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BERDO Implementation & Review Board Technical Assistance

Phase 1 – Training Session 2 (90-min)

Training by RDH Building Science, Inc.

July 8, 2024

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For Questions about today's training, contact:

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bbrown@rdh.com

BERDO Review Board

BerdoReviewBoard@boston.gov

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What To Expect From Today

- Recorded public session
- Many joining, Review Board is primary audience
- Zoom tools: hand raise, chat, mic muted, camera on recommended
- Informal and collaborative, engagement needed
- Opportunity for Board members to ask questions; more opportunity later as well
- Department will circulate a recording and PDF of slide deck materials
- Pre-work shared in advance of this session

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Project Principal
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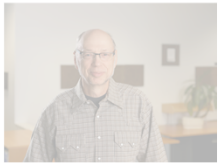

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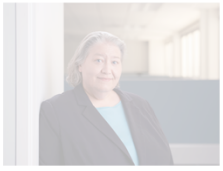
Senior Instructional Designer



Technical Editor
Margaret Thayer, MET
Technical Editor

Project Coordinator
Linh Lao
Project Coordinator

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2024 Training Plan

Phase 1 June – July	~~June 10, Session 1 – Groundwork~~	~~90 min Public Meeting~~
	July 8, Session 2 – Audits + Beyond the Building	90 min Public Meeting
	Week of July 15 + 22, Session 3 – S1 and S2 Recap	45 min Small Cohort Training
Phase 2 Aug – Sept	Session 3	90 min Public Meeting
	Session 4	90 min Public Meeting
	Session 5	45 min Peer-to-Peer Cohort
Phase 3 Oct – Nov	Session 6	75 min Public Meeting
	Session 7	60 min Public Meeting
	Session 8	45 min Peer-to-Peer Cohort

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Training Overview Phase 1

Phase 1 Learning Objectives

1. Introduce **building science and policy fundamentals** to establish a baseline knowledge for building decarbonization.
2. Explain **energy audits** (and alternatives).
3. Explain **BERDO compliance methods** and decision making.
4. Identify compliance support options that go **"beyond the building"** such as district energy systems, RECs, and PPAs.

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Session 1 – A Look Back + Questions?

Learning Objectives

1. Describe how a building functions as a system and the interaction between sub-systems.
2. Define the different types of building-related carbon emissions.
3. Explain why different buildings have different carbon emissions targets.
4. List building-specific factors that influence how a building may comply with BERDO.

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BERDO Learner Survey

Thank you for your feedback

1. Did the level of technical content covered in this training session meet my expectations based on my role on the Review Board.

More Details

Yes, it was the correct level and ...	7
Yes, but it was overwhelming be...	0
Yes, but I already knew this cont...	1
No, it was too basic	0
No, it was too advanced	0

3. Do you have any additional comments regarding the content or learning experience that we should take into account as we prepare future training sessions?

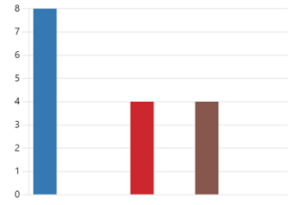
4 Responses

ID	Name	Responses
1	anonymous	Please be sure to detail the abbreviations on slides. Some may not know what they mean.
2	anonymous	Thank you!
3	anonymous	I think the engagement piece was great. More engagement could be beneficial if time allows.
4	anonymous	Examples from real buildings is most helpful.

2. How was the learning experience as you prepare to fulfill your role on the Review Board? (Select all that apply)

More Details

The length of the training was p...	8
The length of the training was t...	0
The length of the training was t...	0
I appreciated the question and ...	4
There needed to be more oppor...	0
I enjoyed the engagements and ...	4
There was not enough engage...	0
There was too much engageme...	0



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Session 2 Training

Learning Objectives

1. Define the **purpose and steps of an energy audit**.
2. Describe why **every building needs a decarbonization plan** and the attributes of a "good" plan.
3. Define **district energy systems**.
4. Describe **RECs** and when they are an appropriate solution for compliance.
5. Describe **PPAs** are and the steps required to sign up for a PPA.

