

# UBC: A Living Laboratory for Sustainability

COST ACTION FP1303 – First Conference



a place of mind  
THE UNIVERSITY OF BRITISH COLUMBIA

**sustainability**

Performance and Maintenance of Bio-based Building  
Materials Influencing Lifecycle and LCA

Kranjska Gora, Slovenia, October 23-24, 2014

# Part 1:

## Context and Introduction



# British Columbia Climate Action Plan

(July 2008)

The government of British Columbia passed legislation that defines BC's approach to reducing greenhouse gas emissions and that prepares BC for the low-carbon realities of the future, including:

- The Greenhouse Gas Reduction (Targets) Act
  - 33% reduction by 2020 – compared to 2007 levels
  - 80% reduction by 2050 – compared to 2007 levels
- The Greenhouse Gas Reduction (Cap and Trade) Act
- The Greenhouse Gas Reduction (Vehicle Emissions) Act
- The Greenhouse Gas Reduction (Landfill Gas) Act
- The Greenhouse Gas Reduction (Renewable and Low-carbon Fuels) Act
- The Carbon Tax Act
- The 2008 Utilities Commission Amendment Act



# British Columbia Climate Action Plan

(July 2008)

Additionally, the plan supports:

- Creating green communities – new Green Building Code and a \$14 billion Provincial Transit Plan
- Championing innovation - \$50 million Clean Energy Fund and Bio-energy Network and \$100 million Pacific Institute for Climate Solutions
- Building on the Value of BC Forests – Net-zero deforestation policy and \$161 million in reforestation
- LiveSmart BC – rebates and incentives



# British Columbia Wood First Act

(Received Royal Ascent on October 29, 2009)

## Purpose:

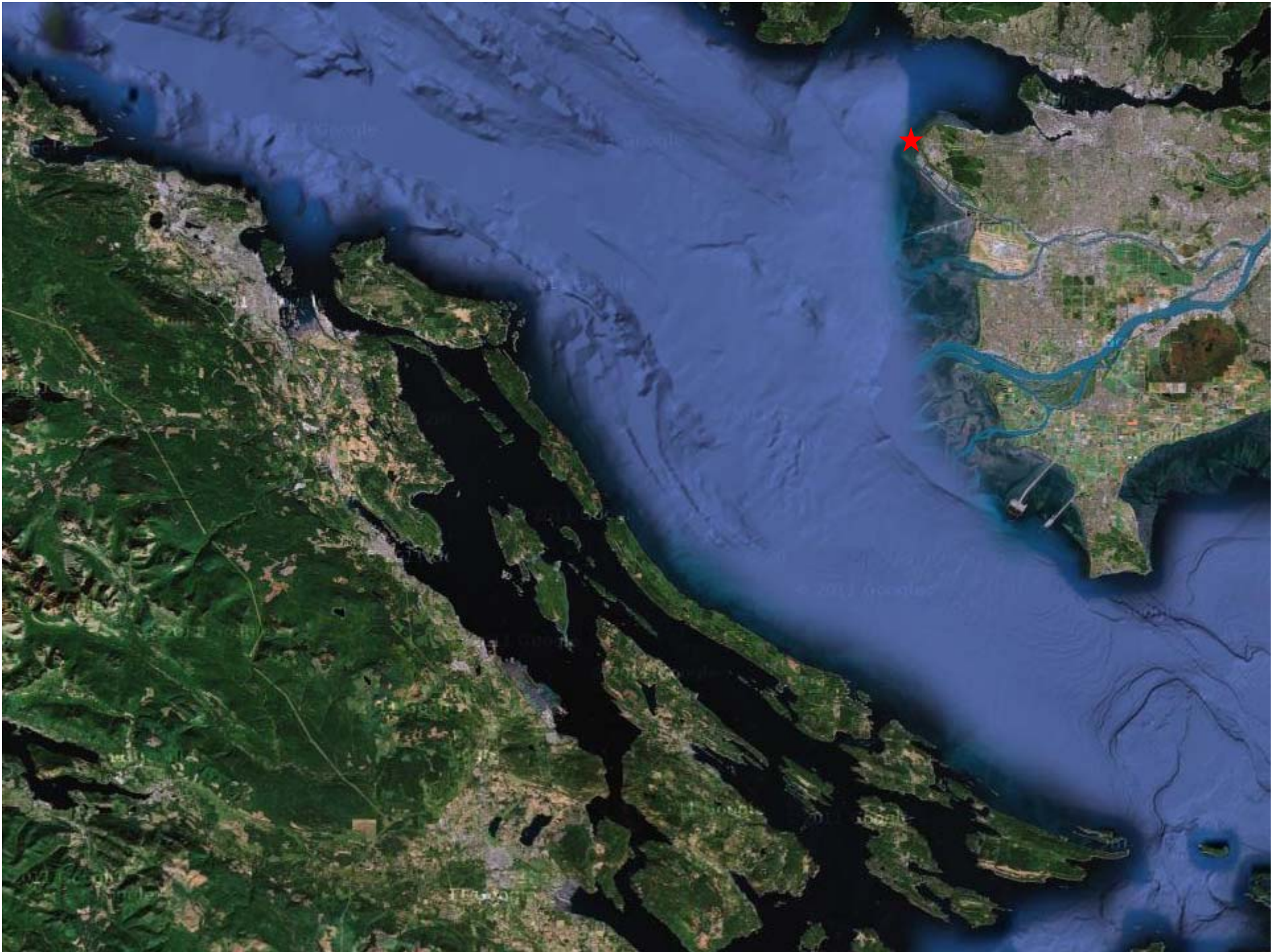
- Facilitate a culture of wood for construction in BC
- Promote the use of wood in provincially-funded projects
- Encourage communities to use wood as appropriate
- Strengthen forest-dependent communities and assist in meeting BC's climate change goals

