

UBC Bioenergy Research & Demonstration Project

PROJECT DESCRIPTION

The UBC Bioenergy Research and Demonstration Project (BRDP) is a 1886m² building that will house biomass gasification process equipment to produce electricity and steam for use by the broader UBC community with the goal of reducing UBC's carbon footprint. The project is located at the the Northwest corner of Agronomy Road and Lower Mall on UBC Campus. Also referred to as the "Lower Greenhouses", the site is currently used as a works yard for UBC Landscape Operations. The site is bound by Lower Mall Research Station to the west, Header building to the north, UBC Services building to the east and Totem Park to the south across Agronomy Road. Important to the site is the mature stand of coniferous trees facing Agronomy Road with some along Lower Mall. Design priorities include sensitive architectural integration into the neighbourhood context, minimising disruption to the natural vegetation and efficient relocation of Landscape Operations.

Gasification of biomass in the form of wood chips, wood pellets, construction wood debris and municipal tree trimmings will be the primary source of fuel for 1) a combustion engine that will produce electricity, and 2) a boiler that will produce steam. The proposed facility will potentially supply 4% of the campus peak demand for electricity and 8% of the steam demand.

As the name states, it is also a research and demonstration facility. As part of a UBC comprehensive "Campus Use Living Lab", the facility will offer research and learning opportunities for students, staff, industrial and community partners - not only for the gasification technology, but also for cross laminated timber (CLT). To support the educational aspects, the building will include a general work / instruction area that can be loosely termed a "lab" and a circulation system that will afford viewing platforms for group demonstrations.

DESIGN POLICY COMPLIANCE

As required by the DP application checklist, below is a description of the project and a Design Policy Compliance response for the UBC Bioenergy Research and Demonstration Project (BRDP) using the eight physical planning principles listed in the UBC document "A Legacy and a Promise".

Principle 1: The University Lands: As One

The important notion of the UBC lands as one greater than the sum of its parts is certainly true with BRDP. As the project is demonstration and research facility that provides power and steam for the benefit of the greater UBC community, the project will *enrich and complete the whole, yet open new horizons for future change*.

Principle 2: The Community: Vibrant and Ever-Changing

Of the thoughts discussed under this principle, attributes such as *intellectual curiosity, ever-changing landscape and regional centre with unparalleled opportunities* apply directly to BRDP. The opportunities for research and demonstration of biomass gasification and cross laminated timber technologies are consistent with the ongoing vision for UBC to be a significant contributor to the economy of the larger surrounding region.

Principle 3: The Experience: A Place to Remember

A variety of uses is absolutely essential and mixed-use projects are highly desirable. Success of projects more and more depends on mixing uses within individual neighbourhoods whether on UBC lands or otherwise. Not only will the BRDP generate power and steam for use by the broader UBC community, it will offer a memorable metaphor to be experienced using the surrounding mature trees as context in direct proximity

to the project building, allowing an immediacy of understanding of the process of converting biomass in the form of wood chips to energy. The boundary between the building and the trees will be made as transparent as possible to reinforce the story. Walkways through the trees will allow pedestrian traffic to experience the grace of the mature trees while looking into the facility that will show case not only the gasification process, but also cross laminated timber (CLT), again, demonstrating a renewable resource and sustainable strategies for building.

Principle 4: The Environment: Incredible Riches

UBC will provide leadership by demonstrating the means to a sustainable community. The BRDP's primary function is production of electricity and steam to be used for the UBC campus. The biomass gasification process is expected to produce electricity in a far more environmentally friendly way than coal fired electrical plants and although BC is blessed with hydro power, it still imports coal fired generated power during peak periods. Research and development of gasification will spur development of smaller scale power generation which will allow resources to be used towards the goal of lessening our collective dependence on fossil fuels.

Principle 5: The Endowment: A Legacy Retained

The integration of the BRDP into its neighbourhood is in keeping with UBC's mission of *using the lands judiciously to promote positive enriching experiences for all users and visitors.* The proximity of the Landscape Operations and UBC Services building support the technical aspects of the project while the setting within the trees enhance the pedestrian, research and development components. Site development has been carefully considered to minimise development of any vegetated parts of the site while allowing the proper function of the facility and the relocated Landscape Operations.