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Every Building Needs a Decarbonization Plan

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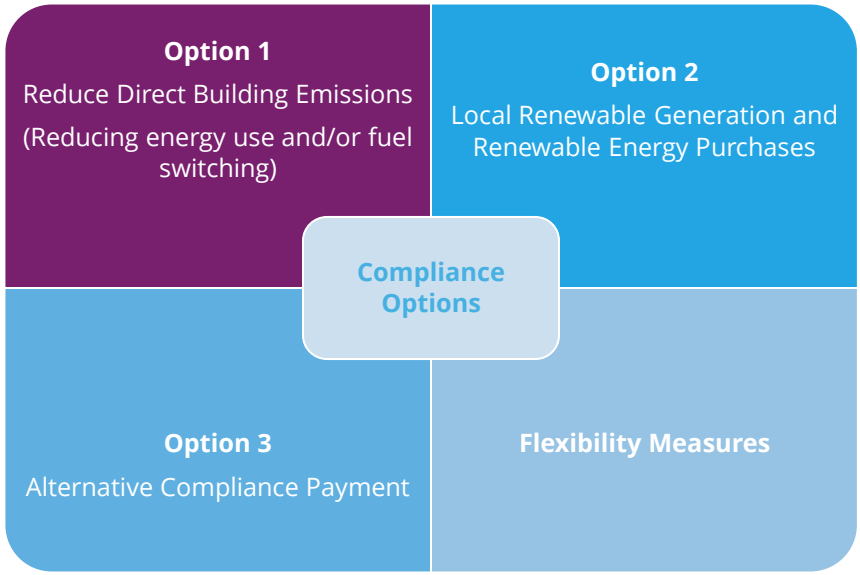

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RDH Source: https://www.rdh.com/resource/risk-to-readiness-constructing-a-retrofit-plan/

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RDH Source: https://www.rdh.com/resource/risk-to-readiness-constructing-a-retrofit-plan/

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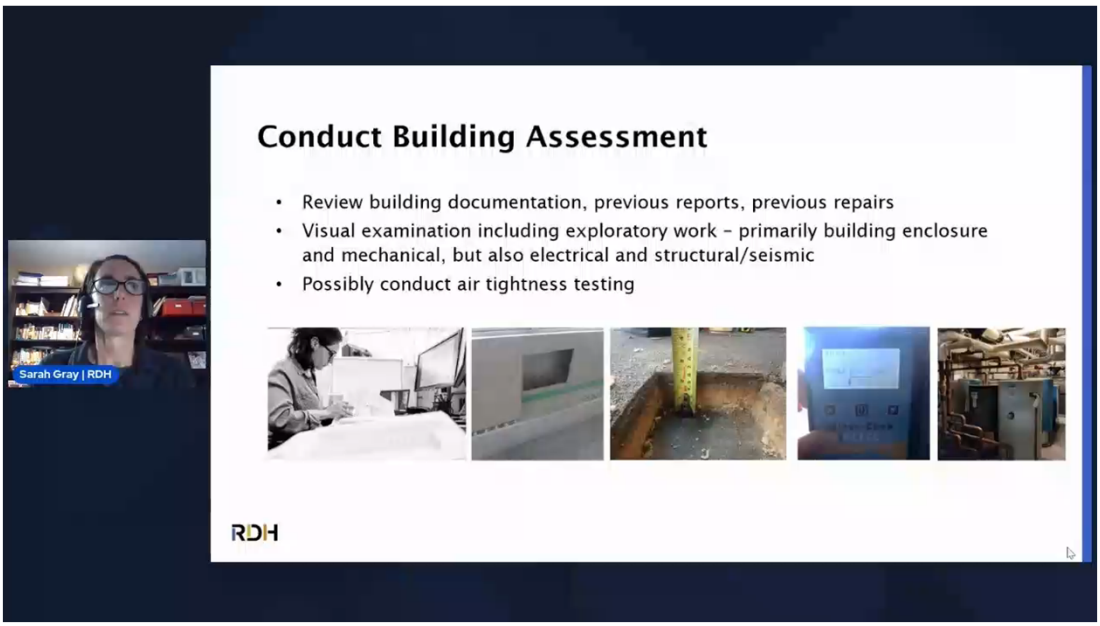

RDH Source: https://www.rdh.com/resource/risk-to-readiness-constructing-a-retrofit-plan/

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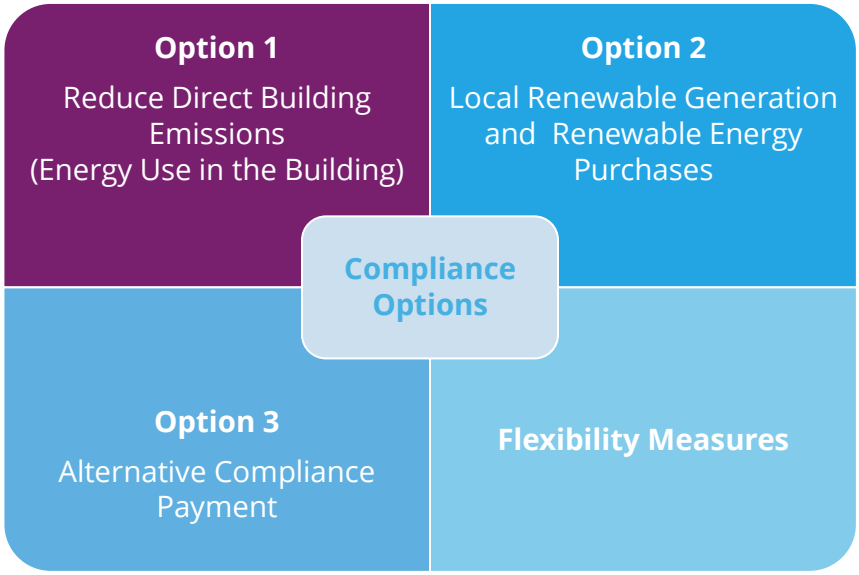

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Questions?