## Requirements:

- Wood to be considered the *primary building material* in all new provincially-funded projects
- Pertains to all new buildings and building expansion projects











# The University of British Columbia



- Two campuses: Vancouver and Kelowna
- 25 faculties, 5 affiliated hospitals
- 5,000 faculty members (2,200 clinical)
- 47,000 undergraduates (15% international)  
9,000 graduate students (20% international)
- Ranked 25<sup>th</sup> worldwide<sup>1</sup>
- Research leader in Canada<sup>2</sup> (Science & Engineering. Social sciences & Humanities)  
\$500 million/year
- Global leader in clean energy, forestry, sustainable development, health research, and Asian studies
- Commercialization leader in Canada
- Small “city” of 75,000 occupying an area of 1,000 acres with more than 400 buildings

<sup>1</sup> Times Higher Education Reputation Rankings, London, UK – 2012 (17,554 respondents from 137 countries)

<sup>2</sup> Higher Education Strategy Associates, Toronto, Canada – 2012



# UBC Sustainability Track Record



**1996** C.K. Choi Building

**1997** Campus Sustainability Office

**1999-2004** ElecTREK and EcoTREK

**2000-2008** LSC, Michael Smith, ICICS, Kaiser, ChemBio

**2003-2010** UBC Renew

**2009–2010** UBC Climate Action Plan

**2010** UBC Sustainability