Guide to Value Analysis and the Integrated Green Design Process

Green Buildings BC – New Buildings Program
Agencies Responsible:
British Columbia Buildings Corporation
Ministry of Finance and Corporate Relations

Burnaby Mountain Secondary School, an example of a project that used an integrated design approach to achieve significant green design features, including geothermal heat, natural treatment of site water, and enhancement of fish habitat and the local ecosystem. (Photo reprinted with permission from the Dominion Company.)

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1.0 Introduction

Purpose of document

This document explains how the Government of British Columbia's Value Analysis (VA) process for provincially funded facilities can be adapted to include an Integrated Green Design approach.

The resulting Integrated Design Process (IDP) described herein is now being applied to a series of Pilot projects under Green Buildings BC's (GBBC's) New Buildings Program. The process is also offered as a resource for use on a voluntary basis by other provincial construction projects.

How it should be used

The *Guide to Value Analysis and Integrated Green Design Process* deals with issues of building design and site planning. Using it, a design team can follow a standardized process – with workshops in pre-schematic design, schematic design, and design development – that focus on incorporating environmental and energy conservation features into the facility design.

Despite this focus, green design must also be integrated into a larger decision-making framework that continues to account for factors such as building programming, functionality and user needs, "constructibility", and the long-term operation and maintenance of the facility.

For ease of exposition, the description below treats IDP as a linear sequence of successive design decisions. In practice, the design process tends to be highly iterative.

This document does not cover program planning, site selection, and the hiring of a design team. It is intended to be used after these earlier design stages have been completed. For more information on the early design phase, see the various resource documents at http://www.greenbuildingsbc.com/new_buildings/resources.html.

Document structure

This guide is organized as follows:

- Background on the New Buildings Program and Green Pilots
- Overview of Value Analysis and Integrated Green Design
- Description of the Integrated Design Process

Details on the IDP workshops, as well as reporting requirements for the Green Pilots, are provided in the Appendices.

2.0 Background

The New Buildings Program

In December 1999, the Government announced the Green Buildings BC – New Buildings Program to develop provincially funded facilities that are consistent with the concept of responsible, sustainable development. This means that the facilities will be more resource-efficient in their use of energy, water, and materials, in addition to generating cost savings and improving the comfort of building occupants.

Green Buildings BC Pilots

To advance these goals, the GBBC – New Buildings Program and the Ministry of Finance and Corporate Relations (MFCR) are using a number of capital projects across BC as "Green Pilot" demonstrations. The design, construction, and post-occupancy performance of the Pilot buildings are being closely monitored to inform the development of a long-term policy for more environmentally friendly projects funded by the province.

The Green Pilots are working to improve environmental performance and minimize resource consumption and life cycle cost (LCC), while ensuring that capital budgets are not exceeded. Minimizing LCC typically involves building design that reduces energy and other utility bills, lowers maintenance costs, and often enhances occupant health, satisfaction, and productivity.

> Life-cycle costs refer to all costs incurred over the building life, including those for initial capital, operating, maintenance, demolition, renovation, and disposal.

For more information

Further information on the program and Pilot projects is available from the GBBC website at www.greenbuildingsbc.com. Specific reporting requirements for the Pilots are outlined in Appendix A.

3.0 Overview of Value Analysis and the Integrated Design Process

3.1 Value Analysis

VA defined

Value Analysis (also known as "value management") is an objective and systematic process to identify the most cost-effective design decisions on a life cycle cost basis. VA provides a methodology for finding major savings in a facility without sacrificing value-for-money, reliability, or performance.

MFCR Guidelines

VA is required on capital projects to which the province contributes funding when the total project cost is $5 million or greater ($3 million for K-12 schools). MCFR's *Value Analysis Guidelines: Provincially Funded Facilities* help a design team examine alternative approaches to optimize decisions from a LCC perspective within the approved budget. The VA Guidelines and Policy can be obtained from www.fin.gov.gc.ca/cd/policies.htm.

VA consultant

Value Analysis involves various participants, including the design team, a VA consultant appointed by MFCR, and specialty consultants (e.g., energy engineer). The VA consultant manages the process and is responsible for ensuring that it meets the value analysis objectives.

For green projects, the VA consultant may delegate meeting facilitation to specialists, such as an energy engineer or a green design consultant. In these cases, the consultant in question should embody the necessary facilitation skills for an open "brainstorming" design process.

3.2 Integrated Green Design

IDP defined

Integrated green design uses a multi-disciplinary team of building professionals who work together from the pre-design phase through post-occupancy to optimize the building for environmental sustainability, performance, and cost savings. This design approach recognizes that a successful green building is best achieved by planning the site, structure, components, and systems as interdependent parts (see Figure 1).

4-step process

An IDP has been developed from the VA process, based on lessons learned during the early Green Pilots and other projects. The adapted process involves four steps, each of which contains green elements:

1. An orientation to Green Buildings BC – New Buildings Program and IDP is provided as part of the Project Kick-off Meeting.
2. Workshop #1 determines goals and objectives, makes green decisions on site design, building siting, orientation, and configuration, and sets non-energy draft Green Performance Targets.

3. Workshop #2 evaluates the building's base case energy use and energy conservation measures (ECMs)[1], selects the optimum package of ECMs, and sets energy draft Performance Targets for the facility.
4. The Design Development Value Analysis Workshop ratifies green targets and decisions and addresses all outstanding VA issues.

Although identified as single events in this document, each workshop can be broken down into more than one meeting, depending on the complexity of the project.

Process diagram[2]

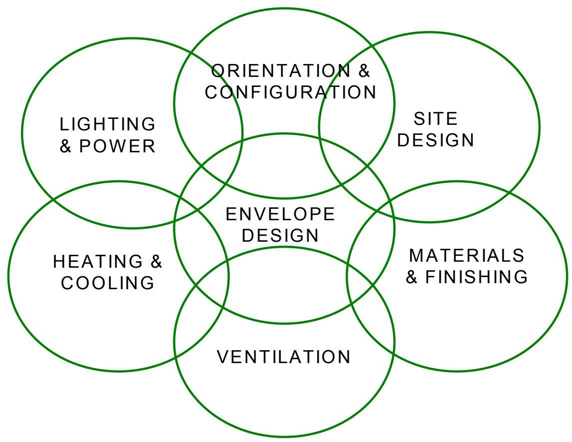

Figure 1: Integrated Design Process

Iterative nature of IDP

As mentioned above, the design process is likely to be less linear, or more iterative, than suggested by these four discrete steps. For example, non-energy green design decisions made in Workshop #1 may be revisited in Workshop #2 and the Design Development VA Workshop. Similarly, the ECMs assessed during the second workshop may be anticipated and discussed in the first workshop.

