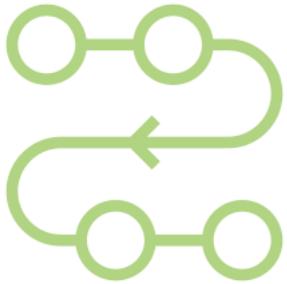
Deep Carbon Retrofit Strategies for Institutional Campuses

CICAN | Tuesday, NOVEMBER 14, 2023

Prism ENGINEERING

Desired Session Outcomes

- Discuss deep carbon and deep retrofit strategies in terms of scope, challenges and considerations for implementation



Agenda

1. Introduction
2. Planning
3. Scope
4. Challenges
5. Solutions
6. Lessons Learned

Introduction

Prism 6-Step Deep Retrofit Process

1

Optimize Systems

- Reduce waste
- Enhance controls

2

Improve Efficiency

- Equipment
- Systems

3

Recover Heat

- Air and water systems

REDUCE ENERGY

4

Low Carbon Electrification

- Consider future needs
- Consider climate

5

Renewable Supply

- Passive options
- Solar Thermal
- Geothermal

6

Offset Remaining

- RNG
- renewable energy credits

REDUCE CARBON

Deep Retrofits

- A deep energy retrofit (DER) focuses on larger-scale upgrades, significant energy reductions and extended ROI

- A deep carbon retrofit (DCR) maximizes energy efficiency and significantly reduces greenhouse gas and carbon emissions

How do different studies compare?

Characteristic	Energy Study	Deep Energy Retrofit Study	Deep Carbon Retrofit Study
Measures to minimize waste	✓	✓	✓
Measures to maximize efficiency	✓	✓	✓
No-cost / Low-cost measures	✓	Limited focus	Limited focus
Measure investment criteria	ROI / Simple payback	ROI / Life cycle cost	ROI / Life cycle & Environmental impact
Investment outlook	Short – Medium	Medium – Long	Long
Climate impact focus	Low	Low/Med	High
Energy resiliency	N/A	✓	✓
Example measures	**Identify Measures** • Controls improvements - Boiler upgrades • VFDs on pumps/fans • Lighting upgrades • Heat recovery	**Energy Study Plus:** • PV • HVAC Redesign • Envelope upgrades	**DER Plus:** • Fuel switching/Electrification • Heat pumps Co-generation • Heat recovery chillers • On-site generation • Biomass heating

Planning

Your Vision and Values

Capilano

- Sustainable actions to enable a better place for future descendants.

Coast Mountain

- Practice social, environmental, and financial sustainability

Douglas

We take the long view. We uphold our responsibility as careful stewards of the financial, physical and environmental resources entrusted to us.

KPU

In 2026, KPU is a learning ecosystem rooted in a culture of sustainability, creativity, justice and quality that inspires our people and our communities

Langara

Our vision is to inspire an ethos of giving in the communities we serve. We envision a future where academic freedom flourishes; community sustainability is assured; and every student has the resources they need to achieve their academic goals and gain the experiential foundation they need to succeed.

NVIT

- We care and support each other and have respect for our environment.

Okanagan

6. **Sustainability.** We strive for social, environmental and economic sustainability.