Principle 6: The Perspective: A World Beyond

Biomass gasification and cross laminated timber technologies are 2 exciting and important technologies currently being pursued by many organisations and professionals across North America. Although both technologies have been used in Europe previously, they are relatively unfamiliar to North American markets. Canada, BC in particular, leading the world on many wood engineering issues, is well placed for inviting the world to partake in the research opportunities that the BRDP will afford.

Principle 7: The Opportunity: Global Leadership in a Changing World

UBC will experiment with new ideas, establish precedents in urban planning, architecture and landscape and building design. UBC will also provide an opportunity to implement ideas...to be showcased to the broader community to invite the curious to approach and explore. These objectives fit quite appropriately with the BRDP. As part of the UBC Campus Living Lab initiative, the building and its contents are showcased for demonstrative and research purposes. Modifying of wood chip will be included in ongoing research. Affects of vibration, acoustic performance, weathering and maintenance will be monitored on the CLTs. These are just a few examples of the educational opportunities of this project.

Principle 8: The Process: Open and Integrated

The team is working in collaboration with all stake-holders and public information meetings are scheduled.

PROJECT DESIGN CHECK LIST - STRATEGY 40 RESPONSE

Site Use and Organisation

The project responds well to this criterion as the building use is comparable in ilk to the Landscape Operations and maintenance works of the UBC Services building to the east. Treed space has been protected, and in fact becomes a vital part of the context for this project. Efficient use of the site allows for the addition

of the gasification building as well as the relocation of the Landscape Operations. Although of comparable "industrial" function, the project is also institutional due to its research and demonstration attributes, which promote a rationalization of the immediate infrastructure.

Responding to Context

The general fabric of the campus is one of integrated mixed-use facilities, placed in a network of interconnected walkways and open spaces. The BRDP responds well to site context at a project and campus scale at 2 fundamental levels - physical and academic. While the sensitive integration of the treed site with the project will be a major key to its success, the research and demonstration components will add to the academic infrastructure. FP Forintek, located on UBC campus will be actively involved in research and monitoring of the CLT panel technology, which is likely to also involve the Forestry department Clean Energy Centre, not so far from the site are expected to use the facility to learn more about the conversion of biomass to electricity. Opportunities also abound for mechanical engineering, power mechanics and electrical engineering. Just as important, students and everyday visitors will be exposed to the technologies to deepen our collective awareness of the environment and management of its finite resources.

The project is designed to be simple but elegant in a way to support the demonstration of the gasification and CLT technologies. The architectural response is a rectangular floor plan with a modestly rising roof slope to accommodate the practical working heights of the process equipment with transparent wall sections to showcase the equipment and CLT panels. This simple expression will result in a quiet but elegant landmark in the treed area, visible to passers-by both on and off site. During the evening hours, the building will emit a soft glow in the trees that will promote a sense of warmth.

Building Envelope

Among the architectural design goals, attention to scale has been carefully considered. The physical size of the gasification equipment is fixed, but the team has worked closely with Nexterra to group as much as practical tall vessels to the west end of the building so that the east facade facing the intersection can be a suitable pedestrian scale. The entrance to the building will be located here. The rising roof plane not only responds to the physical size of the internal equipment, but also makes use of the prevailing east winds by acting as an air foil to create negative air pressure on the leeward side to draw air through the building as part of a natural ventilation strategy.

Building / Open Space Relationships

The south wall of the building will contain glazed sections to connect the treed green space with the internal plant area of the building. This is an important feature of the architecture as it will promote a sense of story and place for the project. The existing grade on the south elevation allows elevated views into the building which will enhance a "haptic" participation from passers-by.

Response to Climate

Strategy 40 speaks of benefits from the sun for indoor and outdoor spaces. In the case of BRDP, it is the obverse; the gasification equipment will generate more than enough heat to meet the building's heating load and hence the building will benefit from the shade of the trees immediately to the south. The under-storey of the trees is wonderfully lit with filtered sunlight and forms an engaging walkway for all visitors.

