UCSB Case Study Building Pictured in Background: Bren Hall

Scan here with your smartphone to download a copy of this brief:

DONALD BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Green Buildings in the United States and China: Bridging the Energy Performance Gap

Project Members
Fernando Accame
Joel Cesare
Ying Chen
Edward Walsh
Qiong Wu

Project Advisor
Dr. Sarah Anderson

The Project

Operational energy demand data indicates green buildings are not meeting energy performance predictions. This discrepancy between predicted and actual performance is commonly referred to as the performance gap. We analyzed four LEED Certified buildings on the UCSB campus for case studies and each demonstrate a significant performance gap. Procedures developed in this research enable building managers to pin-point problems and design effective solutions to help ensure green buildings perform as efficiently as possible.

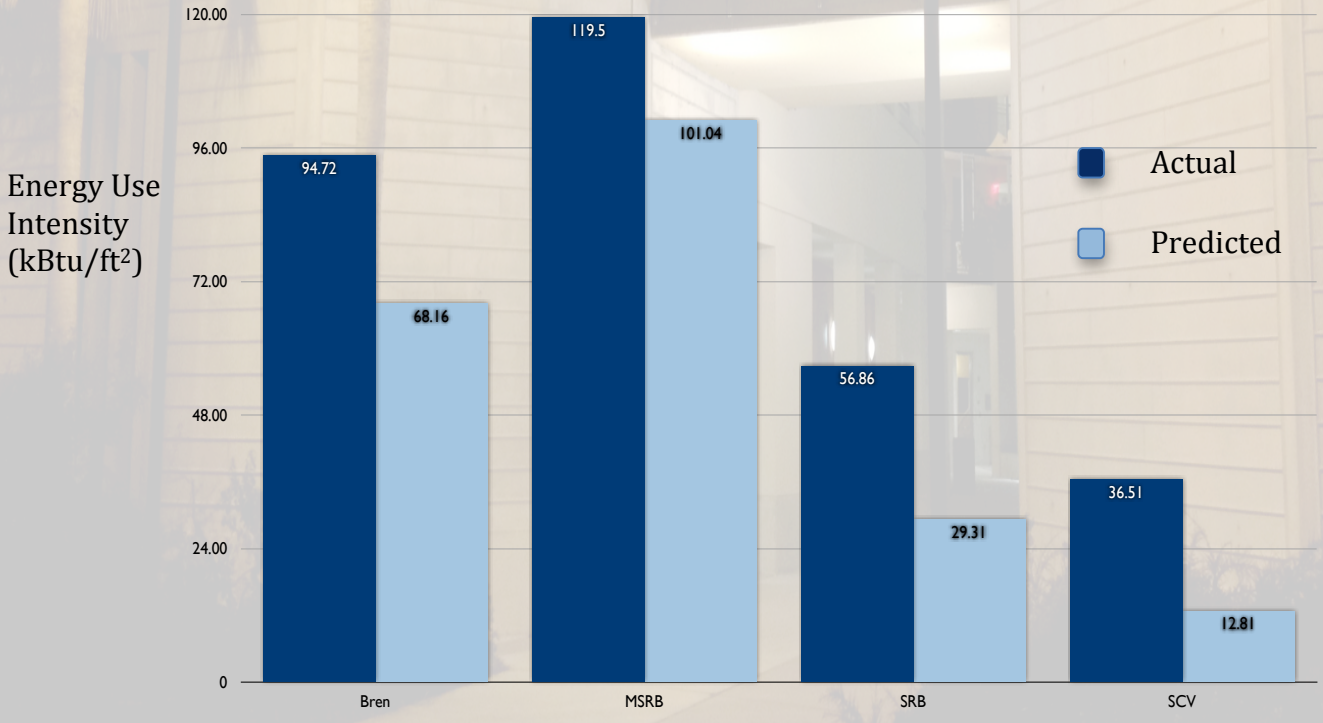
Problem

41% US & China global greenhouse gas emissions

39% US emissions from buildings

35% China emissions from buildings

Performance Gap



Researchers at project client and international engineering conglomerate, AECOM: "With the increasing demand for more energy efficient buildings, the construction industry is faced with the challenge to ensure that the energy efficiency predicted during the design is realized once a building is in use."

AECOM

Bren School Sino-American Working Group

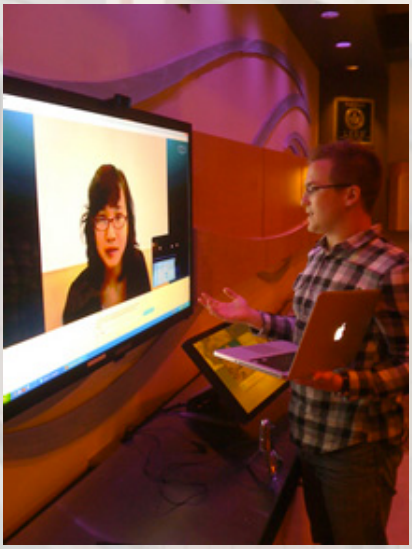
Fostering international collaboration on the world's most urgent environmental problems.

