Dockside Green, a development of 1.3 million square feet of mixed residential, office, retail and industrial space, is one of the first projects to achieve LEED Neighborhood Development (ND) Platinum certification. The first phase was Synergy, a 95-unit residential building. It was completed in 2008 and is serving as a testing ground for innovative products, construction methods and technologies used in the rest of Dockside Green, especially Balance, a residential development that was completed in 2009.

**Sitewide Strategies**

The master plan of the Dockside Green community uses sitewide strategies including a biomass gasification plant completed in 2009 and a wastewater treatment facility completed in 2008.

The biomass gasification plant converts locally sourced wood waste into a clean burning synthetic gas (syngas), which is used to produce heat and hot water. Clean wood waste (made up of local trimmings, land clearing, and waste from construction/industrial uses) is supplemented by wood from forestry projects in the northern part of Vancouver Island, to supply all of the fuel for the biomass plant.

The biomass gasification system (see sidebar) makes the development carbon neutral on a net annual basis without the purchase of green power certificates. This is made possible by selling heat to a neighboring building (outside of the Dockside development). This sale of heat is equal to the electrical profile of the current buildings at Dockside, but each project did purchase green power certificates from the local utility for LEED purposes.

Dockside’s on-site tertiary (final stage) wastewater treatment will save more than 50 million gallons of water annually when the development is fully built out (Synergy alone is calculated to save more than 2 million gallons of water annually based on LEED water calculations). One-hundred percent of all sewage will be treated onsite at the wastewater treatment facility. Also, water is reused for toilet flushing, green roof irrigation and to replenish the greenway.

A series of waterways in Dockside’s central greenway assist in on-site stormwater storage while the greenway itself provides public amenity space.

**Other sustainable features for Dockside Green include rooftop gardens; a car co-op with Smart Cars; and, additional energy-saving features, including ENERGY STAR appliances, heat recovery ventilations units, low-e double-glazed windows and exterior blinds.**
on the west and south faces of each building.

Due to the global economic crisis and a resulting surplus of residential suites on the market in Victoria, construction on Phase 3 (residential) has been postponed. The first two phases of the development are more than 99% sold.

Analysis completed by the firm’s in-house cost consultant showed that being able to sell the units quickly and reducing condominium fees helped offset any capital costs associated with green features.

The success of the marketing and positive media the project has received (both locally and internationally) has helped make the residential portions of the project a financial success.

The two mixed-use commercial developments Inspiration (LEED Platinum) and Insight have leased well. Farmer Construction, the contractor for the project, purchased the third commercial building for its head office.

Synergy
The first phase of Dockside Green, Synergy, was completed in 2008 and achieved LEED Platinum by the Canada Green Building Council at 63 points, making it the highest-scoring LEED Platinum certified project in the world. Sister project Balance tied that record in 2011.

Synergy is a 178,680 square foot project with 95 residential units and approximately 170 residents. Most of the residents are between

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Or something better?
Synergy townhouse patios, as seen from the greenway. The project uses rainwater leaders to direct building runoff to the central greenway. The greenway is designed to mimic natural systems by keeping water on land for as long as possible. The greenway also polishes and conveys the treated effluent from the wastewater treatment plant.

30 and 60 years old, and most of the units have one or two bedrooms. Synergy has also been designed to meet adaptable housing guidelines, allowing for aging in place. In addition to attracting a range of ages, affordable housing units (rental) in Synergy are aimed at those with incomes of $30,000 to $60,000. Synergy was constructed for an approximately $24 million.

DOCKSIDE BIOMASS GASIFICATION PLANT

District Energy System
The district heating strategy was a concept that came out of initial master planning discussions. The vision statement for the project meant that the cleanest, most cost-effective solution for energy production needed to be found. Without access to reliable wind power and a long payback for solar technologies in the overcast Pacific Northwest, a waste-to-energy plant became the obvious choice.

Initial costing suggested that the economy of scale for district energy was most feasible using clean wood waste, as it was plentiful in the region. Gasification technology had been successfully implemented and improved upon in Sweden over the past 30 years. And, waste-to-energy gasification technology had become the cornerstone for Sweden’s greenhouse gas reduction and would prove to be the most environmentally and economically sound means for heat production at Dockside Green. The thermo-chemical process of gasification uses heat to convert a carbon-containing fuel into a cleaner burning gas. Gasification differs from combustion (or incineration) because it uses just 20% to 30% of the air or oxygen needed for complete fuel combustion. During gasification, the amount of air supplied to the gasifier is controlled so only a portion of the fuel burns. This reduced air combustion process provides sufficient heat to chemically break down the balance of the fuel into syngas (syngas).

