



Artist's concept of Dockside Green's main thoroughfare. BACnet is the main networking protocol for this \$1.2 billion development.

# BACnet® for Net Zero

By Robert Rodenhiser

**B**uilt on 15 acres, Dockside Green is a \$1.2 billion development fast becoming a leading ecoresidential and ecoindustrial development. As a model for green living, the Dockside Green community will exceed almost all of the current environmental performance standards for green buildings in Canada. Twenty-four buildings at Dockside Green will pursue LEED® Platinum certification. Dockside Green is the prototype for Platinum LEED-ND (Neighborhood Development) certification. To venture into the uncharted territory of LEED-ND certification, Dockside Green has used several environmentally conscious systems, including a building automation system (BAS) built on the BACnet® protocol.

The site's multiuse components will span 1.3 million ft<sup>2</sup> (120 774 m<sup>2</sup>) of mixed residential, office, retail, and light

industrial space that when completed, will be designed to function as a total environmental system. Form, structure, materi-

als, mechanical and electrical systems, and building automation systems will be interrelated and interdependent, working together to fulfill the defining goal at Dockside Green—to be a self-sufficient, net-zero energy use planned community, where waste from one area will provide fuel for another.

Dockside Green has implemented innovative measures such as power generation, water efficiency, and energy conservation, efficiency, metering, and recovery. Each of these is a vital component in the holistic system.

**Power Generation.** Dockside Green's power will be derived from a centralized biomass waste-wood gasification plant,

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## About the Author

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*Map of Dockside Green's master plan to be completed by 2015. The planned community will be net-zero energy use.*

which produces a gas that can be burned to produce hot water for buildings and domestic hot water heating. Requiring only 0.5 to 0.8 gallons (2 to 3 L) of diesel fuel for initial start-up, the gas production process is smokeless, odorless, and efficient, it is fed by 3,308 tons (3000 Mg) of bone-dry waste wood a year, or roughly half a truck load of wood a day. The gasification plant can accommodate waste wood that is up to 50% moisture content. The biomass energy plant will produce excess energy that will be sold back to the municipality and will make Dockside Green the first community development in North America to be greenhouse gas neutral, or better, from a building energy perspective.

**Water Conservation.** Dockside will treat all of its own sewage on-site and reuse the treated water to flush toilets, run irrigation, irrigate green roof gardens, and maintain the on-site creek and pond system, resulting in minimal water demand from the municipality. It is estimated that the use of treated water at Dockside Green will save about 30.8 million gallons (11.7 million L) of water per year. The sewage treatment plant will produce water that is equivalent to the drinking water standards in Singapore.

**Water Efficiency.** To help reduce the capital and operating costs of the on-site sewage treatment plant, a strategy of decreased water loads was an integral component of the design. All water-dependent appliances are ultraefficient, and when the water efficiency savings are combined with the consumption

savings realized by the treatment facility, the total saved water projections are pushed to 70 million gallons (26.5 million L) a year. In-suite BACnet meters measure hot water and cold water use with an eye to raising greater awareness and realize a further reduction in water consumption. In addition, only treated water will be used for landscaping, and only species native and adaptable to the local sub-Mediterranean climate are being planted. These native species are the cornerstone of the on-site storm water treatment system that uses underground storage facilities to capture and control seasonal runoffs.

**Energy Conservation.** Improved energy efficiency results in lower operating costs for occupants and future-proofs against rising energy costs. The buildings at Dockside Green embrace this philosophy by using *passive* design, which optimizes how building orientation affects energy performance. Building insulation, window shading, and daylighting all affect the size of mechanical systems needed and operating costs. The highest grade insulation, low-e double-glazed windows, ENERGY STAR® rated appliances including front-loading washers and condensing dryers, LED lights in corridors and compact fluorescents in suites, motion sensor lighting controls, and heat recovery technology have all been used to conserve energy.

**Energy—Measuring Performance.** Each residential suite is equipped with meters monitored by BACnet Advanced Application Controllers (B-AACs) that have highly visible displays to show cold water, hot water, heat, and electrical consumption.

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## BACnet is helping to future-proof Dockside Green by using BACnet as the main networking protocol, making possible the future integration of additional door control, card access, security, and lighting control.

According to the Environmental Change Institute at the University of Oxford in Great Britain, and many international studies, changes in consumer behavior result in a reduction of energy consumption by between 3% to 15%, with the higher savings realized by integrated customer education programs.

**Energy—Renewable.** Throughout the development, various renewable energy systems and environmental techniques will be demonstrated, including photovoltaics used for compactors, street traffic signals, and lighting for bus and harbor ferry shelters. Other demonstrations include solar heating products and wind turbines on building roofs.

Additional innovative measures incorporated into the development include extensive on-site tree planting and green roofs, the use of environmentally friendly building materials such as fly ash cement and cork, bamboo, and ecocarpet flooring. Other features are new parks and rejuvenation of shoreline habitat, and the incorporation of products from the bioregional economy. Designs also include human elements such as the development of an affordable housing strategy, a First Nations job training program, and the commissioning of First Nations art, including a grand totem pole. When complete, green spaces punctuated by waterways and walking trails will carpet this sustainable community, which will also feature a Smart Car sharing program, minitransit system, boat launch, bike trail, amphitheater, public art, and dock facilities.

