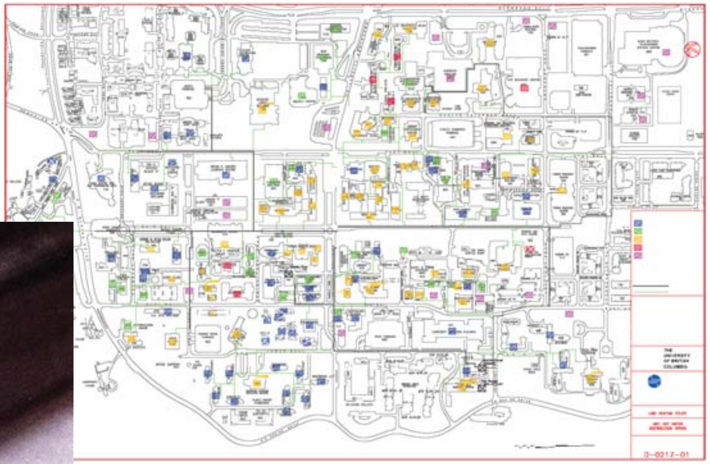
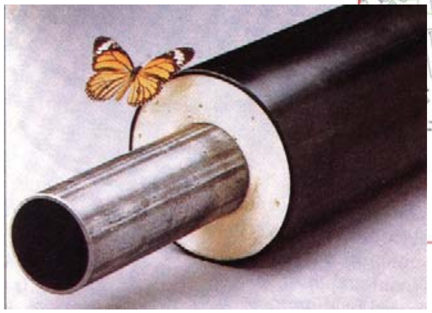
UBC AS A LIVING LAB:
BRITISH COLUMBIA'S HUB FOR SUSTAINABLE INNOVATION

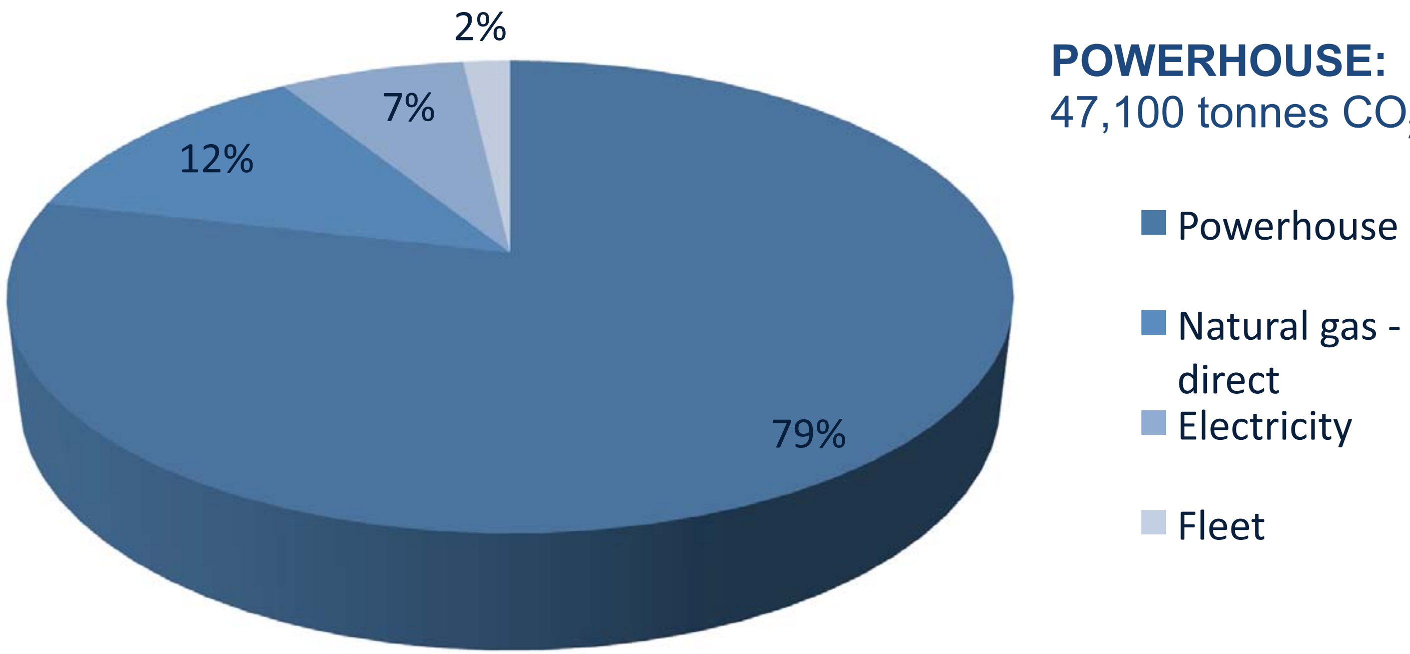
VANCOUVER CAMPUS SMART ENERGY SYSTEM
Steam to Hot Water Conversion Project