DOCKSIDE GREEN OVERALL SITE PLAN

KEY SUSTAINABLE FEATURES FOR DOCKSIDE GREEN

Water Conservation
- Uses no municipal potable water for irrigation; rainwater or reclaimed site black water is used instead
- 100% of all sewage will be treated on-site at the wastewater treatment facility
- Water is reused for toilet flushing, green roof irrigation and to replenish the waterway and pond features
- Achieves a 67% reduction in potable water use over baseline by using dual flush toilets, low flow sinks, showers, and by providing graywater from the wastewater treatment facility

Recycled materials
- Recycling is easily accessible
- Achieved a 96.02% construction waste diversion rate
- Achieved an average of 17.08% recycled content in the building materials
- Achieved an average of 33.3% local/regional materials
- Renewable materials incorporated

Daylighting
- Provides daylight for 95% of regularly occupied spaces and views for 97% of spaces

Operations
- Implements a green housekeeping plan, developer provided six months of eco-certified cleaning products
- Green guidelines and product literature are distributed
- Offers site tours and on-site signage
- Uses operable windows, temperature and lighting controls

Other Major Sustainable Features
- Meets the requirements of ASHRAE Standard 62-2001
- Smoke-free in all common areas of the building
- Monitors carbon dioxide (CO₂) and ventilation
- Follows a stringent IAQ plan and testing
- Uses low VOC adhesives, paints, coatings and sealants in addition to low emitting carpet and urea-formaldehyde free composite wood products
- In compliance with ASHRAE Standard 55-2004
- Erosion and sedimentation control plan was developed
- Site is on former industrial brownfield land

- Provides site density of over 23,000 m²/ha (5,280 ft²/acre)
- Located within 900 meters of area amenities
- Walking distance to public transportation
- Bicycle storage and change rooms are provided
- Two high-efficiency fuel vehicles are provided
- Has a 29% reduction in parking requirements
- Restores open space through use of green roofs
- Total site area restored is 184,697 ft² and is 53% of the remaining site area (excluding the building footprint)
- Rainwater management visibly demonstrates rainfall capture on buildings and flow from the buildings to the central waterway and to the harbor
- Rainwater harvesting is used for site irrigation
- Approximately 90% of all parking is located underground
- Combines green roofs with high albedo roofing materials for 76% of roof surfaces
The building has a recycling room for organic waste collection and strategic partnerships have been forged with local organizations for material diversion. The composting plan meant that sink garbage disposals were unnecessary, saving with reclaimed water from the site in the summer.

Three distinct construction types were used at Synergy. Due to construction schedule and contractor familiarity, one townhouse building used traditional wood frame construction. The nine- and six-story buildings used cast-in-place concrete, while the four-story building piloted the use of insulated concrete forms (ICF).

The use of ICF was piloted on Synergy as its use was new on Vancouver Island. The design and development team wanted to showcase an emerging technology; however, due to the increased cost of construction on the Island, ICF won't likely compete financially with cast-in-place concrete on future phases.

Diversion of waste during construction (greater than 95%) was augmented by an organics composting program. Workers composted the leftovers from their lunches. This organics collection and composting was integrated into the project.

## Synergy Energy Use

<table>
<thead>
<tr>
<th></th>
<th>Heat (kWh)</th>
<th>Electricity (kWh)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>92,209</td>
<td>19,133</td>
</tr>
<tr>
<td>Feb</td>
<td>70,749</td>
<td>110,212</td>
</tr>
<tr>
<td>Mar</td>
<td>72,149</td>
<td>31,124</td>
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<tr>
<td>Apr</td>
<td>55,530</td>
<td>100,995</td>
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<tr>
<td>May</td>
<td>38,970</td>
<td>29,125</td>
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<tr>
<td>Jun</td>
<td>28,030</td>
<td>91,053</td>
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<tr>
<td>Jul</td>
<td>25,000</td>
<td>31,196</td>
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<tr>
<td>Aug</td>
<td>23,700</td>
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<tr>
<td>Sep</td>
<td>27,200</td>
<td>29,689</td>
</tr>
<tr>
<td>Oct</td>
<td>46,740</td>
<td>88,121</td>
</tr>
<tr>
<td>Nov</td>
<td>32,979</td>
<td>32,507</td>
</tr>
<tr>
<td>Dec</td>
<td>104,009</td>
<td>113,187</td>
</tr>
<tr>
<td>Total</td>
<td>677,355</td>
<td>763,826</td>
</tr>
</tbody>
</table>

