

## **Savings Calculations for Savings By Design using LabPro**

### **Energy Savings Estimation Using LabPro (retailer is Phoenix Controls)**

LabPro simulates the interactive effects of fume hoods, labs, corridors and office spaces.

See Appendix A for Methodology.

The modeled results are displayed on the various LabPro reports. Samples included in Appendix B.

A copy of the software is available on CD from the utility.

### **Demand (kW) savings using EnergyPro**

The modeled results are displayed on the Demand Savings Worksheet. Sample included in Appendix B.

## Appendix A

# Methodology for Fume Hood Modeling using LabPro

### Background

LabPro 1.2 is a proprietary software program designed by the Phoenix Controls Company. This program simulates the interactive effects of fume hoods, labs, corridors and office spaces. LabPro is currently the best tool we have found to determine annual consumption and savings when modeling fume hoods.

### Methodology

#### LabPro 1.2

Model the spaces that contain the fume hoods using LabPro 1.2 to determine fume hood annual savings. Note that the output for LabPro 1.2 (Project Cost Comparison Sheet) is displayed in annual dollars saved per year.

Energy Savings: LabPro uses bin method weather data for energy savings. It compares constant volume fume hood consumption to fume hoods using variable speed drives and occupancy sensors at the hoods.

Demand Savings: LabPro using bin method weather data, determines the cooling and heating loads for the building using constant volume fume hoods and for the building using VAV fume hood control with occupancy sensors. The VAV scenario typically consumes less energy therefore there is a reduced cooling load and less demand.

### Spreadsheet

Several worksheets are used to account for the savings and incentive when using the results of LabPro. The worksheets are described below.

Demand Savings Worksheet. This sheet converts the results of LabPro's Fan System Summary Sheet displayed as fan hp and central plant kW/ton to kW.

LabPro Annual Savings Worksheet. This sheet converts the results of LabPro's Project Cost Comparison Sheet from annual dollars saved to annual kWh and therms saved. This sheet also displays the Systems Approach incentive rate and incentive resulting from the LabPro results.

## Appendix B

Project Name  
SDG&E Contract No.

### LabPro Annual Savings Worksheet

LabPro 1.2 Results

LabPro Energy Cost Comparison (annual)

TAKEN FROM LABPRO "PROJECT COST COMPARISON"  
USED IN LABPRO ANALYSIS "PROJECT DEFAULTS"

Constant Volume System (annual consumption)	Constant Volume	Electrical Energy Rate (\$/kWh)	Therm Rate (\$/therm)	kWh w/o correction	Fan Efficiency (%)	kWh w fan efficiency correction	Therms	Total
Annual Cooling Energy Cost	\$ 36,195	\$ 0.10		361,950		361,950		
Annual Heating Energy Cost	\$ 5,906		\$ 0.80			-	7,383	
Annual Reheating Energy Cost	\$ 65,041		\$ 0.80			-	81,301	
Annual Supply AHU Energy Cost	\$ 82,446	\$ 0.10		824,460	65%	535,899		
Annual Exhaust Fan Energy Cost	\$ 41,725	\$ 0.10		417,250	65%	271,213		
Total						1,169,062	88,684	

VAV System (annual consumption)	VAV	Electrical Energy Rate (\$/kWh)	Therm Rate (\$/therm)	kWh w/o correction	Fan Efficiency (%)	kWh w fan efficiency correction	Therms
Annual Cooling Energy Cost	\$ 23,137	\$ 0.10		231,370		231,370	
Annual Heating Energy Cost	\$ 3,333	-	\$ 0.80			-	4,166
Annual Reheating Energy Cost	\$ 25,244	-	\$ 0.80			-	31,555
Annual Supply AHU Energy Cost	\$ 28,203	\$ 0.10		282,030	65%	183,320	
Annual Exhaust Fan Energy Cost	\$ 25,505	\$ 0.10		255,050	65%	165,783	
Total						580,472	35,721

VAV System (annual savings)	VAV	Electrical Energy Rate (\$/kWh)	Therm Rate (\$/therm)	kWh w/o correction	Fan Efficiency (%)	kWh w fan efficiency correction *	Therms
Annual Cooling Energy Cost	\$ 13,058	\$ 0.10		130,580		130,580	
Annual Heating Energy Cost	\$ 2,573	-	\$ 0.80			-	3,216
Annual Reheating Energy Cost	\$ 39,797	-	\$ 0.80			-	49,746
Annual Supply AHU Energy Cost	\$ 54,243	\$ 0.10		542,430	65%	352,580	
Annual Exhaust Fan Energy Cost	\$ 16,220	\$ 0.10		162,200	65%	105,430	
Savings						588,590	52,963
Savings per hood		48	Hoods			12,262	1,103

