Energy committee background and discussion of possible integration of Embodied carbon and Life Cycle analysis into project planning

Background :

"Equipment with longer lifespans: Any system or piece of infrastructure that has a useful life that extends to or beyond 2050 and is being **installed or replaced in the next decade either needs to align with the Commonwealth's decarbonization pathways or will need to be replaced before the end of its useful life**. This is particularly important for natural gas infrastructure, **building envelopes**, district systems, and building HVAC, which may or may not be replaced between now and 2050 depending on the system and use. The Commonwealth can play a key role in ensuring early adoption of alternatives where technological solutions are already available and cost-effective, supporting near-term reductions and health benefits, while avoiding long-term costs in emissions or for their replacement."

Massachusetts Interim Clean Energy and Climate Plan (binding)
Page 12. Bold text by Bob Higgins-Steele

https://www.mass.gov/doc/interim-clean-energy-and-climate-plan-for-2030-december-30-2020/download?_ga=2.265809798.88800511.1729181751-203723322.1729004296&_gl=1*1dumxnt*_ga*MjAzNzIzMzIyLjE3MjkwMDQyOTY.*_ga_MCLPEGW7WM*MTcyOTE4MTgwOS4xLjEuMTcyOTE4MjM4OC4wLjAuMA..

Article 53 2022 Truro ATM

Move to have the Select Board charge the Climate Action Committee and Energy Committee to work with other pertinent Town committees to define a Carbon Net Zero standard for new construction and deliver that standard for approval to Town Meeting

FROM the Energy Committee courtesy of Brian Boyle Co-chair:

Ad Hoc Committee 10/24/24 Packet

Whole-Life Carbon Building Projects Evaluation

To evaluate a building project in terms of its carbon cost, we need to assess both the *embodied carbon* and *operational carbon*.

1. **Embodied Carbon (One-Time Carbon):**

This is the total carbon emissions associated with producing and transporting building materials, construction processes, and the eventual demolition or disposal of the building. To evaluate embodied carbon[1]:

- **Materials: Calculate the carbon footprint of raw materials (e.g., concrete, steel, glass, etc.) based on life cycle assessments (LCAs) or databases like Environmental Product Declarations (EPDs).**
- **Construction: Include emissions from construction activities, including transportation of materials, energy used in construction machinery, and waste management.**
- **Demolition/Disposal: Consider the carbon costs of demolishing the building at the end of its life cycle and recycling or disposing of materials.**

2. **Operational Carbon (Recurring Carbon):**

This refers to the carbon emissions from energy consumption during the building's operation, such as heating, ventilation, air conditioning (HVAC), lighting, and appliances. Operational carbon is typically calculated[2] based on:

- **Energy Use: Estimate the energy demand for operating the building (usually in kWh/m²/year) and the carbon intensity of the energy source (e.g., natural gas, electricity from renewable or non-renewable sources).**
  The MEI system sponsored by MA Green Communities tracks MBTU usage (thousands of BTUs) as the unit of measure, and it will provide ongoing tracking of actual energy usage.
- **HVAC and Systems: Consider the efficiency of the HVAC systems, insulation, windows, and lighting, which directly affect energy use.**

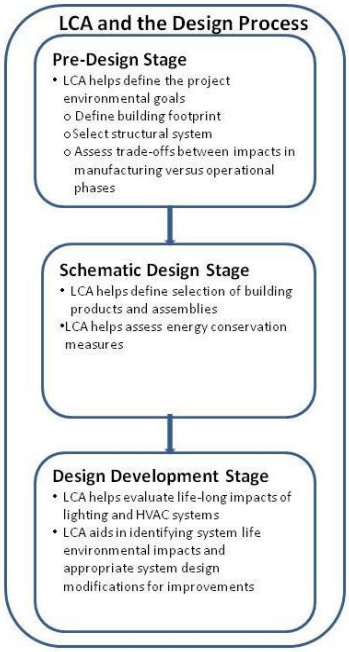
3. **Carbon Reduction Strategies: Incorporate energy-efficient designs, renewable energy sources, or passive systems (natural ventilation, solar heating) to reduce operational carbon.** **Whole-Life Carbon Assessment**:
   - **Combine both embodied and operational carbon to get a comprehensive understanding of the building's total carbon impact. This approach is called *whole-life carbon assessment*, which considers the carbon footprint over the building's entire lifecycle, from construction to demolition.**
   - **Use Life Cycle Assessment (LCA) frameworks to evaluate both the one-time embodied carbon and recurring operational carbon over the building's expected lifespan (e.g., 50 or 100 years).**

4. **Net Zero and Carbon Offset Strategies**:
   - **To further mitigate carbon costs, you can explore net-zero carbon strategies. This could involve using renewable energy for operations, and sourcing low-carbon materials.**

By quantifying both the one-time embodied carbon and the recurring operational carbon, you can assess the total carbon footprint of a building project and explore strategies to minimize its environmental impact.

