

Smart energy systems at UBC: a framework for innovation

Presentation at QUEST IV conference
Halifax, Oct 12-14, 2010

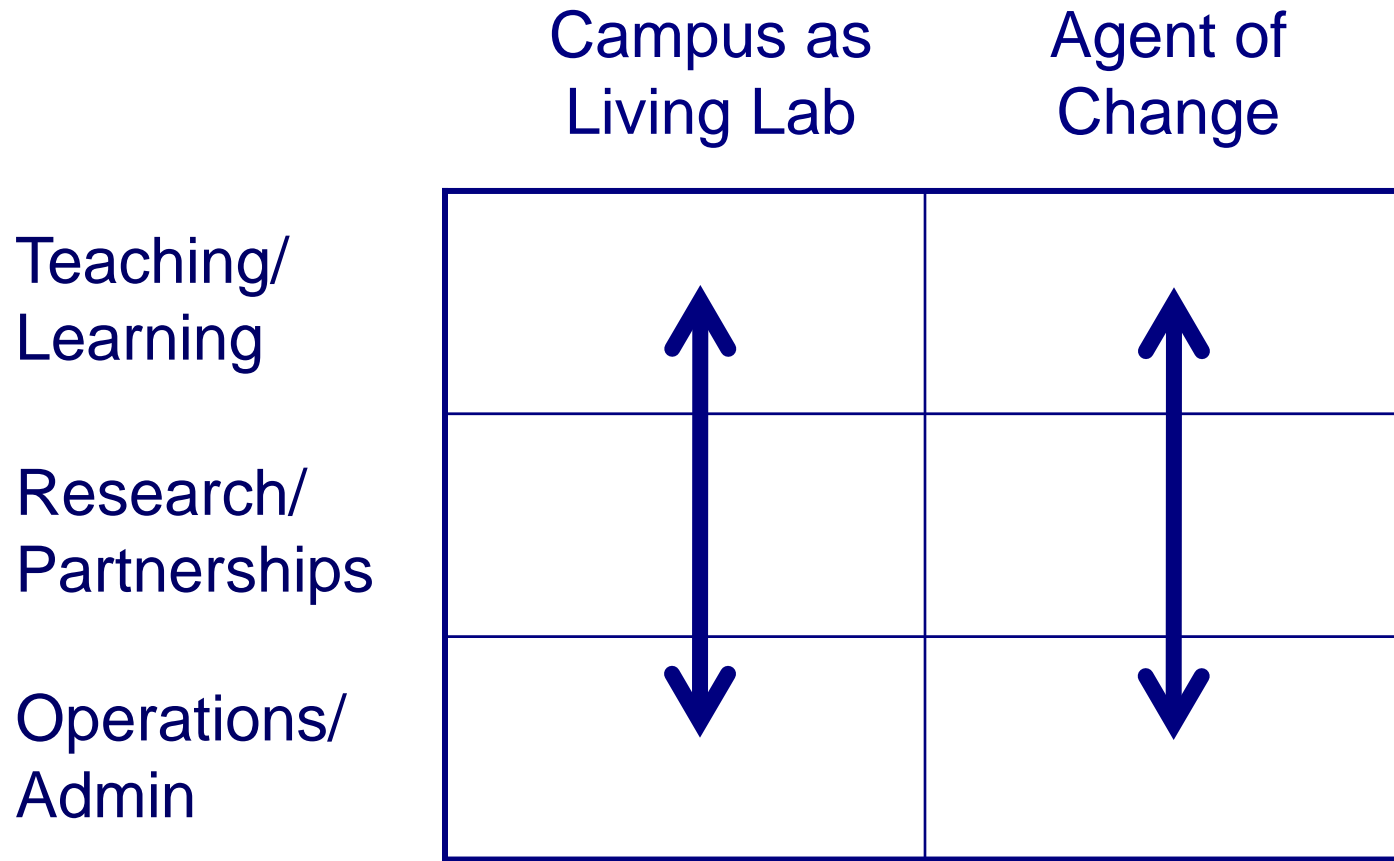
