

ADVANCED HVAC SYSTEMS FOR IMPROVING INDOOR ENVIRONMENTAL QUALITY AND ENERGY PERFORMANCE OF CALIFORNIA K-12 SCHOOLS

Final Evaluation Report

Prepared For:

California Energy Commission
Public Interest Energy Research Program

Prepared By:

Architectural Energy Corporation



Arnold Schwarzenegger, *Governor*

CONSULTANT REPORT

June 2006
CEC-500-03-003
Subtask 2.10d Deliverable

CALIFORNIA ENERGY COMMISSION

Prepared By:

Architectural Energy Corporation
John Arent

Submitted By:

Vernon Smith
Program Director
Boulder, Colorado
Commission Contract No. 500-03-003

Prepared For:

Brad Meister
Commission Contract Manager

Ann Peterson

PIER Buildings Program Manager

Nancy Jenkins

Office Manager

ENERGY EFFICIENCY RESEARCH OFFICE

Martha Krebs, Ph.D.

Deputy Director

**ENERGY RESEARCH AND DEVELOPMENT
DIVISION**

B. B. Blevins

Executive Director

DISCLAIMER

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

Purpose

This report documents the feedback received from professional design seminars delivered at state Energy Centers. Professional design trainings were held at the Sacramento Municipal Utilities District on April 27, 2006 and Southern California Edison's Customer Technology Applications Center (CTAC) on May 2, 2006. The seminars were targeted towards architects, engineers and school district personnel.

The initial scope of work mentioned that seminars would be delivered at the five state energy centers. Since only two of five trainings were delivered, Architectural Energy Corporation documented other information outreach activities that occurred during the course of the PIER project:

- Half-day design charrette for LAUSD, for a new K-12 School that was being designed with displacement ventilation
- ASHRAE Winter Meeting Presentation on DV Performance Monitoring Results
- CASH Conference presentation on DV, UVC and high performance relocatables (with Mike Apte of LBNL)
- ACEEE 2006 Summer Study Paper Submittal – Displacement Ventilation in Action – Performance Monitoring of DV Classrooms
- Engineered Systems article on displacement ventilation (April 2006)
- ASHRAE Journal May 2006 article on high performance schools and displacement ventilation

A copy of these presentations and papers is provided in a separate deliverable.

DV Seminar Summary Results

Summary results were obtained by energy center staff; compiled summary results are provided with this report. Overall, the material was very well received by the audience. The SMUD training had approximately 35 in attendance, and the SCE CTAC training had approximately 65 in attendance. The audience included architects and engineers, university facilities staff, air quality and acoustics experts, and utility incentive program managers.

SMUD Seminar

The SMUD seminar was held on Thursday, April 27, from 9:00AM to 3:00PM. A forty minute presentation was provided by Stacia Okura on the results of the PIER research on UVC germicidal lamps for coil cleaning. Feedback was positive, and minor suggestions were made for improvement. Some questions arose on the basis for the recommended load calculation procedures.

Afterwards, a brief tour was provided of the Coyote Ridge DV demonstration classroom in Roseville, CA. A few engineers and representative from AAON and Mitsubishi Electric joined Tom Duval of Capital Engineering, John Arent and Charles Eley for the tour. Both AAON and Mitsubishi are interested in the technology and both have products that could work for displacement ventilation.

For the SMUD seminar, two evaluation forms were distributed: a standard form developed by SMUD, and a form developed by Architectural Energy Corporation.

CTAC Seminar

The May 2, 2006 seminar at CTAC was very well attended, with 63 in attendance. The seminar was from 9:00AM to 2:30PM. The diverse audience included representatives from the Savings By Design program, university engineers and facilities staff, LAUSD representatives, building owners and maintenance staff. John Arent also included a very brief description of the UVC study in his presentation.

SMUD Evaluation Summary

SMUD Evaluation Form

Thursday, April 27, 2006

VALUE: For the statement, "The seminar was a value of their time"

52% Strongly Agreed

96% Strongly Agreed, Agreed

100 % Strongly Agreed, Agreed, Neither Agreed nor Disagreed

How did you hear about this workshop?

3	SMUD Mailing	5	Your Supervisor	0	Contact from SMUD Employee
4	SMUD Web Site	5	Your Coworker/Peer	8	Email
2	Other: SMUD Emp., Friend				

Principal business of your firm:

3	Architecture	0	Developer/Builder	3	Manufacturer
10	Government	1	Utility	0	Contractor
2	Consultant	7	Engineering	3	Other: <u>California State University-Education, Distributor</u>

Your title or position:

2	President or Owner	0	Management/Purchasing	2	Plant/Facilities
5	Architect	13	Engineer	3	Salesperson
0	Energy Specialist	4	Other: (3) Industrial Hygienist, Project Manager		

Please state whether you **strongly agree (SA)**, **agree (A)**, **neither agree nor disagree (N)**, **disagree (D)**, or **strongly disagree (SD)** with the following statements.

