DRAFT FOR DISCUSSION
4/12/08 (SESelkowitz)

Partnership for Zero Energy Buildings: A Basis for a Shui On/LBNL Collaboration

In the March 24th video conference between Shui On and LBNL we discussed the current "5-5" building project as an opportunity to begin a collaboration. Since the building is already partially designed, the timing is good for immediate impact, but opportunities for some types of solutions may already have been missed. However, we envision this project as an initial step to test the waters for building a collaborative partnership. In the document below, we outline a series of proposed activities to 1) incrementally improve the energy performance of the 5-5 building, and then describe three related activities: 2) the design of a yet-to-be-designated future building with more aggressive performance goals, 3) the development of a quantitative series of performance benchmarks and guidelines for "Best Business Practice" with respect to all of Shui On's existing and future building stock, and 4) an opportunity to become engaged in a new multi-client research program based in Berkeley with leading global manufacturers.

The scope of each of these (in outcomes, and therefore time and cost) is subject to further refinement and discussion. Technical consultant services can be obtained from many private contractors on an hourly basis. We propose defining a multiyear Shui On / LBNL/UC Berkeley partnership to address current and emerging building energy efficiency objectives. The initial estimated cost of $625K over the next 6-8 months includes a significant technical assistance effort for task 1 ($350K with details TBD based on status of ongoing work of the A/E team), a modest planning effort for Task 2 ($75K), a larger scoping and initial benchmarking effort for Task 3 ($200K), and some coordination time for Task 4 (no cost).

The potential scope of the tasks is laid out below. Please note that these are presented to generate discussion and are not intended as a draft work statement. We look forward to hearing from you to see if these tasks align with Shui On's interests and to discuss next steps.

1. **Technical Assistance on the "5-5 Building"**
   (Note: this focuses on a building identified by Shui On, already partway into conceptual design; opportunity to get immediately engaged with a project of limited scope/objectives, establish a working relationship for both partners)
   a. Objectives: For an existing building project already under development 1) provide assistance to the owner and design team to reduce energy consumption (and associated carbon emissions) by a factor of 2 relative to existing similar Shui On properties while maintaining acceptable comfort and indoor environmental quality (IEQ), and 2) establish new process by which these results can be repeated in the future. The approach will include a preliminary assessment of embodied energy and associated carbon emissions in the material used to construct the building.
   b. Outcomes:
      i. Simulation model of building designs with parametric energy and carbon impacts

ii. Recommendations for specific energy efficient and carbon emission reduction features with estimates of costs and savings
iii. Exploratory analysis of embodied energy and associated carbon emissions, with recommendations on ways of cutting these emissions.
iv. Specifications for energy and IEQ performance monitoring systems
v. Design alternatives, energy and carbon estimates, and specifications for key building systems: e.g. shading, lighting , daylighting controls, HVAC
vi. Plan for energy and carbon dashboard display in lobby and energy/carbon management guidelines/plan for tenants
vii. Documented "integrated design process" for use in future building designs

c. Tasks: (note – tasks to be done in collaboration with A/E team)
   i. Advise/assist the A/E team on development of an EnergyPlus model of the building
   ii. Use the model to explore cost/benefit tradeoffs and systems interactions of design alternatives
   iii. Explore framework for estimating embodied energy and carbon emissions for this project; focus on structural system
   iv. Develop glazing and shading concepts, with estimated performance, cost
   v. Develop lighting/daylighting control system concepts
   vi. Develop and assess alternative HVAC concepts, including natural ventilation and thermal storage;
   vii. Provide design guidance to enhance operability and maintenance
   viii. As appropriate, mock-up and test performance of potential systems on small spaces in existing Shui On buildings.
   ix. Advise on atrium design issues to minimize cooling loads
   x. Document existing design process, track key decisions and energy/carbon emission outcomes
   xi. Assist in developing building operations and maintenance documentation and training

(Note that a number of these tasks can be used in all subsequent projects, either directly or with minor modification)

2. Design assistance and optimization on a future new building

a. Objective: For a selected new project, develop a building design that pushes the state of the art in energy use and sustainability. Performance goals would be a building that uses only 20-30% as much energy/carbon as current Shui On building stock while providing required business services and maintaining acceptable IEQ. If conditions are favorable for onsite PV, wind or biogas, this could then be a candidate to become a "zero energy building". The project is designed not only as a technical

demonstration but a business and economic testbed to guide future management decisions for Shui On.