John Robinson
UBC

Oct 14, 2010

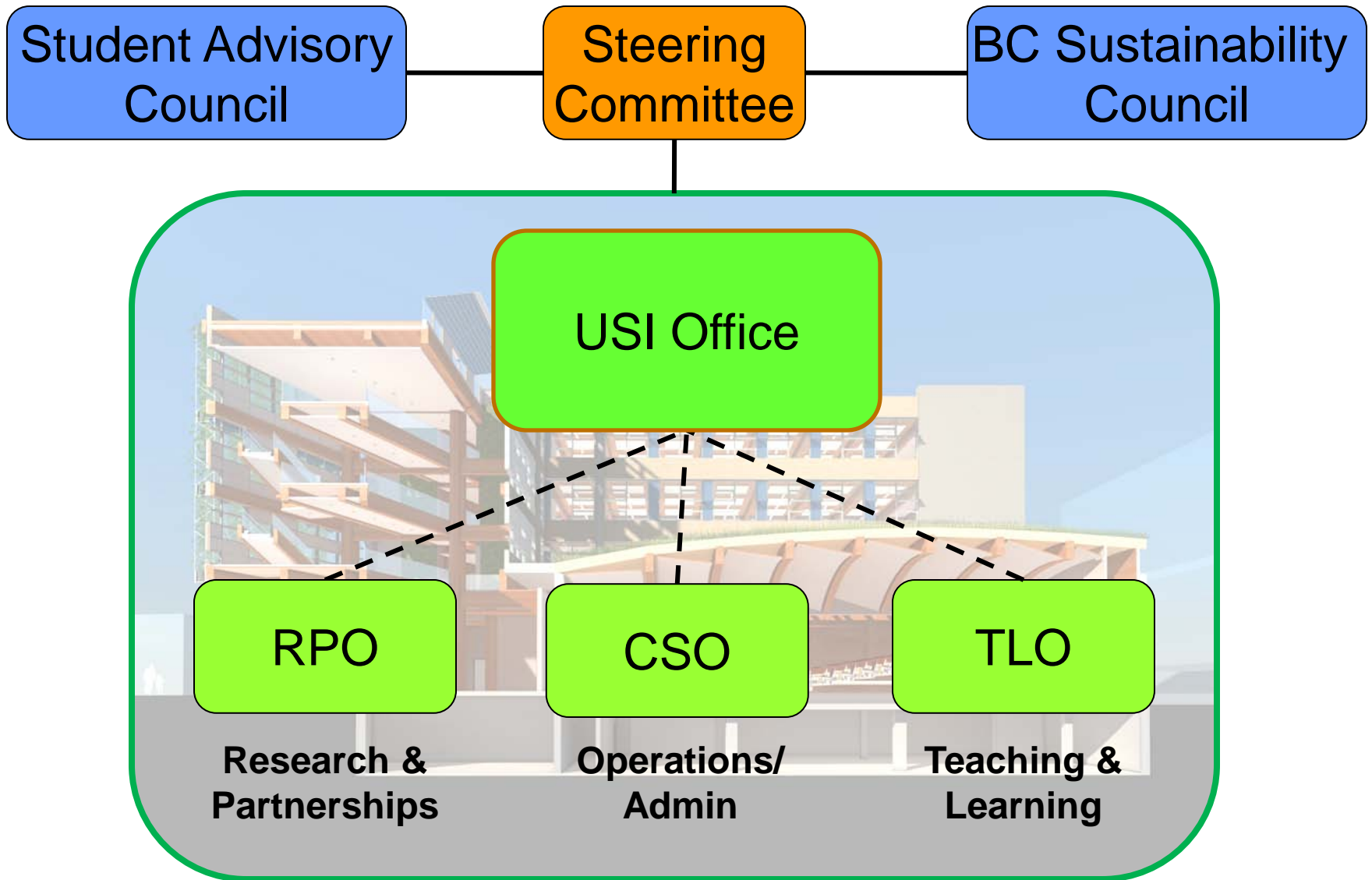
Campus as sustainability test-bed: societal proving grounds