Green design consultant

The Integrated Design Process calls for new roles and functions. Of these, the green design consultant can make a major contribution where the design team lacks experience with green design. He or she is both a specialist in emerging aspects of green design and a generalist with broad cross-disciplinary green design knowledge.

The green design consultant can provide expertise in approaches that are new to most BC designers at the present time, including:

- building energy simulation
- passive solar heating
- natural ventilation and cooling
- materials selection for enhanced indoor air quality (IAQ) and lower environmental impact

[1] These and other terms and acronyms are defined in the Glossary at the end of the document.
[2] Bunting Coady Architects (2000), *Integrated Team Facilitation* (Vancouver: BCA), p. 2.

- on-site stormwater management
- construction and demolition waste management
- renewable energy technologies, including solar electricity generation and solar air and water heating
- water conservation and treatment
- climate-appropriate landscaping
- building and systems commissioning

If the green design specialist also has skills in facilitating collaborative brainstorming and decision-making workshops, these can be especially effective in releasing the creativity of the design team and gaining their buy-in on Green Performance Targets.

Energy engineer

Currently, GBBC pilot design teams are asked to try and meet energy conservation targets 50% below a design minimally compliant with the Model National Energy Code for Buildings (MNECB). This exceeds the eligibility requirement of the federal Commercial Building Incentive Program (CBIP) threshold of at least a 25% reduction. To reach these performance levels, an energy engineer experienced in sophisticated energy simulation software is invaluable.

> For most buildings, about 85 percent of their lifecycle environmental and resource impacts are due to heating, cooling, and lighting.

New to traditional design teams, energy engineers embody special expertise in building science, analysis, and engineering and the application of energy conservation and renewable energy measures. Typically, they have cross-disciplinary skills and a whole systems perspective. As a result, they offer an important resource to more generalist design team members.

Building energy simulations

An energy engineer's toolkit usually includes a variety of computer building energy simulation programs that allow the comparison of different design approaches aimed at reducing heating, cooling, and lighting loads, and energy and operating costs over a typical year.

Depending on the simulation tool(s) used, energy-conserving design approaches may include:

- building siting and form
- shading by landscaping and surrounding structures
- daylighting and glare control
- HVAC systems design and equipment selection
- photovoltaic electricity generation
- envelope thermal properties
- natural and mechanical ventilation
- lighting systems design and fixture selection
- HVAC and lighting control strategies
- active solar systems for air and water heating

In addition to computer simulations, the energy engineer can provide advice on energy issues, as required, throughout the preparation of working drawings and specifications, verifying the design's energy performance near its completion.

3.3 How Integrated Green Design Differs from Value Analysis

The Integrated Green Design approach for green buildings is similar to the standard VA process in that it helps the design team assess design choices and their cost implications. However, there are some key differences under IDP, as summarized below. Each of the following elements is essential for the design process to work effectively.

Enhanced design team

As noted earlier, IDP involves an enhanced design team that includes specialist consultants, such as an energy engineer and a green design consultant, in addition to the required cost and VA consultants. These green specialists take part in pre-design, schematic design, and early design development.

From the consultants the design team receives immediate feedback on the environmental, operating, and capital cost implications of alternative design strategies. This information is essential to ensure that LCC and adverse environmental impacts are minimized.

Earlier and fuller collaboration

The building owner, design professionals, cost and specialist consultants, and project managers work more closely as a team than in the traditional design process. Given the interdependence of building systems, each member of the expanded team must understand how his or her particular design elements influence the performance of other parts of the building and overall project costs.

> Energy, environmental, and cost issues of buildings are systemic; each element affects every other.

The team is urged to work collaboratively throughout the design process, during construction, and after occupancy. Early collaboration at the pre-design phase is an important feature of IDP. Before embarking on the design process, the building owner and occupants, regulators, and planning officials are consulted on site environmental issues and desired comfort conditions.

More decisions upfront

In general, the schematic design phase of an IDP is slightly more intense, and more decisions are made earlier. For example, a detailed wall assembly may be selected during early design development, through the energy simulations of Workshop #2, instead of later in the working drawings. Likewise, the selection of plant materials may be determined during schematic design, as part of Workshop #1, rather than later in design development.

Ongoing value management

The two workshops replace the Schematic Design Value Analysis session of the standard VA process. Schematic-level VA still occurs, but on an ongoing basis throughout schematic design, with the close cooperation of the VA consultant and other design team members.

Computer energy simulation

IDP uses computer building energy simulations as one means to identify ongoing operating costs, an important element of life cycle costing of the facility. These tools allow the design team to have LCC estimates at their fingertips (i.e., by running simulations during the workshops), to enable better-informed decisions.

Performance Targets set and tracked

The full design team agrees upfront on a set of Green Performance Targets to guide the entire design process. These targets refer to ultimate goals and objectives, and progress is tracked to ensure that the design remains congruent with them.

Ideas and options are successively tested against the Performance Targets and project constraints. As this occurs, targets are refined so that they better reflect the project's unique opportunities, as well as its constraints.

The targets are eventually ratified at the end of design development to become the Project-specific Green Performance Targets.

Post-occupancy evaluation

Post-occupancy Evaluations are essential and provide a valuable learning tool for green demonstration projects. These evaluations examine the actual performance of the green design features and ECMs and how it relates to the Project-specific Performance Targets.

4.0 Description of the Integrated Design Process

This section outlines the primary tasks and results of the four-step Integrated Design Process. More detail on workshop preparation and content is contained in the Appendices. The discussion throughout draws heavily on information provided by the Vancouver-based design firm of Bunting Coady Architects.[3]

Process sequence

The process described below is structured according to a typical design process where buildings are first massed out, then elevations are determined, and finally the building systems are added.

Under IDP, however, "additional support and information is provided so that the massing supports the envelope design, which in turn supports the system design".[4] The result is solutions that "tend to get the building working as an integrated system itself".[5]

The importance of creativity

The success of any IDP depends largely on the ability of the expanded design team to come up with creative design solutions that meet the project's various needs. Particular emphasis is on synergistic solutions that address several goals at once, such as environmental improvement, resource conservation, cost control, functionality, and "constructibility". Design teams are encouraged to have fun during the process, exploring novel and innovative green design approaches for their facilities.

4.1 Green Orientation Session

The first step in an IDP is the orientation to the Green Buildings BC – New Buildings Program and Integrated Green Design. This takes place in conjunction with the orientation to the government approval process normally presented in a standard Kick-off Meeting.