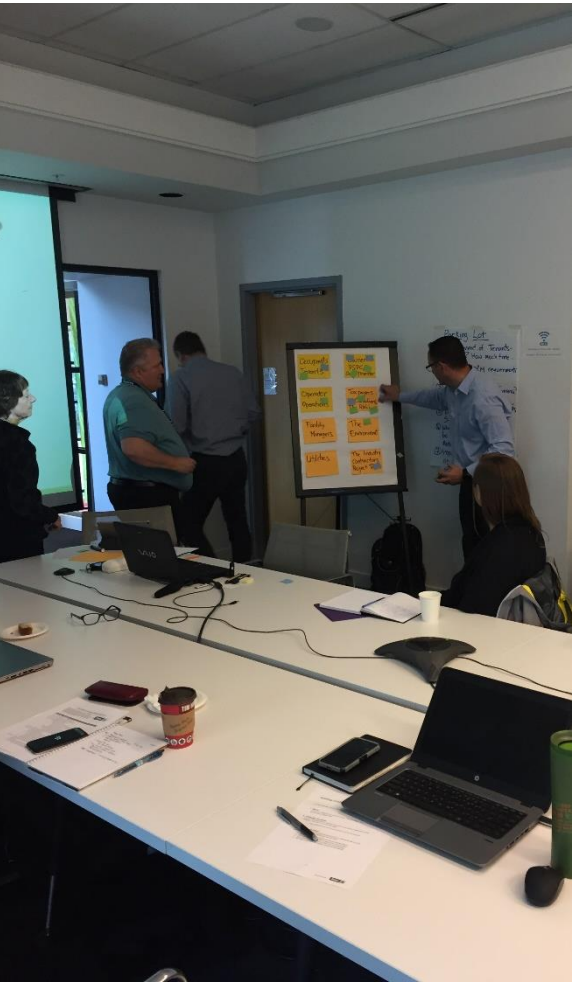
VCC

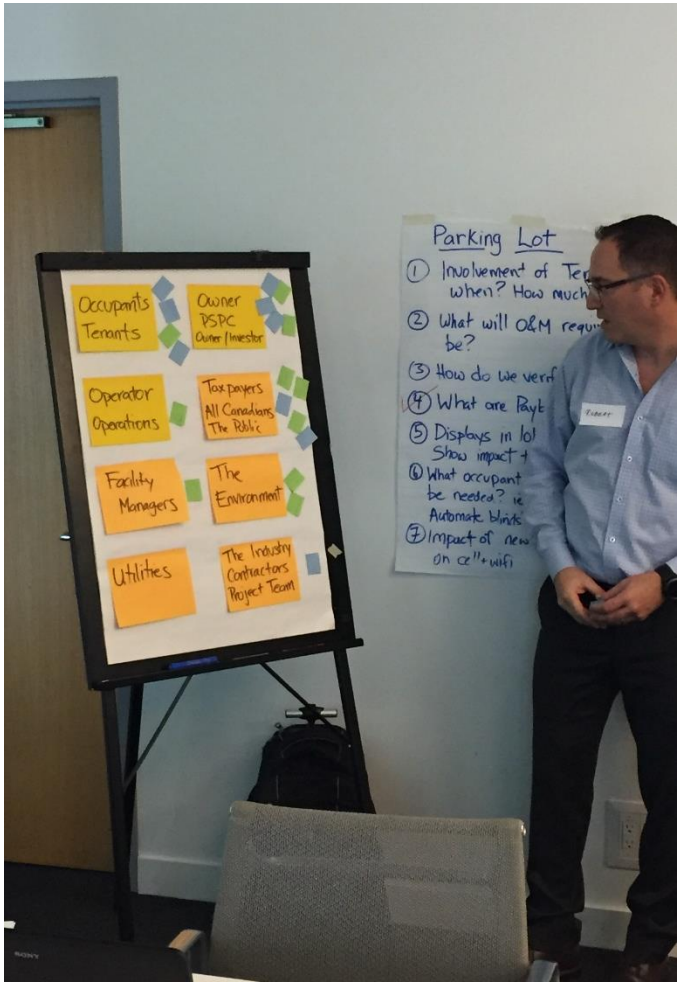
- **Stewardship:** We are responsible for overseeing the resources that are entrusted to us and are focused on working in the best interests of the college community as a whole.

DCR Study Scope – Stakeholder Engagement

- Buy-in and positive participation of all stakeholders is critical to the project success
- Engage staff in the process (both study and implementation) and the importance of building operations and maintenance considerations
- Conduct workshops to review priorities, and concepts with stakeholders on the feasibility of doing deep retrofits

DCR – Stakeholder engagement workshops



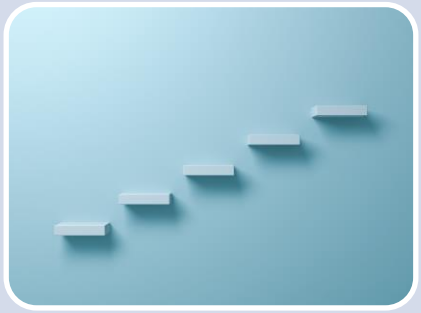


Visioning Workshops

- Identify key considerations:
  - GHG goals
  - Financial considerations
  - Leadership
  - Long-term planning
  - Capital plans and equipment renewal
  - Gap analysis
  - Risk tolerance
  - Provincial priorities
- Outcome:
  - Decision-making framework

