Covell Commons Dining Facility, UCLA

DEMAND CONTROL KITCHEN VENTILATION

Selecting, financing and implementing best-practice solutions campuswide

This business case provides 3 different scenarios for estimated savings, incentives and on bill financing information for Demand Control Kitchen ventilation. Title 24 changes take effect January 1, 2014 and will significantly alter the baseline for calculating incentives.

» **See page 6 for details**

Most of California's colleges and universities have ambitious sustainability goals that lead the way to the state goals set forth by AB 32 and the zero net energy goals from the California Public Utilities Commission (CPUC). Implementing new and retrofit energy efficiency technologies will be crucial in reaching these goals. One such technology that offers consistent energy and cost savings is demand control kitchen ventilation (DCKV) for kitchen exhaust hoods. Implementation can be relatively simple in either new construction or retrofit scenarios and the cost savings substantial.

The UC/CSU/IOU Energy Efficiency Partnership Incentive Program provides energy efficiency incentives to UC and CSU campuses, based on the kilowatt-hours saved by proposed energy efficiency projects. These incentives can be combined with on-bill financing offered by utilities, or loans from the UC Statewide Energy Partnership (SEP) Program. Together, these funding and financing opportunities create a compelling business case for large-scale implementation of demand control kitchen ventilation (DCKV) in many small, medium, and large kitchen exhaust hood installations.

Covell Commons kitchen

KITCHEN VENTILATION ONLY WHEN YOU NEED IT.

Ventilation in commercial kitchens can account for half of the HVAC energy use in restaurants and dining facilities. Conventionally, kitchen exhaust fans and the associated makeup air handlers are switched manually and left to run at full speed for all operating hours. The power needed to exhaust air in a kitchen hood increase by a cube factor with respect to air flow. This means that even a relatively modest reduction in air flow can result in large fan energy savings. In addition to direct savings due to reduced fan energy, every cubic foot of air exhausted from the building must be replaced by another cubic foot of conditioned air. Reducing the amount of air exhausted from the building saves energy that would have been required to condition newly introduced outside air.

There are many DCKV control packages which can significantly reduce the energy consumed by these devices. Typical devices will control the speed of the exhaust and make-up air fans through variable frequency drives (VFDs) based on input signals from temperature probes placed within the exhaust duct collars as well as infrared (IR) beams that cross the length of the fume hood. The systems will automatically manage fan operation and speed to provide an appropriate degree of ventilation according to temperature and effluent sensed in each kitchen hood. Demand control kitchen ventilation often reduces fan energy by more than 50%, and may additionally reduce conditioning loads for these spaces by 20% or more.

Multiple case studies have already been performed using this technology and the savings are well proven. A comprehensive performance assessment has been made in a separate SPEED Technology Study on this subject. Installations on hoods with combined hood and make-up air motor nameplate ratings from 7 to 90 HP have shown an average electrical energy reduction of 62% and additional heating savings.

INSTALLATION COSTS

Based on expected savings for fan energy, heating and cooling energy and the cost of electricity and natural gas, total annual savings can be estimated. This can then be coupled with the expected system cost to determine your payback. The installed cost of a DCKV package at any particular kitchen facility depends on the manufacturer and how many control systems the kitchen needs. Some systems allow multiple hoods to be controlled by a single controller; therefore there is a step up in cost once a certain amount of hoods in a project is exceeded. Typical costs range from $14,000 to $32,000 per system, depending on the number of hoods and fans, and whether the work is new or retrofit. In reviewing 9 projects that were completed recently on CSU and UC campuses, the system cost for installations before incentive ranged from roughly $1.00 to $2.50 / CFM of rated kitchen hood ventilation installed. This wide range illustrates the fact that the cost for implementing this technology will vary greatly depending on the specifics of the project. For instance, some projects may require long runs of wiring and long hours of work, whereas other projects will be relatively simple. Each project will need to be individually evaluated against the expected savings, the quoted cost of installation. Incentives and funding source to clearly define the business case for each project.

Costs for new construction cases are typically lower because installation complexity is reduced. Energy savings depend on the fan motor loads at full speed, the variability of the kitchen operation during the day, and the number of operating hours in the year. It should be noted that the 2013 T-24 energy code now requires certain energy efficiency measures, which may include demand control kitchen ventilation, on any hood with a rated flow greater than 5,000 CFM.