Tasks

- Introduce the project client and the design team to the New Buildings Program.
- Review the Integrated Design Process that results in a green project within the defined capital cost budget.
- Introduce Green Performance Targets using the GBBC – New Buildings draft document.[6]
- Review the relationship between life cycle costs and capital costs, LCC estimation procedures, and LCC assumptions set by MCFR.

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[3] Bunting Coady Architects (2000), *Integrated Team Facilitation*.
[4] *Ibid.,* p. 1.
[5] *Ibid.*
[6] Green Buildings BC (2000), *Performance Targets for Pilot Projects Green Buildings BC – New Buildings Program*, available from www.greenbuildingsbc.com/new_buildings/performance_targets.html.

- Identify the roles and preparation required for Workshop #1 by design team member.

- Identify the need for specialist design consultants, an energy engineer, a facilitator for Workshop #1, and an independent commissioning agent.

- Review the role of each design team members, including the VA and Cost consultants' responsibilities for estimating LCCs and the energy engineer's role in energy simulation and other functions.

Results

The entire extended design team is familiar with the New Buildings Program, the concept of Green Performance Targets, IDP, and the roles of all team members, so that they can proceed with the design process and subsequent workshops.

Further information

More information on this session is provided in:

Appendix B – Project Kick-off Meeting Agenda.

4.2 Workshop #1 – Goals, Objectives, and Non-energy Performance Targets; Site Design, Building Orientation, and Configuration

The first workshop determines the project's goals and objectives, develops green options for site design, building siting, and form, and drafts non-energy Green Performance Targets specific to the project.

Tasks

<u>PART 1 – GOALS AND OBJECTIVES; GREEN PERFORMANCE TARGETS</u>

- Explore environmental goals and objectives to be pursued for the facility from design through post-occupancy.

- Review goals and objectives against the program requirements for the project, to ensure consistency and compatibility.

- Obtain agreement and commitment from the entire design team on these goals and objectives.

- Start defining Project-specific Green Performance Targets for non-energy issues, such as material selection, potable water conservation, and commissioning.

<u>PART 2 – SITE DESIGN, BUILDING ORIENTATION, AND CONFIGURATION</u>

- Explore green design approaches for site design and locating the building given site characteristics and constraints. Address issues such as parking, landscaping, shade requirements, fresh air ventilation strategies, water reuse and reduction strategies, grey-water reuse potential, storm-water management, and access to transportation.

The site and building complement each other and are designed to optimize the energy efficiency and environmental sustainability of the project. Bunting Coady Architects

- Explore green design approaches for the building orientation and configuration to minimize heating, cooling, and lighting loads. Issues to be addressed include fenestration strategies, basic thermal mass and daylighting, and active versus passive solutions.

- Decide if concept building energy modelling is necessary, depending on the building size and program

- Draft the most promising siting and form concept(s) to address facility programming, site constraints, and load requirements

PART 3 – TARGET REVIEW

- From the work done in Part 2, agree on non-energy draft Project-specific Green Performance Targets related to site design

- Flag green design strategies and issues (e.g., use of renewable energy, grass paving) requiring more information and capital and life cycle costing, and assign items to design team members

Results

The information gathered and the decisions made at this workshop will enable the selection of an optimal site design and building form and siting concept to meet project-specific needs and goals. The selected concept will be used as the Base Case building model for the detailed energy simulations in Workshop #2.

The selection of the best siting and form concept will be made or confirmed between the first and second workshops, at a meeting convened by the architect and attended by the owner, VA consultant, cost consultant/quantity surveyor, and mechanical and energy engineers. This selection will be based on the results of schematic-level capital cost estimates and any energy simulations of the concept designs. The group will also identify ECMs for the Base Case to be included as options in the energy simulation and costed prior to Workshop #2.

Further information

More information on this session is provided in:

Appendix C – Preparation for Workshop #1
Appendix D – Workshop #1 Agenda
Appendix E – Background to Workshop #1

4.3 Workshop #2 – Building Systems, Building Materials and Finishing, and Energy Performance Targets

The second workshop focuses on the energy conservation aspects of the facility design. In this session, the design team will explore a number of issues related to the buildings systems and the final selection of building materials:

Envelope design – The goal for the building envelope design is to optimize energy efficiency while minimizing glare. Issues to be explored include thermal mass, glazing and window framing, glare and sun shading, and insulation values.

Ventilation – The goal here is to improve indoor air quality while maintaining energy efficiency. Issues include quantity of outside air, filtration, and distribution.

Lighting and Power – The goal here is to optimize daylighting and reduce lighting loads. Issues include the use of light shelves, clerestories, task lighting, equipment, and controls.

Heating and Cooling – The goal here is to select the HVAC configuration that meets the building's functional requirements while cost-effectively minimizing energy use. Issues include system layout, system performance, space conditioning, renewable energy sources, and control system sizing.

Building Materials – The goal here is to select building materials that improve the indoor air quality and energy efficiency of the facility. Issues to be explored include the use of salvaged materials or materials with high recycled content and construction methods to reduce the quantity of materials used.

Tasks

PART 1 – BUILDING SYSTEMS

- Review the Base Case building model and selected ECMs that were identified prior to the workshop.
- Choose the basic mechanical system to meet building heating and cooling loads.
- With the help of the energy simulations and cost information, evaluate energy and cost savings opportunities from design tradeoffs between different building systems (e.g., ventilation and heating/cooling systems). Do the same for different components of specific building systems (e.g., between pump energy and chiller energy).
- Select the best package of load reduction and mechanical system measures in terms of energy consumption and costs.

PART 2 – BUILDING MATERIALS AND FINISHING

- Review decisions made in Workshop #1 on building material selection.
- Select materials and products for finishing to meet air quality/ ventilation requirements and minimize energy use, including embodied energy.

PART 3 – TARGET REVIEW

- From the work done in Part 1, agree on energy draft Project-specific Green Performance Targets for the best ECM package. Figure 2 provides an example of a Project-specific Performance Target and how it relates to the ultimate goal of the GBBC – New Buildings Program.

- Review, revise, and ratify non-energy green design approaches and non-energy draft Project-specific Green Performance Targets from Workshop #1.