Presentation to:
UBC Campus as a Living Lab symposium
September 27, 2010





UBC'S VANCOUVER CAMPUS ACADEMIC BUILDINGS
GHG EMISSIONS (2009)



SCOPE 1 & 2 EMISSIONS:
59,920 tonnes CO_2e

POWERHOUSE:
47,100 tonnes CO_2e

UBC GHG REDUCTION TARGETS

UBC adopted its Climate Action Plan in 2010, committing the university to aggressive greenhouse gas (GHG) reduction targets of:

33% below **2007** levels by **2015**

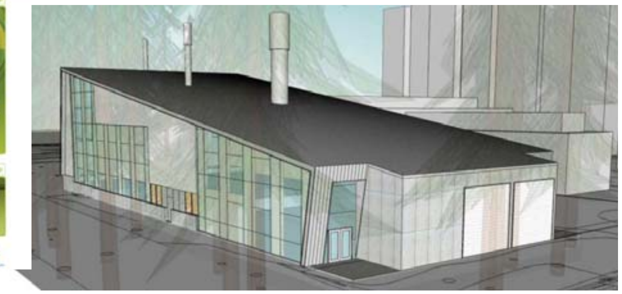
67% below **2007** levels by **2020**

100% below **2007** levels by **2050**

Becoming a Living Laboratory

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 industrial and community partners to make UBC, both in Vancouver and in the Okanagan, **the most sustainable and innovative campus on Earth.**

ACHIEVING GHG REDUCTION TARGETS



These three projects will achieve the 2015 target of 33% reduction:

1. Bioenergy Research and Demonstration project - Committed
2. Energy optimization in buildings - Committed
3. **Steam to hot water conversion of district heating system – Proposed**

These additional initiatives will achieve the 2020 target of 67% reduction:

4. **8.5MW Clean Energy plant (biomass) - Proposed**
5. BC Hydro self-sufficiency (carbon neutral electricity by 2016) - Committed

Vancouver Campus GHG Forecast

UBC CAMPUS GHG REDUCTIONS (2007 baseline)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Nexterra cogen	0%	9%	9%	9%	9%	9%	9%	9%	9%	9%
Continuous Optimization	0%	2.5%	5%	7.5%	10%	10%	10%	10%	10%	10%
Hot Water Conversion	0%	0%	8%	13%	17%	22%	22%	22%	22%	22%
8.5 MW Clean Energy	0%	0%	0%	0%	0%	0%	23%	23%	23%	23%
BC Hydro Self Sufficiency	1%	2%	3%	4%	5.0%	6.5%	6.5%	6.5%	6.5%	6.5%
TOTAL Campus % GHG Reduction	**1%**	**13%**	**24%**	**33%**	**41%**	**47%**	**70%**	**70%**	**70%**	**70%**

- GHG targets can be tracked and calculated very easily as they will be reflected in the total amount of natural gas purchased each year.
- It is quite conceivable that we could be more successful with each phased implementation in reaching our desired targets.

