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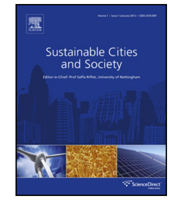

The role of international institutional partnerships in delivering low-energy building design: A case study

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ABSTRACT

This paper explores the role of international partnerships to facilitate low-energy building design, construction, and operations. We briefly discuss multiple collaboration models and the levels of impact they support. We present a case study of one collaborative partnership model, the Scientific Planning Support (SPS) team. Staff from the Lawrence Berkeley National Laboratory, the Austrian Institute of Technology, and Nanyang Technological University formed the SPS team to provide design assistance and process support during the design phase of a low-energy building project. Specifically, the SPS team worked on the CleanTech Two project, a tenanted laboratory and office building that seeks Green Mark Platinum, the highest green building certification in Singapore. The SPS team hosted design charrettes, helped to develop design alternatives, and provided suggestions on the design process in support of this aggressive energy target. This paper describes these efforts and discusses how teams like the SPS team and other partnership schemes can be leveraged to achieve high performance, low-energy buildings at an international scale. Specifically, it discusses how international institutional partnerships build capacity for low-energy design, challenge the status quo for building design, and create new resources in support of energy savings on the order of 40%.

1. Introduction

Design assistance partnerships often contribute to capacity building and "out of the box" thinking that in turn facilitates energy savings. Design assistance partnerships also contribute to knowledge transfer and challenging the status quo for design and operation of commercial buildings (U.S. DOE, 2011). In particular, design assistance teams may be most effective on high-energy-intensity buildings, where operational requirements may eliminate some 'typical' low-energy strategies and technologies (e.g., higher temperature setpoints, common in low-energy office buildings, may not be possible in laboratory settings). Design assistance teams can review literature and provide institutional knowledge to broaden the range of low-energy solutions considered for a given project, increasing the likelihood that energy savings will be realized.

This paper briefly describes several international collaboration models that support low-energy, high performance buildings. In particular, these collaborations may be most effective in Brazil, Russia, India, and China, where economies and energy demand continue to rise (U.S. EIA, 2011). In fact, the U.S. Energy Information Administration (U.S. EIA) forecasts international energy demand will increase 53% from 2008 to 2035, with most of the growth attributable to non-Organization for Economic Cooperation and Development (non-OECD) countries (2011). Non-OECD countries, India and China in particular, represent a unique opportunity because much of the infrastructure is new. Thus, builders can design and construct energy-efficient commercial and residential buildings from the outset, rather than retroactively creating policies and technologies to manage exorbitant consumption (e.g., Banerjee & Solomon, 2003; Geller, Harrington, Rosenfeld, Tanishima, & Unander, 2006).

Glasbergen and Groenenberg (2001) explain international collaboration is often required to solve international problems, like climate change. Tae and Shin (2009) reaffirm this view and

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enumerate other benefits of international partnerships and collaborations, particularly for low-energy buildings, including opportunities to adapt international policy and standards to a local context and educational opportunities. To the former point, Thilakaratne and Lew (2011) cite the prevalence of LEED in Asia, in India and China in particular, and suggest that Asian countries may want to work with U.S. collaborators to develop their own green building rating systems that address the unique climate needs of individual Asian countries. Finally, to the latter point, Kua and Lee (2002) highlight educational benefits of international partnerships and collaborations centered on low-energy buildings, especially when collaborations include exchange programs and face-to-face meetings. These studies highlight the superior energy performance of buildings developed with international collaboration, suggesting that these collaborations support low-energy building designs. However, the studies do not list the energy savings attributable to the partnership itself, as this causal relationship is more difficult to identify or quantify than the energy savings due to specific efficiency features in a building.

While most research describes the benefits of international partnerships for low-energy building projects, it also cautions of potential difficulties and drawbacks associated with such partnerships. For instance, Glasbergen and Groenenberg (2001) caution that international partners may not have sufficient understanding of the cultural and policy context in the country they work in. Iwaro and Mwasha (2010) further explain that architecture-engineering-construction professionals often form international partnerships to complete low-energy building projects in developing countries, where building energy data may be lacking. The partners may decide to address this lack of data by using data from developed countries. Iwaro and Mwasha argue this may not be appropriate, as the only available data may be from developed countries that use different building materials and systems than may be common in the developing world. In general, however, literature supports the notion that international partnerships facilitate low-energy buildings; in fact, literature often suggest such partnerships to address technical and non-technical barriers to achieving energy efficiency in buildings (e.g., Glasbergen & Groenenberg, 2001; Iwaro & Mwasha, 2010; Kua & Lee, 2002).