The developers were able to use sustainable woods in their construction in the community by using a revolutionary underwater harvesting technology that uses guided submersible tree fellers. Dockside Green was able to use wood products from preserved trees submerged behind British Columbia's large hydroelectric dams and incorporate them into the frames of the Dockside Green townhouses. With 45,000 major dam reservoirs around the world containing an estimated 300 million trees, submerged forests represent a significant source of nonliving timber that can be used for a wide variety of industrial and consumer applications.

These bold initiatives have traditional as well as nontraditional conservationists seeing green, but how will the developers achieve this grand design? A robust "triple bottom line" development model was endorsed in which developers balance financial profits with environmental and social dividends. The term triple bottom line was originally coined by John Elkington in 1994 and was later expanded and articulated in his 1998 book, "Cannibals with Forks: The Triple Bottom Line of 21<sup>st</sup> Century Business."<sup>1</sup> According to Joe Van Belleghem, Develop-

ment Manager for Dockside Green and founder of the Canada Green Building Council, "We wanted to demonstrate that it is possible for developers to embrace ecological regeneration and social principles in a development while being economically successful."

The BAS installed at Dockside Green is much like the water filtration system or the sewage treatment system, in that it is one of many components that contribute to the community's commitment to sustainability. The BAS that best fits into the community's design is a BACnet system. BACnet mirrors the triple bottom line development model used at Dockside Green by offering its own financial, sociological, and environmental returns. The financial return on investment of BACnet is well recognized with an open international standard that is extendable by the consensus of ASHRAE members and volunteers. The BACnet protocol monitors and controls building operational efficiency and comfort, and in doing so, pays an environmental dividend of reduced energy consumption and conservation of water. The rich diversity of objects, services, and networks within BACnet delivers outstanding communication ability. This allows meaningful performance data to be quickly gathered, calculated, and communicated to the occupant so they can readily view the impact of their behavior, helping them make healthy and informed choices.

The BACnet building control systems installed in the development's first two phases, *Synergy* and *Balance*, have already begun to closely monitor and control each residential unit's environment and keep an account of the tenant's carbon footprint. In addition to local access within the individual suite, residences have Web access to their suite's environment control system from anywhere around the world using the Internet. Communicating energy, water, and carbon emission information to each occupant is an important aspect of a sustainable community.

Communications from the B-AAC to the resident begins with metering in each suite for:

- Domestic water;
- Fan-coil energy calculation;
- Domestic hot water; and
- Electrical consumption.

Domestic water meters used in each suite are standard water meters with a scaled pulse output (i.e., 1 pulse = 1 U.S. gallon [3.78 L]). B-AACs read the pulses and totalize the volume daily, weekly, and year-to-date.

Hydronic fancoil units are each used to calculate hot water

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heating consumption. A two-position heating control valve feeds hot water through a constant flow device. By timing how long the valve is open and knowing the  $\Delta T$  for the system, the BAS can calculate and totalize instantaneous heating consumption.

Domestic hot water heating consumption is similarly calculated by monitoring the volume of water consumed and the inlet and discharge water temperatures for the domestic hot water heating system.

Supplied electricity meters have a scaled pulse output, which is totalized by the B-AAC.

A resident's carbon footprint is derived from multiplying the above energy consumption by the CO<sub>2</sub> emission factors corresponding to the energy source used. Water consumption is also communicated to the resident via the B-AAC.

At the time of publication, the controls installed at Dockside Green are provided by a single vendor. However, the entire network is configured to use BACnet protocol in anticipation of other vendor devices being available in the future. BACnet devices added at a later date could be networked via IP Ethernet or EIA-485. The current network spans all of the residences in the first phase of development and will accommodate further stages of development at the site. Each phase of development will have the main devices connected via Ethernet.

In addition to viewing energy consumption parameters of their suite through their wall-mounted B-AAC, residents can also access this information from any Internet-connected PC. This is made possible by an on-site server that is responsible for interrogating the BACnet network and serving the information as HTML/XML Web pages. The server is a BACnet device, communicating via BACnet/IP. Residents access the server by connecting to a router with a dedicated public static IP address.

BACnet is helping to future-proof Dockside Green by using BACnet as the main networking protocol, making possible the future integration of additional door control, card access, security, and lighting control. BACnet has enabled this installation to leverage the strengths of a flat network topology to its advantage. To date, installations at Dockside Green include 12 BACnet Building Controllers, 266 BACnet Advanced Application Controllers, and 13 BACnet Application Specific Controllers. Near-term additions include nine BACnet Building Controllers, 222 BACnet Advanced Application Controllers, and four BACnet Application Specific Controllers.

#### References

1. New Society Publishers. 1998. *Cannibals with Forks: The Triple Bottom Line of 21<sup>st</sup> Century Business*. ●

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*Advertisement formerly in this space.*