Initiative and Okanagan Sustainability Institute

**2009-2012** LEED Gold Standard (Law, CIRS, ESB, Pharmacy)



# UBC and Climate Change



\$3m/year in carbon taxes/offsets to fund green infrastructure

# The Sustainability of Limits



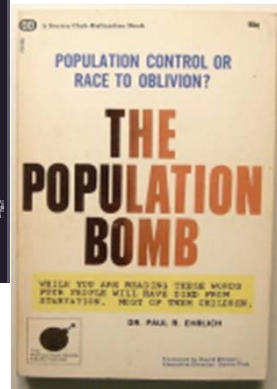
1962



1966



1968



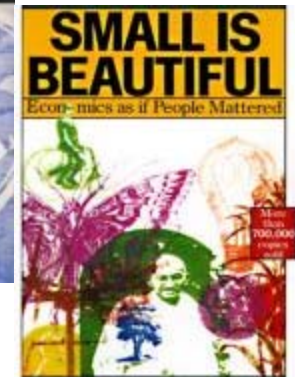
1969



1972

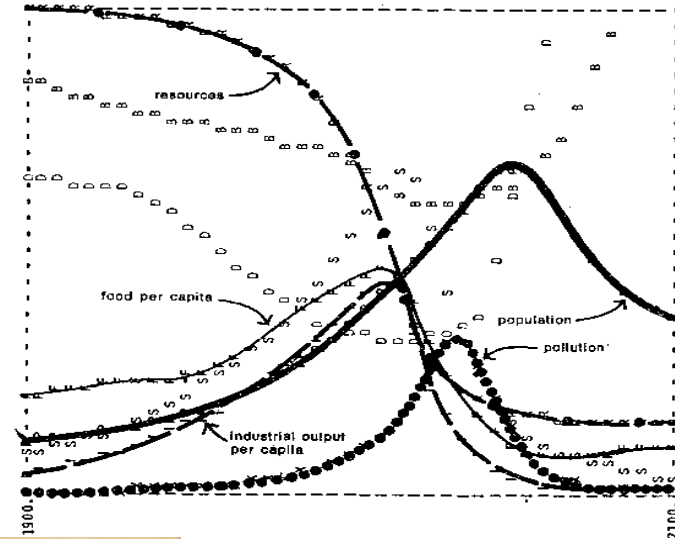


1972



1973

Figure 35 WORLD MODEL STANDARD RUN





# Limits Storyline

Harm reduction

Damage limitation

Mitigation

Cutting back

Sacrifice



# Two Problems

## **Procedural:**

Not motivating

People don't like to sacrifice

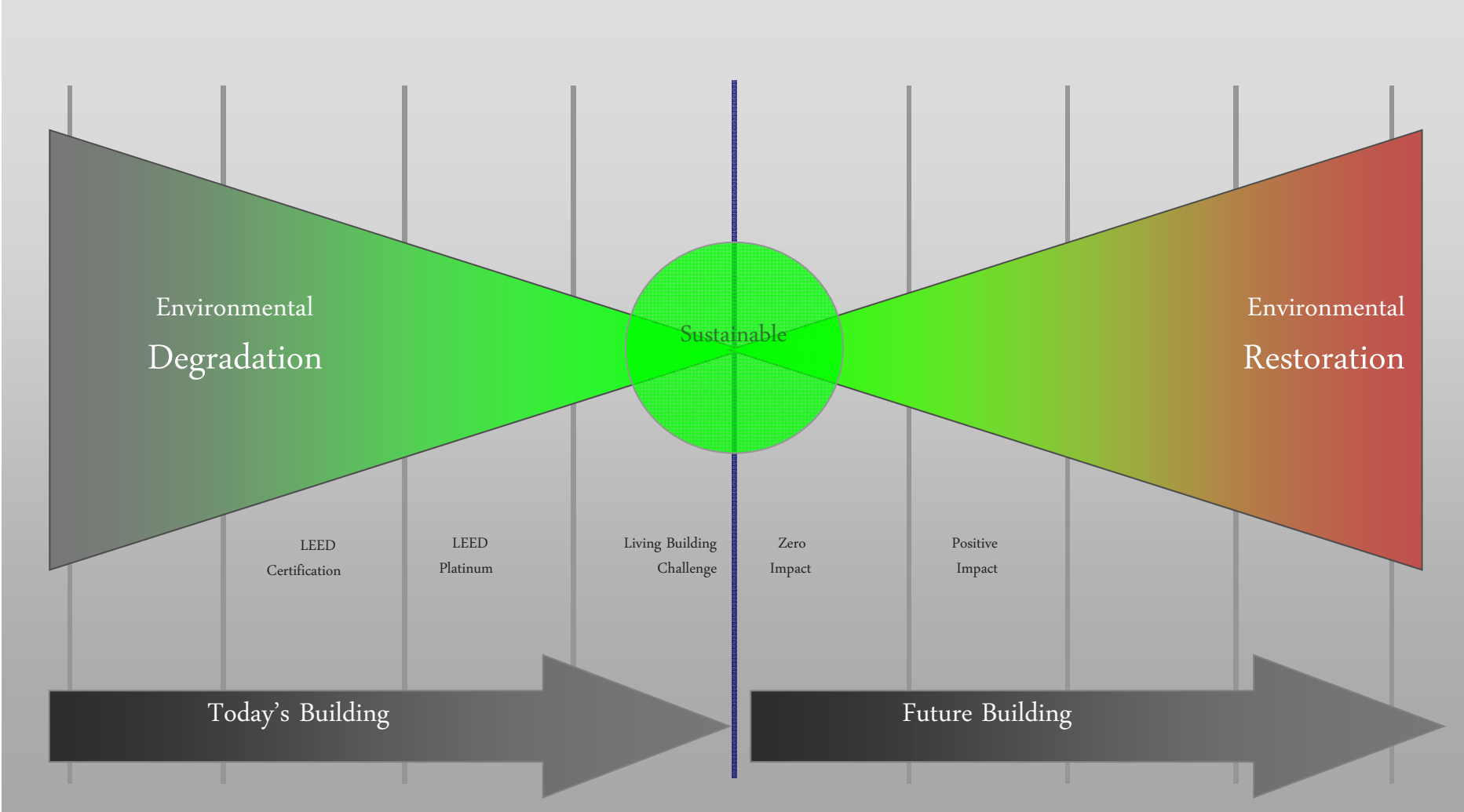
## **Conceptual:**

Doesn't go far enough

We need to go beyond net  
zero



# Towards a Restorative Framework











# The CIRS Building



Location: UBC Point Grey Campus

Program: sustainability research and operations; teaching; food services

Certified LEED Platinum and targeting Living Building Challenge recognition

Gross Area: 5,675 m<sup>2</sup>

Construction Cost: \$24,000,000

Total Project Cost: \$35,000,000

Completion: November, 2011





# Living Laboratory for Sustainability



- Sustainability showcase
- Building = research
- “Process” vs “product”
- Modular construction
- Flexibility/adaptability
- Plug-and-play



