ENERGY UPDATE

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Research Powers the Future

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Commercial Kitchen Ventilation Advances Show Great Promise

When it comes to reducing energy consumption in California's restaurant industry, there is one challenge that comes to the forefront. And it's full of hot air. Not to mention smoke, grease and other effluent.

A project recently completed by the California Energy Commission's Public Interest Energy Research Program (PIER) will reduce energy consumption by restaurants with improved "makeup" air design strategies.

Restaurants consume more energy per square foot than any other commercial use, for example eight times more than office buildings and three times more than hospitals. And like every good dinner, it all starts in the kitchen.

Because large volumes of food are prepared in a relatively small area, restaurants must use exhaust systems to remove cooking effluent. These exhaust hoods are designed to remove the tainted grease–laden air in order to avoid fires and health issues for the workers.

Making Up The Air: Why Is This Important?

Undoubtedly, we have all pulled extra hard opening the door to a restaurant on our lunch hour, as the suction coming from inside the building makes opening the door a little more difficult.

That's because there is not enough "makeup air" being supplied to replace the air being exhausted. Since the hoods in the kitchen are unable to remove more air than is being put into the building, suction is created.

On the other side of the air balance equation, some designs are too conservative, resulting in exhaust rates that are higher than needed. In turn, these designs require more replacement air.

To the extent that a design over-exhausts and over-supplies, heating and cooling energy may be wasted. The heated and cooled air is simply being removed by the kitchen exhaust system at great cost to the business owner.

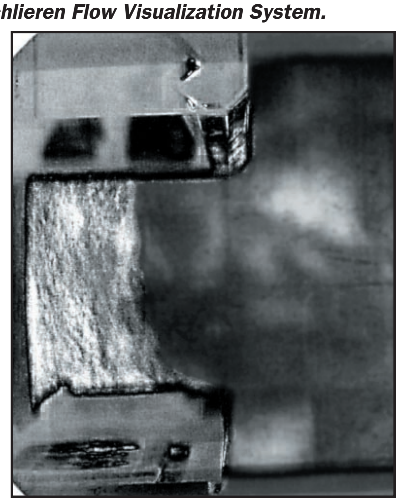
The key to reduced energy costs is to adopt a design that minimizes exhaust and replacement airflow rates while assuring proper capture and containment by the hoods.

But What Goes Out Must Also Be Replaced

Replacement or "makeup air" may come from several sources, including the building's heating and air conditioning system and/or an independent makeup air unit. When a system either over-exhausts or over-supplies the kitchen area, valuable energy is wasted, at great cost to the operator.

Test setup from the perspective of the Schlieren Flow Visualization System.

Two 3-ft. charbroilers under an 8-ft. wall-mounted short-circuit canopy hood.



Schlieren image showing capture and containment exhausting 3500 cfm with 600 cfm (17%) makeup air supplied internally.

Schlieren image showing spillage at 3375 cfm total exhaust and 2100 cfm (62%) makeup air supplied internally. Spillage began at about 25% makeup air.

(Cont.)

Deriving improved exhaust techniques for restaurant industry operators is the key to energy efficiency. Researchers estimate that applying these techniques across California could reduce energy use about 70 GWh or 14 MW, enough energy to provide power to 10,500 homes.

Improving Performance and Reducing Energy Use

Some of the strategies developed through PIER research include:

•Group appliances according to effluent production, placing the most effluent-producing appliances in the center of the hood system, allowing for fewer "leaks" and more efficient effluent removal.

• Select exhaust hoods carefully, using side panels when possible and including features such as interior angles to promote improved operation. In laboratory testing, exhaust systems with this design pulled the least amount of "makeup air" from the kitchen area.

•Avoid "short circuit" and "air curtain supply" hoods which typically require high makeup air flow.

• Avoid supplying large percentages of replacement air within the vicinity of an exhaust hood. When a draft is created around an exhaust hood, the effluent is pushed away from the exhaust system by the new air. To compensate, the exhaust system must be set to a higher level, resulting in increased energy consumption to operate both the exhaust system and the heating and cooling system for the building.

•Introduce air from the dining room into the kitchen, reducing the makeup air supply that must come from the heating and air conditioning system. Traditionally, kitchen and dining areas each operate separately from one another, with air moving in and out of each area utilizing its own system. In the new model, air from the dining room is moved into the kitchen, allowing the operator to use the air twice – one time for guest comfort in the dining area and a second time as "makeup air" in the kitchen.

•Use evaporative cooling systems to provide semi-conditioned makeup air, where applicable. This less expensive source of air allows the restaurant operator a way to reduce energy consumption by decreasing air conditioning system operating loads.

These suggestions, and more, are described in the California Energy Commission's Design Guide–*Improving Commercial Kitchen Ventilation System Performance*–available at www.energy.ca.gov/pier/buildings/reports, puublication no. P500-03-007F. Building on the Energy Commission's efforts, California electric utilities are finalizing plans to apply the improved strategies in several kitchens slated for remodeling. In addition, Southern California Edison will develop a second volume to accompany the Energy Commission's Design Guide, providing additional details to help system designers and facility owners select improved systems that will cut operating costs. Exhaust hood manufacturers are also pursuing these results and the Commission research team has conducted additional testing and product development for several suppliers.

The Early Returns

In one case, a full-service restaurant utilized a standard kitchen design. The kitchen's hood exhausted 8,000 cubic feet per minute (cfm). The makeup air needed came from the kitchen air conditioning (7,000 cfm) and was also provided from the dining room (1,000 cfm).

Base Case Energy Cost: $4,800 per year

In its new design, the revamped hood system operated effectively at 6,000 cfm. The makeup air supply was also revamped, with 1,500 cfm supplied by the kitchen air conditioning, 1,500 cfm from the dining air conditioning and 3,000 cfm from a newly installed evaporative cooling system.

New Design Energy Cost:
$2,000 per year

Summary:
$2,800 per year in savings
with an energy savings of 58.3%.

The new design not only conserves energy, but translates into higher profits for California business. With the support of the Energy Commission, the PIER program is dedicated to providing energy-efficient solutions to California's business community.

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