Also about Embodied Carbon

From: AIA Guide to Building Life Cycle Assessment in Practice 2010



LCA is applicable at each of the three design stages; however, the stage of performance is important defines the tool to be used and the types of impacts evaluated.

Pre-Design Stage

During this stage, LCA can help define the environmental goals of a project. LCA could be used to make decisions regarding the building footprint among several options. The basic decisions for choosing a structural system can also be based on LCA. Trade-offs between impacts from manufacturing phase and operational phase can be evaluated to select assembly types.

Schematic Design Stage

Choices regarding selection of building products and assemblies can be made with the help of LCA. Energy conservation measures can be assessed for their environmental burdens and an informed decision can be facilitated by the use of LCA.

Design Development Stage

In the design development stage, LCA can help evaluate the life-long impacts of proposed lighting and HVAC systems. The most crucial stages in a system's life can be identified in terms of environmental impact, and appropriate modifications to the system design can be proposed. Material finishes can also be compared with the help of LCA results, and the right choices can be made.

Pre-Design Stage	Schematic Design Stage	Design Development Stage
Identify owner's requirement	Site plan and principal floor plans prepared	**Detailed site plan indicating building location and site improvements prepared**
Departmental and room-by-room interaction matrix established	Views, elevations, sketches and models prepared to convey building configuration	Detailed plans, elevations, sections, schedules and notes prepared
Preliminary structural, mechanical, electrical and other engineering systems determined	**Comparative structural, mechanical, electrical and other systems analyzed**	Structural, mechanical, electrical and other building systems finalized
Block plans created showing all rooms, corridor and vertical solutions	Space and location requirement for these systems determined	**Review obtained from regulatory agencies**
Estimates prepared for total project cost and annual project operating expenses	**Preliminary screening of materials, equipment and fixtures carried out**	Code compliance check

Table 1. Typical Design Activities and Tasks Accomplished

*(Activities in "**red**" indicate those where input from and LCA is clearly relevant.*

Challenges in the Use of LCA

Although LCA is doubtless the best tool for analyzing the environmental impact of product or project, the methodology and underlying data are still being developed. LCA is a complex method heavily relying on the availability and completeness of data (LCI) and methodologies for tabulating material use within the LCA tools.

Full guide here:

https://content.aia.org/sites/default/files/2016-04/Building-Life-Cycle-Assessment-Guide.pdf

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[1] Tools such as **Tally** or **OneClick LCA** can be used to model the embodied carbon of materials and construction processes.

[2] Tools like **EnergyPlus** and **eQUEST** can help model and predict a building's operational energy use and emissions over its lifetime.

END

The Applicable Energy Code for the DPW is the 2022 specialized code

We need to verify that we are doing the all-electric pathway w/ Jarrod, W&S and OPM Note:

From the stretch specialized code:

SECTION CC104 ALL ELECTRIC PATHWAY

CC104.1 General. New a*ll-electric buildings* shall comply with Sections CC101.4, CC101.5 and with one of the following:

1) **Section C401.2.1 and Section C401.4.3**
2) **Section C407.3 Passive House**
3) **Exclusively R-use buildings permitted prior to January 2024 may comply with Section C407.4 when all dwelling units have a HERS rating of 45 or less.**

CC101.5 *Add Section CC101.5 as follows:*

CC101.5 Minimum *electric vehicle ready parking* requirements. New parking spaces shall provide *electric vehicle ready spaces* in accordance with Section C405.13 and Table C405.13.