## From “less bad” to “net positive” on:

- **Environmental performance**

Energy

Water

Structural Carbon

Operational Carbon

- **Human well-being**

Health

Happiness

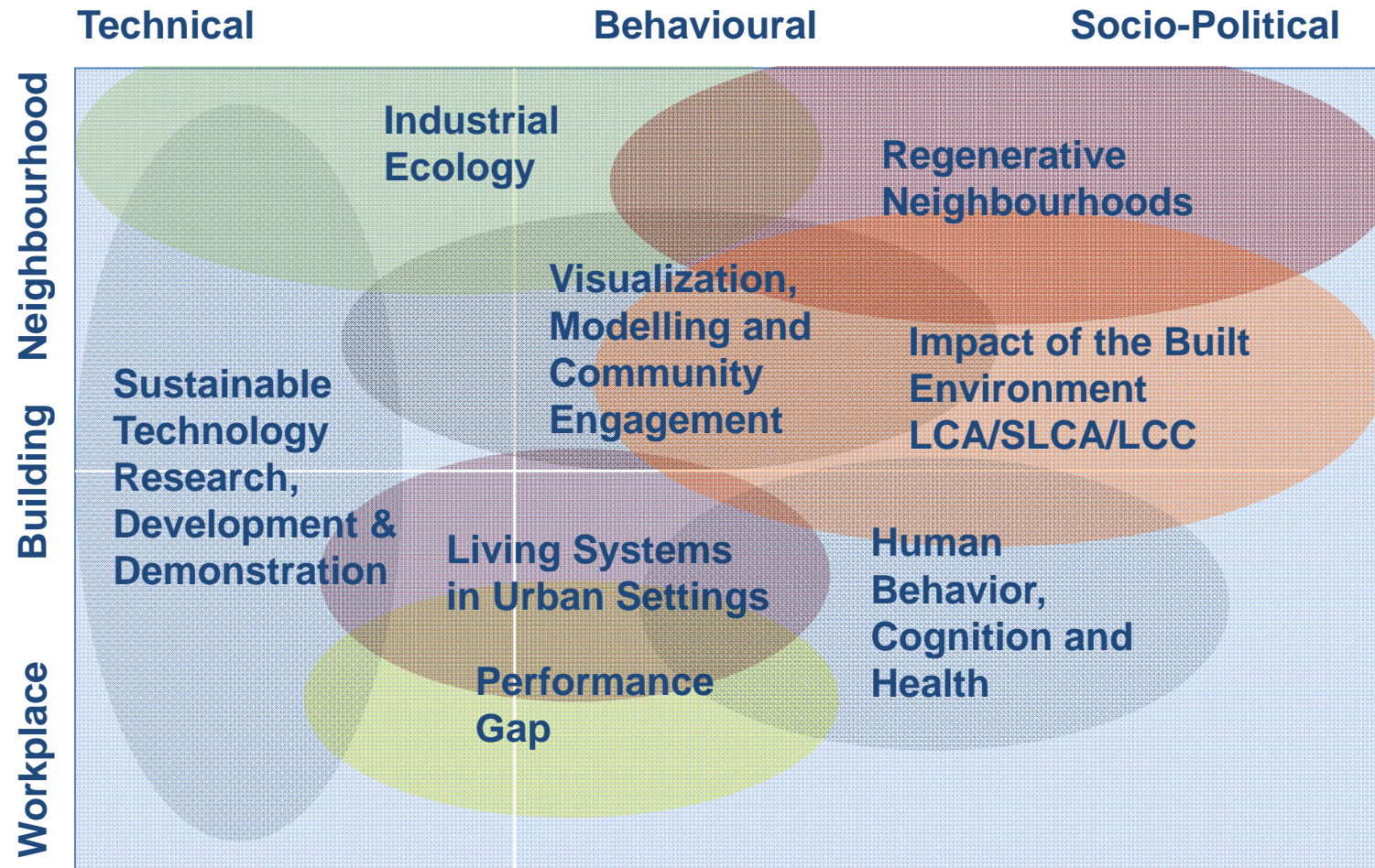
Productivity

Is “regenerative sustainability” technically, financially and institutionally feasible?