Illustration of performance targets

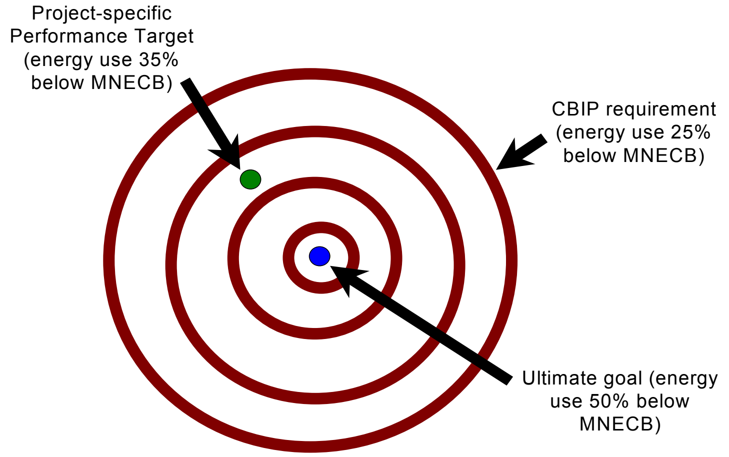

Figure 2: Energy Performance Target Example

Results

The various building systems are determined to optimize the energy efficiency and environmental sustainability of the facility. The various building materials are selected to optimize air quality and minimize embodied energy.

Further information

More information on this session is provided in:

Appendix F – Preparation for Workshop #2
Appendix G – Workshop #2 Agenda
Appendix H – Background to Workshop #2

4.4 Design Development Value Analysis and Subsequent Process

Special care must be taken at the design development and subsequent stages not to undo critical green decisions.

Once the second workshop and its follow-up work are complete, a Design Development Value Analysis is conducted and a subsequent process is followed to ensure that green decisions and targets are carried out as planned during the pre-schematic design and schematic design phases.

Tasks

- Conduct a Design Development Value Analysis according to existing VA Guidelines (www.fin.gov.bc.ca/cd/policies.htm). This includes the preparation of a Design Development Value Analysis Report (see Appendix A).

- Track progress and closely coordinate design teamwork to ensure that accepted green and energy conservation measures are properly implemented in design drawings and specifications.

- Undertake a final computer energy simulation when working drawings and specifications are 95% complete, to verify that the final design meets or exceeds its energy Project-specific Performance Targets and to release CBIP incentive payments.

- If post-tender negotiations occur, follow up to ensure that green measures and ECMs are reflected and respected. Of particular importance at this stage is the integrity of the building as a system. Undoing the approved package of ECMs will jeopardize overall system performance.

- Follow up on the implementation of green measures, ECMs, and other environmental issues that may arise during the construction phase.

- Carry out independent commissioning of the facility and its systems to ensure that green measures and ECMs operate according to the design intent.

- Conduct one or more Post-occupancy Evaluations, the first about a year after occupancy, to investigate the actual performance of the green measures and ECMs relative to the final Project-specific Green Performance Targets.

Result

The green design features are successfully implemented in the remaining phases of design development, construction, building commissioning, and post-occupancy.

Glossary of Terms and Acronyms[7]

ASHRAE	The American Society of Heating, Refrigeration and Air Conditioning Engineers.
Building energy simulation	Computerized modelling of a building and its systems that predicts energy consumption performance; typically based on hourly weather inputs and scheduled profiles of occupants, loads, and systems.
CAR	Capital Approval Request
Commercial Buildings Incentive Program (CBIP)	A program from Natural Resources Canada's Office of Energy Efficiency that provides financial incentives of up to $60,000 for new commercial/institutional buildings that are 25% more energy efficient than MNECB.
Commissioning	A comprehensive plan and process that ensures all building systems perform according to the documented design intent and the owner's operational needs.
Daylighting	Lighting spaces within a building with natural light.
DDR	Design Development Report
Energy conservation measure (ECM)	A specific device or action that reduces energy consumption in a building.
Ecosystem	A complex set of natural, interconnected elements on which a habitat's survival depends directly or indirectly.
EE	Electrical Engineer
Embodied energy	The energy used to grow, harvest, extract, manufacture, refine, process, package, transport, install, and dispose of a particular product or building material.
Envelope	Building element (e.g., walls, roofs, floors, windows) that enclose conditioned spaces and through which energy may be transferred to and from the exterior.
Fenestration	The way in which windows are arranged in a building.
Greywater	The wastewater from faucets, showers, and clothes washing that does not contain sewage or faecal contamination. (Kitchen sink and toilet water is called "blackwater".) Greywater can be reused for irrigation after it is filtered.
GBBC	Green Buildings BC

[7] The definitions of terms are taken from Ministry of Finance and Corporate Relations (2000), *Green Buildings Checklist* (Victoria: Capital Division, December), and Rocky Mountain Institute (1998), *Green Development: Integrating Ecology and Real Estate* (New York: John Wiley & Sons).

HVAC	Heating, Ventilation, and Air Conditioning
Indoor air quality (IAQ)	Acceptable IAQ is defined by ASHRAE standards. Defined as air that is not likely to pose a health risk and if a substantial majority of occupants do not express dissatisfaction.
IDP	Integrated Design Process
LCC	Life Cycle Cost
Life cycle costing	An economic analysis that includes capital costs, transportation costs, installation costs, operating costs, maintenance costs, and disposal costs.
LEED	Leadership in Energy and Environmental Design
Massing	The combined effect of the height, bulk, and silhouette of a building or group of buildings.
ME	Mechanical Engineer
MNECB	Model National Energy Code for Buildings.
MFCR	Ministry of Finance and Corporate Relations
Potable water	Water that is safe and satisfactory for drinking and cooking.
Recyclables	Materials that can be collected and recycled in the vicinity of where they were collected.
Recycled materials	Materials that are bought new but have used some recycled content in the manufacturing process.
Programming	The sequence of events or procedures to be followed in order to implement a project.
Renewable energy	Energy from sources that are continuously being renewed, such as wind energy, solar energy, and micro hydro.
Salvaged materials	Materials that have been used before and have not been remanufactured, but may require some minor processing.
SE	Structural Engineer
Thermal bridge	A pathway for heating energy flow through with little resistance. Any highly conductive element such as a metal stud, spacer, or channel in the building envelope that penetrates or bypasses the insulation will act as a bridge through which heat can escape.
VA	Value Analysis

Workshop	A working meeting, or meetings, in which all project team members come together in the early phase of the project's design to set goals and generate design ideas.
Xeriscaping	Creating landscaping design for conserving water that uses drought-resistant or drought-tolerant plants.

Appendix A: Pilot Reporting Requirements

Design teams taking part in the Green Buildings BC Pilot projects are required to report on their experience and the performance of their facilities at several points in the Integrated Design Process.

Typically, to minimize additional work by the design team, reporting is done in an appendix to the VA reports already required by MCFR. These include the Schematic Design and Design Development Value Analysis Reports, which are then passed along to New Buildings Program staff. The reports are usually followed up by telephone or face-to-face interviews with participants.