### Systems Approach Incentive

	Systems Approach Incentive Rate		Systems Approach Incentive Amount		
	Electrical (\$/kWh)	Gas (\$/therm)	Electrical	Gas	Systems Approach Total
Incentive (Owner)	\$ 0.03	\$ 0.34	\$ 17,658	\$ 18,007	\$ 35,665
Incentive (Designer)	\$ 0.01	\$ 0.11	\$ 5,886	\$ 5,826	\$ 11,712
Total					\$ 47,377
Incentive per hood					\$ 987

\* kWh correction factor is the annual kWh fan energy x fan efficiency  
this factor is used because equations 9.1 and 9.11 and 9.12 on page A-18 of the LabPro manual divide by the fan efficiency twice  
multiplying by the fan efficiency, the additional fan efficiency in the denominator is eliminated.

03/09/2007

LabPro & EnergyPro Master Summary Sheet example 1.xls

## Project Cost Comparison

### Generic Building -

March 9, 2007

#### LabPro Flow Summary

	Unit	CV	CV-PHX	VAV	VAV-PHX	CV-UBC	VAV-UBC
Design Exhaust System Flow	CFM	27,000	27,000	20,283	20,283	21,627	17,598
Average Exhaust System Flow	CFM	27,000	27,000	14,067	14,067	16,654	8,893

#### LabPro HVAC Initial Cost Comparison

Cooling Tons Required	Tons	114	114	73	73	81	57
Cooling System Cost	USD	228,000	228,000	146,000	146,000	162,000	114,000
Heating System Cost	USD	54,000	54,000	34,598	34,598	38,478	26,838
Reheat System Cost	USD	0	0	0	0	0	0
Supply AHU Cost	USD	81,270	81,270	54,315	54,315	59,706	43,534
Exhaust Fan Cost	USD	20,250	20,250	15,212	15,212	16,220	13,199
VFD Cost	USD	0	0	4,922	4,922	5,411	3,945
Duct Cost	USD	51,300	51,300	38,538	38,538	41,091	33,436
Filter Cost	USD	6,750	6,750	4,511	4,511	4,959	3,616
Balancing Cost	USD	750	300	750	300	300	300
ATC Cost	USD	2,700	2,700	2,700	2,700	2,700	2,700
ATC Interface Cost	USD	1,500	1,500	1,500	1,500	1,500	1,500
Lab Controls Cost	USD	27,000	36,000	100,000	100,000	72,000	115,000
Hood Certification Cost	USD	900	450	900	450	450	450
<b>Total HVAC Initial Cost</b>	<b>USD</b>	<b>474,420</b>	<b>482,520</b>	<b>403,947</b>	<b>403,047</b>	<b>404,816</b>	<b>358,517</b>
HVAC Initial Cost per Avg Flow	USD/CFM	17.57	17.87	28.72	28.85	24.31	40.31
HVAC Initial Cost per Fume Hood	USD	26,356.67	26,806.67	22,441.50	22,391.50	22,489.76	19,917.63
HVAC Initial Cost per Unit Area	USD/Sq. Ft	316.28	321.68	269.30	268.70	269.88	239.01

#### LabPro Energy Cost Comparison (annual)

Annual Cooling Energy Cost	USD	49,274	49,274	26,043	26,043	30,689	16,751
Annual Heating Energy Cost	USD	5,241	5,241	2,659	2,659	3,175	1,626
Annual Reheat Energy Cost	USD	88,098	88,098	44,583	44,583	53,286	27,177
Annual Supply AHU Energy Cost	USD	50,891	50,891	12,748	12,748	18,702	4,426
Annual Exhaust Fan Energy Cost	USD	49,364	49,364	25,718	25,718	30,447	16,260
<b>Total Annual Energy Cost</b>	<b>USD</b>	<b>242,868</b>	<b>242,868</b>	<b>111,751</b>	<b>111,751</b>	<b>136,300</b>	<b>66,240</b>
Annual Energy Cost per Average Flow	USD/CFM	9.00	9.00	7.94	7.94	8.18	7.45
Annual Energy Cost per Fume Hood	USD	13,492.65	13,492.65	6,208.38	6,208.38	7,572.20	3,679.99
Annual Energy Cost per Unit Area	USD/Sq. Ft	161.91	161.91	74.50	74.50	90.87	44.16

