



# Developing Energy-Efficient Communities

PIER Buildings Program

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## The Issue

The next two decades will see billions of square feet of new construction and remodeled facilities across the U.S.—homes, offices, public facilities, and whole communities. The potential exists to make these facilities far more efficient than current codes require, and to work synergistically to make entire communities energy efficient. However, more knowledge is needed to predict what the actual potential is, as well as what it would take, in terms of technologies, strategies, and policies, to achieve that potential.

## The Solution

Researchers at the National Energy Center for Sustainable Communities (NECSC) selected two planned development sites in the City of Chula Vista, California, for study. Their goal was to explore the potential economic and environmental benefits and costs of different energy technology and community design alternatives in large-scale projects.

The research team conducted detailed building energy modeling and site design analysis to compare the energy efficiency, emissions reduction, and economic performance of the various alternatives to the performance expected from a conventional approach to development. The local utility, San Diego Gas & Electric, also examined the modeling results to determine the potential of these alternatives to reduce peak demand and to make better use of the existing utility infrastructure. In addition, a series of workshops and surveys with real-estate development experts, public officials, and utility representatives helped to identify the best ways to encourage energy-efficient development in California.

## Features and Benefits

The list of studied energy-efficient alternatives included higher-efficiency grades of wall and roof insulation, windows, doors, lighting, and HVAC equipment, including thermal storage, appliances, solar thermal technology, and a district cooling system. In addition, researchers considered four alternative development scenarios: a builder-proposed baseline, an energy-efficiency package, an energy-efficiency package with fossil-fueled distributed generation, and an energy-efficiency package with photovoltaic (PV) technology. They also looked at several community design options: mixed use, moderate-density development, urban runoff mitigation, carbon storage

and sequestration, urban heat island mitigation, and passive solar building orientation.

The efficiency measures and scenarios were put together in simulations that covered 40 building types and space uses that are common to urban and residential development projects in California. The results were combined to simulate the planned Chula Vista communities as well as a third, hypothetical site that enabled researchers to study a wider range of community design options. **Figure 1** shows the site utilization plan for one of the communities now being developed.

The modeling showed that strategic integration of energy-efficiency measures, technologies, and design features had the potential to reduce aggregate energy consumption of large-scale development projects by as much as 43 percent, peak demand by 45 percent, and carbon dioxide (CO<sub>2</sub>) emissions by 33 percent compared to a Title 24-compliant development project. The optimum combination of measures, technologies, and features that can deliver these reductions is dependent on building type, space uses, and local weather conditions. The combinations modeled are described in two attachments to the project report (see For More Information).

**FIGURE 1: Site utilization plan for a planned community**

Researchers modeled typical buildings in an urban development and simulated annual communitywide energy performance. Elements shown in the plan include various types of residences, retail spaces, hotels, and offices.



Economic analysis followed the energy analysis and found that significant economic incentives will be required to encourage the adoption of energy-efficiency measures that go beyond code requirements. The average maximum cost increment that the California building industry will accept for energy-efficient structures is between \$1.59 and \$7.41 per square foot, but the range calculated for the enhancements modeled in this research project was \$2.00 to \$15.00 per square foot.

A segmented market survey indicated that the acceptability of incremental costs varies significantly by industry practitioner. For example, design professionals are willing to pay more for energy-efficient features than are developers.

In the case of the energy-efficiency package that included upgrades to wall and roof insulation and higher-efficiency windows, doors, lighting, appliances, and HVAC, designers found the modeled costs to be acceptable, but developers did not. In the case of both the fossil-fueled and solar PV distributed-generation scenarios, respondents in all industry segments found the modeled costs to be unacceptable.

Results of these analyses indicate a need for new public and private management models to address the barriers impeding the adoption of these technologies and site features. These barriers include:

- Misalignment between those who invest in energy efficiency and those who benefit;
- Inadequate direct and indirect financial support for the building industry;
- Insufficient local capacity and incentives to encourage energy-efficient projects;
- Consumers' reluctance to pay premiums for energy efficiency (lack of market demand); and
- Investment risks that inhibit capital project financing.

Resolving these issues will require a fundamental market transformation, and state agencies must take a leadership role in facilitating the transformation.

## Applications

The general methodology established here can be applied to any community development effort, although the actual

achievable savings will vary depending on the specifics of the project and the climate zone.

## California Codes and Standards

A comprehensive review of relevant state, regional, and local public policies will help determine where policy innovations can facilitate energy-efficient community development in California. The results of the project could influence the requirements in the next version of Title 24.

## What's Next

Researchers recommend translation of this research into improved modeling tools, methods, and site development guidelines that local communities and the private development industry can use to advance energy-efficient projects.

## Collaborators

The organizations involved in this project included the NECSC at San Diego State University; the City of Chula Vista, California; Gas Technology Institute; PlaceMatters; FVB Energy; Burnham-Moores Center for Real Estate, University of San Diego; the Colorado Energy Group; Otay Land Company; McMillin Development Company; and San Diego Gas & Electric. Additional funding was provided by the U.S. Department of Energy, National Energy Technology Laboratory and the International District Energy Association.

## For More Information

Reports documenting this project may be downloaded from the web at [www.energy.ca.gov/2011publications/CEC-500-2011-019/CEC-500-2011-019.PDF](http://www.energy.ca.gov/2011publications/CEC-500-2011-019/CEC-500-2011-019.PDF).

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### About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

**Edmund G. Brown Jr., Governor**  
**California Energy Commission**

**For more information see** [www.energy.ca.gov/research](http://www.energy.ca.gov/research)

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