Campus Steam to Hot Water Conversion

- Replaces existing steam system infrastructure (boilers, distribution piping, building heat exchangers) with equivalent infrastructure for a hot water district energy system
- Provides process steam equipment for those buildings that still require steam for research or operational purposes
- Largest Hot Water Conversion in North America
  - 14 km pre-insulated hot water distribution piping
  - 131 energy transfer stations in building mechanical rooms
  - Implemented over 5 year period
  - $84.8 million preliminary capital cost estimate
- Produces 24% energy saving and 22% GHG reduction

Why Hot Water (versus Steam)?

- **Aging infrastructure** – Replaces end-of-life steam infrastructure (high deferred maintenance and operating costs) which would need to be replaced anyway in the next 10-20 years at a cost of over $40 Million.
- **Energy cost savings** – Results in estimated 24% energy savings. UBC currently pays $6.3M/yr for natural gas to make steam + 2.3M/yr for carbon liabilities. Carbon taxes are scheduled to increase in the coming years.
- **Operating cost saving** – Requires fewer operating personnel to comply with Provincial regulatory requirements.
- **GHG reduction** – Reduces GHG emissions by 22%. Contributes significantly to achievement of 33% reduction by 2015 and 67% reduction by 2020.
- **Fuel source flexibility** – Increases ability to use energy from alternative sources i.e. waste heat and ocean thermal sources.
- **UBC as a Living Lab** - Enables opportunities for demonstration of innovative clean energy technologies and partnering with industry.
- **Sustainability leadership** – Demonstrates UBC commitment to long term investment for a more sustainable future.

Why District (versus Distributed) Energy?

- **Operating costs** – Centralized systems typically last longer, cost less to operate and are more reliable than stand alone building systems.
- **Backup energy** – Terasen Gas curtails the supply of natural gas to campus on the coldest winter days. When this happens a central plant can switch to fuel oil.
- **Space requirements** – The majority of mechanical rooms in existing UBC buildings are not sized to accommodate boilers.
- **Fuel flexibility** – A district energy system more easily allows for integration of economically scaled alternative energy sources such as biomass, solar and waste heat sources.

BC electricity is cheap and GHG free
Why not use electric boilers?