Examples of the reports are provided below.

Design Development VA Report

The design team fills out a form supplied by the New Buildings Program on the Project-specific Green Performance Targets that have been agreed upon and the green measures and ECMs that will be incorporated into the design.

Final Design Report

After submission of the completed design documentation for the building permit and project tender, the design team reports on whether the Project-specific Green Performance Targets have been achieved or missed. The Final Design Report also explains the reasons underlying any changes to the targeted performance and summarizes the design team's experience in implementing the green measures and ECMs.

The report is partially based on a final computer energy simulation performed by the energy engineer and based on the design when working drawings and specifications are approximately 95% complete. This simulation also serves as confirmation of the design's energy performance to be submitted for CBIP incentives. A copy of the simulation report is submitted to GBBC, as part of the final report on the environmental and resource aspects of the design.

Construction Report

Immediately after occupancy of the facility, the design team, aided by the contractor, reports on its experience implementing the green and energy conservation measures, and the potential impact of any changes on the Project-specific Performance Targets.

Post-occupancy Evaluation(s)

The New Buildings program will work with the facility owner to undertake a Post-occupancy Evaluation after one year.

Appendix B: Project Kick-off Meeting Agenda

The following agenda indicates the kinds of issues that are dealt with in a typical Project Kick-off Meeting. It is provided here to illustrate how green issues (highlighted in green) can be integrated into the overall Capital Project Process.

Attendees

Core Project Team Members
Architect
Structural Engineer (SE)
Mechanical Engineer (ME)
Electrical Engineer (EE)
MFCR Project Analyst
Value Analysis (VA) consultant
Cost consultant
GBBC New Buildings Program representative

Additional Members
Green design consultant(s)[8]
Planning/regulatory approvals staff[8]
Facilities staff (O&M)[8]

Agenda

1. Introduction of Attendees (all)

2. Ministry of Finance and Corporate Relations
   - Roles, responsibilities, and expectations:
     - Review project scope and budget (Design Aid Sheet)
     - Project stays on budget and within scope
     - Roles/lines of communication
     - Cost models (if applicable)
     - Value Analysis Guidelines
     - Off-site Policy, Supplementary Funding Policy
     - Design Development Report (DDR)
     - Capital Approval Request (CAR)
     - Pre-tender Estimate/MCFR Approval to Tender
     - Set Project Schedule and Target Dates
     - Project Closure

3. Integrated Green Design Capital Project Process
   - Green Buildings BC – New Buildings Program
   - VA/IDP overview
   - Green design workshops
   - Draft Green Performance Targets
   - Use of computer building energy simulation and role of energy engineer
   - Life cycle cost procedures and assumptions (discount rate, forward escalation rates, cyclical renewal periods, regular maintenance, etc.)
   - Specialist green design consultants
   - Independent commissioning agent
   - Reporting Requirements
   - Preparation required for Workshop #1

[8] Optional.

Appendix C: Preparation for Workshop #1

The information outlined below should be collected and prepared for the first workshop on Site Design/Building Siting and Building Orientation and Configuration. Specific information requirements for each design team member should be reviewed in the project Kick-off Meeting (see Appendix B).

C.1 Information Required from the Project Client

The architect, while reviewing the facility program, typically collects the following information from the building owner. A green design consultant may assist in areas where the architect is unfamiliar with specific issues.

Indoor air quality

1. Is IAQ a key issue for the owner and occupants?

2. Has poor IAQ led to labour disputes or legal action in the recent past, or is it likely to do so?

Environmental and resource management

3. What importance do the owner and occupants place on environmental and resource management issues?

4. How do regional environmental issues relate to the building design?

Demonstration of environmental responsibility

5. Do the owner and occupants see significant benefits from an enhanced environmental image (e.g., marketing, public relations, staff and occupant morale, closer relationship with public agencies and strategic partners)?

Productivity

6. How important for the owner and occupants are the productivity impacts of a high-quality indoor environment (e.g., increased job performance due to daylighting, reduced absenteeism from better IAQ)?

Operation and maintenance

7. Who is responsible for building O&M and what skills/resources are available to them?

8. Can O&M staff (preferably a technician who has performed the actual work on similar buildings) attend design workshops to identify and inform the team on O&M issues?

9. Are maintenance staff currently using toxic materials (cleaners, insecticides) and, if so, can non-toxic substitutes be used?

10. How can the design facilitate little or no use of toxic materials?

Occupant comfort conditions

11. Are occupants willing to trade off rigid control of comfort conditions for greater individual control over their indoor environment?[9]

Municipal infrastructure

12. Does the local municipality have environmental or infrastructure capacity constraints that the building should address (e.g., storm-water management, potable water supply, sewage treatment)?

13. Can money be saved by treating waste and storm water on site?

14. Will the local municipality accept greater emphasis on alternative forms of transportation, including public transport, carpooling, pedestrian, and bicycle access to displace single occupancy vehicles and related parking requirements?

15. Can some of the money saved as a result of these features be used to fund other green initiatives?

Potable water management

16. Is the owner interested in a xeriscape approach to landscaping that could reduce the need for potable water and pesticide use?

17. Are there regulatory or programmatic barriers to the use of low-flow fixtures and greywater or rainwater capture systems?[10]

Salvaged material

18. Is the owner interested in using salvaged materials?[11]

19. Are there any buildings scheduled for demolition that might provide salvaged materials for use in the new facility?

Commissioning

20. Has the owner hired a commissioning agent to prepare a commissioning plan for the facility? (Note that this is a support-able extra fee expense for Green Pilots that may be incorporated into the project at the DDR/MFCR Completion Funding Request stage.)

Features to be protected/retained

21. Are there features that the owner, municipality, or other regulatory bodies desire/require to be retained or protected (e.g., trees, streams, heritage building facades)?

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[9] Providing greater occupant comfort control, combined with relaxed comfort conditions as required by ASHRAE standards, is one way to reduce the size of the mechanical system and, therefore, capital and operating costs. Furthermore, studies show that occupants tolerate a wider range of indoor climatic conditions if they have individual control over comfort conditions, and if their actions have an immediate and obvious response.

[10] Effective potable water conservation may result in a smaller connection to water main supplies, potentially resulting in lower capital and operating costs, if allowed by the local municipality or district.