Potential Pathways

- Outcome from Visioning Workshop (Example):



Incremental Approach

Replacing equipment over time incrementally

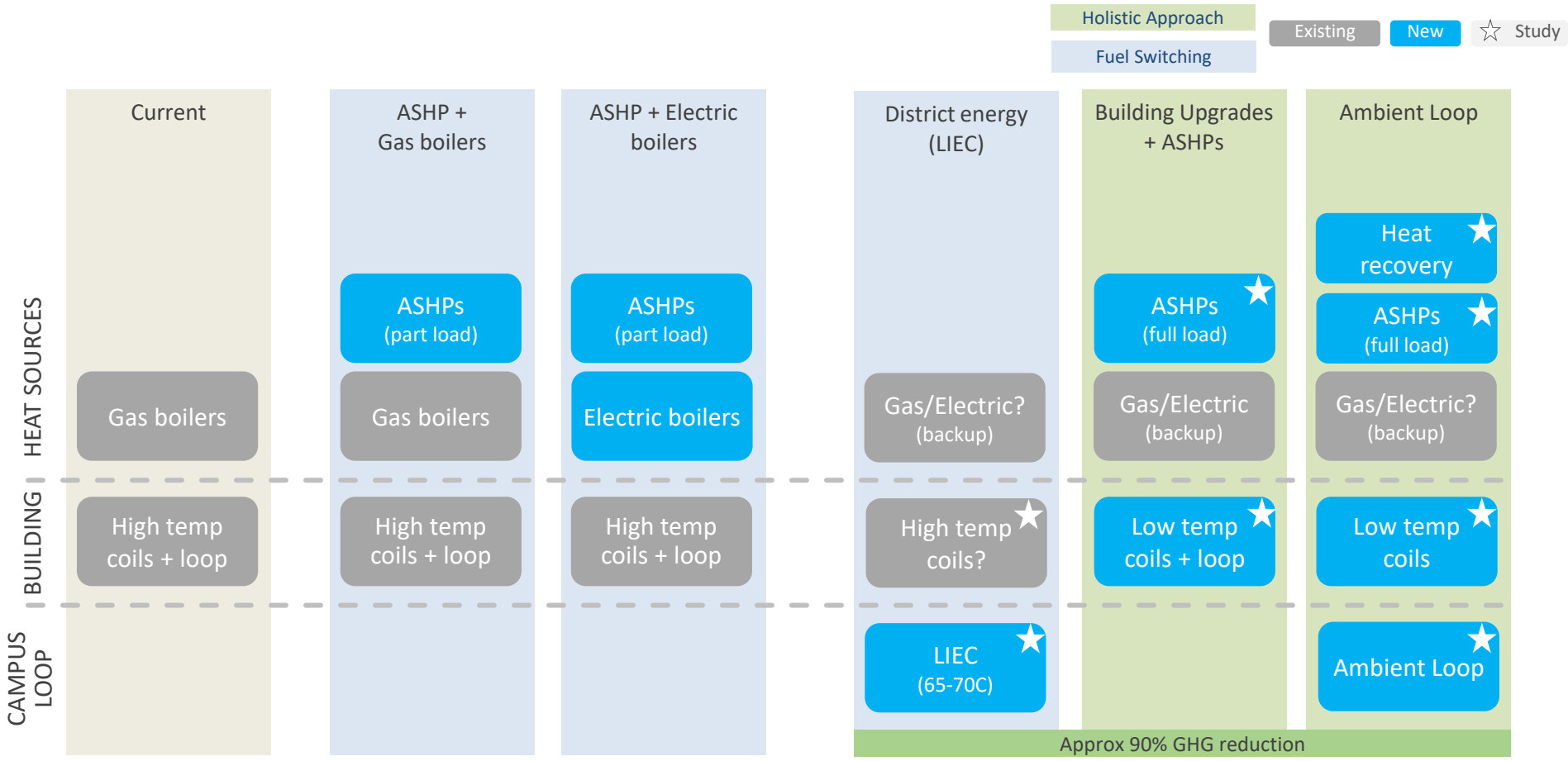
Windfall Approach

Replace entire systems based on increased capital funding

Outsourcing Approach

Outsourcing costs to 3rd party utility

Pathways


Holistic Approach
Fuel Switching
Existing
New
Study
HEAT SOURCES
BUILDING
CAMPUS LOOP
Current
ASHP + Gas boilers
ASHP + Electric boilers
District energy (LIEC)
Building Upgrades + ASHPs
Ambient Loop
Gas boilers
High temp coils + loop
ASHPs (part load)
Gas boilers
High temp coils + loop
ASHPs (part load)
Electric boilers
High temp coils + loop
Gas/Electric? (backup)
High temp coils?
LIEC (65-70C)
ASHPs (full load)
Gas/Electric (backup)
Low temp coils + loop
Heat recovery
ASHPs (full load)
Gas/Electric? (backup)
Low temp coils
Ambient Loop
Approx 90% GHG reduction

Pathway & Visioning

Priorities	Rank (23=High, 1=Low)
Leverage internal or external funding	23
Demonstrate sustainability and climate action leadership	21
Improve social and environmental outcomes	21
Tackle climate change as quickly as possible	20
Improve climate resiliency of our facilities	19
Learn from and collaborate with peer institutions	18
Maximize innovation	16
Leverage research & development opportunities	16
Align with long term master plans	12