Circulation

Circulation in and around the building are planned to engage pedestrians. The 2nd level mezzanine is accessible.

Building Entrances

The entrance is located near the corner of Lower Mall and Agronomy and is the primary access to the upper floor mezzanine research work area. The east end of the building is the most suitable location as the scale of the building is appropriate for the entry and is in the correct location for demonstrating the sequence of the gasification process. The entrance lobby is more than a vestibule to allow medium sized groups to gather before being toured through the facility. The entrance will also take advantage of the trees to set the tone of the building experience.

Transparency and Territoriality

For safety reasons, the plant area will be secure, but the lab area and control room will be open for public access. The plant area will be open for demonstration and research under the supervision of the plant personnel.

Location of Public Facilities

The public lobby is located on the ground floor. The public areas for research and demonstration are located in the 2nd level mezzanine to afford good views of the entire gasification equipment operation. A lift is planned to meet accessibility requirements

Long Life / Loose Fit

The BRDP is a unique building in that the process equipment does not need a building to house it. The building allows demonstration and research while integrating the project architecturally within the context of the site. That said, it is not inconceivable that at some point the equipment could be removed and the building could be used for other purposes.

Architectural Expression

The building with its contextual setting is in keeping with the goal of providing an environment to support the adventure of the mind and spirit. The quest for new knowledge is also supported and with the landscaped pathways in the wooded surroundings will make the project open, accessible, welcoming and familiar.

Scale

Efforts have been made to keep the size of the building down to match the size of the equipment. In doing so, an integrated design approach resulted in a simple, elegant, but bold geometric shape whose silhouette will be read both during daylight and evening hours. The rising roof line forming the top of what is basically a rectangular volume "pushed" into the ground on one end will be a memorable landmark.

Exterior Materials

The building cladding will be secondary to the structure and internal equipment. The cladding will be corrugated metal and glazed wall sections. A project mandate is the inclusion of CLT panels which will be showcased as structural components of the exterior walls, interior partitions and roof deck planes.

Landscape Quality

From the start, the trees on this site provided a defining direction for the project to follow. The trees are an integral part of the architectural response. The richness of the treed area makes landscape development an easy task.

Servicing

Service entrances are located on the north elevation and face a work yard space shared with Landscape Operations. This area is secure and away from public access.

Technical Performance

UBC and Nexterra have agreed upon a performance specification that will result in emissions far lower than conventional power generation projects within urban settings. The internal combustion engine that produces electricity is the piece of equipment requiring the most noise attenuation strategies. An acoustic consultant is on board to ensure that measures are taken to meet the noise level criteria for the neighbourhood.