[11] Studies done for the Greater Vancouver Regional District show that the use of salvaged material can lead to significant savings. See Kernan, Kadulski, and Labrie (2001), *Old to New: Design Guide; Salvaged Building Materials in New Construction* (Vancouver: GVRD, March). Because the current salvage industry is geared towards small-scale residential projects, the challenge for larger projects is to gather sufficient quantities of the desired materials. If large enough quantities can be purchased from one source, significant savings are possible, despite some added cost for deconstruction and storage of materials. However, materials must be sourced early, storage arranged, and lead time allocated for processing.

C.2 Other Information Required from the Project Client and Design Team

The architect and other members of the core design team (SE, ME, EE) generally collect a variety of information while reviewing local, provincial, and federal regulations and codes applicable to the facility. In addition, the design team should gain some general understanding of desired building features, their costs, and related items. A listing of the information typically collected is provided below.

Site and regulatory information

- Site condition data:
  - Soils report (SE, architect, or owner)
  - Local stormwater management regulations and data (SE, architect, or owner)
  - Percolation tests to determine if on-site stormwater management is feasible

- Local microclimate data:
  - Sun path diagrams (architect)
  - Prevailing wind direction and speeds for average year and days in 4 seasons (architect, ME, or EE)
  - Average daily temperature profile for 4 seasons (architect, ME, or EE)
  - Design temperatures (ME, EE, owner, and/or occupants representative)
  - Shading profiles of site and surrounding topography, trees, and buildings (architect)
  - Features of concern – trees, streams, archaeological, etc. (architect, landscape architect)

- Local regulatory issues for potable water conservation: greywater use, rainwater collection, on-site sewage treatment (ME)

- Environmental protection regulations (architect, specialist green design consultants)
  - Need for environmental assessment
  - Applicable stream and habitat regulations

Design team general knowledge

In addition, the design team might want to ensure some familiarity with the following issues.

- Capital and life cycle costs of desired components, assemblies, and systems
- Potable water conservation:
  - Greywater collection and use (architect, landscape architect, ME)
  - Rainwater collection and use (architect, landscape architect, ME)
  - Xeriscaping (architect, landscape architect)

- Stormwater management best practices (architect, ME, landscape architect)

- Indoor air pollution by interior finish materials and cleaning and maintenance products (architect, ME)
- Daylighting, solar control, and natural ventilation design considerations (architect, ME, EE, SE)
- Commissioning process (architect, ME, EE, SE, owner)

Further resources

Other GBBC and outside resources on the information items required for Workshop #1 include:

- *The Guide to Green Buildings Resources*, available from www.greenbuildingsbc.com/new_buildings/resources.html.
- *Design, Construction and Planning Strategies for Green Buildings*, also available from the above website.
- The *Reference Guide* for the US Green Building Council's LEED Green Building Rating System, which can be obtained from www.usgbc.org/resource/index.htm.

Appendix D: Workshop #1 Agenda

The following agenda outlines the tasks for the first workshop to determine project-specific goals and objectives; site design, building orientation, and configuration; and non-energy draft Green Performance Targets. More details on the working session (Item #4 below) are provided in Appendix E.

Attendees

Core Project Team Members	Additional Members
Architect	Energy engineer
SE, ME, EE consultants	Landscape architect
MCFR Project Analyst	Client representative
VA consultant	Occupants representative
Cost consultant/quantity surveyor	Facilities staff (O&M)
GBBC – New Buildings Program representative	Specialist green design consultants[12]
	Planning/regulatory approvals staff[12]

Agenda

1. Introduction of Attendees (all)

2. Review Facility Program and Site Constraints (architect)
   - Highlights of facility program and local environmental issues
   - Site and microclimate conditions

3. Review Lifecycle Cost and Value Analysis (VA consultant)
   - Discounted cash flow decision-making tools
   - LCC assumptions – discount rate, building life, general and fuel escalation rates, etc.

4. Working Session (all)

   Part 1 – Goals, Objectives, and Performance Targets
   - Explore environmental goals and objectives to be pursued from design through post-occupancy
   - Review goals and objectives against the project's program requirements
   - Obtain design team agreement and commitment on goals and objectives
   - Start defining non-energy Project-specific Performance Targets

   Part 2 – Site Design, Building Orientation, and Configuration
   - Explore green design approaches for locating the building on site, given facility program, solar and wind access/ protection, habitat and vegetation protection, and access to transportation
   - Explore green design approaches for the building orientation and configuration to minimize heating, cooling, and lighting loads
   - Decide if concept building energy modelling is necessary, depending on the building size and program

[12] Optional.

- Draft the most promising siting and form concept(s) to address facility programming, site constraints, and load requirements

Part 3 – Target Review

- Based on the results of Part 2, agree on non-energy draft Project-specific Performance Targets related to site design
- Flag green design strategies and issues requiring more information and costing and assign items to design team members

5. Review Preparation and Schedule for Workshop #2 on Building Systems

Appendix E: Background to Workshop #1

This appendix provides some background for the first workshop on site design/building siting and building orientation and configuration (see the agenda in Appendix D). Workshop #1 typically requires 6 to 8 hours, including a brief lunch break.

E.1 Part 1 – Goals, Objectives, and Performance Targets

Goal-setting

At the start of the working session, the design team explores the environmental and resource conservation goals and objectives to be pursued throughout the facility's design stage and beyond. All team members must participate in this process, agree to the final goals and objectives, and commit to supporting them.

Helpful documents

To assist with setting goals and performance targets, the design team can use the GBBC *Performance Target Document*[13] and/or the LEED Green Building Rating System objectives.[14] The GBBC document outlines 13 goals in the form of Draft Performance Targets related to energy, water, waste materials, site ecology, air quality, cost, and other site characteristics.

Exploration of strategies

The heart of the working session is when team members collaboratively explore systemic approaches to reduce the facility's environmental and resource impacts.

The design team begins by generating a number of green design approaches that address the agreed upon goals and objectives. Each option is analyzed for its applicability and match to the building program and site constraints. The VA and cost consultants provide rough estimates of the options' capital and lifecycle costs. The design team then decides which approaches to incorporate into the design in schematic design and design development, and sets Project-specific Green Performance Targets for these issues.

At this stage, the team will start considering two issues that are important to ensuring effective green design: building material selection and commissioning of the building and its systems.

Building material selection

Building materials are selected from both an energy perspective and a ventilation/air quality perspective. From an energy perspective, the goal is to improve building energy efficiency. Therefore, materials that cause thermal bridging or allow for heat gain or loss would be avoided.

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[13] BCBC and MFCR (2000), *Performance Targets for Pilot Projects Green Buildings BC – New Buildings Program* (Draft), available from http://www.greenbuildingsbc.com/new_buildings/performance_targets.html.
[14] See www.usgbc.org/resource/index.htm.