These are the stretch code requirements C401.2 and C104.1.4.3 mentioned above

CHAPTER 4 [CE] COMMERCIAL ENERGY EFFICIENCY

SECTION C401 – GENERAL

C401.2 *Replace Section C401.2 as follows:*

C401.2 Application. Commercial buildings shall comply with either Section C401.2.1 or C401.2.2. When constructed for the first time, all requirements imposed on the building housing a *tenant space fit out zone* shall also apply to the *tenant space fit out zone*. Commercial buildings containing multiple use type classifications (mixed-use buildings) shall comply with C401.2.4

C401.2.1 Prescriptive and Performance Compliance. Commercial buildings shall comply with one of the following:

1. **Prescriptive Compliance: This pathway may only be used for any nonresidential building, or portions thereof when following C401.2.4, up to 20,000-sf. The Prescriptive Compliance**

pathway requires compliance with Sections C401.3, C402 through C406, and Section C408.

2. **Targeted Performance Compliance: This pathway shall be used for dormitory, fire station, library, office, school, police station, post office, and town hall buildings, or portions thereof when following C401.2.4, over 20,000-sf which have average ventilation at full occupancy of 0.5 cfm/sf or less. This pathway can also be used for any building of any size. After 1 July 2024, this pathway shall be used for residential buildings, or portions thereof when following C401.2.4, over 12,000-sf, or the building may comply with Section C401.2.2. The Targeted Performance Compliance pathway requires compliance with Section C401.3, Sections C402 through C406, Section C407.1, Section 408, and select sections of ANSI/ASHRAE/IESNA 90.1-2019 Appendix G as described in Section 407.1.**
3. **Relative Performance Compliance: This pathway may be used by buildings not required to use Option 2. The Relative Performance Compliance pathway requires that the Proposed building complies with Sections C401.3, C402.1.5, C402.2.8, C402.3, C402.4, C402.5, C402.6, C402.7, C403.5, C403.7, C405.2.4, C405.13, C406, C407.2,**
C408, and ANSI/ASHRAE/IESNA 90.1-2019 using the Appendix G compliance pathway as modified in Section C407.2.

Exception: Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5. This exception does not include *tenant space fit out zones* when constructed for the first time.

C401.2.2 Certified Performance Standard Compliance. Commercial buildings or portions thereof when following C401.2.4 shall comply with one of the following certified performance standards:

1. **Passive House Compliance: This pathway can be used for any building of any size. The Passive House Compliance pathway requires compliance with Sections C401.3, C402.3, C405, C407.3 and C408.**
2. **HERS Compliance: This pathway can be used for any Group R building with multiple individual *dwelling units*. The HERS pathway requires compliance with Section C401.3, C402.3, C405, C407.4 and C408.**

C401.2.4 *Add Section C401.2.4 Mixed Use Buildings*

Designing for incentives:

The Town qualifies for up to a 50% direct pay (check) for their Investment tax credits from the federal government under the Inflation Reduction Act. Solar arrays and geothermal systems qualify for these incentives. The design team and OPM should keep that in mind

https://www.irs.gov/pub/irs-pdf/p5817g.pdf

Clean Energy Tax Incentives: Elective Pay Eligible Tax Credits

The Inflation Reduction Act of 2022 ("IRA") makes several clean energy tax credits available to businesses; tax-exempt organizations; state, local, and tribal governments; other entities; and individuals. The IRA also enables entities to take advantage of certain clean energy tax credits through its elective pay provision (also colloquially known as direct pay). Elective pay allows several types of entities, such as tax-exempts and governments, to treat the amount of certain credits as a payment against tax on their tax returns and as a result receive direct payments for certain clean energy tax credits.