(For each statement, please check only one.)

	SA	A	N	D	SD
The presentation was easy to understand.	12	14	1	—	—
Instructor was effective in presenting material.	11	15	1	—	—
Useful ideas were presented.	12	15	—	—	—
Your individual questions were clearly answered.	10	9	6	—	—
This information will be constructive in your work.	9	15	3	—	—
Subject matter was covered thoroughly.	12	13	2	—	—
You can immediately apply information presented in class.	8	13	4	1	—
This seminar was a value of your time.	14	12	1	—	—

What part of the workshop did you find the most useful?

Load calculation, DV system provider comfort / Architectural design portion / Comparison studies / Load calculation discussion / First hour overview of topic / Benefits of DV how to implement / I enjoyed the simulations / Presentation of the system set up / Studies presented / All-not any one specific item / Detailed comparisons between DV & conventional systems / Good discussion of supporting evidence of concepts / The overall discussion about how the system works / I liked that case studies were presented / New ways to condition the space / All / Overview, IAQ, examples

What improvements in the course would you suggest?

None / More factual data / It would be good a brief explanation of DV system components and description / See below / Better quality hard copy printing / Color handouts so display matches power point. Difficult to see subtle differences / More in depth research w/ multiple vendors / Retrofit of existing system should be addressed more / The second half was a bit dry / Sample design of classroom, including how to select diffusers, # of diffusers, etc. / Less in depth technical ideas work better for architects, but are needed for mechanical engineers / Avoid overlap or repetitiveness of material in each section. Noticed that some information was repeated more than once / Like less engineer speak / Need more time in HVAC design / More graphics

On what other HVAC, manufacturing, or energy topics would you like more training?

Load calculations, Residential Unit, Sizing Unit / HVAC system and balancing / Acoustics / Embodied energy of each system / HVAC, IAQ / Under floor air distribution / Equipment that satisfies sensible & latent comfort under all conditions as minimal energy / Lighting, alternative systems for general office spaces, optimizing / Motor technology / Load Calculations / HVAC equipment utilizes VAC and the controls associated with that

Do you prefer morning, afternoon or evening seminars?

Morning 25 Afternoon 9 Evening 3

Day of the week you prefer to attend these types of seminars/workshops (please circle all that apply)?

Monday 8 Tuesday 16 Wednesday 17 Thursday 20 Friday 11 Saturday 1 Sunday 0

Other Comments:

Thank you / Thank you for including healthy food! / Thanks / Good information overall / Powerpoint graphs with multiple lines for multiple variables need symbols (not colors) to distinguish them when black & white copies are made / Excellent presentation, perfect follow up to the prior seminar attended @ PG&E in SF two years ago. That introduced the CHPS program 2 DV principles but didn't examine details. I have a school district that needs this for retrofitting a 3-yr old HVAC gross failure of design on a High School. If that is possible contact me @ GJOHNSON@BDI.COM They would need to be approached and convinced they could be helped – GENE JOHNSON / Very well done. Thank you / This is the second ETC class I have attended. I would like to thank the center personnel for these very informative classes

**Thank you for attending this Energy & Technology Center seminar.
Please visit our website at: www.smud.org/etc**

Typed exactly as read by:
Tracy Berel
Student Assistant
Energy & Technology Center
5/31/2006

SMUD Seminar - Architectural Energy Corporation Evaluation

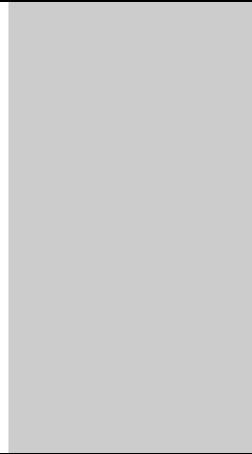
This summary was obtained by Architectural Energy Corporation from a second evaluation form that rated individual sections of the seminar.