The amount of embodied energy is also considered when selecting materials. Although this is an evolving area of research, reducing embodied energy can be done by choosing salvaged material or material with high recycled content. Another approach is to reduce the amount of material used in the buildings through innovative construction methods.

Commissioning

A formal commissioning process:

- Ensures that the building's systems and equipment function properly and efficiently
- Trains future operators on the most efficient O&M of the building
- Provides complete and detailed operating manuals (control sequences and algorithms etc.)
- Informs occupants with respect to the proper operation of the facility

Commissioning is often minimized in order to accommodate tight occupancy deadlines and delays in construction, to the detriment of building operations. For best results, a commissioning plan should be created during the design process. The Green Pilots strongly recommend that the owner hire a dedicated commissioning agent and pay him or her directly, rather than as a subcontractor, to avoid conflicts of interest with the design team and/or contractors.

Further analysis of design strategies

In some cases, additional information may be required to make a decision on a specific design approach. These should be flagged for action and discussion at Workshop #2 and the Design Development VA meeting.

E.2 Part 2 – Site Design, Building Orientation, and Configuration

Site design and building siting

The purpose of this phase is "to rationalize the site design in terms of requirements for parking and pedestrian access along with considerations of the site as an eco-system contributing to the sustainability of the project as a whole".[15] Site design should be consistent with sustainability goals and should include building siting as an integral element.

Green design approaches that may be considered here include:

- potable water conservation
- climate-appropriate landscaping
- on-site stormwater management
- use of special site features (e.g., streams, treed areas) for natural cooling, water filtration, and fresh air circulation
- building siting to optimize access to pedestrian pathways, cycling paths, and bus routes

[15] Bunting Coady Architects, *Integrated Team Facilitation*, p. 3.

Building orientation and configuration

In this phase, the design team works to develop the optimal form of the building and its orientation on the site. The architect, owner, and other team members (e.g., the energy engineer, where appropriate) develop and analyze the options for building massing and orientation. The goal is to "meet performance criteria for the site and building and for basic energy loads".[16]

Concept energy modelling

If the building's HVAC loads are likely to be dominated by outdoor conditions, the design team may decide to have the energy engineer perform computer energy simulations at this stage. These "envelope-dominated" buildings are typically smaller facilities on sites that offer location flexibility, with high envelope area to volume ratios and/or low internal loads.

The energy simulations will allow the team to assess the performance of site and form concept designs generated in this first session. Evaluation results would then be reviewed in a follow-up meeting of the architect and mechanical and energy engineers, in order to select the most promising siting and form concept for more detailed energy simulations prior to the second workshop.

The design team explores how the building's location, form, and massing may reduce heating, cooling, and lighting loads. Typically, this will involve considering passive solar heating, natural ventilation and cooling, daylighting and light control, renewable energy collection technologies (e.g., solar electricity generation, solar water and air heating), and any other design approaches raised by the team. Preliminary fenestration strategies are also developed at this stage.

Siting and form concept designs

The design approaches are incorporated into sketches of the facility that depict selected siting and form concept alternatives. These options are evaluated and one is selected during the preparation for Workshop #2 (see Appendix F).

E.3 Part 3 – Target Review

Non-energy draft Performance Targets

Based on the evaluation of green design approaches above, the team sets draft Project-specific Green Performance Targets for non-energy design issues. Draft energy targets cannot be determined until the detailed energy simulations have been completed in Workshop #2.

The draft Green Performance Targets are quantitative and qualitative benchmarks for assessing progress on the project's goals and objectives from Part 1. Because of site and facility constraints, project-specific targets will differ from the overall targets of the GBBC – New Buildings Program.

[16] *Ibid.*, p. 2.

Appendix F: Preparation for Workshop #2

Several pieces of work must be completed before the second design workshop can be scheduled and implemented.

F.1 Energy Simulations and Cost analysis

Energy simulations at concept stage

If it was determined in Workshop #1 that energy simulations were required to decide between two or more design concept options, then the following must be done:

1. Complete computer energy simulations and schematic-level capital cost estimates of the concept designs (EE and cost consultant/ quantity surveyor in consultation with the VA consultant, and helped by the architect and ME)

2. Select the most promising siting and form concept to serve as the Base Case building model (architect, assisted by ME, EE, VA consultant, and potentially the cost consultant /quantity surveyor)

Establishment of Base Case and selection of ECMs

Once the design concept has been selected (with or without the help of energy simulations), the design team selects a number of ECMs to be applied to the Base Case building model.

The energy engineer, with information and advice from the architect and the rest of the design team, proceeds with the detailed energy simulations. These simulations include:

- Reference building model (as a baseline for CBIP incentive payments)
- Base Case building model, representing typical construct-ion practice and the siting and form concept design
- all the various ECMs identified by the team

The cost consultant, in contact with the VA consultant and helped by the EE, ME, and architect, prepares schematic-level capital cost estimates of the Base Case, as well as schematic-level unit cost estimates of the ECMs.

Schematic-level energy and cost estimates are done for comparative purposes and should not be used to create capital budget.

F.2 Information Requirements

In order to proceed with the energy performance workshop, the energy engineer needs the following information at least two weeks prior to the workshop so that the detailed energy simulations can be performed in advance.

Architect

- ~80-90% complete schematic architectural design drawings:
  - floor plans
  - elevations
  - building sections
  - Base Case envelope sections – wall, roof, and floors

Mechanical Engineer

- Outdoor air and exhaust quantities
- Schematic supply air quantities (cfm/sq ft conditioned floor area, or L/s-sq m conditioned floor area)
- Base Case HVAC, system, equipment selections, and supply and exhaust air zone sketch indicating the supply air unit for each zone
- Suggestions for HVAC systems and energy conservation measures to investigate in Workshop #2

Electrical Engineer

- Lighting Power Densities for Base Case schematic design and sketch of applicable areas
- Lighting Power Densities for alternative schematic design approaches
- Exterior lighting power for Base Case schematic design and alternatives

Cost consultant (with VA consultant)

- Unit costs for each ECM to be examined in the workshop

The energy engineer will supplement the information listed above with meetings or telephone conversations with the architect and mechanical engineer to clarify details and finalize a list of ECMs for examination. If the architect and ME are not available, an alternate should be designated for consultation with the energy engineer.

Appendix G: Workshop #2 Agenda

The following agenda outlines the tasks for the second workshop on building systems and finishing that determines the facility's energy conservation measures and draft energy Performance Targets. More detail on the agenda items is presented in Appendix H.