b. Outcomes:
    i. Roadmap for Shui On Policy with regard to Zero Energy Buildings.
    ii. Detailed design program and integrated design process that will achieve project objectives.
    iii. Detailed BIM for the building, used in energy and carbon emission optimization and cost estimating, and useful for construction management and operations.
    iv. Detailed energy, carbon emission, and cost data for final design and alternatives.
    v. Low energy and reduced carbon emission design solutions and specifications for envelope, façade, lighting, HVAC, elevators, IT systems, misc loads. This includes embodied energy and carbon emissions associated with the building construction materials. Detailed specification for controls infrastructure and operating sequences.
    vi. Required data for tenants in terms of tenant fit-out and operations
    vii. Commissioning plans and building operating/maintenance plans.
c. Tasks:
    i. Working with the owner, develop detailed performance goals and expectations for overall building and major subsystems.
    ii. Working with the A/E team, develop BIM-based models useful for energy (including embodied energy), carbon emission, and IEQ modeling and cost estimating.
    iii. Working with A/E team and manufacturing partners develop and test integrated systems using highly efficient components and optimized controls.
    iv. Develop optimized designs with alternatives for minimizing direct and embodied energy use and carbon emissions with “acceptable” cost tradeoffs; exploring innovative financing and cost accounting practices.
    v. Develop plan for highly efficient tenant fit-out packages.
    vi. Working with contractors, manufacturers, and facility operators develop commissioning plan and optimal operating/maintenance guidelines and practices.
    vii. Develop tools to facilitate effective day-to-day operations/maintenance decisions

3. Technical assistance on quantifying and analyzing performance of Shui On building stock

a. Objectives: Provide a suite of tools and associated measurement capability to characterize performance of all existing Shui On buildings as a basis for 1) continuous improvement program to track and reduce

existing building energy use and carbon emissions, and 2) defining performance goals for new buildings

b. Outcomes:
    i. Performance metrics defined and database of all existing building performance data related to direct and embodied energy use, carbon emissions, and IEQ
    ii. Tools for data mining and tracking existing building performance
    iii. Tools and protocols for continuous tuning of existing building performance to meet performance requirements
    iv. Cost effective protocols/ tools for short and long term measurements of building performance
    v. Benchmark data on occupant satisfaction with occupied spaces
    vi. Benchmarking tool for informing design goals of new buildings based on performance of existing buildings
    vii. Shui On management "dashboard" for tracking all building energy use
c. Tasks:
    i. Design database structure or identify commercial software to accommodate Shui On benchmarking needs
    ii. Develop Energy Use Index and carbon emission and IEQ rating for all existing Shui On buildings with building description and utility bills;
    iii. Add data to each building file on key characteristics based on short walkthroughs, e.g. HVAC type/capacity, lighting power density, computer and office equipment survey, types of controls in use
    iv. For a subset of buildings and for limited spaces within buildings, deploy submetering and stand-alone data collection systems to collect component and system energy use (short term and continuing), and IEQ data for prototypical building spaces.
    v. Explore use of occupant survey in one or more buildings
    vi. Explore adaptation of EnergyIQ to Shui On buildings

4. Collaboration in High Performance Building Research and Implementation Center (HiPerBRIC)

LBNL would welcome the opportunity to engage Shui On in discussions about participating in HiPerBRIC – a new public-private collaboration of national laboratories, academia, and a global manufacturing consortium that will enable the in-depth transformation of the commercial buildings sector as rapidly as possible. LBNL and UC Berkeley are HiPerBRIC founding members.

The current HiPerBRIC vision is to develop a robust set of tools, technologies and systems that will allow leading companies like Shui On to create and operate buildings with a targeted reduction in energy consumption of 90% in new buildings (over current baselines) and more than 50% in retrofits, while

simultaneously improving health, comfort, safety/security, and water usage. We are looking forward to engaging and partnering with the international buildings community in implementing this vision in global markets.

The HiPerBRIC Research, Development & Demonstration focus is on an *integrated systems approach* to buildings design and operation, along with engineering design methodologies, that will lead to mature hardware and software, both scalable and widely deployable in future and current building stocks.

A Shui On/HiPerBRIC collaboration might include the following elements.

a. Objective: Cost-shared RD&D activities that will allow Zero Energy Buildings to be developed, operated and maintained reliably and at lower cost than solutions today, and support similar large reductions in energy use in existing buildings.
b. Outcomes:
    i. Roadmap for next generation technology and systems development
    ii. Demonstrations of integrated software and hardware solutions at LBNL testbed facility
    iii. Demonstrations of emerging integrated system solutions at selected Shui On buildings
    iv. Partnerships with leading building system suppliers.
c. Tasks:
    i. Develop management framework and business model for HiPerBRIC with Shui On participation and input
    ii. Develop and continuously update R&D Roadmap
    iii. Identify, implement, evaluate and report on results from demonstration projects.

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