- Universities uniquely suited for this role
 - Owner- occupiers of significant land base and building stock – important scale for sustainability
 - Own utilities and energy, water and waste systems
 - Public institutions, with longer planning time horizon
 - Teaching and research part of core mission
- Develop integrated campus-scale systems
 - Prove out economic and technological potential
 - Study system integration and behavioural interface
 - Engage and train students; develop new curricula and programs

UBC Sustainability Academic Strategy



UBC Sustainability Initiative (USI)



Centre for Interactive Research on Sustainability

“Accelerating Sustainability”



Energy Balance - Summary

-860 MWh
nat. gas
-154 t CO2e

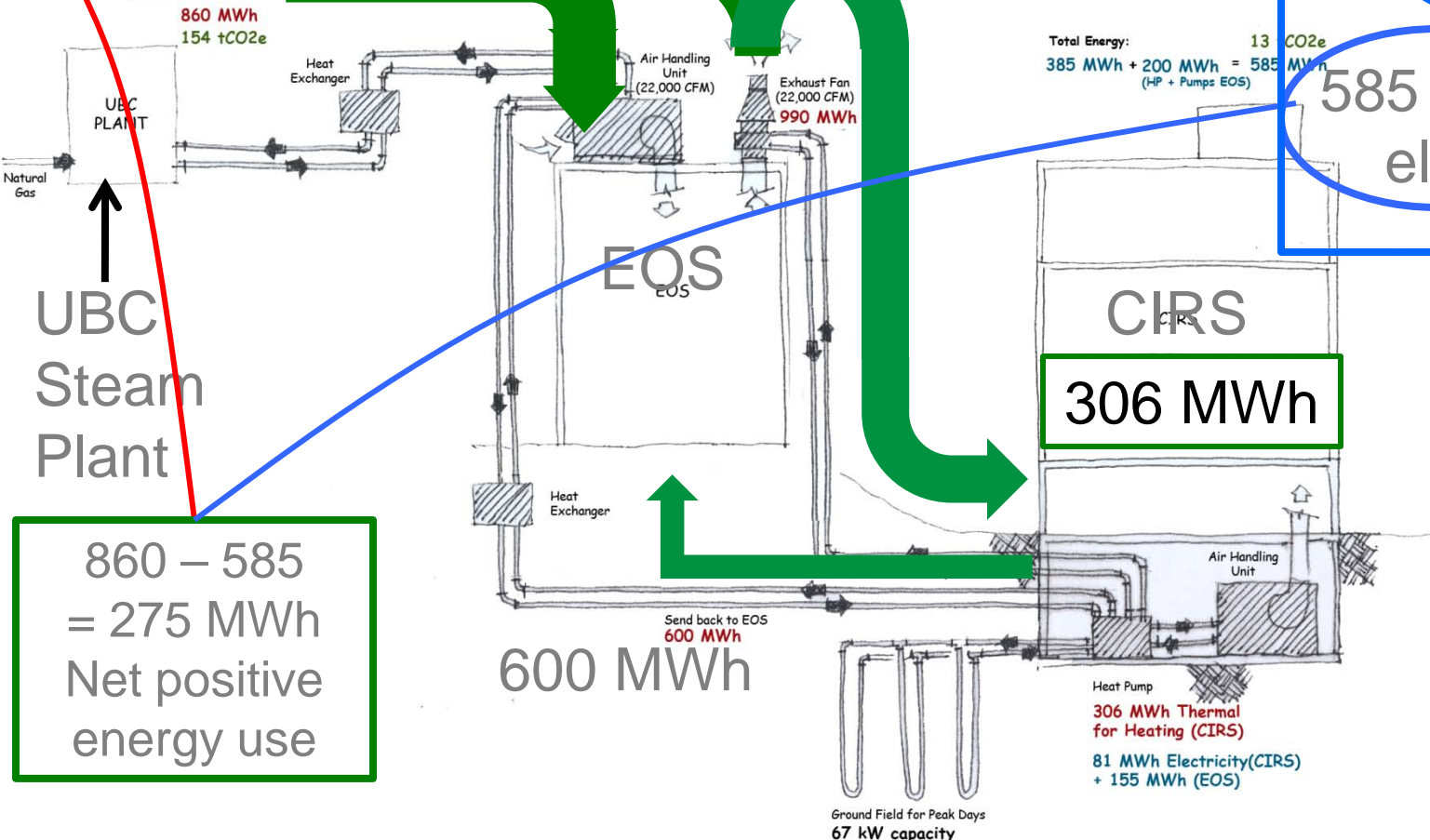
1600-600=
1000 MWh 990 MWh

- Electricity
- Thermal Energy
- tCO2e

Note: All values are approximates

Total Energy: 13 tCO2e
385 MWh + 200 MWh = 585 MWh
(HP + Pumps EOS)

585 MWh
elec.



860 - 585
= 275 MWh
Net positive
energy use

Ground Field for Peak Days
67 kW capacity

		Market Building	Bundle#1	Bundle#2
			CIRS Base Bundle	CIRS plus EOS preheat
End Use	Energy Type			
Lights	Electricity, kWh	172,500	88,000	88,000
Plug Loads	Electricity, kWh	69,100	69,100	69,100
Heating				0
Heating				5,300
Cooling				7,700
Pumps				4,500
Fans				5,100
DHW - G				0
DHW - E				7,900
Total				5,500
Total - E				5,500
Total - G				-
Total - G				-
Savings				6,300
Savings				
Savings				6,300
Demand				
Demand				
Energy				
Total				4,600
Cost Savings - Electric	Electricity, \$	-	\$20,000	\$11,600
Cost Savings - Gas	Gas, \$	-	\$0	\$0
Cost Savings - Total	Both, \$	-	\$20,000	\$11,600
EUI	kwh/m2/yr	157	70	106

Savings

Lighting: -49%

Cooling and Fans: -57% (-39% incl. EOS)

Electric heating: -75% (-27 incl. EOS)