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Case Study: Municipality Administrative Building

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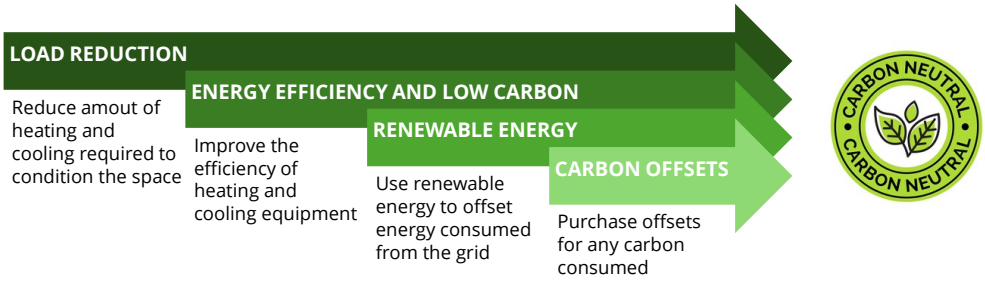
Every Building Needs a Plan



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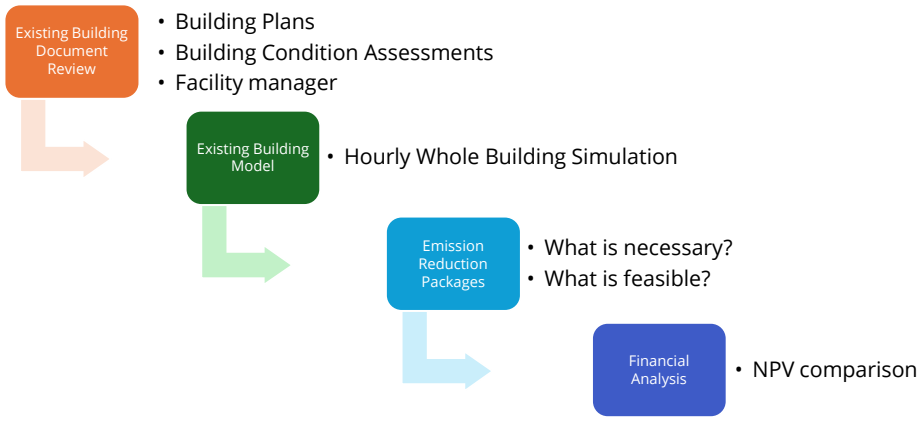
Project Goal:

Develop a cost-effective retrofit path to achieve operational carbon emissions by 2050



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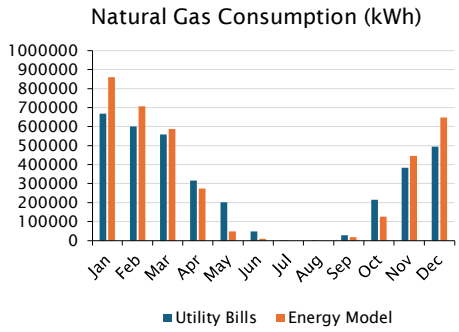
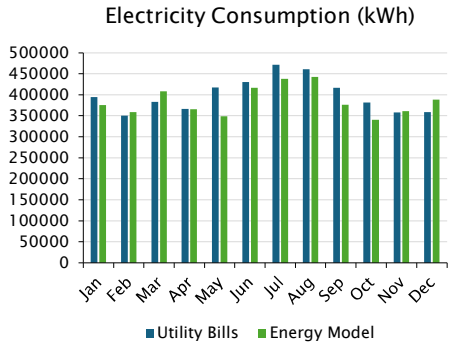
ASHRAE Level 3 Energy Audit