Meet our incremental targets on schedule	12
Align with values	12
Enable flexibility	12
Engage researchers and students in testing new technologies	11
Meet our targets ahead of schedule	10
Take into account total cost of ownership / life cycle costing	8
Align with long term capital planning	8
Keep operating costs low	7
Taking a whole systems approach to retrofit	6
Meet our targets at the lowest life cycle cost	5
Align with or exceed provincial targets	3
Align with Other Prov Priorities (other than targets)	3
Meet our targets at the lowest capital cost	2
Minimize costs	1

Example – Langara

- Planning for 25-year campus vision:
  - Central plant interconnect to all buildings
    - low temperature and future ambient loop operation
  - Decouple DHW and add heat recovery chiller
  - Low temperature building conversion (B, C, G, LSU)
    - Carbon neutral heating options
    - Campus geothermal capacity

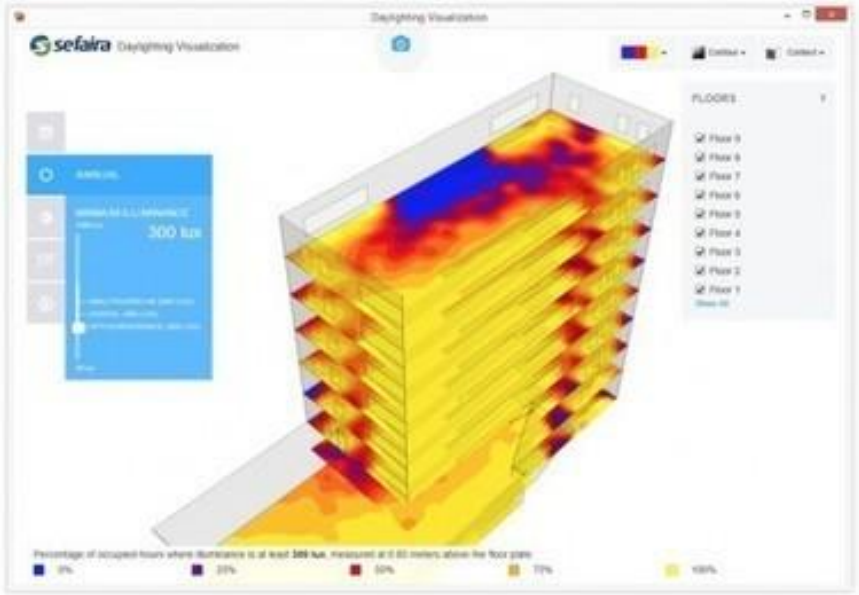
Scope

DCR Study Scope - Systems

- Holistic review of entire facility and the interaction of its systems, including:
  - building envelope
  - HVAC
  - building automation
  - electrical systems (lighting, plug loads and elevators)
  - renewable energy systems

DCR Study Scope - Modelling

- A building energy model or simulation will often be required to account for the interaction of the building elements and their cross dependencies.