Attendees

Core Project Team	Additional Members
Architect	Energy engineer
SE, ME, EE consultants	Landscape architect
MCFR Project Analyst	Client representative
VA consultant	Occupants representative
Cost consultant/quantity surveyor	Facilities staff (O&M)
GBBC – New Buildings Program representative	Materials consultants
	Planning/regulatory approvals staff[17]

Agenda

1. Introduction of Attendees (all)

2. Review Background Information
   - Use of schematic-level energy simulations and costing (EE)
   - Utility rates and available incentive programs (EE)
   - Selected siting and form concept design (architect)
   - Unit and lifecycle costs of ECMs (cost consultant/quantity surveyor)

3. Review Base Case Model and Selected ECMs (EE, all))
   - Check Base Case model assumptions with design team and revise, as necessary
   - Review Base Case energy end-uses and identify best opportunities for energy conservation

4. Working Session (all)

   Part 1 – Building Systems
   - Select mechanical system to meet building heating and cooling loads
   - Using energy simulations and cost information, evaluate energy and cost savings potential from design tradeoffs between different building systems and building system components
   - Select best package of load reduction and mechanical system measures based on analysis above

   Part 2 – Building Materials and Finishing
   - Review decisions made earlier on material selection.
   - Select building materials for air quality/ventilation requirements and embodied energy levels.

[17] Optional.

5. Summarize Results of Working Session
    - Review and confirm final package of ECMs (EE)
    - Identify ECMs requiring close coordination and roles of team members for each measure (all)
    - Review action items, persons responsible, and dates for completion (architect or facilitator, EE)
    - Agree on energy draft Project-specific Performance Targets (all)

6. Review Outstanding Items from Workshop #1 (all)

    Part 3 – Target Review
    - Review green design issues and approaches flagged for further research and costing in the first workshop
    - Discuss and decide on final non-energy green design approaches, and identify those requiring close coordination and roles of team members for each
    - Ratify draft project-specific non-energy Performance Targets from Workshop #1 (all)

Appendix H: Background to Workshop #2

This appendix provides some background on the second workshop on building systems, materials, and finishing (see the agenda in Appendix G). Workshop #2 typically requires 5-6 hours, including a short lunch break; if there are outstanding items from Workshop #1, it may extend longer.

The workshop starts with a presentation of the agreed-upon Base Case design. The design team then has two working sessions of 2-3 hours each, where member work together to refine the Base Case and HVAC system design, collaboratively exploring a variety of ECMs.

H.1 Cost Estimates and Simulations

Real-time energy and cost data

In preparation for this workshop, the cost consultant/quantity surveyor will have prepared schematic unit cost estimates for the proposed ECMs. During the workshop itself, the energy engineer provides the team with instantaneous feedback on operating costs and pollutant emissions, based on the computer simulations. At the same time, the cost consultant/quantity surveyor estimates schematic capital costs of the ECMs being examined, using the previously prepared unit costs. These two key pieces of information allow the design team to make most decisions immediately at the workshop.

Accuracy of cost estimates

Operating and capital cost estimates in Workshop #2 reflect the schematic level of detail available at this point in the design process. The energy engineer and the cost consultant/quantity surveyor should not attempt to provide unnecessary precision in their advice at this stage. The point of the workshop is to choose between schematic alternatives. Therefore, providing accurate *incremental differences* in capital or energy costs between design options is more important than the absolute precision of an estimate for any given ECM or package of measures.

H.2 Review of Information

Background information

To provide background for the workshop, the energy engineer briefly outlines the use of computer simulations as a design tool and the effects of utility rates and possible incentives. The architect summarizes the rationale for having selected the site and form concept design for the Base Case model. In addition, the cost consultant/quantity surveyor reviews the basis for unit and life cycle cost estimates.

Base Case model assumptions

The energy engineer reviews the Base Case model assumptions to ensure that the simulations reflect the design intent. If changes are necessary, these may be done on the spot; otherwise, follow-up simulations may be necessary to confirm the workshop results.

Energy end-uses and ECM potential

The annual end-use energy breakdown of the Base Case is then presented, to help the design team focus on the best energy conservation opportunities.

Selection of Base Case mechanical system

Often, several mechanical systems are proposed for the facility. In this case, each is simulated prior to the workshop using Base Case architectural and electrical assumptions. The results of these simulations are presented to the team for review and discussion. Members then collectively decide which system simulation should be used during the workshop to explore load reduction and HVAC system ECMs. The team also identifies which systems merit further investigation after the workshop.

H.3 Working Session

Load reduction and HVAC measures

The initial focus of the working session is on reducing heating, cooling, and lighting load. Once loads have been reduced, attention shifts to ECMs mostly associated with the HVAC system. These may include different equipment efficiencies, staging, outdoor air heat reclaim methods, solar air preheat, economizers, control strategies and systems, etc., as suggested by the mechanical and energy engineers and other design team members.

Analysis of ECMs

In both cases, the process of analyzing an ECM is the same:

1. The energy engineer presents energy consumption, cost, and pollutant emissions from prepared simulation results, or from an on-the-spot simulation.

2. The ECM capital cost is estimated by the cost consultant/quantity surveyor.

3. Maintenance issues, frequency, and replacement intervals are discussed by the design team, and their input is used for a LCC estimate.

4. the team then accepts or rejects the ECM, on the basis of performance, issues raised in discussion, or its cost impacts.

Packaging measures

It is often found that several ECMs have synergistic effects that increase their combined effectiveness and/or reduce their cost. At the end of the load reduction and HVAC system sessions, the accepted measures are packaged together and a simulation that combines these measures is performed. The simulation results then inform a discussion on whether to accept, reject, or refine the package, following the same reasoning used for an individual ECM.

H.4 Workshop Wrap-up

Workshop summary

At this point, the main features of the design are established and the team will have a good sense of the complexity of its elements and systems. The energy engineer summarizes the workshop results and the decisions made. Available incentive payments for energy efficiency are identified and the final bundle of ECMs is reviewed. Those measures requiring particular attention or coordination are highlighted, and team members designated for action.

Energy Performance Targets

The energy portion of the workshop ends with the design team's agreement on energy Project-specific Performance Targets. (Note that the estimated annual energy cost must be at least 25% below that of the MNECB Reference building to qualify for CBIP incentive payments; the ultimate goal of the GBBC – New Buildings Program is 50% or more.)

Review of Workshop #2 items

The final task is to follow up on items carried over from Workshop #1. The team should review information gathered in the interim and finalize the list of (non-energy) green design approaches and measures. The meeting closes with design team consensus on Project-specific Green Performance Targets that will guide their subsequent work.