ASHRAE 14 Calibrated Whole Building Energy Model

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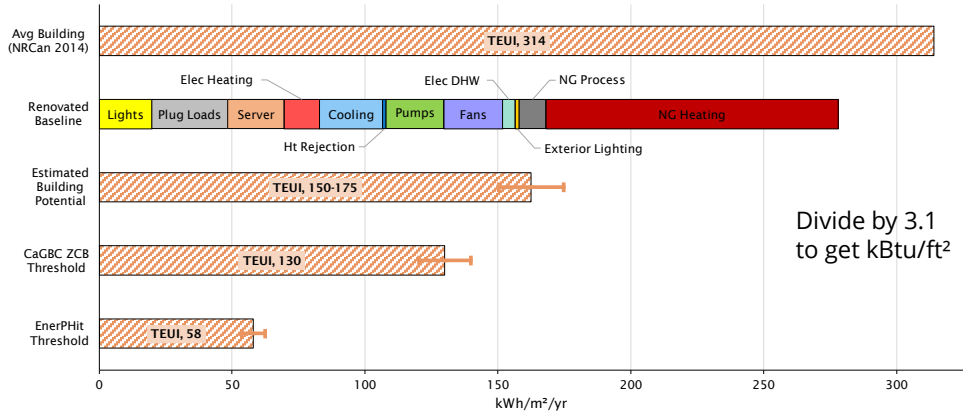
Existing Building Performance – TEUI

Total Energy Use Intensity (TEUI)



Divide by 3.1 to get kBtu/ft²

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* EnerPHit requirement for Renewable Primary Energy (PER) estimated to convert to a TEUI of 58 kWh/m2

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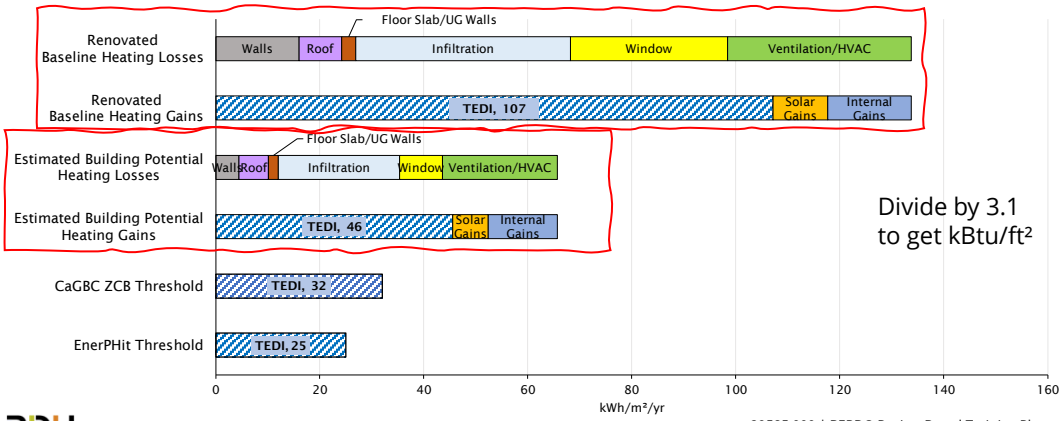
Existing Building Performance – TEDI

Thermal Energy Demand Intensity (TEDI)

→ ∑Annual Heating Losses – ∑Annual Heating Gains



Divide by 3.1 to get kBtu/ft²

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* EnerPHit requirement for Space Heating Demand (SHD) is 30 kWh/m2 using the Treated Floor Area (TFA). This is estimated to be 25 kWh/m2 using the conditioned floor area.

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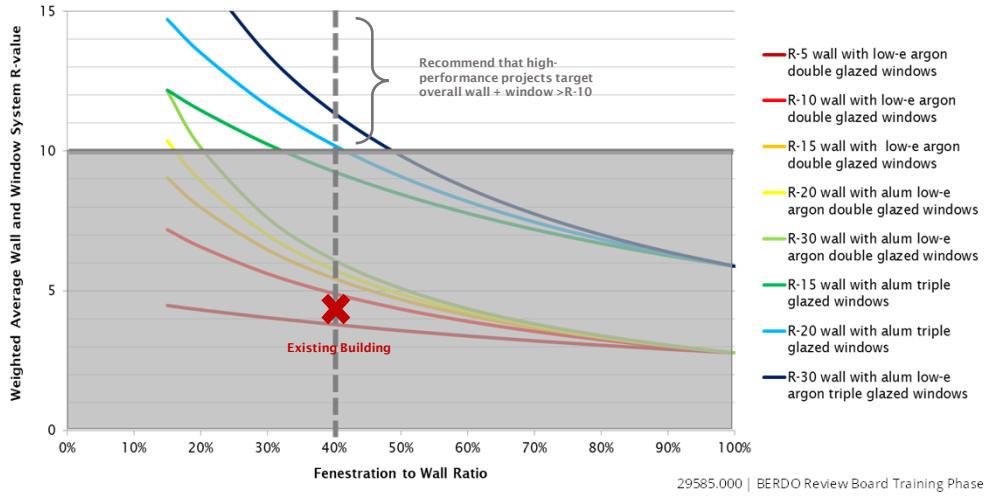
Contemplated Enclosure Upgrades