DCR Study Scope - Recommendations

Unlike an Energy Audit, the presentation of recommendations in a DCR Study is not based solely on ROI. Recommendations must be presented as business cases, including potential carbon pathways such as maximum possible GHG savings.

Approaches include:

- Bundling of high cost and low-cost measures
- Establishing an internal price on carbon
- Leveraging **non-energy benefits** including:
  - Environmental impact
  - Equipment renewal
  - Leadership by example

DCR Study Scope – Long Term Planning

- View the integration of long-term capital upgrades to replace outdated equipment as an opportunity to consider low-carbon strategies as part of an equipment renewal plan.

- Low-carbon strategies will be easier to justify when evaluating the option against the incremental cost over a "like for like" capital replacement.

Scope – Langara

- Campus Fortis Study (2021)
  - Developed a GHG pathway for Campus wide solution

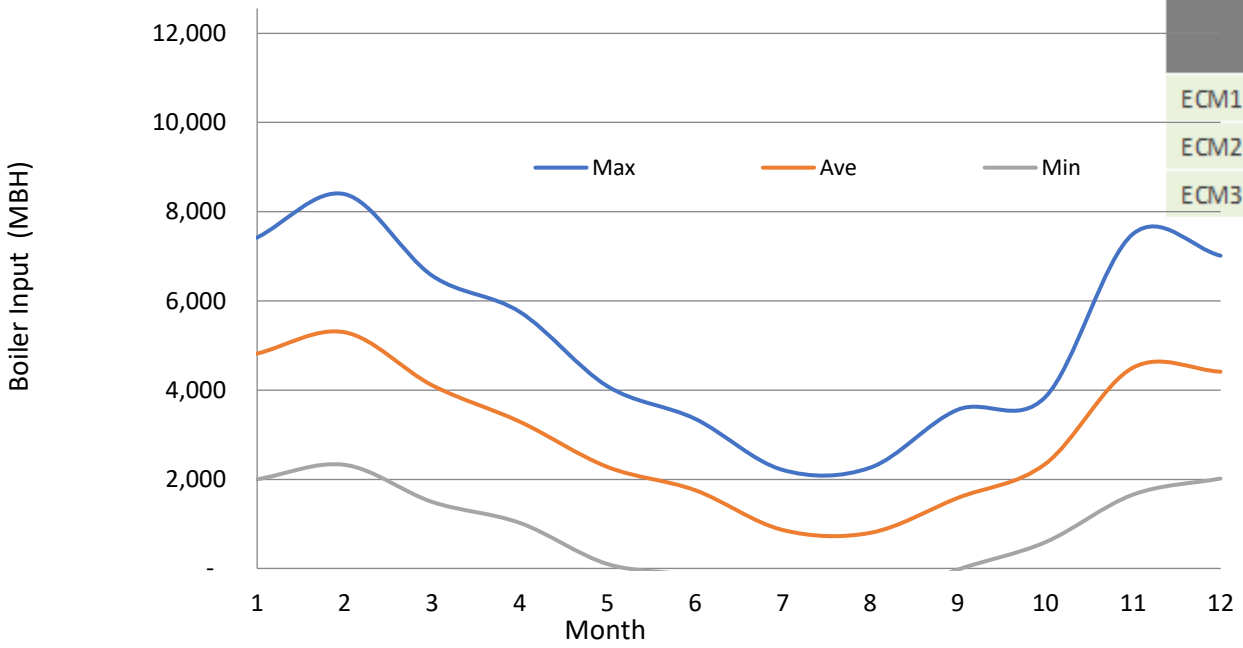
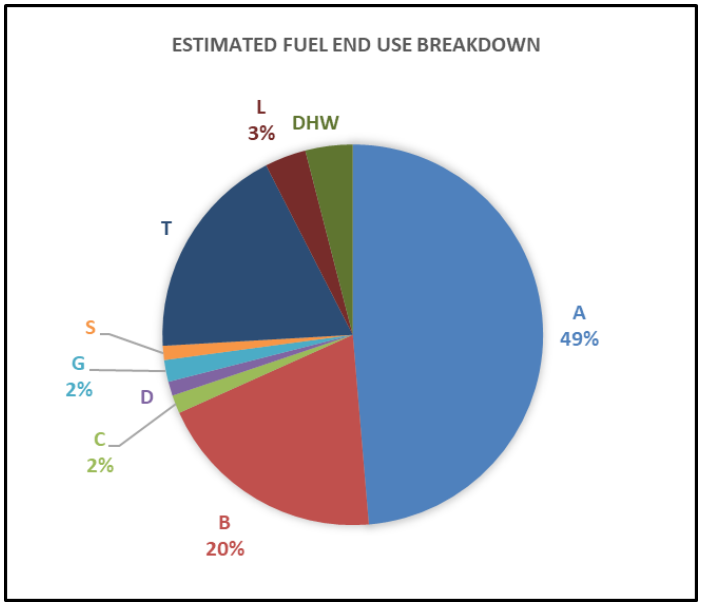