TABLE 1: ESTIMATED SAVINGS

	SCENARIO 1-SMALL		SCENARIO 2 - MEDIUM		SCENARIO 3 - LARGE	
Technology	Incumbent	DCKV	Incumbent	DCKV	Incumbent	DCKV
Cost		$12,000		$20,000		$30,000
Specific Cost [$ / CFM]		$2.67		$2.22		$1.67
Expected Useful Life [yrs]		15		15		15
Energy						
Rated Air Flow [CFM]	4500	4500	9000	9000	18000	18000
Motor Ratings [HP]	3.3	3.3	6.5	6.5	13	13
Annual Ventilation [kWhe]	15,689	9,482	31,378	18,964	62,757	37,927
Annual Cooling [kWhe]	935	743	1,870	1,486	3,739	2,972
Annual Heating [Therms]	1,957	1,556	3,914	3,112	7,827	6,223
Applicable Electricity Price [$ / kWhe]	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
Applicable NG Price [$ / Therm]	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00
Annual Ventilation Savings		$620.75		$1,241.50		$2,483.00
Annual Cooling Savings		$19.18		$38.35		$76.70
Annual Heating Savings		$401.00		$802.00		$1,604.00
Total Annual Utility Savings		**$1,041**		**$2,082**		**$4,164**

Table 1 examines the amount of energy that can be saved by installing DCKV on kitchen hoods of varying sizes. The total savings depends on both the size of the installation and also the location. For this example savings were calculated for climates typical of the Los Angeles area. The cost estimates are meant as rough guidance, however as previously mentioned the cost for any particular project can vary greatly.

TABLE 2: PARTNERSHIP INCENTIVES

ESTIMATED INCENTIVES	SMALL	MEDIUM	LARGE
UC/CSU/IOU Partnership Incentive	$1,937	$3,874	$7,747
2013-14 Cost Cap: 80% of Project Cost	$9,600	$16,000	$24,000
Cost Capped?	No	No	No
Balance of Project Cost*	**$10,063**	**$16,126**	**$22,253**

**Computed using the estimated Partnership incentives*

ECONOMIC ANALYSIS, INCENTIVES & LIFECYCLE ANALYSIS

UC/CSU/IOU ENERGY EFFICIENCY PARTNERSHIP INCENTIVES

The UC and CSU campuses have a multi-year partnership with California's investor-owned utilities (IOUs). Through this partnership campuses provide energy savings to help utilities meet their goals, and utilities provide Partnership incentives to campuses undertaking efficiency upgrades. More details on this are available at **www.uccsuiouee.org**.

Partnership incentives for the 2013–2014 period are $0.24/kWh for annual kWh saved and $1.00 per Therm for annual Therms saved. Partnership incentives for HVAC projects are capped so as not to exceed 80% of total project costs.

ON BILL FINANCING

Campuses may find zero-interest on-bill financing is available to fund project costs. Each IOU provides up to $1,000,000 per campus, at zero interest, with loan periods of up to 10 years (120 months). The program is structured to maintain bill neutrality, that is, the loan payment is structured to be equal to the expected cost savings that will be achieved by installing the savings measure. In this way, the customer should see no net change in their utility bill until the loan has been repaid. Local utilities can provide more details.

UC STATEWIDE ENERGY PARTNERSHIP (SEP) PROGRAM

The SEP program, coordinated by the UC Office of the President (UCOP), combines Partnership incentives with UC bond funds to provide 15-year loans to the UC campuses for energy efficiency projects. The UC SEP loan program is managed to keep the ratio of debt service to energy cost savings below 85% for each campus.

For details visit the SEP website: **workingsmarter.universityofcalifornia.edu/projects/statewide-energy-partnership/overview/**.

OTHER INCENTIVES

CALIFORNIA IOU ENERGY WISE PROGRAM

The California IOUs and some of the public utilities offer a $350 / HP rebate for DCKV installations in its service territory. Information about this program can be found by contacting the Food Service Technology Center or the local utility that you are served by. Be aware of that this program cannot be used simultaneously with the UC/CSU/IOU Partnership incentive.

Various localities and municipalities also may have incentives available for this technology. The D-sire database is a good place to check: **http://www.dsireusa.org/incentives** as well as the Food Service Technology Center: **http://www.fishnick.com**

TABLE 3: UTILITY-ON-BILL FINANCING

	SMALL	MEDIUM	LARGE
Financed Cost	$10,063	$16,126	$22,253
Annual Interest Rate	0%	0%	0%
Term (Years)	9.7	7.7	5.3
OBF Elgible?	Yes	Yes	Yes
Annual Net Cash Flow During Finance Term	-	-	-
Annual Net Cash Flow After Finance Term	$1,040.93	$2,081.85	$4,163.70
NPV*	**$3,834**	**$10,651**	**$27,758**

TABLE 4: UC SEP LOAN PROGRAM

	SMALL	MEDIUM	LARGE
Financed Cost	$10,063	$16,126	$22,253
Annual Interest Rate (UC Loan)	5%	5%	5%
Term (Years)	15	15	15
Debt Service / Energy Cost Savings	93%	75%	51%
Annual Debt Service	$(969.51)	$(1,553.65)	$(2,143.88)
Annual Net Cash Flow During Financing Term	$71.42	$528.20	$2,019.82
Annual Net Cash Flow After Finance Term	$1,040.93	$2,081.85	$4,163.70
NPV*	**$794**	**$5,873**	**$22,457**

**NPV based on 15 years expected useful life and 4% discount rate*

PROJECT ANALYSIS

As with many HVAC projects, the cost to implement this technology is based on many factors and can vary greatly from site to site. Even with the variations in installation costs, **the eight campus DCKV systems reduced fan energy by more than 60%**, and may additionally reduce conditioning loads for these spaces by 20% or more. Simple paybacks range from 4.2 to 7.8 years without incentives. Each installation will be unique, and because of this, the easiest way to evaluate a project for favorable payback is to obtain specific quotes for your installation and then calculate the cost of the project on a cost / CFM basis. Once this has been done, a rough idea of how the project fits with the on-bill and SEP financing criteria can be determined by using Figure 1. Generally speaking, projects with costs less than $3 per CFM deserve further consideration.