2010 Total: 1,441,181

*Data shown is actual BC Hydro billing data. This billing data does not represent usage during the given months shown, only the amount billed during that monthly utility billing cycle.
The buildings use two condensing 90.5% efficient boilers as backup to the district energy plant. Boilers were initially installed as the project was completed before the construction of the district heating system. The exhaust air from the washrooms is centrally exhausted through a heat recovery wheel with an effectiveness of 81%. There is no vapor-compression cooling equipment, but a four-pipe fan coil system using domestic hot water (DHW) for heating, and domestic cold water makeup for summer cooling preheats the DHW.

While this system does not provide year-round cooling, a system to chill water could be added for a full cooling system. In winter, the district heating system provides all DHW.

A reduction in overall lighting power density (average of 0.6 W/ft²), and use of ENERGY STAR labeled appliances throughout, contributed to overall electrical savings. Energy argon-filled glazing, and a doubling of insulation values over code requirements (average of R-29 for walls and R-40 for roof), the project significantly reduced heat gains and losses compared to a baseline building. Operable shading devices were also used to limit south and west solar heat gain. The supplied shades are designed to automatically retract during a windstorm to ensure that the fabric does not get damaged.

Water. Clearly labeled and accessible bins make it easy for residents to separate waste for recycling.

Energy Reduction Strategies

Central to Synergy’s energy efficiency are a selection of high performance building strategies coupled with district energy efficiencies. The design of a high performance envelope along with passive solar oriented buildings ensured that the heating and ventilation systems could be right sized. Daylight penetration through the whole site is enhanced by the stepped and broken building forms.

The building masses have been oriented in an east/west direction to maximize the spaces between for light penetration while minimizing east/west building faces and solar heat gain. Open plazas are placed to maximize sun exposure while landscape is developed to maximize winter solar penetration while providing shading during the summer. Shadowing goes hand in hand with light penetration. Maximizing light penetration typically minimizes shadowing. However, sometimes shadowing is desired. To accommodate this and to reduce solar heat gain within buildings, horizontal sun shades and deciduous trees are used on south and south/west facing façades. Shading devices are designed to reflect light in winter and to provide shade in summer. Through a combination of thermally broken double glazed low-e argon-filled glazing, and a doubling of insulation values over code requirements (average of R-29 for walls and R-40 for roof), the project significantly reduced heat gains and losses compared to a baseline building. Operable shading devices were also used to limit south and west solar heat gain. The supplied shades are designed to automatically retract during a windstorm to ensure that the fabric does not get damaged.

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Biomass gasification and wastewater treatment system

District energy and water systems. Dockside uses bioreactor tanks and filter membranes to treat all sewage on-site, making it virtually drinking water quality. Treated water is used for irrigation and flushing of toilets, reducing the project’s potable water consumption by 67%. Synergy received all Energy + Atmosphere credits under LEED NC Canada.
The green roofs and rooftop gardens were a huge success. However, the northernmost gardens are shaded during the summer by the mechanical penthouse, so most of the gardeners found that area to be a less desirable location.

The combination of a high performance envelope and HVAC efficiencies suggested that the building would perform 56% better (by cost) than the Canadian Model National Energy Code for Building (MNECB). This is roughly equivalent to 52% better than ASHRAE/IESNA Standard 90.1-1999 and was good enough for eight out of 10 Optimize Energy Performance points under LEED Canada NC 1.0.

The final two energy points and all onsite renewable energy credits (three out of three credits) came from the cost effectiveness of the centralized wood-powered biomass gasification plant. Synergy was completed in 2000, but the district energy system didn’t come online until early in 2009, so the project ran for a short time on the backup natural gas boilers.