Table 1: Summary Energy Conservation Measures

	Measure	Fuel Savings (GJ/yr)
ECM1	Plant A and Plant L Integration	7,840
ECM2	Install DHW Boiler and Integrate Systems	860
ECM3	Convert A Buildng to Low Temperature	1,300

Scope – Langara - Ongoing

- Deep Carbon Retrofit
  - C Building
- Refine Pathway
  - Campus Roadmap

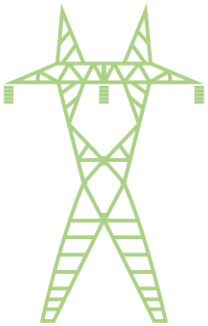


Challenges

Practical Challenges

Technical

- Possible electrical capacity constraints
- Expertise of contractors, consultants, operators
- Space to accommodate new systems
- Major mechanical systems may need swing space
- Architectural and heritage aspects of envelope renewal
- Carbon intensity of electricity grid



Practical Challenges

People

- Additional operator training requirements for more complex systems
- Renovation impact on occupants
- Expertise of contractors, consultants, operators

Practical Challenges

Financial

- High-cost upgrades
- Seek out opportunities for incentives, rebates, and loans
- Revise RFP/procurement evaluation to place larger emphasis on firms with experience in this area. (Lowest cost studies are not always the best!)
- Alternate implementation methods

Example – Langara CHP

Langara.

Procurement:

- Public RFP with defined scope for studies, incentive review and implementation
- Implementation based on a defined scope, open to adjust based on study outcomes
- Prequalify contractors

People

- Engage stakeholders throughout investigation, design and installation project phases