Note that the finance metrics will change as the cost of energy changes. For example, a system is being evaluated for install on a 9,000 CFM system and the cost for install is expected to be $20,000, therefore the project cost is $2.22 / CFM. Using Figure 1 it can be seen that the expected Debt Service to Savings ratio for this project is 75% and the term of a loan financed through On Bill Financing method would be 7.7 yrs, when assuming $0.10 / kWh and $1.00 / Therm energy costs. The financial metrics will improve as the cost of energy increases.

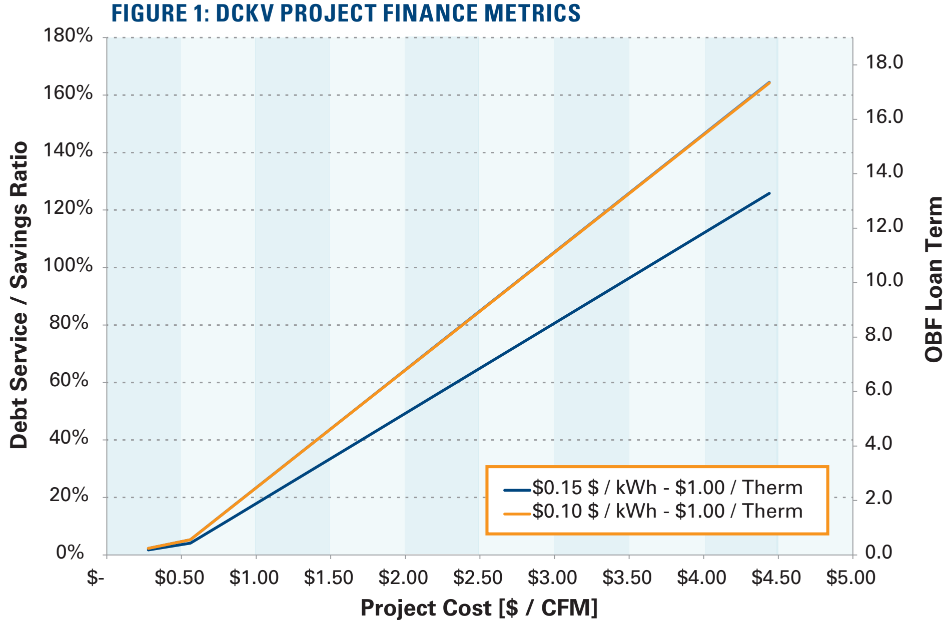
2013 TITLE 24

Changes made to the 2013 Title 24 Energy Code require that DCKV be installed on any kitchen hood that is sized greater than 5,000 CFM of exhaust air. Be aware that after January 1, 2014 DCKV systems over 5,000cfm will be required by code and not eligible for IOU incentives.

ADDITIONAL RESOURCES

The Food Service Technology Center has further resources for calculating savings and planning for the integration of your Demand Control Kitchen Ventilation project. Project resources include design guides, a publication library, and an outdoor air load calculator.

FIGURE 1: DCKV PROJECT FINANCE METRICS



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DEMAND CONTROL KITCHEN VENTILATION: A SMART INVESTMENT

A number of UC and CSU campuses, including, UCLA, UC Berkeley, UC Santa Cruz, and CSU Humboldt, have already begun saving energy and cutting electricity costs with investments in demand control kitchen ventilation systems. These systems use heat and particulate sensors to constantly adjust exhaust fan speed to the lowest possible level based on what is needed.

Combining the 2013 Partnership incentives with financing from the UC SEP loan or zero-interest on-bill financing from utilities can offer a positive net cash flow for each retrofit scenario presented in this business case study.

Campuses should submit applications for Partnership incentives as early as possible to allow adequate time for the review and approval process. Project agreements executed before December 31, 2013 may use the 2008 Title 24 baseline for calculating Partnership incentives. Starting January 1, 2014 the 2013 Title 24 baseline must be used to calculate incentives. For more details contact the UC/CSU/IOU Energy Efficiency Partnership directly or visit the Partnership website: **www.uccsuiouee.org**.

ABOUT THE STATE PARTNERSHIP FOR ENERGY EFFICIENT DEMONSTRATIONS (SPEED) PROGRAM: The SPEED program is supported by the California Energy Commission and managed through the California Institute for Energy and Environment (CIEE). SPEED demonstrations are coordinated by the CIEE in partnership with the California Lighting Technology Center and the Western Cooling Efficiency Center, both at the University of California, Davis.

Any questions about this project, including technology costs, can be directed to:

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For more resources and information, including technology catalogs, business case studies and demonstration maps, visit PARTNERSHIPDEMONSTRATIONS.ORG.

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