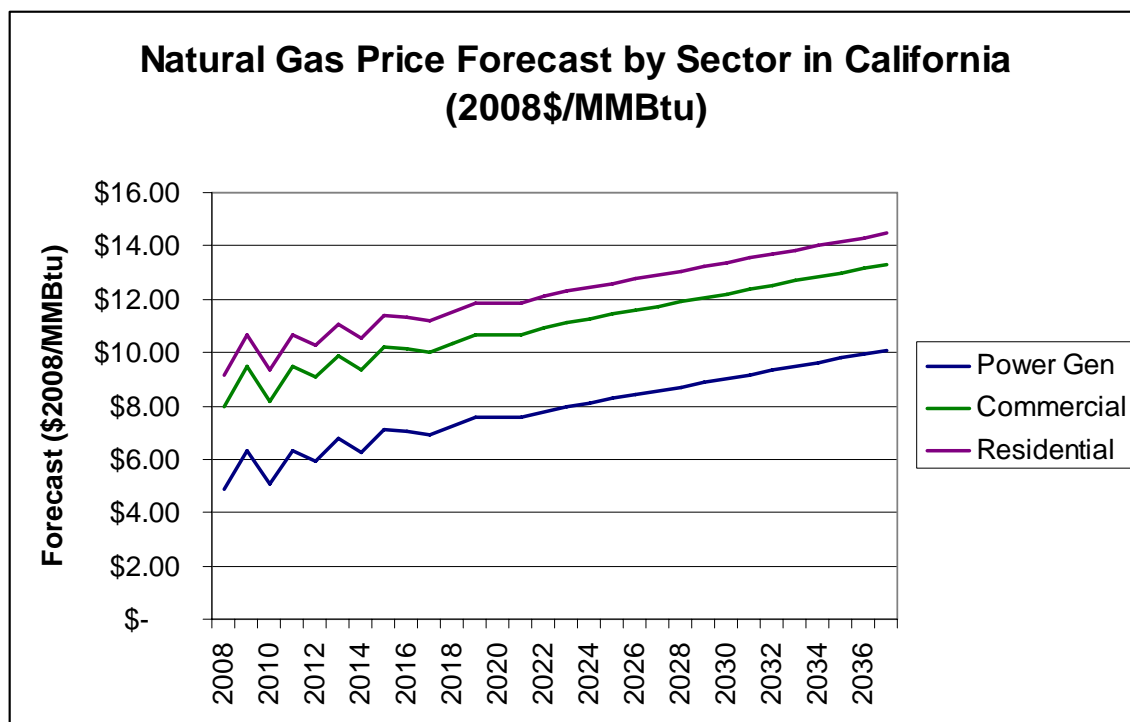


Figure 6. Statewide Average Natural Gas Price Forecast by Sector

7. Propane Price Forecast

This spreadsheet contains the propane price forecast for 2008-2037.

Spreadsheet Link:

<http://www.ethree.com/Title24DR/calculation/propane2008TDVbased2005.xls>

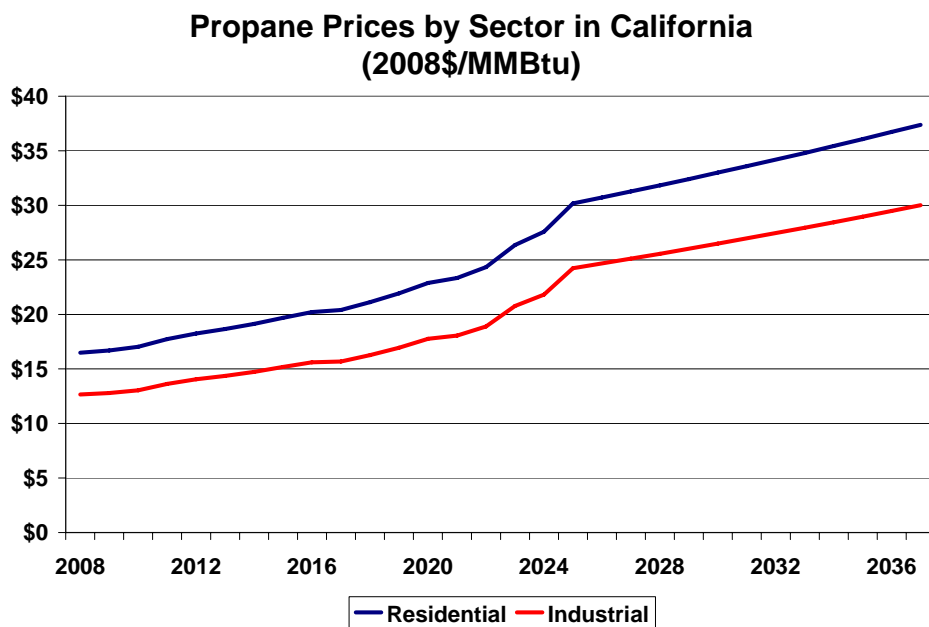


Figure 7. Statewide Forecast of Propane Prices by Sector – 2008 through 2037

IV. Air Emissions Savings

In order to estimate air emissions savings from TDV measures, the emissions rates based on the TDV assumptions are provided for electricity, natural gas, and propane. For electricity, the emissions rates are provided by hour, for natural gas and propane the emissions rates are the same for all hours of the year.

Spreadsheet link:

http://www.ethree.com/Title24DR/TDV_values/2008TDVemissions.xls

Figure 8, below, shows the emissions rates assumed in each hour for southern California - Climate Zones (6, 7, 8, 9, 10, 15). The emissions rate are given in lbs/MWh for NOx and PM10 and in tons/MWh for CO2.