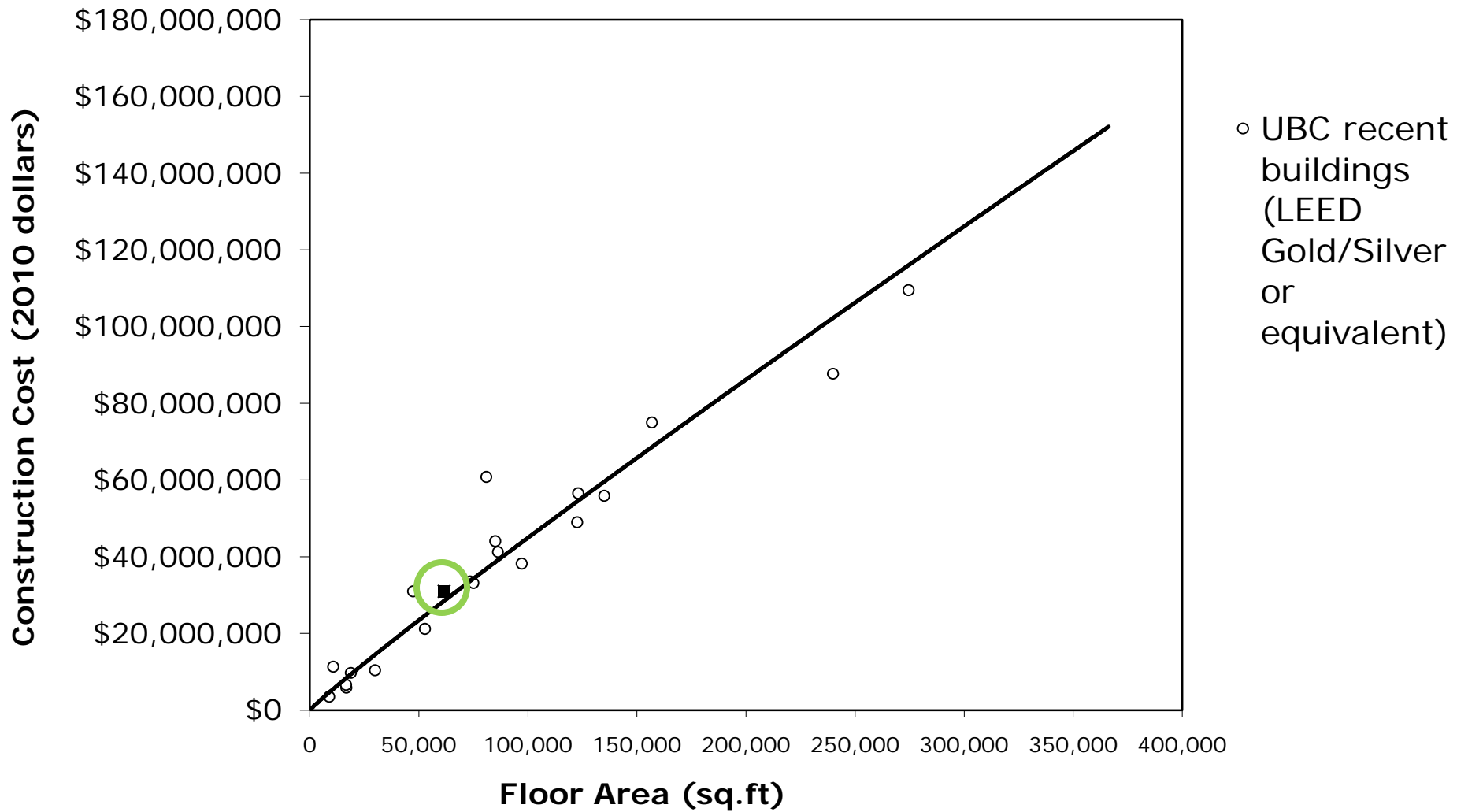
Electric hot water: -80%

Pumps: -14% (+3% incl. EOS)

Total: -54% (-32% incl. EOS)

Plug Loads assumed to be the same

Capital Cost of UBC Buildings



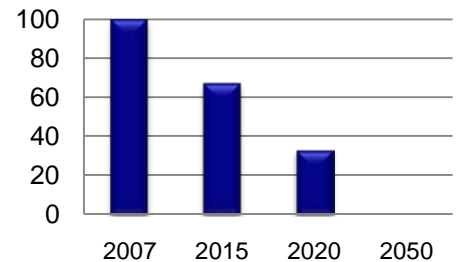
UBC Campus as a Living Lab



UBC Campus Steam and Cooling System

- ~14 million sq. ft.
- ~270 core buildings
- ~ 300 hectares

“UBC will be the world’s leader in developing and demonstrating energy savings and clean technology initiatives by combining the talent of our researchers and students, the expertise of our operators and the entrepreneurship of our community partners to make UBC the most sustainable campus on Earth in Vancouver and in the Okanagan Valley.”