#### LabPro Operation and Maintenance Cost Comparison (annual)

Annual Energy Cost	USD	242,868	242,868	111,751	111,751	136,300	66,240
Annual Balancing Cost	USD	750	300	750	300	300	300
Annual Hood Certification Cost	USD	900	450	900	450	450	450
Annual Lab Controls Maintenance	USD	5,400	0	13,500	0	0	0
Annual ATC Maintenance Cost	USD	1,500	1,500	1,500	1,500	1,500	1,500
Annual Filter Cost	USD	6,750	6,750	4,511	4,511	4,959	3,616
Annual Downtime Cost	USD	1,080	0	2,700	0	0	0
<b>Total Annual O&amp;M Costs</b>	<b>USD</b>	<b>259,248</b>	<b>251,868</b>	<b>135,612</b>	<b>118,512</b>	<b>143,509</b>	<b>72,106</b>
Annual O&M Cost per Average Flow	USD/CFM	9.60	9.33	9.64	8.42	8.62	8.11
Annual O&M Cost per Fume Hood	USD	14,402.65	13,992.65	7,534.00	6,584.00	7,972.70	4,005.87
Annual O&M Cost per Unit Area	USD/Sq. Ft	172.83	167.91	90.41	79.01	95.67	48.07

Phoenix Controls Corporation

LabPro Software

## Project Defaults

**Project Name** Generic Building  
**Project Description**  
**Company Name**  
**Contact**  
**Address**  
**Phone**

March 9, 2007  
 Page 1

### General

Occupied Hour 8:00:00 AM  
 Unoccupied Hour 6:00:00 PM

Exhaust System Design Percentile 99.00 %  
 Supply System Design Percentile 95.00 %  
 Central Plant Design Percentile 99.00 %  
 Weather Station San Diego

### Room and Corridor

Corridor Floor Area 600.00 Sq. Ft  
 Corridor Heat Gain 2.00 Watts/Sq. Ft  
 Corridor ACH 4.00

Room Ceiling Height 9.50 Ft  
 Room Floor Area 300 Sq. Ft  
 Room Temperature 74 Deg F  
 Room Heat Gain 10.00 Watts/Sq. Ft  
 Room ACH Occupied 6.00  
 Room ACH Unoccupied 6.00

VAV GEX Quantity 1  
 VAV Supply Quantity 1  
 Offset Percentage 10%

### Hood Usage

UBC Flow Normal Mode 100 %  
 UBC Flow Standby Mode 60 %

Sash Position with User Present 100 %  
 Sash Position with User Absent 50 %

### Fan and Central Plant

Cooling Efficiency 1.40 kW/Ton  
 Heating Efficiency 80 %  
 Supply Air Temperature (Cooling) 72 Deg F  
 Supply Air Temperature (Heating) 72 Deg F

Supply AHU Static Pressure 5.00 "w.c.  
 Supply AHU Efficiency 65 %  
 Supply AHU Control Type Variable Frequency Drive

Exhaust Fan Static Pressure 5.00 "w.c.  
 Exhaust Fan Efficiency 65 %  
 Exhaust Fan Control Type Constant Air Volume

### HVAC Initial Costs

Cooling System Cost 2,000.00 USD/Ton  
 Heating System Cost 2.00 USD/CFM  
 Reheat System Cost 0.00 USD/CFM  
 Duct Cost 1.90 USD/CFM  
 Supply AHU Cost 3.01 USD/CFM  
 Exhaust Fan Cost 0.75 USD/CFM  
 VFD Cost 225.00 USD/Hp  
 Filter Cost 0.25 USD/CFM  
 ATC Cost 900.00 USD/CFM  
 ATC Interface Cost 500.00 USD/CFM

VAV-UBC Controls Cost 115,000.00 USD  
 VAV-Phoenix Controls Cost 100,000.00 USD  
 VAV-Other Controls Cost 100,000.00 USD  
 CV-UBC Controls Cost 4,000.00 USD  
 CV-Phoenix Controls Cost 2,000.00 USD  
 CV-Other Controls Cost 1,500.00 USD

### Operating Costs

Interest Rate 5 %  
 Hurdle Rate 3 %  
 Analysis Period 5 Years  
 Balancing Cost-Phoenix 100.00 USD  
 Balancing Cost-Other 250.00 USD  
 Certification Cost-Phoenix 25.00 USD  
 Certification Cost-Other 50.00 USD  
 Lab Downtime Cost 20.00 USD  
 CV Maint. Cost-Other 300.00 USD  
 VAV Maint. Cost-Other 750.00 USD  
 CV, CV-UBC Maint. Cost-Phoenix 0.00 USD  
 VAV, VAV-UBC Maint. Cost-Phoenix 0.00 USD  
 ATC Maintenance Cost per Room 500.00 USD