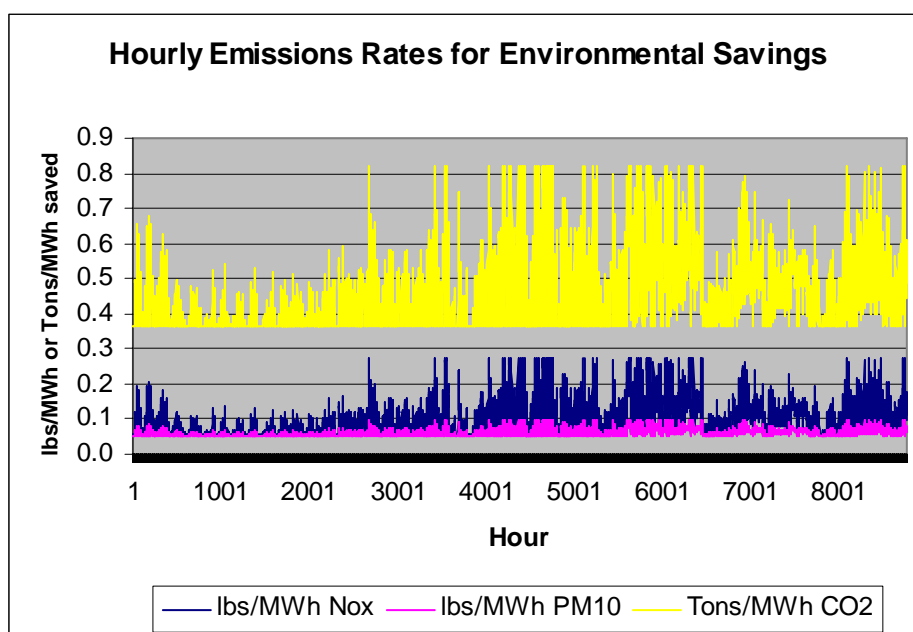


Figure 8. Hourly Emissions Rates per MWh, Climate Zones (6, 7, 8, 9, 10, 15)

Table 5, below, shows the assumptions for emissions per Btu of natural gas combustion and the present value of the total cost per MMBtu.

Table 5. Natural Gas Emissions Rates and Costs

Measure Life	15-years	30-years
NOx emission rate (lb/MMBtu)	0.092	0.092
CO2 emission rate (lb/MMBtu)	117	117
NOx cost (PV\$/MMBtu)	\$ 7.78	\$ 19.45
CO2 cost (PV \$/MMBtu)	\$ 1.92	\$ 6.86
Total Environment (PV \$/MMBtu)	\$ 9.70	\$ 26.31

Table 6, below, shows the assumptions for emissions per Btu of propane combustion and the present value of the total cost per MMBtu. For example, the present value of reducing the combustion of one MMBtu of propane per year for 30 years is \$27.66.

Table 6. Propane Emissions Rates and Costs

Measure Life	15-years	30-years
NOx emission rate (lb/MMBtu)	0.092	0.092
CO2 emission rate (lb/MMBtu)	140	140
	15	30
NOx cost (PV\$/MMBtu)	\$ 7.78	\$ 19.45
CO2 cost (PV \$/MMBtu)		
	\$ 2.30	\$ 8.21
Total Environment (PV \$/MMBtu)	\$ 10.08	\$ 27.66

V. Links to All Output Files

TDV Output Files (8760 Curves) for All Fuel Types (Electricity, Natural Gas, and Propane) in compressed file format.

http://www.ethree.com/Title24DR/TDV_values/2008TDVoutput4-18-2006.zip

TDV Output Files (8760 Curves) for Natural Gas

http://www.ethree.com/Title24DR/TDV_values/naturalGas2008TDVoutput.xls

TDV Files (8760 Curves) for Propane

http://www.ethree.com/Title24DR/TDV_values/propane2008TDVoutput.xls

TDV Output Files (8760 Curves) for Electricity

The TDV values for electricity are made up of 6 files, three files with TDV (kBtu/kWh) units, and three files with lifecycle value units (\$/kWh)

TDV Units (kBtu/kWh)

Residential 30 Year

http://www.ethree.com/Title24DR/TDV_values/electrickBtuperkWh/Res2008TDV.xls

Non-Residential 15 Year

http://www.ethree.com/Title24DR/TDV_values/electrickBtuperkWh/NonRes-15yr2008TDV.xls

Non-Residential 30 Year

http://www.ethree.com/Title24DR/TDV_values/electrickBtuperkWh/NonRes-30yr2008TDV.xls

Lifecycle Value (\$/kWh)

Residential 30 Year

[http://www.ethree.com/Title24DR/TDV_values/electric\\$perkWh/Res2008TDV.xls](http://www.ethree.com/Title24DR/TDV_values/electric$perkWh/Res2008TDV.xls)

Non-Residential 15 Year

[http://www.ethree.com/Title24DR/TDV_values/electric\\$perkWh/NonRes-15yr2008TDV.xls](http://www.ethree.com/Title24DR/TDV_values/electric$perkWh/NonRes-15yr2008TDV.xls)

Non-Residential 30 Year

[http://www.ethree.com/Title24DR/TDV_values/electric\\$perkWh/NonRes-30yr2008TDV.xls](http://www.ethree.com/Title24DR/TDV_values/electric$perkWh/NonRes-30yr2008TDV.xls)