Financial

- Funding through utilities and province

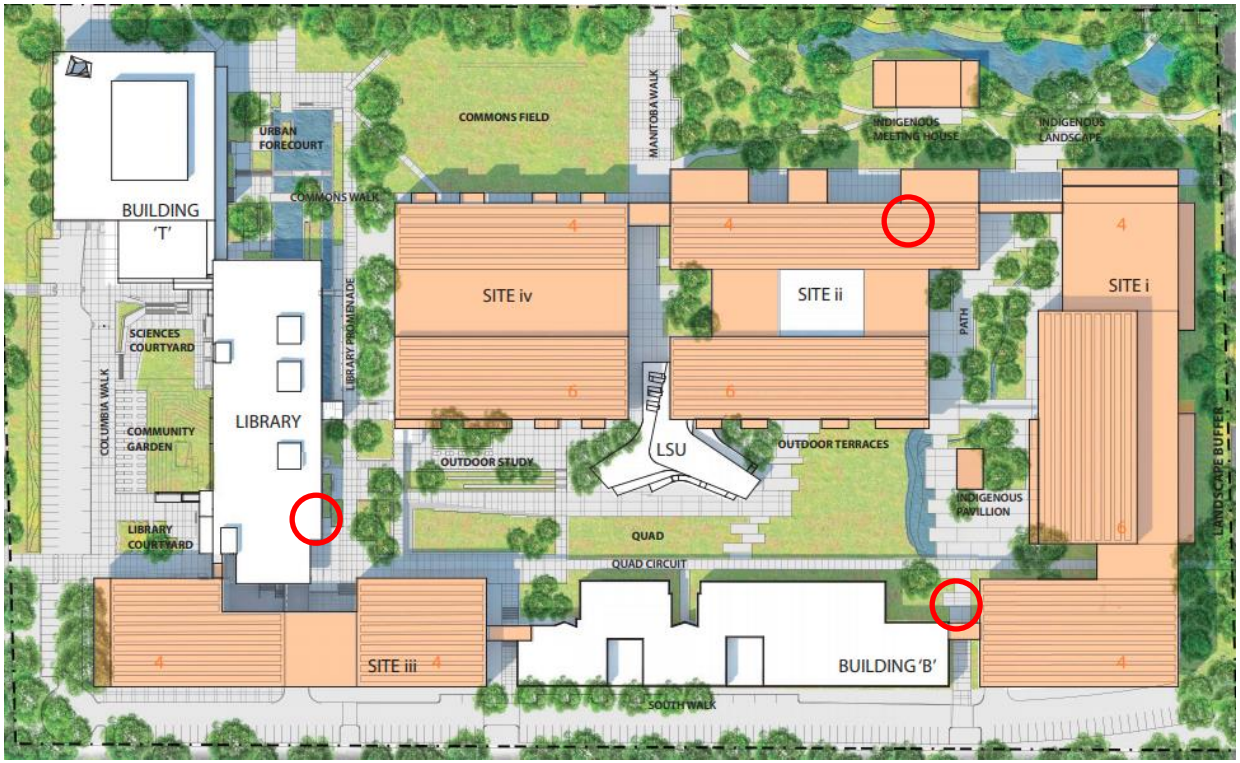
Solutions

Solutions

- Mindshift – financial investment to asset renewal and low-carbon
- Consider an acceptable ROI based on a threshold for dollar invested per ton of CO_2 saved
- Successful commissioning of innovative and complex systems can be overcome with a skilled group of practitioners.

Example – Langara CHP

- Planning – Future Building Integration



Example – Langara CHP

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- Equipment – Reuse and relocation