### Energy Costs

Cooling Fuel Type Electricity (kWh)  
 Cooling Fuel Cost 0.150 USD  
 Cooling Fuel BTU's 3,413  
 Heating Fuel Type Natural Gas (therm)  
 Heating Fuel Cost 1.500 USD  
 Heating Fuel BTU's 100,000  
 Reheat Fuel Type Natural Gas (therm)  
 Reheat Fuel Cost 1.500 USD  
 Reheat Fuel BTU's 100,000  
 Electricity Cost per kWh 0.150 USD

USED FOR  
 RATES IN  
 LABPRO  
 ANNUAL  
 SAVINGS  
 WORKSHEET

**Project Name**

SDG&amp;E Contract No.

**Demand Savings Worksheet (Labpro results)****LabPro 1.2 Results****Constant Volume System**

Fan No	CFM	SP	Fan Efficiency (%)	hp	Drive Efficiency	VFD Efficiency (%)	kW
SF1	57,054	5.75	65%	79.42	97%	100%	61.08
EF1	57,054	3.00	65%	41.44	97%	100%	31.87

Chiller No	Tons Cooling	Efficiency (kW/ton)
CH1	241	0.73

Total

kW

175.93

268.88

TAKEN FROM  
LAB PRO  
"FAN SYSTEM SUMMARY"

**VAV System**

Fan No	CFM	SP	Fan Efficiency (%)	hp	Drive Efficiency	VFD Efficiency (%)	kW
SF1	44,829	5.75	65%	62.40	97%	96%	49.99
EF1	44,829	3.00	65%	32.56	97%	100%	25.04

Chiller No	Tons Cooling	Efficiency (kW/ton)
CH1	189	0.73

Total

kW

137.97

213.00

TAKEN FROM LAB PRO  
"PROJECT COST COMPARISON"

**Savings (kW)****55.88**

## Fan Systems Summary

Generic Building -

March 9, 2007

Page 1

Exhaust Fan System							
Name	Area Served	Control Type	Design Flow	Design Power	Static Pressure	Fan Efficiency	Speed Control
EFan 1	Main Exhaust	CV	9,000 CFM	10.9 Hp	5.00 "w.c.	65 %	Constant Air Volume
		VAV	6,761 CFM	8.2 Hp			
		CV-UBC	7,209 CFM	8.7 Hp			
		VAV-UBC	5,866 CFM	7.1 Hp			
EFan 2	Main Exhaust	CV	9,000 CFM	10.9 Hp	5.00 "w.c.	65 %	Constant Air Volume
		VAV	6,761 CFM	8.2 Hp			
		CV-UBC	7,209 CFM	8.7 Hp			
		VAV-UBC	5,866 CFM	7.1 Hp			
EFan 3	Main Exhaust	CV	9,000 CFM	10.9 Hp	5.00 "w.c.	65 %	Constant Air Volume
		VAV	6,761 CFM	8.2 Hp			
		CV-UBC	7,209 CFM	8.7 Hp			
		VAV-UBC	5,866 CFM	7.1 Hp			
Total		CV	27,000 CFM	32.7 Hp			
		VAV	20,283 CFM	24.6 Hp			
		CV-UBC	21,627 CFM	26.2 Hp			
		VAV-UBC	17,598 CFM	21.3 Hp			

**Project Name**  
SDG&E Contract No.

### Plant Efficiency (used for LabPro 1.2 input)

Unit No.	Device	Units	Quantity	Amount	kw/ton	Conversion	kW
CH-1	Chiller	tons	1	410.0	0.55		225.5
CT-1	Cooling Tower	tons	1	410.0			
		fan hp	1	30.0		0.746	22.38
CHWP-1	CHW pump primary	gpm	1	710.0			-
		hp	1	12.0		0.746	8.95
CHWP-2	CHW pump secondary	gpm	1	800.0			-
		hp	1	20.0		0.746	14.92
CWP-1	CW pump	gpm	1	1,230.0			-
		hp	1	35.0		0.746	26.11
B-1	Boiler	bth/hr	1	3,900,000.0			
	pump	gpm	1	250			
		hp	1	8			
Total					0.73		297.862