Integrated DSM Case Study 1: Energy Efficiency, Load Management and Self-Generation

Over the past decade, Sonoma State University has saved 2.6 million kWh of electricity, contributed 1,400 peak kW of demand reduction, and received nearly $800,000 in incentives by taking a creative, integrated approach to managing its energy use. And it has accomplished this while meeting the energy needs of a growing campus.

Integrated Energy Planning Pays Off for Sonoma State University
SSU caught the energy efficiency bug early on—replacing aging lighting and HVAC systems with more efficient equipment in the 1980s. By the early 1990s the planning, design, and construction staff viewed every building project on campus as an opportunity to implement energy-efficient design, equipment, and operations. PG&E provided technical support and advice on utility programs. The campus adopted PG&E’s Savings by Design Program metrics, which call for exceeding by at least 10% the requirements of Title 24, California’s building energy performance standard. Recent projects at SSU far surpass even that goal.

By taking advantage of multiple program offerings that cover energy conservation, energy efficiency, demand response, and self-generation, SSU has been able to control its costs, reduce its energy use, and better manage its facilities while garnering the environmental benefits that result from avoided energy consumption.

Salazar Hall Renovation Wins Awards, Earns Rebates

The renovation of Salazar Hall is a striking example of SSU’s integrated energy planning. Extensive remodeling in 2001–2002 made the classroom, computer laboratory, and office building one of the most energy efficient public buildings in northern California, winning it the Energy User News 2003 Energy Efficient Building Award and ASHRAE’s Technology Award for Institutional Buildings. This $20 million project combines state-of-the-art lighting, innovative low-energy cooling, and solar electricity generation.

The renovation incorporated a rooftop photovoltaic (PV) electric system that works in tandem with the facility’s new cooling system: highly efficient evaporative cooling and outdoor air economizers minimize the energy needed to cool the building, while the PV system generates enough energy to meet the building’s entire cooling load, even on the hottest summer days.

PG&E incentives for the Salazar Hall project restored nearly $450,000 to the University’s budget. SSU effectively used its energy-efficiency incentive as a “down payment” on the PV system. In addition, PG&E offered design assistance with energy efficient glazing, daylighting, efficient lighting systems, lighting control systems, premium efficient motors, and variable speed drives.

Because of its effective integration of energy efficiency and renewable energy, Salazar Hall’s energy use is 42% below the 1998 Title 24 standards. When the renovated building re-opened in 2002, Keith Marchando, project design engineer said of it: “There is not an installation quite like this, where all of these forms of energy conservation come together at this magnitude.” The success of the Salazar Hall renovation clearly demonstrates the value of integrated energy planning. PG&E anticipates that the newly completed Recreation Center, with a similar combination of demand-side technologies, may prove to be 50% below the more stringent 2001 Title 24 standards.
Elements of SSU’s Integrated Design Projects

SSU has kept its energy requirements and costs low because its architecture and engineering team approaches each project asking, “What are the most appropriate and cost-effective measures that will work in this situation?” The result, across projects, has been a set of measures that combine energy conservation (EC), energy efficiency (EE), time-of-use management (TOU), demand response (DR), and self-generation (Gen) technologies.

■ **Energy Management System** (EC/EE/TOU) — A campus-wide energy management system controls building equipment, can advise staff when to decrease energy use during peak hours, and simplifies identifying trouble spots, diagnosing problems, and implementing operational improvements over time.

■ **Radiant Floor Heating** (EC) — Radiant heating makes rooms “feel” warmer than the actual temperature setting indicates, enabling the facilities manager to lower thermostats and use less energy without compromising comfort.

■ **Upgraded Lighting and Daylighting** Daylighting (EC/EE) — Light-sensing systems work in conjunction with adjustable, “dimmable,” electric lighting systems and available daylight.

■ **Innovative HVAC System** (EE) — A two-stage indirect/direct evaporative cooling system saves nearly 100% of the cooling energy a mechanical system would draw.

■ **Buildings’ Thermal Mass** (EE) — Many of the original campus buildings were built of concrete and therefore have a high thermal mass. An indirect/direct evaporative cooling system works exceedingly well in concert with the high thermal mass, which can be pre-cooled at night.

■ **Rooftop PV System** (Gen) — Even on the hottest days, the Salazar Hall PV system output exceeds the building’s cooling power requirement during mid-day on-peak hours.

■ **Demand Reserves Partnership** (DR) — Under this program, the University has committed to drop 250 kW of load on 24 hours’ notice in exchange for a monthly “reservation payment,” as well as compensation for any actual reductions.

![HVAC Load and PV Power Production at Salazar Hall on a Mid-Summer Day](image)

**HVAC Load and PV Power Production at Salazar Hall on a Mid-Summer Day**

On this peak cooling day (July 22, 2003), PV output exceeded the cooling power requirement during mid-day on-peak hours. Because PV energy production coincides with cooling system demand, SSU avoids peak cooling period energy charges and significantly reduces peak demand charges.

■ **Thermal Energy Storage** (TOU) — Chillers working at night charge a 750,000-gallon insulated tank with chilled water, so that cooling requirements during hours of peak energy prices can be met from the tank without operating the chillers. Although this practice doesn’t reduce the total energy used, it does reduce the cost of cooling.

**Optimizing Performance**

To get the most out of its investment in energy systems, SSU is beginning to submeter its buildings to better understand how each is used, establish benchmarks of kWh per square foot, and work to lower those benchmarks. In addition, new and renovated buildings on campus are “commissioned”—i.e., inspected, tested, and fine-tuned to ensure that the systems in place are those that were specified and that their operating parameters are met. This process of bringing operations into line with engineering design can make a difference of as much as 10% in the savings achieved.
Making It Pay

SSU project engineer Keith Marchando understands that making energy efficiency a priority sometimes involves higher initial costs—but he also understands that a low first cost can result in a lifetime of higher operating expenses and the need for subsequent retrofits.

Lifecycle analysis focuses on the long-term cost-effectiveness of an investment—a worthwhile approach for buildings intended to last for 25 or 30 years. Lifecycle analysis considers not only the initial construction/installation cost, but also long-term energy costs/savings, operations and maintenance costs/savings, and planned replacement of equipment. For example, while PG&E incentives helped defray the upfront cost of Salazar Hall’s cooling system, the project penciled out because the potential cost of expanding the chiller plant could be avoided, and the actual cost of the new cooling units was offset by expected future energy savings.

SSU’s highly successful energy projects demonstrate that it pays to look at the whole spectrum of PG&E’s Demand-Side Management offerings, rather than considering each program as a one-off opportunity. A PG&E account representative will work with your planners, designers, and facility managers to help you identify the right combination of energy systems to meet your organization’s goals and the right combination of incentive programs to support your project.

PG&E 2004-05 Energy Program Offerings for Businesses, Industries, and Institutions

Energy Efficiency Programs
- Savings by Design
- Express Efficiency: Lighting, Refrigeration, HVAC, Food Services, Gas
- Standard Performance Contract Program

Demand Response Programs and Tariffs
- Critical Peak Pricing (CPP) Tariff
- Demand Bidding Program Tariff
- Demand Reserves Partnership Program

Renewable On-site Generation
- Self Generation Incentive Program

For further information, contact your local account representative or visit www.pge.com/biz.