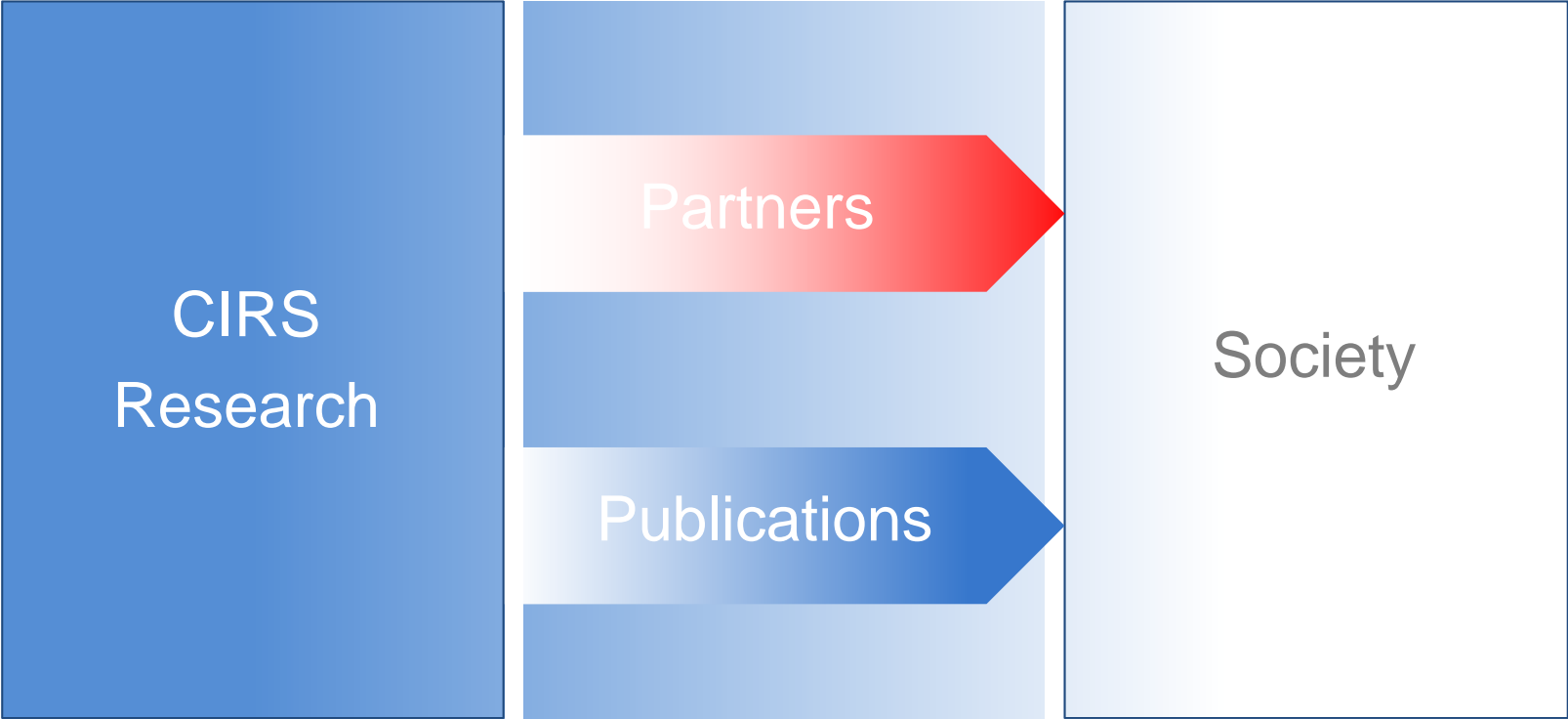


# CIRS Research Clusters





# CIRS Research Program: Accelerating Change



# CIRS Current Partnerships

## Industry

- Arup (London, United Kingdom)
- Ascent Technologies (Kamloops, BC)
- Bentall Kennedy (Vancouver, BC)
- BuiltSpace (Vancouver, BC)
- ByNature Design (Vancouver, BC)
- Coldstream Consulting (Vancouver, BC)
- Dialog (Vancouver, BC)
- Eco-Tek Ecological Technologies (Langley, BC)
- Enerphoton Engineering (Vancouver, BC)
- Giacomini (Milan, Italy)
- Haworth (Holland, MI)
- Honeywell (Minneapolis, MN)
- Integral Group (San Francisco, CA)
- Kasian (Vancouver, BC)
- Modern Green (Beijing, China)
- Orange Goes Green (Amsterdam, The Netherlands)
- Perkins+Will (Atlanta, GA)
- Stantec (Edmonton, AB)
- VanAir (Vancouver, BC)