Actual Performance
Synergy’s overall energy performance in 2009 was 29.2 kBtu/ft², with consumption going down in 2010 to 27.6 kBtu/ft². These values are based on electrical utility readings (British Columbia Hydro) and biomass central plant readings (Corix also included the small amount of natural gas from early 2009).

This energy performance is consistently better than the LEED compliance energy model assumption of 32 kBtu/ft². While the actual electrical performance was close to building owner/representative
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Perkins+Will Canada
General Contractor
Farmer Construction Inc
Mechanical Engineer
Stantec
Electrical Engineer
Stantec
Energy Modeler
Stantec
Structural Engineer
Read Jones Christoffersen
Civil Engineer
Worley Parsons Komex and RCL Consulting
Environmental Consultant
Aqua-Tex Scientific Consultants
Landscape Architect
PWL Partnership Landscape Architects
LEED Consultant
Perkins+Will Canada

Energy Recovery
Highly energy-efficient Greenheck EIV products provide fresh outdoor air to meet the ASHRAE 62 ventilation rate standard, while recovering energy from the exhaust air stream.

Air Measuring Dampers
Our new air measuring damper series combines an accurate airflow measuring station and a low leakage damper into one compact assembly that both measures and regulates airflow volumes to a target set-point.

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The Sure-Aire® Airflow Monitoring Station provides flow verification to ensure proper system balancing, while improving air quality and controlling industrial processes.

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Greenheck products improve energy efficiency and air quality (many contribute to LEED credits).
what was predicted in the energy model, the biomass gasification heating system was either more efficient than anticipated or heating demands were lower than predicted. It was anticipated that Synergy would use 919,000 kWh of biomass energy whereas only 764,000 kWh was required of the central plant in 2009 and only 677,000 kWh in 2010. Conclusion While the design of Synergy has helped contribute to the energy performance of the project, it has become evident from actual energy consumption data and the level of engagement the residents have taken, that behavior cannot be ignored in high performing buildings. The real-time energy and water data available to residents on their personal computers has helped them make good choices about their usage. The project has seen lower than modeled energy use with the numbers continuing downward in 2010. While commissioning, weather and operational factors are likely at play, there is no question that the residents at Synergy deserve some of the credit for its success as a high performing building.

ABOUT THE AUTHOR

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LES SONS LEARNED

As Synergy was the first phase in this multi-phased development, many of the lessons learned have already been applied to Phase 2 (Balance).

While the angled awnings at Synergy function well, they are more sensitive to wind conditions and frequently retract into a protected position. As a result, during windy days that also see direct solar gain on glass, the shades often automatically retract to protect them rather than shield the building from solar gain. Vertically mounted horizontal blinds were used at Balance with a greater number of days of direct solar protection achieved.

The first phase of Dockside was an opportunity to use some innovative materials such as wheat board and bamboo. Due to warranty callbacks from delamination in shady areas, most of the gardeners are some shade plants that grow well by the mechanical penthouse. While there were sold. However, the northern-most garden plots being claimed before all units were built. The project’s green roofs and rooftop gardens were a huge success, with all the plots being sold. However, the northern-most gardens are shaded during the summer by the mechanical penthouse. While there are some shade plants that grow well in shady areas, most of the gardeners found this area a less desirable location. Greater consideration for rooftop gardening would have created a more democratic distribution of plots.

Airtightness testing of homes has been around for more than 20 years. Various energy programs and fluctuating energy bills have provided homeowners an incentive to improve the airtightness of their homes. Energy tax credits can also be received by homeowners but only if the house airtightness has been verified that is last leaky after remodeling than before. Efforts to make commercial buildings more energy efficient in the US has only recently been incorporated into various “green” initiatives. Tests of commercial buildings show that they tend to be more leaky than the average house, based on air leakage per square foot of surface area. That means that commercial buildings are less energy efficient than the average house.

To measure the actual airtightness of a large building means more air is needed to maintain a reasonable test pressure. The Energy Conservatory, a leader in airtightness testing, has kits available to directly measure more than 18,000 cubic feet per minute of air leakage. Multiple kits and fans can be used simultaneously to generate more air for accurate and reliable measurements of air leakage for testing before and after retrofitting.

For more information on multi-fan systems, contact: The Energy Conservatory 612-827-1117 or visit our website at www.energyconservatory.com

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