	Tax Provision	Description
Energy Generation & Carbon Capture	**Production Tax Credit for Electricity from Renewables** (§ 45, pre-2025)	**For production of electricity from eligible renewable sources**, including wind, biomass, geothermal, solar, small irrigation, landfill and trash, hydropower, marine and hydrokinetic energy. **Credit Amount (for 2022):** 0.55 cents/kilowatt (kW); (1/2 rate for electricity produced from open loop biomass, landfill gas, and trash); 2.75 cents/kW if Prevailing Wage and Apprenticeship (PWA) rules are met [1,2,3,7]
	Clean Electricity Production Tax Credit (§ 45Y, 2025 onwards)	**Technology-neutral tax credit for production of clean electricity**. Replaces § 45 for facilities that begin construction and are placed in service after 2024. **Credit Amount:** Starts in 2025, consistent with credit amounts under section 45 [1,2,3,6,7]
	Investment Tax Credit for Energy Property (§ 48, pre-2025)	**For investment in renewable energy projects** including fuel cell, solar, geothermal, small wind, energy storage, biogas, microgrid controllers, and combined heat and power properties **Credit Amount:** 6% of qualified investment (basis); 30% if PWA requirements met [1,4,5,6,8]
	Clean Electricity Investment Tax Credit (§ 48E, 2025 onwards)	**Technology-neutral tax credit for investment in facilities that generate clean electricity** and qualified energy storage technologies. Replaces § 48 for facilities that begin construction and are placed in service after 2024 **Credit Amount:** 6% of qualified investment (basis); 30% if PWA requirements met [1,4,5,6]
	Low-Income Communities Bonus Credit (§ 48(e), 48E(h)) Application required	**Additional investment tax credit for small-scale solar and wind (§ 48(e)) or clean electricity (§48E(h)) facilities** (<5MW net output) on Indian land, federally subsidized housing, in low-income communities, and benefit low-income households. Allocated through an application process. **Credit Amount:** 10 or 20 percentage point increase on base investment tax credit [7]
	Credit for Carbon Oxide Sequestration (§ 45Q)	**Credit for carbon dioxide sequestration** coupled with permitted end uses in the United States. **Credit Amount:** $12-36 per metric ton of qualified carbon oxide captured and sequestered, used as a tertiary injectant, or used, depending on the specified end use; $60-$180 per metric ton if PWA requirements met.[1,7]
	Zero-Emission Nuclear Power Production Credit (§ 45U)	**For electricity from nuclear power facilities.** Facilities in operation prior to August 16, 2022. **Credit Amount (for 2023):** 0.3 cents/kWh (reduced rate for larger facilities); 1.5 cent/kWh if PW req's met [1,7]
Manufacturing	**Advanced Energy Project Credit** (§ 48C) Application required	**For investments in advanced energy projects.** A total of $10 billion will be allocated, not less than $4 billion of which will be allocated to projects in certain energy communities. **Credit Amount:** 6% of taxpayer's qualified investment; 30% if PWA requirements are met [1]
	Advanced Manufacturing Production Credit (§ 45X)	**Production tax credit for domestic clean energy manufacturing** of components including solar and wind energy, inverters, battery components, and critical materials. **Credit Amount:** Varies by component
Vehicles	**Credit for Qualified Commercial Clean Vehicles** (§ 45W)	**For purchasers of commercial clean vehicles**. Qualifying vehicles include passenger vehicles, buses, ambulances, and certain other vehicles for use on public streets, roads, and highways. **Credit Amount:** Up to $40,000 (max $7,500 for vehicles <14,000 lbs) [8]
	Alternative Fuel Vehicle Refueling Property Credit (§ 30C)	**For alternative fuel vehicle refueling and charging property**, located in low-income and non-urban areas. Qualified fuels include electricity, ethanol, natural gas, hydrogen, and biodiesel. **Credit Amount:** 6% of basis for businesses and can increase to 30% if PWA is met.
Fuels	**Clean Hydrogen Production Tax Credit** (§ 45V)	**For producing clean hydrogen** at a qualified, U.S.-based clean hydrogen production facility. **Credit Amount:** $0.60/kg multiplied by the applicable percentage (20% to 100%, depending on lifecycle greenhouse gas emissions), amount increases if PWA is met [1,7]
	Clean Fuel Production Credit (§ 45Z, 2025 onwards)	**Technology neutral tax credit for domestic production of clean transportation fuels**, including sustainable aviation fuels, beginning in 2025* **Credit Amount:** $0.20/gallon ($0.35/gal for aviation fuel) multiplied by CO2 "emissions factor"; $1.00/gallon ($1.75/gal for aviation fuel) multiplied by CO2 "emissions factor" if PWA is met [1,7]

Please see the notes on the next page or see IRS.gov/cleanenergy for more information.

Dandelion Energy is a Geothermal system consultant, designer and installer presented to EC some months ago. They work mainly in the residential market.

However, Dandelion can and will work w/ W&S and or MEP designer to design a closed loop ground source heat pump

(GSHP) and thermal radiant system (floors) and/or ducted heat if applicable for the DPW project.