## Government

- Forestry Innovation Investment (Vancouver, BC)
- Shared Services British Columbia (Victoria, BC)

## NGOs

- Bullitt Foundation (Seattle, WA)
- EcoDistricts (Portland, OR)
- Kresge Foundation (Detroit, MI)
- Institute for Environmental Research and Education (Tacoma, WA)
- McCall MacBain Foundation (Geneva, Switzerland)
- Pacific Institute for Climate Solutions (Victoria, BC)
- RBC Blue Water Foundation (Toronto, ON)
- Real Estate Foundation of BC (Vancouver, BC)
- UBC Neighbourhood Association (Vancouver, BC)



# Part 2:

## Campus as a Living Laboratory (CLL)





2100: Low-carbon resilient





# Urban Challenges and Opportunities

## Sustainable Development Imperatives related to:

Water

Energy & Climate Change

Materials & Waste

Transportation

Land Use Patterns

Food

Biodiversity & Habitat

Security

Health

Air Quality

Human Development

Social Relationships

Democracy & Social Justice

*Global Municipal Infrastructure Deficit:*  
\$70 trillion dollars  
(Booz and Company, 2008)

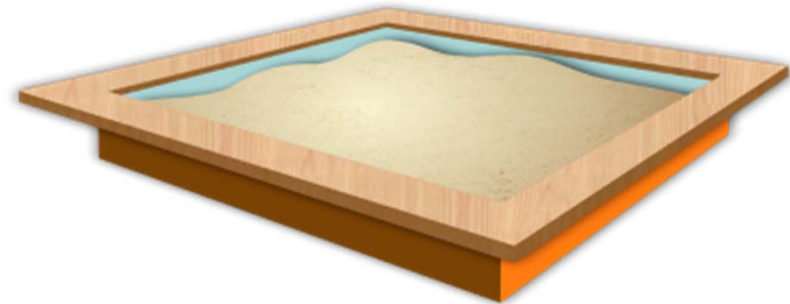
*Global Clean Tech Investment* could reach \$2 trillion dollars per year by 2020



# Campus as Sustainability Test-Bed

Universities uniquely suited for this role:

- Single owner-operator
- Public mandate
- Teaching
- Research

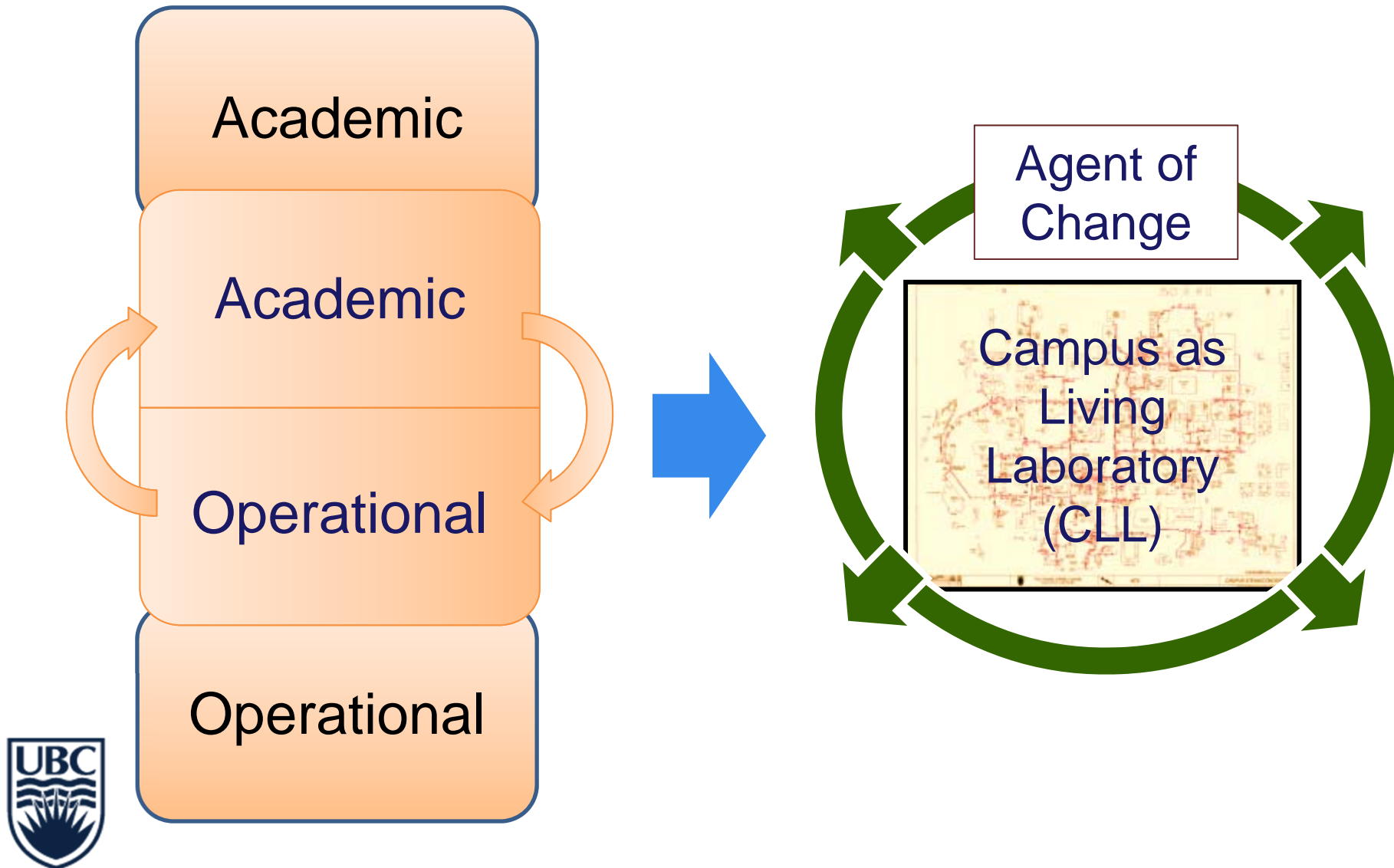


Develop integrated campus-scale systems:

- Demonstration and research
- Engage and train students
- Develop new curricula and programs



# Sustainability Initiative



# Utown@UBC



## 2001 Population: 9,400

- 7,000 Students
- 700 in Faculty & Staff Rental
- 1,700 in Family Housing



## 2010 Population: 15,500

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



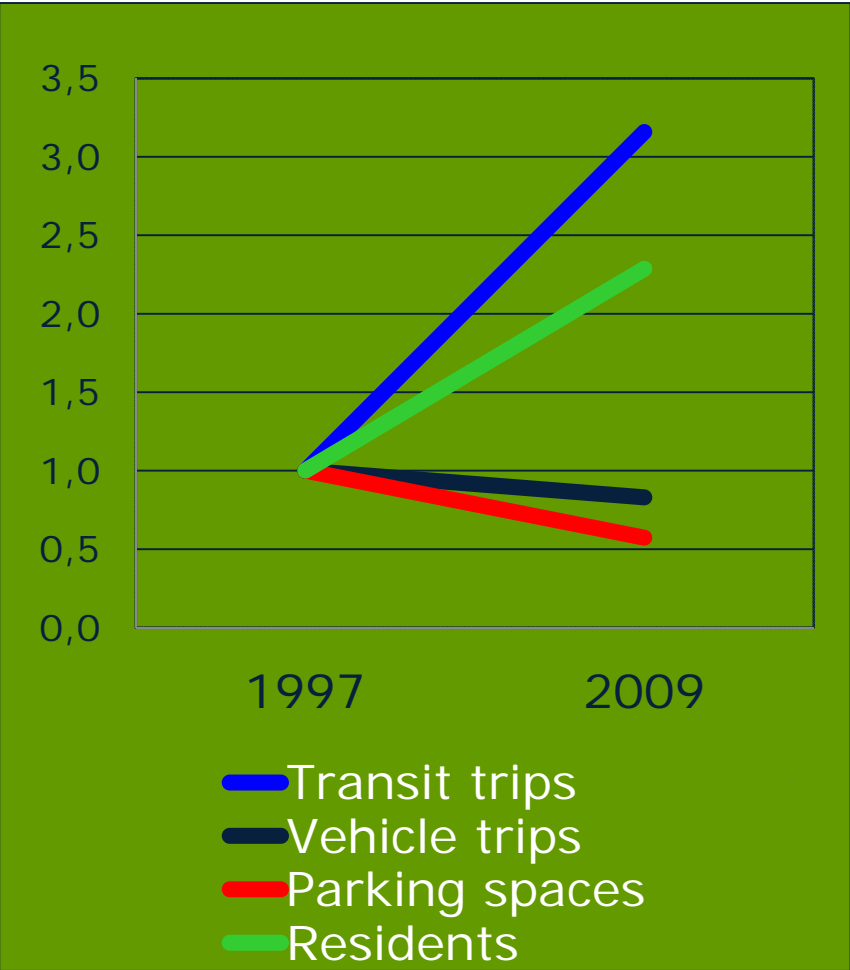
## 2025 Population Projection: 28,100

- 12,000 Students
- 3,300 in Faculty & Staff Rental
- 12,800 in Market Housing/  
Co-Development