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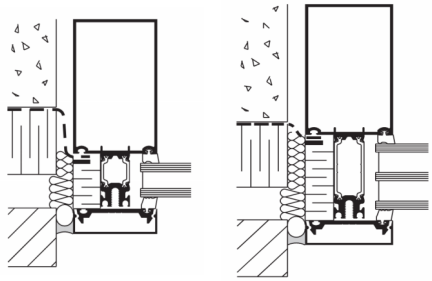
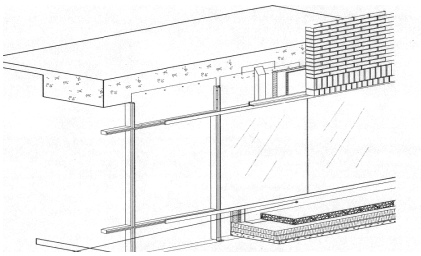
Contemplated Enclosure Upgrades - Windows

Windows among highest heat losses in current building

Challenge, curtain wall framing extends behind existing opaque façade, necessitating cladding removal to change to triple glazed windows.

Insulated Glazing Units in curtain wall currently needs replacing, can we use Triple Glazed? Notice new curtain wall frames are needed.





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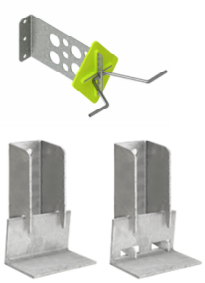
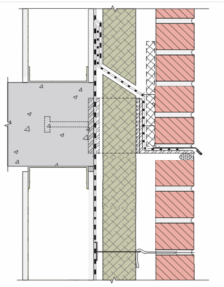
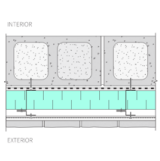
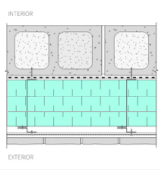
Contemplated Enclosure Upgrades - Opaque Stone Veneer Walls

Cladding due to be replaced in 2040-2050, add exterior insulation





	Stone Veneer Cladding with 3" (75mm) XPS Insulation	Stone Veneer Cladding with 8" (200mm) XPS Insulation
		
NOMINAL INSULATION R-VALUE	R-15 (RSI-2.64)	R-40 (RSI-7.04)
CLEAR WALL ("EFFECTIVE") R-VALUE	R-12 (RSI-2.11)	R-32 (RSI-5.64)
WHOLE WALL R-VALUE	R-6 (RSI-1.06)	R-16 (RSI-2.82)

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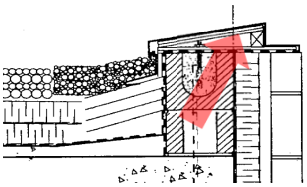
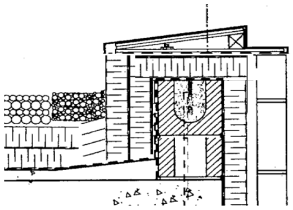
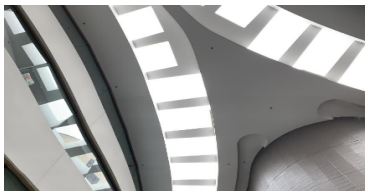
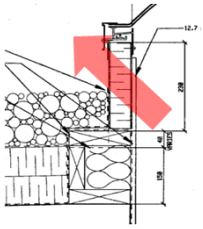
Contemplated Enclosure Upgrades - Roof and Skylight

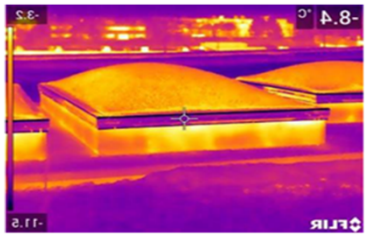
Roof due to be replaced in 2040-2050, opportunity to address parapet thermal bridge...











... and replace current acrylic dome skylights with high performance triples. And insulate curb framing to remove thermal bridge.

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Ventilation

Energy Conservation Measure

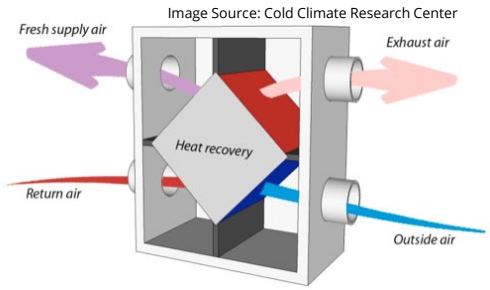
Demand Control Ventilation (DCV)

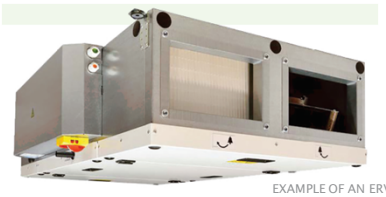
- Install/recommission in Council Chambers, Committee Room A&B, Seminar Room

