Building Energy Analysis, Comparison and Benchmarking


Research Objectives

- Develop and pilot a market-oriented, practical system for benchmarking building energy performance in China and an associated national energy performance database and benchmarking policy that will drive: energy and carbon reductions in Chinese buildings; sale of US energy efficiency technologies in China; and deliver long-term, sustained innovation in Chinese policy, including inclusion of benchmarking in China’s 13th Five Year Plan.
- Conduct research to inform evolution and advancement of US and Chinese building energy policy, with initial focus on application of real-time, on-line, energy monitoring to increase efficiency and reliability of data collection and carbon emissions trading schemes (ETS) that incorporate commercial buildings.

Technical Approach

- Use nationally representative data sets (when available).
- Compare energy performance in terms of source energy.
- Perform multiple regression analyses to find the combination of statistically significant operating characteristics that explain the greatest amount of variance in building source energy use.
- Use the nationally representative data set to determine the distribution of energy performance across the entire population of hotels and commercial offices. A table is created and the benchmark rating is based on the ratio of actual energy consumption to that predicted by the regression analysis.

Figure 1. The hotel benchmarking tool is complete and available online at http://www.cabr-cecc.com/.
Recent Progress

- Completed a Web-based benchmarking tool for hotels that is housed at China’s largest building research institute—the China Academy of Building Research.
- Developed an Excel-based prototype benchmarking tool for commercial offices that automatically normalizes for the key drivers of energy use in Chinese commercial offices (size, location, operating hours, etc.) so office energy performance can be fairly compared.
- With CSTC, CABR, and Tsinghua, completed a draft national hotel energy characteristics data set for China, including data points for more than 750 hotels.
- Provided US DOE with a draft report on Chinese innovations in real-time, on-line building energy monitoring and emissions trading for the commercial buildings sector, and lessons and recommendations to advance US building energy policies.

Expected Outcomes

- Significant potential energy and CO₂ emission reductions over the short, medium, and long term as a result of the availability of comparative energy benchmarking tool for hotels and commercial offices in China (as detailed in Table 1)

Table 1. China Energy and CO₂ Impact

<table>
<thead>
<tr>
<th></th>
<th>Total m² Benchmarked (2%)</th>
<th>Total Savings from Benchmarked Buildings (kWh)</th>
<th>GHG Emission Reduction (MtCO₂e)</th>
<th>Wind Turbines Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term: 2016-2017 (2yr)</td>
<td>29,400,000</td>
<td>1,169,197,200</td>
<td>949,797</td>
<td>262</td>
</tr>
<tr>
<td>Med-term: 2016-2020 (5yr)</td>
<td>78,000,000</td>
<td>6,086,232,000</td>
<td>4,944,151</td>
<td>1,362</td>
</tr>
<tr>
<td>Long-term: 2016-2025 (10yr)</td>
<td>171,000,000</td>
<td>23,784,354,000</td>
<td>19,321,220</td>
<td>5,321</td>
</tr>
</tbody>
</table>

- A marked increase in sales of energy-saving technologies and building equipment due to the availability of comparative building benchmarking tools and more buildings obtaining a practical understanding of their energy performance and need for improvement. As the leading suppliers of green building technologies globally, U.S. companies stand to gain a substantial market share of these equipment and technology sales in China. If five percent of all buildings benchmarked invested in advanced lighting; heating, ventilation, and air-conditioning systems; and other equipment and technologies, U.S. companies could generate substantial additional sales and revenue (as detailed in Table 2).

Table 2. Projected Revenue from Sale of U.S. Green Building Technologies in China

<table>
<thead>
<tr>
<th></th>
<th>Total m² Investing in Technology (%)</th>
<th>Estimated Retrofit Cost Per Square Meter (USD)</th>
<th>Total Sales (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term: 2016-2017 (2yr)</td>
<td>1,470,000</td>
<td>$82.93</td>
<td>$121,904,883</td>
</tr>
<tr>
<td>Med-term: 2016-2020 (5yr)</td>
<td>3,900,000</td>
<td>$82.93</td>
<td>$323,427,000</td>
</tr>
<tr>
<td>Long-term: 2016-2025 (10yr)</td>
<td>8,550,000</td>
<td>$82.93</td>
<td>$709,051,500</td>
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