Living Lab Roadmap

2015

33% GHG Reduction

Supply:

Biomass demonstration:
Nexterra Pilot (9%)

Demand:

Steam to Hot water
conversion (start) (17%)

Continuous Optimization;
Pulse Energy Rollout (10%)

New Buildings: Low
temperature and energy

CIRS

2020

67% GHG Reduction

8.5MW Clean Energy:
Biomass II, Triumph? (23%)

Steam to Hot water conversion
(completion) (5%)

Continuous Optimization; BC
Hydro Self-Sufficiency (6.5%)

New Buildings: Low
temperature; energy neutral

Smart Energy System

2050

100% GHG Reduction

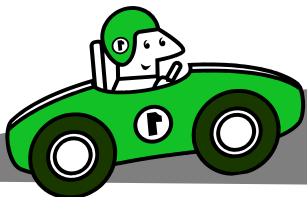
New clean energy sources:
Ocean, Waste, Aquifer?

Extend District Heating
system to all campus buildings

Continuous Optimization

New Buildings: energy
neutral

Transport changes



Continuous Optimization in Buildings

- Partnership with BC Hydro
- 72 large academic buildings completed in four phases between 2010 and 2016
- Energy conservation measures
 - “Tuning” the building automation system
 - Demand control strategies for laboratories
 - Improved behavior change programs
- Target: 10% GHG reduction



UBC Bioenergy Demonstration

Nexterra Partnership

Building: 4 story CLT building

Heating mode 6 MW

Cogen mode 2 MW(elec) + 3 MW(heat)

CO2 Reduc'n: 4,000 tpy of GHG



GE
Energy



BC hydro



Steam to Hot Water Conversion

- Largest Hot Water conversion in North America - \$80-90M
- 24% Energy and 22% GHG savings
- Replaces aging infrastructure with high operational and deferred maintenance costs
- Increases fuel source flexibility
- Project Financing being worked on



1997 OCP Targets and Achievement

Land Use Plan	Target	Current
Housing		
• full-time undergraduates in residence	25%	29%
• new housing as ST rental	20%	27%
• non-market new rental housing	50%	66%
• staff students & faculty in family housing areas	50%	51%
Transportation		
• traffic reduction	- 20% from 1996	- 20%

Ecological Sustainability | Transportation

- Since 1997, transportation initiatives, including the U-Pass, have reduced GHG emissions by 16,000 tonnes annually and decreased single-occupancy vehicle trips by 14% overall
- We have reduced the total number of parking spaces by one-third, from 15,000 spaces to 10,000 spaces