Ventilation Energy Recovery

- Sanitary Exhaust – Glycol Runaround
  - Make-up air supplied by atrium air handlers
  - Balanced flows between AH1A1, AH1C1 and bathroom exhaust fans
- General Exhaust Energy Recovery – ERV
  - AH1D1 and AH1E1 replaced with 2 ERVs per floor, per Block
  - Replaces existing basement make-up air units

Image Source: Cold Climate Research Center





EXAMPLE OF AN ERV

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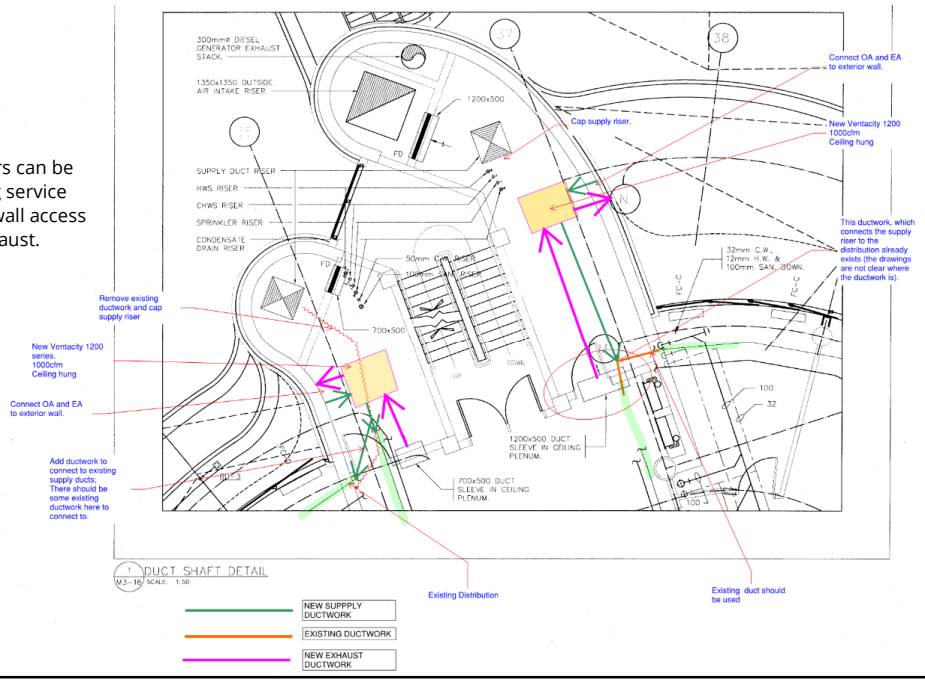
Ventilation

Energy recovery ventilators can be ceiling installed in existing service rooms (2 per floor), with wall access to exterior for supply/exhaust.



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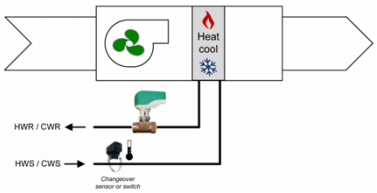
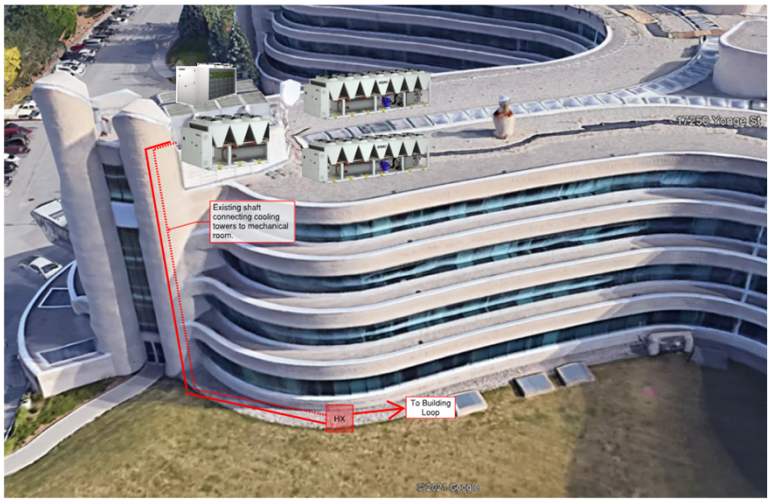
Plant Electrification with Air Source Heat Pumps

Heating/cooling currently provide through local fan coils connected to hydronic system for hot and cold water.

Fan coils sized for cooling load, and thus oversized for heating load. Already compatible with low temperature, 120°F heat pump supply water temperature.