This paper presents the experience of one international team working on a low-energy building project in Singapore. Thus, we classify this research as case study research (e.g., Yin, 2008). Specifically, we classify this as a Type 2 case study (p. 46), as we describe a single case but discuss multiple phenomena associated with this case study, including energy efficiency measures and roles and responsibilities of the collaborative team. We present one international partnership model, known as a Scientific Planning Support (SPS) team, in detail. We discuss the SPS experience on a case study project in Singapore. Specifically, we discuss the composition and role of the SPS team and how their outputs contributed to the design of a low-energy laboratory building. We further discuss the benefits of SPS teams and suggest where these may be strategically deployed.

2. International partnership and collaboration models

Collaboration models for buildings research and development (R&D) span a spectrum from potential public-private/domestic and international partnerships. Fig. 1 shows different levels of collaboration models, ranging from multi-lateral programs, which are broadest in terms of impact, to institutional collaborations, which are narrowest in terms of impact, but may be the deepest in terms of savings achieved. The benefits from these collaboration models are many. Firstly, an international team can offer unbiased, scientific, innovative, and effective solutions to drive energy efficiency with an unprecedented speed and scale (e.g., CBERD, 2014; Hong et al., 2013). Secondly, collaboration models that draw upon global expertise support knowledge transfer through lessons learned and insights, which in turn facilitate "leaps and breaks" in building energy efficiency for the host country (e.g., CBERD, 2014). The latter may be more effective as game-changing advances in the field of building energy efficiency compared to incremental improvements through only in-country approaches. Thirdly, complementarity in learning through bi-lateral or multi-lateral R&D can create a powerful and synergistic approach that supports a mutual evolution of building energy efficiency in the collaborating countries.

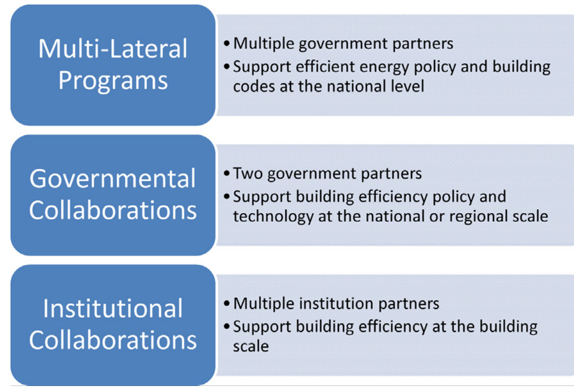

Fig. 1. Three levels of building energy efficiency collaboration models.

Multi-lateral programs in energy-efficiency offer an effective means for regional or global-scale collaboration. For instance, the Lawrence Berkeley National Laboratory (LBNL) participates in the Climateworks Global Buildings Performance Network, an organizational partnership between the U.S., E.U., China, and India for mutually beneficial work in building energy codes and labels (GBPN, 2013). Similarly, through the Clean Energy Ministerial, LBNL is advancing technical expertise in energy efficient appliances to spur the transition to clean energy in 23 countries (Energetics Inc., 2014).

Governments may also form partnerships that may have wide-ranging policy implications within the partner countries. For instance, LBNL is leading two bilateral programs—initiated through Memoranda of Understanding at the national government level—where researchers and design experts from both countries collaborate to push the envelope for building energy-efficiency. The first, the U.S.-China Clean Energy Research Center for Building Energy Efficiency (CERC-BEE) seeks to build a foundation of knowledge, technologies (e.g., Liu, Lu, Cai, & Chen, 2013), tools, human capabilities, and relationships that position the United States and China for a future with very low energy buildings resulting in very low CO_2 emissions (Hong et al., 2013). This collaboration has strengthened the capabilities of Chinese institutions to promote energy efficiency. Moreover, as this collaboration proves fruitful at the building level, both parties are shifting their focus to scaling up energy efficiency to the city level through the China Low-Carbon Cities and Eco-cities programs.

The U.S.-India Joint Center for Buildings Energy Research and Development (CBERD) program represents a second example of government-level collaboration. This project, recently awarded to LBNL under the auspices of the U.S.-India Partnership to Advance Clean Energy (PACE), seeks to draw upon the complementarity of R&D partners' experience and knowledge to deliver strategies for building lifecycle performance assurance while emphasizing solutions that leapfrog transitional technologies. In India, these solutions would be for new construction since two-thirds of the commercial building stock is still to be built, while in U.S.

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