Utown@UBC



2001 Population: ~10,000

- 7,000 Students
- 700 Faculty/ Staff Rental
- 1,700 Family



2010 Population: ~15,000

- 9,500 Students
- 1,000 Faculty/ Staff Rental
- 5,000 Family/ Co-Development



2025 Population: ~30,000

- 14,000 Students
- 3,300 Faculty/Staff Rental
- 12,800 Housing/Co-Development

Our Goals

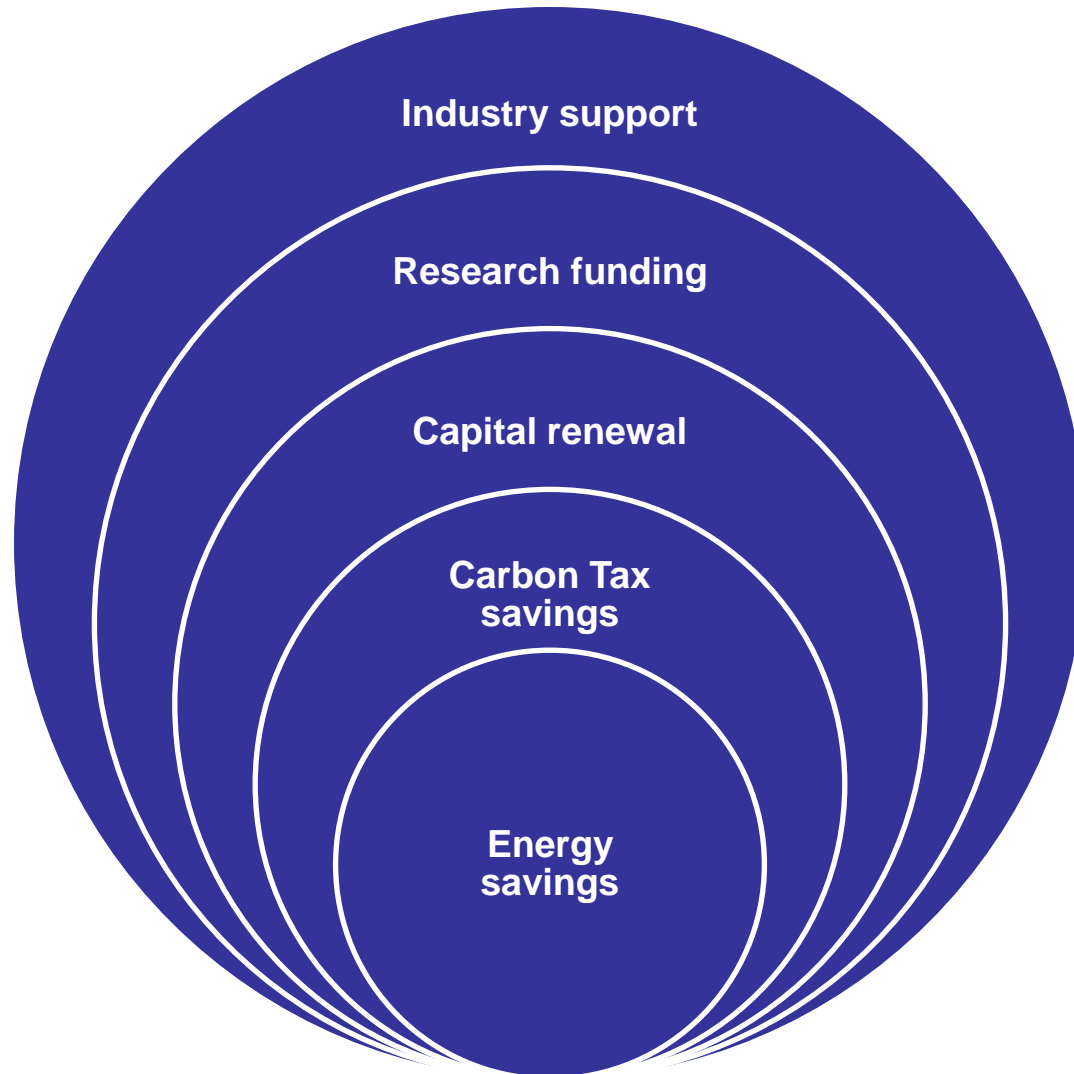
The goal is to create a vital, lively, healthy - and sustainable - community where people can work and learn and shop and play, where they can walk or take transit easily, and where most of what they need is readily at hand.

- Stephen Toope, UBC President and Vice-Chancellor

- Transform from commuter campus to a complete, sustainable community
- Build more affordable housing for students and families to live on campus
- Enhance academic engagement, campus life and the environment
- Build UBC's financial endowment to support the academic mission



Fund through Innovation



Living Lab Partnerships



Honeywell

Interface



GE
Energy



Jenbacher



CIRS Site Oct 1, 2010

Substantial Completion April 2011

Occupancy May 2011

USI Move June 2011



USI Driving Forces

- Sustainability track record (10 years)
- Leadership (Stephen Toope, Executive)
- Provincial policy context (carbon pricing, mandated LEED Gold for new construction)
- Socio-cultural context in BC (e.g. recruitment effects)
- Arrival of CIRS on Vancouver campus

Next steps and priorities

- Finalize BC Hydro deal on green electricity rate
- Finalize and implement steam to hot water conversion
- Take UNA partnership to the next level (zero waste)
- Complete district energy feasibility study for the remaining areas of Wesbrook Place
- Continue to expand City of Vancouver breadth and depth
- Refine bilateral agenda with international and local partners
- Explore opportunities for Provincial support for such an agenda
- Integrate Okanagan research agenda into partnership opportunities