Example – Langara CHP

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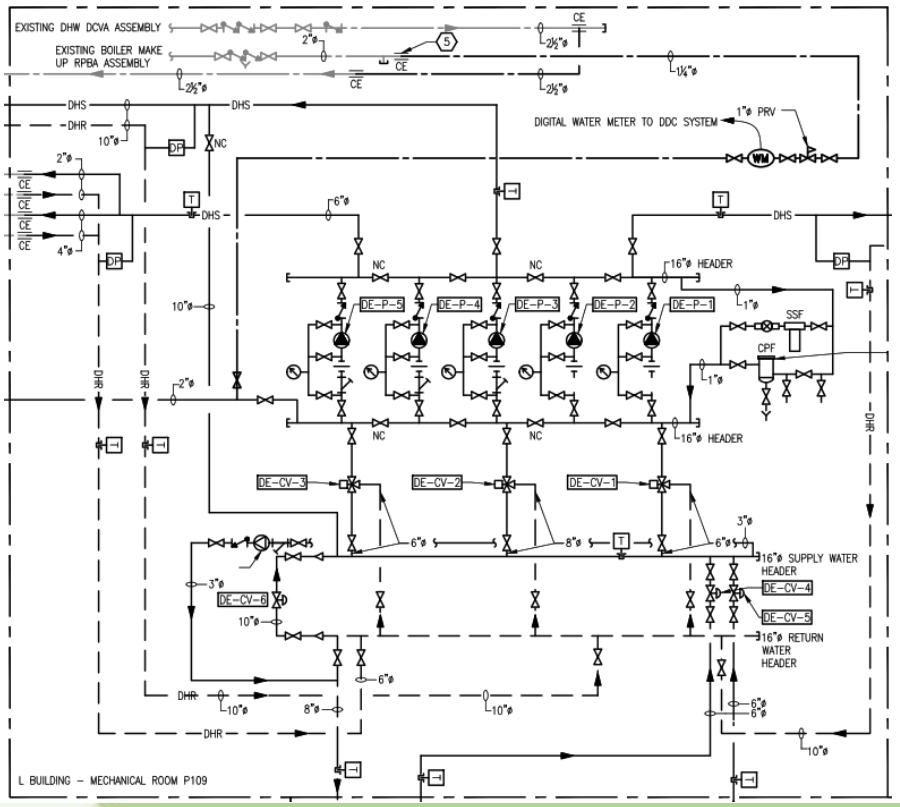
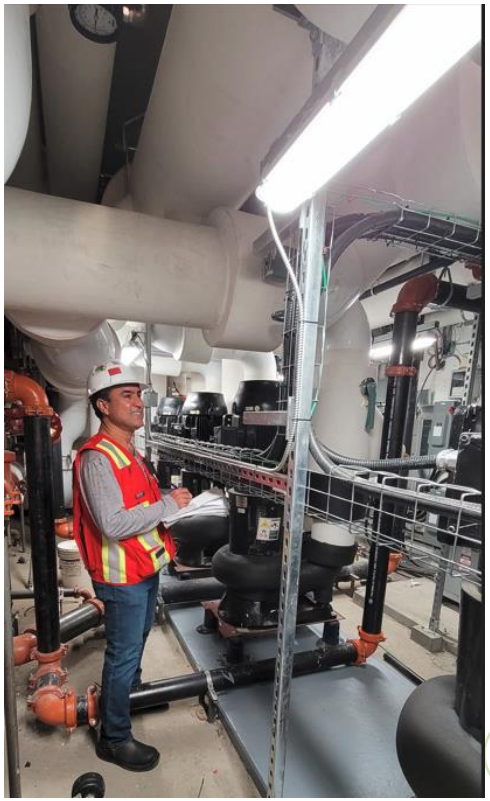
- Engagement with Operations

Example – Langara CHP

- Technical – Phased approach –
  - Flow, Temperature, Optimization



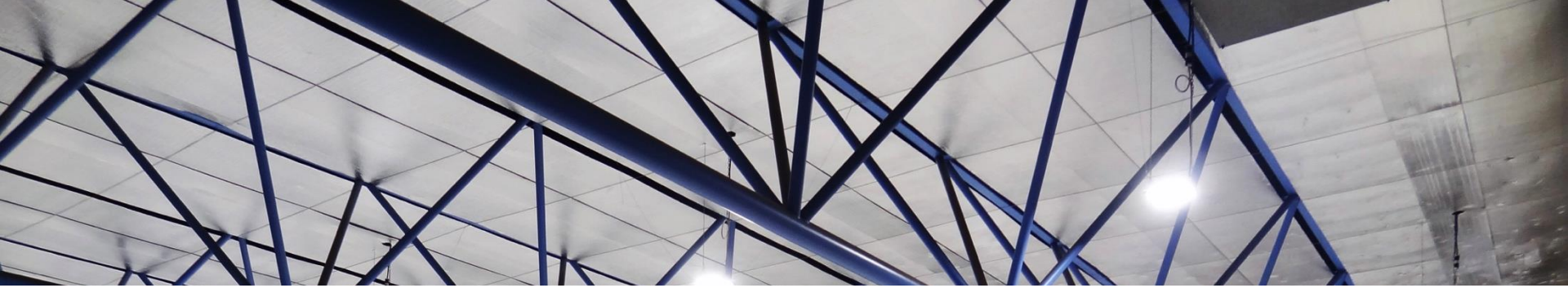


Lessons Learned

Apply Carbon Pricing Policies

Timing is Key: Consider Asset Renewal

Engage Stakeholders



Enlist Specialized Expertise

Collaborate and Communicate

Provide Comprehensive Cx and Training

Moving Forward

The institutional sector has a great **responsibility and opportunity** to reduce carbon output at a much more aggressive rate than generations past.

Deep carbon retrofits in existing buildings are a large part of this future.

Thank you.

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