LEED Canada-NC 1.0 Project Checklist

Yes	?	No	Responsibility		
8	4	2		Sustainable Sites 14 Points	
Y				Prereq 1	Erosion & Sedimentation Control Required
1			A	Credit 1	Site Selection 1
	1		A	Credit 2	Development Density 1
		1	A	Credit 3	Redevelopment of Contaminated Site 1
1			A	Credit 4.1	Alternative Transportation, Public Transportation Access 1
1			A	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms 1
	1		A	Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles 1
	1		A	Credit 4.4	Alternative Transportation, Parking Capacity 1
		1	A	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space 1
1			A	Credit 5.2	Reduced Site Disturbance, Development Footprint 1
1			C	Credit 6.1	Stormwater Management, Rate and Quantity 1
	1		C	Credit 6.2	Stormwater Management, Treatment 1
1			A,C	Credit 7.1	Heat Island Effect, Non-Roof 1
1			A,L	Credit 7.2	Heat Island Effect, Roof 1
1			E,C	Credit 8	Light Pollution Reduction 1
Yes	?	No	Responsibility		
5				Water Efficiency 5 Points	
1			L	Credit 1.1	Water Efficient Landscaping, Reduce by 50% 1
1			L	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation 1
1			M	Credit 2	Innovative Wastewater Technologies 1
1			M	Credit 3.1	Water Use Reduction, 20% Reduction 1
1			M	Credit 3.2	Water Use Reduction, 30% Reduction 1
Yes	?	No	Responsibility		
15	2			Energy & Atmosphere 17 Points	
Y			CA	Prereq 1	Fundamental Building Systems Commissioning Required
Y			EN	Prereq 2	Minimum Energy Performance Required
Y			M	Prereq 3	CFC Reduction in HVAC&R Equipment Required
10			EN	Credit 1	Optimize Energy Performance 1 to 10
1			E,M	Credit 2.1	Renewable Energy, 5% 1
1			E,M	Credit 2.2	Renewable Energy, 10% 1
1			E,M	Credit 2.3	Renewable Energy, 20% 1
1			CA	Credit 3	Best Practice Commissioning 1
1			M	Credit 4	Ozone Protection 1
	1		M,E	Credit 5	Measurement & Verification 1
	1		A	Credit 6	Green Power 1
Yes	?	No	Responsibility		
6	1	7		Materials & Resources 14 Points	
Y			A	Prereq 1	Storage & Collection of Recyclables Required
		1	A	Credit 1.1	Building Reuse: Maintain 75% of Existing Walls, Floors, and Roof 1
		1	A	Credit 1.2	Building Reuse: Maintain 95% of Existing Walls, Floors, and Roof 1
		1	A	Credit 1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements 1
1			GC	Credit 2.1	Construction Waste Management: Divert 50% from Landfill 1
1			GC	Credit 2.2	Construction Waste Management: Divert 75% from Landfill 1
		1	A,S	Credit 3.1	Resource Reuse: 5% 1
		1	A,S	Credit 3.2	Resource Reuse: 10% 1
1			A	Credit 4.1	Recycled Content: 7.5% (post-consumer + ½ post-industrial) 1

	1		A	Credit 4.2	Recycled Content: 15% (post-consumer + ½ post-industrial)	1
1			A	Credit 5.1	Regional Materials: 10% Extracted and Manufactured Regionally	1
1			A	Credit 5.2	Regional Materials: 20% Extracted and Manufactured Regionally	1
		1	A	Credit 6	Rapidly Renewable Materials	1
		1	A	Credit 7	Certified Wood	1
1			BS	Credit 8	Durable Building	1

Yes ? No Responsibility

10	5			Indoor Environmental Quality	15 Points
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Y			A	Prereq 1	Minimum IAQ Performance	Required
Y			A	Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
	1		M	Credit 1	Carbon Dioxide (CO₂) Monitoring	1
1			M	Credit 2	Ventilation Effectiveness	1
1			GC	Credit 3.1	Construction IAQ Management Plan: During Construction	1
1			GC	Credit 3.2	Construction IAQ Management Plan: Testing Before Occupancy	1
1			A	Credit 4.1	Low-Emitting Materials: Adhesives & Sealants	1
1			A	Credit 4.2	Low-Emitting Materials: Paints and Coating	1
1			A	Credit 4.3	Low-Emitting Materials: Carpet	1
1			A,S	Credit 4.4	Low-Emitting Materials: Composite Wood and Laminate Adhesives	1
1			A	Credit 5	Indoor Chemical & Pollutant Source Control	1
1			A,E	Credit 6.1	Controllability of Systems: Perimeter Spaces	1
1			M,E	Credit 6.2	Controllability of Systems: Non-Perimeter Spaces	1
	1		M	Credit 7.1	Thermal Comfort: Compliance	1
	1		M	Credit 7.2	Thermal Comfort: Monitoring	1
	1		A	Credit 8.1	Daylight & Views: Daylight 75% of Spaces	1
	1		A	Credit 8.2	Daylight & Views: Views 90% of Spaces	1

Yes ? No Responsibility

5				Innovation & Design Process	5 Points
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1			A	Credit 1.1	Innovation in Design: Exemplary Performance: Renewable Energy 100%	1
1			A	Credit 1.2	Innovation in Design: CLT Pannels	1
1			M	Credit 1.3	Innovation in Design: Educational	1
1			C	Credit 1.4	Innovation in Design: Green Housekeeping	1
1			A	Credit 2	LEED® Accredited Professional	1

Yes ? No

49	12	9		Project Totals (pre-certification estimates)	70 Points
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Certified 26-32 points Silver 33-38 points Gold 39-51 points Platinum 52-70 points