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On-site Renewable Energy

PROPOSED LOCATIONS FOR PV SYSTEMS

BALLASTED ROOF MOUNTED PV SYSTEM

PARKING CANOPY PV SYSTEM

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Summary of Contemplated Carbon Reduction Measures

		ZERO CARBON RETROFIT PATH		BUSINESS AS USUAL PATH	
		EMISSION REDUCTION MEASURES	VALUE	REPLACEMENETS AT END OF LIFE	VALUE
ARCHITECTURAL	WALLS	Exterior Wall Reclad with Improved Performance	R-20 Whole Wall *Increase exterior insulation from 3" to 8"*	Exterior Wall Reclad *Like-for-like replacement*	R-6 Whole Wall
		Insulate Parkade Suspended Slab	R-15 Ceiling, R-10 Walls Clear Field *Add 5" spray applied glass fiber insulation*	No Cost/Do Nothing	Uninsulated
	GLAZING	Full Glazing System Replacement with Improved Performance	U-0.15 (IP) *Fibreglass frame, triple glazed*	IGU Replacement	U-0.33 (IP) Double glazed, low e coating, argon filled
	ROOF	Skylight Replacement with Improved Performance	U-0.2 (IP) *Triple-glazed, over-insulate the skylight curbs*	Skylight Replacement	U-0.67 (IP)
		Main Roof Replacement with Improved Performance	R-40 Clear Field *Roof membrane replacement with 2" additional insulation (8" total)*	Main Roof Replacement	R-30 Clear Field
		Terrace Roof Replacement with Improved Performance	R-40 Clear Field *Roof membrane replacement with 2" additional insulation (8" total)*	Terrace Roof Replacement	R-30 Clear Field
		Improved Parapet Detailing	Accounted for in Exterior Wall Reclad and Terrace Roof Replacement	No Cost/Do Nothing	N/A
	AIRTIGHTNESS	Targeted Air Sealing Improvements	2 L/s/m2 @ 75 Pa	No Cost/Do Nothing	3 L/s/m2 @ 75 Pa Assumed
		Improve Whole Building Airtightness	1.5 L/s/m2 @ 75 Pa	No Cost/Do Nothing	
MECHANICAL	GENERAL	Recommissioning	N/A	Recommissioning	N/A
	PLANT	Boiler Replacement with AWHP Plant	Rated Heating COP = 2.4 Rated Cooling COP = 3.0	Natural gas condensing boiler and centrifugal chiller replacement	Boiler COP=85% Chiller COP=5.2 Assumed
		Boiler Replacement with 100% GSHP Plant	Rated Heating COP = 4.1 Rated Cooling COP = 4.0		
	VENTILATION	Demand Control Ventilation (Occ or CO2)	N/A	No Cost/Do Nothing	Not used
		Ventilation Heat Recovery - General	Sensible Eff=75% Latent Eff=55%	No Cost/Do Nothing	No heat recovery
		Ventilation Heat Recovery - Washrooms	Sensible Eff=50%	No Cost/Do Nothing	No heat recovery
	RENEWABLE ENERGY	Solar PV Parking Canopy	650 kWp array 180 W/m² panel efficiency	No Cost/Do Nothing	N/A
		Ballasted Solar PV Array at Roof	475 kWp array 180W/m² panel efficiency	No Cost/Do Nothing	N/A

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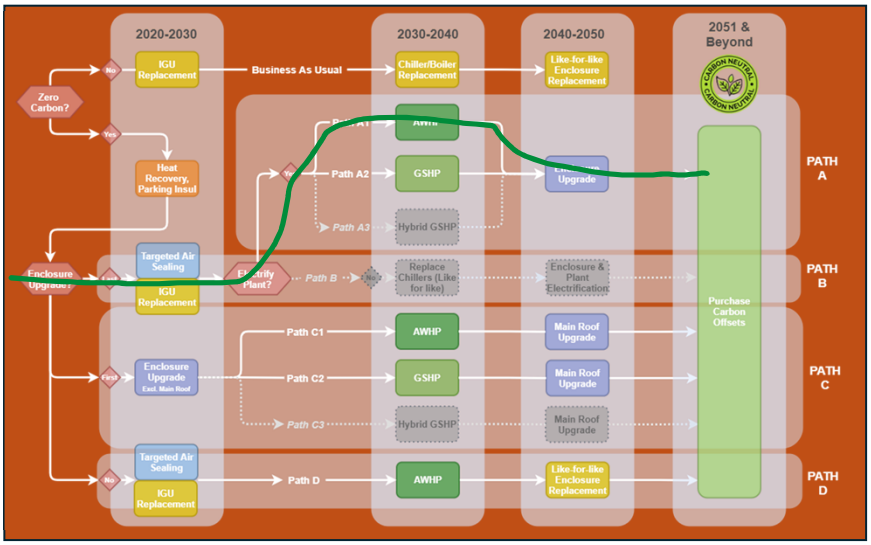
Carbon Reduction Measures – Retrofit Roadmap