The well drilling and installation could be a filed sub bid open to equivalent.
GSHPs use less electricity and have twice the service life of air source heat pumps (ASHP)

Dandelion's product and service offering

DANDELION

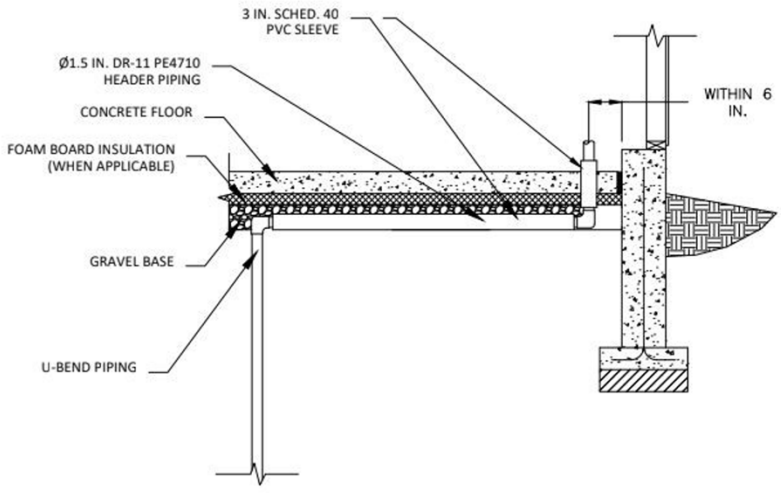
End-to-end design and build services

- Ground loop design, engineering, and installation
- Proprietary geothermal drilling equipment
- Turnkey ground loop installation service
- Best in class heat pump specification & materials
- Install training, technical support and ongoing performance monitoring.

Value add, flexible partner

- Dandelion employs industry-leading experts in geothermal HVAC engineering and ground-loop system design.
- We partner with your existing HVAC providers; you get continuity of service combined with world-class geothermal expertise and products
- Our policy team helps you get you the highest federal and local geothermal incentive dollars while making sure you're staying ahead of regulatory changes in your area

Dandelion's Ground Loop Schematic



DANDELION

Financial Overview

- **30-50% emissions and operating cost reduction** in cooling-based climates next to ASHP or Gas+AC.
- **Low maintenance** - equipment inside the home is protected from outdoor exposure and more resilient to extreme weather events.
- **Long lasting** - Avoid 10-12 year replacement costs – geothermal heat pumps will last 20-25 years + ground loops that last the life of the building.
- **HERS reduction of 5-10 points** compared to ASHP or conventional fossil fuel systems, potentially opening up additional incentives

END DESIGN FOR INCENTIVES

Minutes

Minutes of Wellfleet Site visit will be sent October 24, 2024

September 12 Below

TOWN OF TRURO - ADHOC BUILDING COMMITTEE- FOR THE FUTURE PUBLIC WORKS FACILITY - MEETING MINUTES
THURSDAY, September 12, 2024, at 4:30 PM EDT

Meeting conducted via Zoom:
http://truroty.truro-ma.gov/CablecastPublicSite/show/7291?site=1

A quorum of committee members was present:
Co-Chair Bob Higgins Steele, Co-Chair Michael Cohen, Members Anthony Garrett, and Leif Hamnquist.
Other attendees: Select Board Liaison Bob Weinstein, and DPW Director Jarrod Cabral. public

1) **Assign Notetaker**
   Co-Chair Higgins-Steele will complete the meeting minutes for 9/12/24.
Co-chair Higgins-Steele and Member Garrett shared their experiences with AI notes, finding them useful despite occasional accuracy issues.

2) **Public Comment**
   a. Michael Forgione, town voter, suggested that the committee publish the design requirements including "must have" and "like to have" components of the project to minimize future issues.
   b. To "protect the ad hoc committee" he also questioned the precedent of citizen presentations outside of public comment
3) **Approve meeting minutes**
   Approved minutes from August
4) **Staff/member update**
   DPW director Cabral provided an update on the Phase 2 project, including the discovery of barrels and solid waste debris, and the ongoing investigation of PFAS findings and environmental study. Member Garrett expressed that resolving the lingering issue was positive from an environmental and legal standpoint. The team discussed the $220,000 contract for an environmental study and remediation, the acquisition of an abutting property for public water supply, and the proposal from Weston and Sampson for a survey to aid in the design process. They also discussed negotiating a fee structure with Weston and Sampson (W&S) once an OPM is on board. The Town does not need to continue using W&S for the design phase. There would be considerable delay if we were to solicit a new project designer
   Action Items associated with update:
   - DPW Director Cabral to post the draft Phase 2 environmental report on the committee web page
   - DPW director Cabral will share Marion DPW facility plans and contact information with any committee members that requests them
   - Member Garrett and Member Hamnquist could reach out to the Marion DPW facility architect for additional insights