China

Chinese residents are migrating to cities at a rate the world has never seen before. The population in urban zones is expected to double from its 2000 level by 2030 and more than 2 billion square meters of buildings have been constructed annually in China since 2000. GHG emissions from buildings in China are currently estimated at 25% of the country's total and this figure is expected to increase to 35% by 2020. The Chinese government recognizes the problem and is actively requiring 3-Star certification for new buildings. 3-Star is a rating system based on LEED.

Collaboration

The theme of low carbon development is now a major focus of attention both in China and in the US. This is especially evident in California and Jiangsu Province, which have entered into a cooperative agreement designed to encourage communication and collaboration in this realm. Our Group Project contributes to this effort by engaging in applied research and analysis on a collaborative basis. We have worked with a group of students at Nanjing University's School of the Environment to establish consistent methodologies and share ideas. Research is on going and the Bren team will travel to Nanjing in Summer 2012 to participate in joint workshops and cultural events.



METHODS

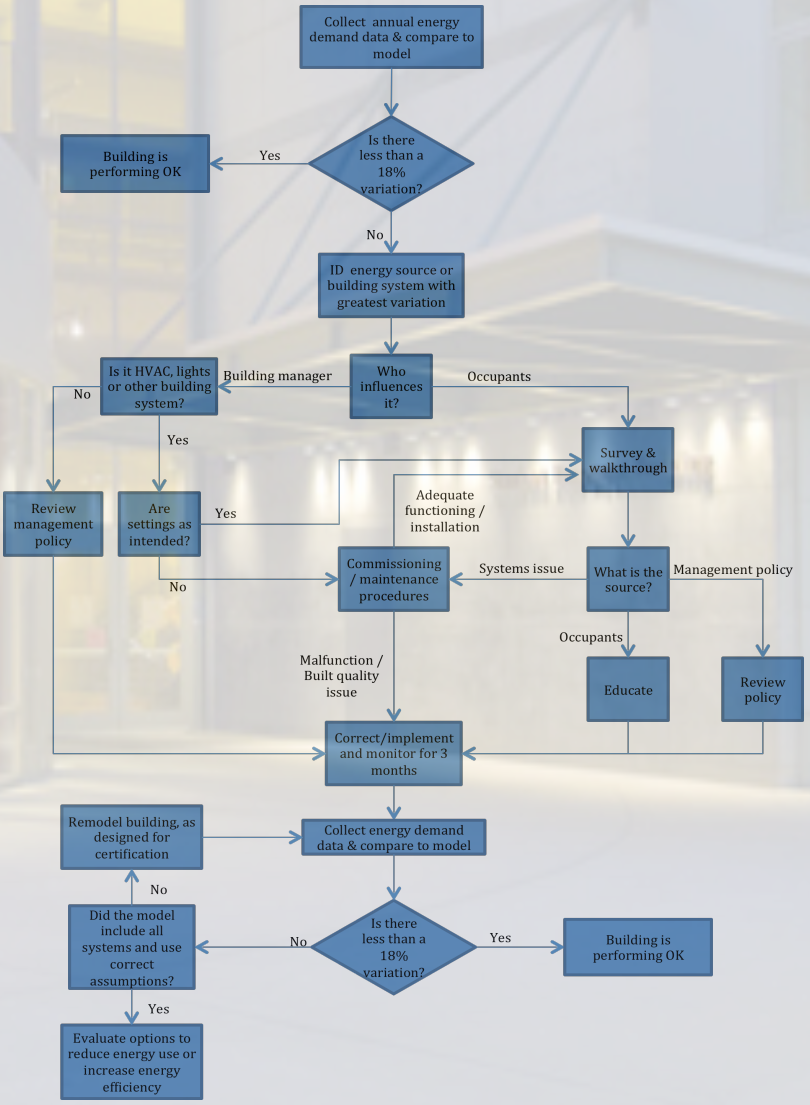
We developed a process to measure the performance gap, analyze the systems driving it and establish customized measures to evaluate what the major causes are. It is implemented in this order:

1) Convert energy consumption data from main electricity, chilled water, natural gas and renewable energy on utility bills into standard Energy Use Intensity (EUI) units.
2) Analyze energy simulation model reports for predicted EUI.
3) Administer Post-Occupancy Evaluation (POE)
4) Compare results of POE with performance gap system data breakdown.
5) Refer to our customized building manager energy performance decision tree guidelines for next step.