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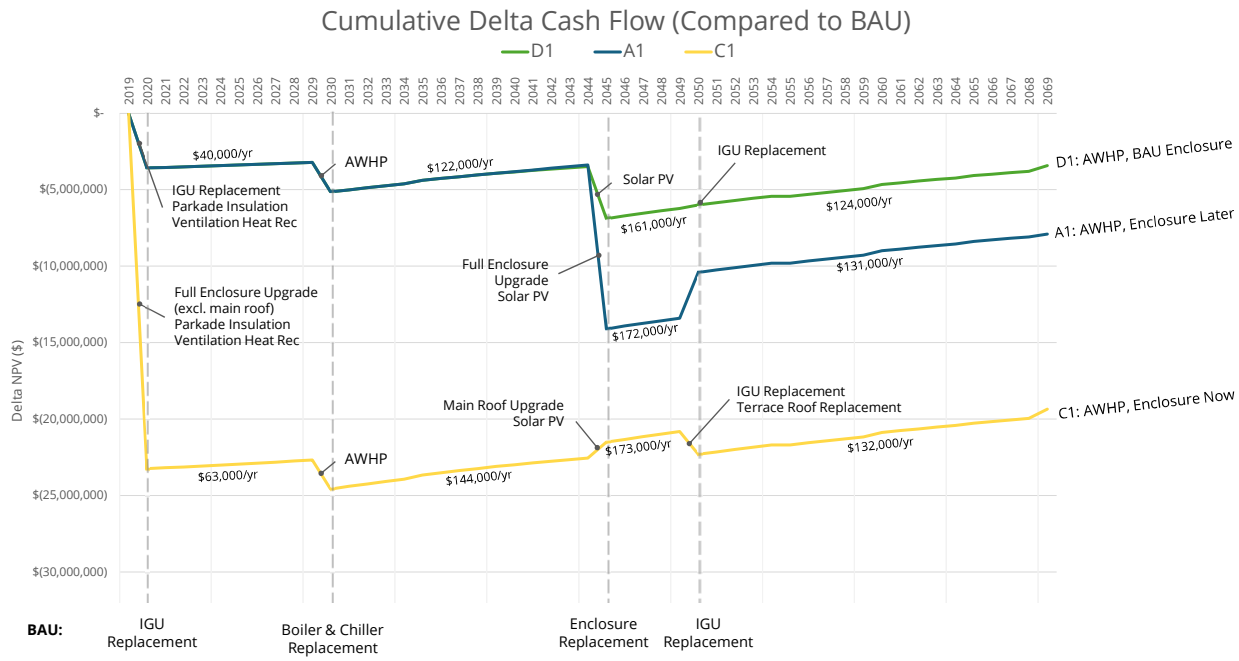

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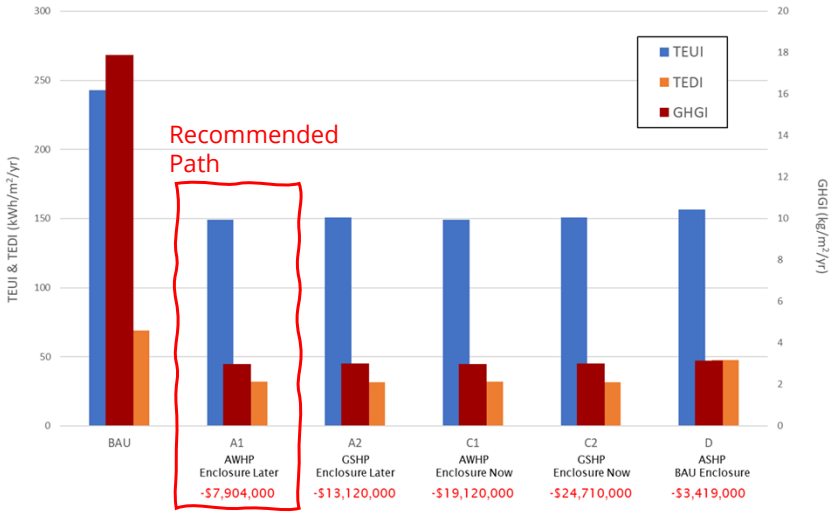
Path Selection though Cost/Benefit Life Cycle Cost Analysis



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Questions?

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Learner Survey

Duration: 2 minutes

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On-Call Technical Support

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Next Steps…

- Small Cohort Training
  - Confirmed week of June 17th
  - Scheduled for 3rd and 4th week of July
  - Topics to be informed by survey feedback
- On-call technical support available now
- Phase 2 Training (Aug – Sept)

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