Name (optional):	3 Architect	0 School District Staff
Company (optional):	11 Engineer	1 Manufacturer
	0 Contractor	2 Other:
	0 Utility Representative	distributor
		consultant pm
		4 Left Blank

		Satisfaction (Avg. Response)
1. How would you rate the following:	Overview and Benefits	4.65
	Design Requirements	4.52
	Architectural Design	4.29
	Load Calculations	4.4
	HVAC Design	4.35
	Energy Modeling	4.35
	Performance Monitoring	4.19
2. Did you have former knowledge of Displacement Ventilation?		10-Yes 10-No
3. Was the content relevant to your needs?		20-Yes 1-No
4. How do you rate the materials provided?		4.1
5. Was this Seminar a valuable use of your time?		18-Yes 0-No
6. How would you rate your expertise of sustainable design practices?		3.6
7. After attending this seminar do you feel more inclined to select a DV system?		18-Yes 0-No
8. What do you find to be the greatest benefit to DV?		
	<ul style="list-style-type: none"> ▪ Noise, IAQ ▪ No ▪ Energy Sav ▪ Efficiency & Quality (air) ▪ Extended economizer use ▪ Energy savings ▪ Energy ▪ Saving energy ▪ Higher acoustic benefit & ventilation benefits ▪ IAQ, acoustics ▪ Acoustic performance ▪ IAQ & better IAQ ▪ IAQ ▪ simple ▪ less noise, better ventilation 	

9. Do you still have any unanswered questions about DV?

- **Plenty as we evolve**
- **No**
- **TVOC?**
- **Not now (yet?)**
- **no**
- **yes**
- **not right now**
- **no**
- **no**
- **more details on how to implement/design.**
- **no**
- **not at the moment**
- **no**



10. Please provide us with any additional feedback that you see fit:

- **What happens to TVOC?**
 - **Excellent & professional presentation**
 - **Presenter on UV read from slides. Too many slides, too much info – cut back & focus on key findings.**
 - **Provide color handout w/ readable font size. Excellent presentation! Thank you!**
-
-

Seminar Evaluation

Displacement Ventilation

Class Date: 05/02/2006

Event #: 14952

Event Location : CTAC

**CUSTOMER RESPONSES REPORTED ON A SCALE OF 1 to 5
(5=Excellent, 4=Above Average, 3=Average, 2=Below Average, 1=Poor)**

	Average Score	Weighted %
Overall Quality of Program	4.24	79 %
How would you rate the Presenter?		
Knowledge of Subject	4.45	93 %
Effectiveness of the Presentation	4.15	78 %
Seminar Content/Materials		
Received Useful Information	4.55	95 %
Usefulness of Course Materials	4.41	85 %
Relevance to Business or Work (old form)	0.00	0 %
Up - to - date Information (old form)	0.00	0 %
How would you rate the Facility?		
Was the class room conducive to learning?	4.62	95 %
Overall, how do you rate Energy Center?	4.74	100 %
Scheduling Convenience (old form)	0.00	0 %
Value of the Cost (old form)	0.00	0 %
<u>Overall Score</u>	4.45	89 %

Customer Survey Comments

Class Name Displacement Ventilation
 Class Date: 05/02/2006
 Event Number : 14952

Location: CTAC

NAME	COMPANY	PHONE	COMMENTS ON QUESTIONS
Walt Allen	Walt Allen Architect	(951)693-0301	Not a scintillating topic - tough to make exciting. The presentation environment might benefit from displacement ventilation. Impressive venue for learning. Thank you for providing the opportunity.
James Duncan	J. Duncan Electric	(310)283-8515	Really likes the new chairs.
Vincent Foster	LAUSD	(213)633-7028	Keep UVC off the presentation.
Jack Geortner	York Johnson Controls	(310)365-1980	Well presented, well prepared. Good solid info. Would be a plus to have speaker slids available on CD Rom
Marianne Guevarra	SDGE	(858)636-5728	Some images on presentation did not run on projector. Font on some slides too small to see.
Satinder Gulati	CSU Office of the Chancellor, Long Beach	(562)951-4105	Excellent presentation. Suggest providing color graphs in the handouts.
Agnes Leung	Chevron Energy Solutions	(626)304-4709	Allow more time to discuss load calculation using simulation tools for engineers. Create a shorter version for architect audience.
Chuck Poindexter	SDGE	(858)636-5735	Very useful workshop
Ponciano Rongavilla	Port of Los Angeles	(310)732-3692	Everything is good but the graph must be colored in order to read thru
Daynard Tullis	LAUSD	(213)215-0778	Should have omitted UVC coil issue.
Ernest Vasquez	B.T.E.N.A.	(949)283-0425	Adjust HVAC - too cold; too much white noise.
Hofu Wu	Cal State Poly Univ	(909)869-4527	Great seminar! More options for lunch.

Customer Survey Comments

Class Name Displacement Ventilation

Location: CTAC

Class Date: 05/02/2006

Event Number : 14952

NAME	COMPANY	PHONE	COMMENTS ON QUESTIONS
------	---------	-------	-----------------------