# Sustainability Indicators



# Living Lab Roadmap

**2015**

**33% GHG Reduction**

## **Supply**

Biomass Research and  
Demonstration Facility (~10%)

## **Demand**

Steam to Hot water conversion  
(start) (~15%)

Continuous Optimization; Pulse  
Energy Rollout (~10%)

**New Buildings: Low  
temperature and energy**

**2020**

**67% GHG Reduction**

10MW Clean Energy:  
TRIUMF (~20%)

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

Continuous Optimization; GHG-free  
Electricity (~5%)

**New Buildings: Low  
temperature; net zero**

Smart Electro-mechanical Energy  
Systems

**2050**

**100% GHG Reduction**

New clean energy sources:  
Ocean, Waste, Aquifer?

Extend District Heating  
system to all campus  
buildings

Continuous Optimization

**New Buildings: net zero**

Transportation changes



# Signature Projects



Continuous  
Optimization  
of Campus  
Buildings

Centre for  
Interactive Research  
on Sustainability

Steam to Hot Water  
Conversion of  
Campus District  
Energy System

Bioenergy  
Research &  
Demonstration  
Facility



Capital Investment: \$150 million



# Ongoing Projects

BIO ENERGY



ENERGY STORAGE



ELECTRIC VEHICLE



POWER OVER ETHERNET



BIOMASS TO HYDROGEN



Underway ----- Developing ----- Emerging



# Cornerstones of UBC's CLL Initiative:

- Integrates core academic mission with operations
- Partnerships between UBC and public, private and NGO organizations
- Sound financial use of UBC infrastructure
- Potential for knowledge transfer beyond UBC



# CLL Challenges

- Faculty engagement
- Beyond Applied Science
- Teaching connections
- Social sustainability
- NGO and public sector involvement





# CLL Insights

## Ingredients for success:

- Strong research, teaching and learning interest
- Identified operational needs
- Committed/motivated partners
- Dedicated project management
- Frank and open communications
- Access to third-party funding (e.g. research grants)



# Part 3:

## CLL and Wood



## ENVIRONMENTAL IMPACT OF WOOD USE (POST-CONSTRUCTION CALCULATION)



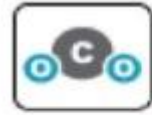
Volume of wood products used:  
940 cubic meters (33,196 cubic ft) of lumber and sheathing



British Columbia forests grow this much wood in:  
3 minutes



Carbon stored in the wood\*:  
701 metric tons of carbon dioxide



Avoided greenhouse gas emissions by using wood instead  
of other building materials\*\*:  
1473 metric tons of carbon dioxide



Total potential carbon benefit (avoided GHG emissions +  
carbon stored in wood):  
2173 metric tons of carbon dioxide

THE ABOVE GHG EMISSIONS ARE EQUIVALENT TO:

(US EPA 2010)



415 cars off the road for a year



Energy to operate a home for 185 years

\*Estimated by the Wood Carbon Calculator for Buildings, based on research by Sathre, R. and J. O'Connor, 2010, A Synthesis of Research on Wood Products and Greenhouse Gas Impacts, FPInnovations (this relates to carbon stored and avoided GHG)

\*\*CO<sub>2</sub> in this case study refers to CO<sub>2</sub> equivalent



# Ancestral and Vernacular Construction Material











# Biomass and Bio-energy











# Performance-based Building Codes













# Repurposing and Recycling













# Engineered Wood Products and Hybrid Construction













# Dimensional Lumber and Sustainability











# Tall Wood Buildings





# UBC Example

- Brock Commons Residence
- 400 student residence beds
- 16-18 floors
- 53 meters high
- 14,585 m<sup>2</sup>
- \$44,000,000
- Anticipated completion: August 2017
- Powerful influence toward the 2020 Canadian National Building Code revision
- Showcase, demonstration and R&D



Alberto Cayuela, P.Eng., PMP, LEED AP  
Director, Operations and Business Development  
Centre for Interactive Research on Sustainability | University of British Columbia  
2260 West Mall | Vancouver, BC Canada V6T 1Z4  
P 604-827-3999 | C 604-218-3761  
[alberto\\_cayuela@ubc.ca](mailto:alberto_cayuela@ubc.ca)  
[www.cirs.ubc.ca](http://www.cirs.ubc.ca)