Post-Occupancy Evaluation: Streamlined

POE is defined as a diagnostic tool and system, which allows facility managers to identify and evaluate critical aspects of building performance systematically. Traditional POE is often too time-intensive and costly for stakeholders to implement so we customized our POE to provide a streamlined approach. Through surveys of building occupants, walkthrough audits and interviews with building and facility managers we were able to determine what was causing the performance gap. The decision tree below was designed so building managers can replicate our process simply and efficiently.

Building Manager Energy Performance Decision Tree



POE Data

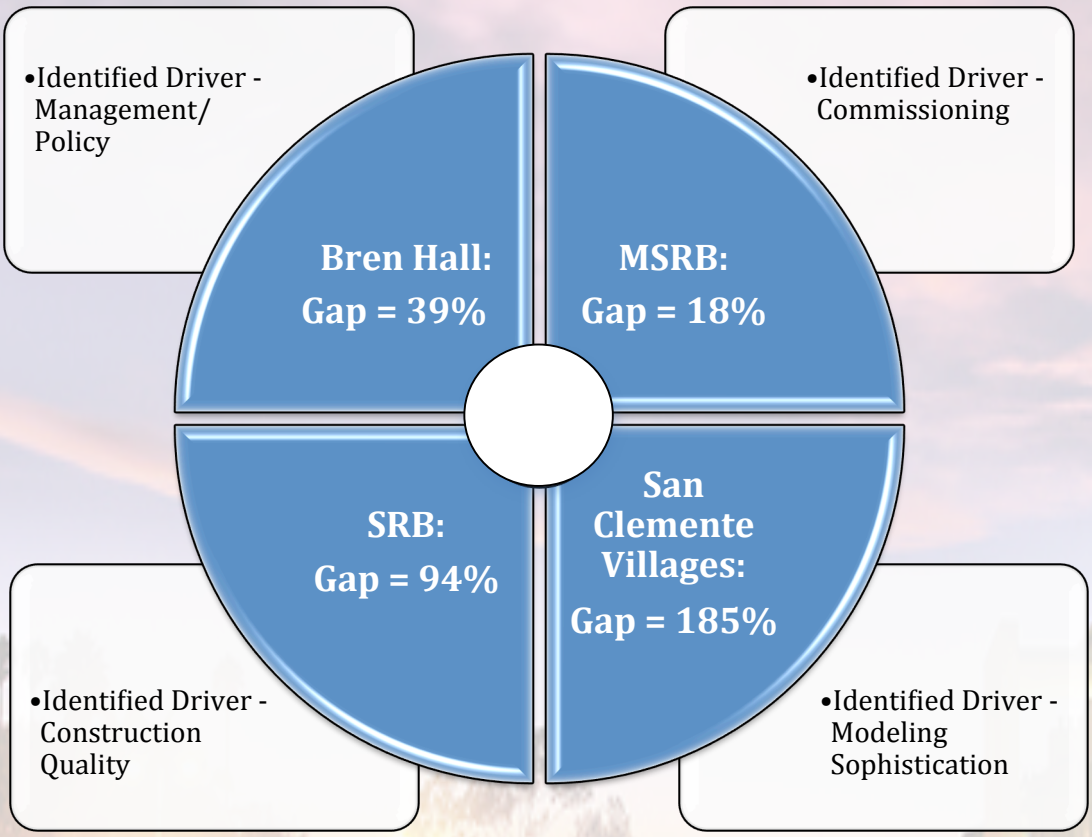
386 Paper Surveys Delivered
- 45% Response Rate

1143 Online Surveys Delivered
- 22% Response Rate

15 Interviews Conducted

123 Rooms Observed

What is Causing the Gap?



Conclusions

1. There is no smoking gun. Causes of the gap are variable and require a customized POE to identify.
2. Occupancy schedules, lighting density and receptacle loads are consistently underestimated in predictive energy models.
3. Traditional POE is not practical or cost-effective to deliver. Our decision tree tool provides a simple, efficient approach for building managers to utilize.
4. Analyzing the performance gap enables identification of building inefficiency drivers to reduce greenhouse gas emissions.

Acknowledgements

Special thanks to:

AECOM

YARDI

Dr. Sarah Anderson

Dr. Oran Young, Bryan Henson, Perrin Pellegrin, Jordan Sager, Craig Whan

Nanjing University:
Lei Yue 雷月
Rongrong Zhang 张荣荣
Miaomiao Liu 刘苗苗
Advisor: Haikun Wang 王海坤

Follow us on twitter

@BrenGPnanjing