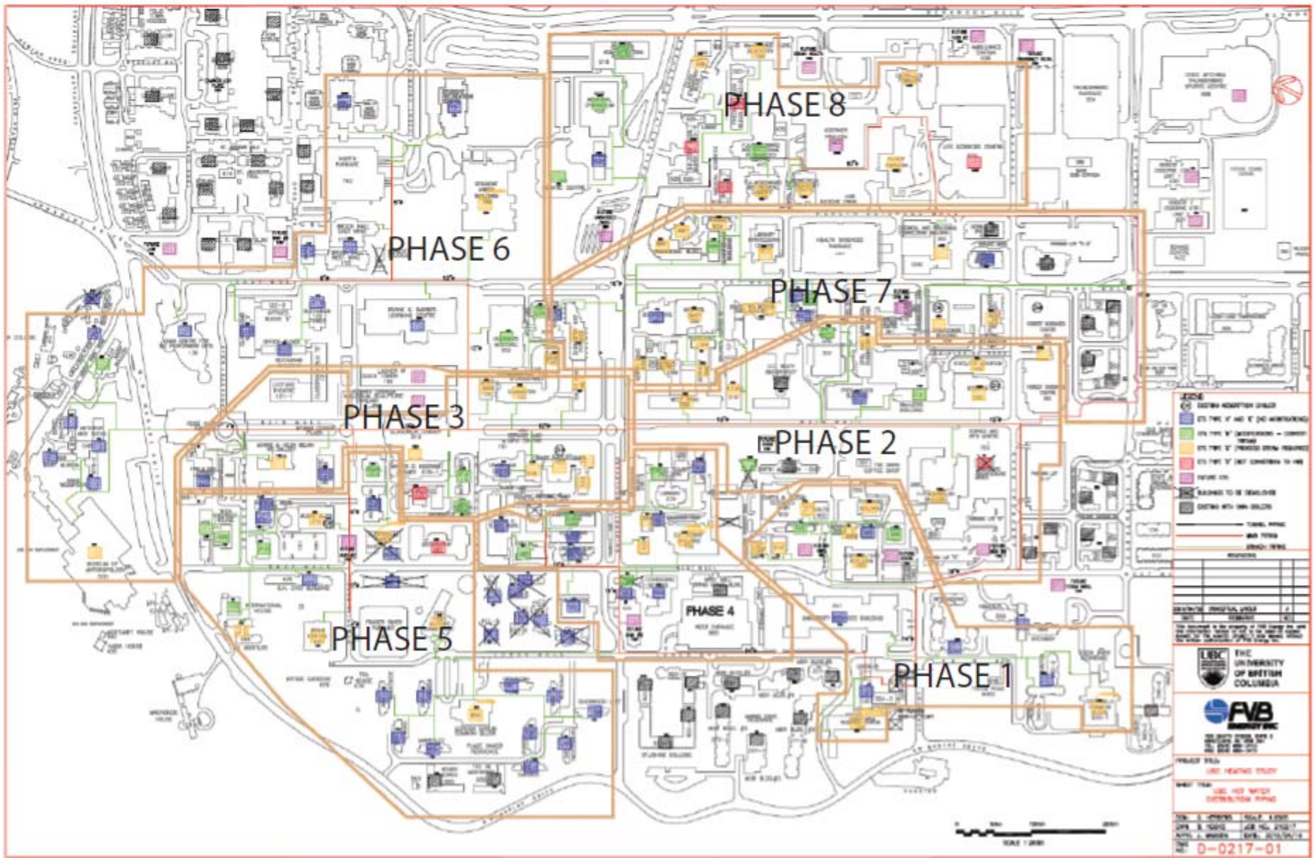
Energy inputs	2010 -2015 average $/GJ	Efficiency	Cost per GJ Delivered
Natural gas	$ 10.53	87%	$ 12.11
Electricity (Off Peak)	$ 12.51	97%	$ 12.90
Electricity (With Peak)	$ 16.08	97%	$ 16.58
Savings off peak			$ (0.80)
Savings with peak electricity			$ (4.47)

- Electricity costs more than natural gas per unit of energy.
- BC Hydro emissions factor does not include large amounts imported electricity from coal and natural gas plants which operate at only 33% efficiency.
- Electrical service capacity to campus is limited and would need to be upgraded for peak use of electric boilers.
- Off-peak use of electric boilers would still require natural gas boilers for peak use. Therefore does not avoid need to replace existing natural gas boilers.

HOT WATER CONVERSION
Phasing plan

2010 2015 2020	% GHG reduction	Capital Cost Estimate X 1000
52 MW Hot Water plant	0%	$24,816
Hot Water Phases 1,2	8%	$12,336
Hot Water Phase 3,4	13%	$13,473
Hot Water Phase 5,6	17%	$15,479
Hot Water Phase 7,8	22%	$18,653
Total (Hot Water Conversion)		**$84,757**
8.5 MW Clean Energy (biomass)	55%	$6,204
Total proposed (HWC + 8.5 MW Clean Energy)		**$90,961**

Proposed Phasing of Hot Water Conversion Project



Next Steps

Board Property & Planning Strategy Session	Sep 15, 2010
Executive 2	Sep 2010
Executive 3	Oct 2010
Board 1	Nov 2010
Board 2	Apr 2011
Board 3	Jun 2011
Commence HWC project	Jul 2011

a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA