



Teaching hope in the age of Crises

INTROSPECTION AND
ADAPTATIONS

LILAH AMLANI, P.ENG.

Overview

- Context (6th mass extinction, smaller pop'n of workforce, low ownership in Vic)
- Solution A: Change Economic Structure? UBI
- Solution B: Diversified Building Usage
- Solution C: Sustainable Villages (urban planning incl. energy flows)
- Solution D: More Social Housing (paid by government – FF subsidies to this)
- Solution E: Natural ventilation (earth tubes, trombe walls)
- Solution F: Biodegradable/Inert Building Materials (ref: indigenous cultures)
- *Discussion:* What else would we like to see for the next generation? What could we be teaching them?

6th Great Mass Extinction Event

- Researchers postulate that we are within earth's 6th Great Mass Extinction Event, which threatens all of life as we know it, including humanity.
- A challenge so great, it can hardly be realized by the human mind, as our very existence is the primary cause.

• I am, therefore I am not?



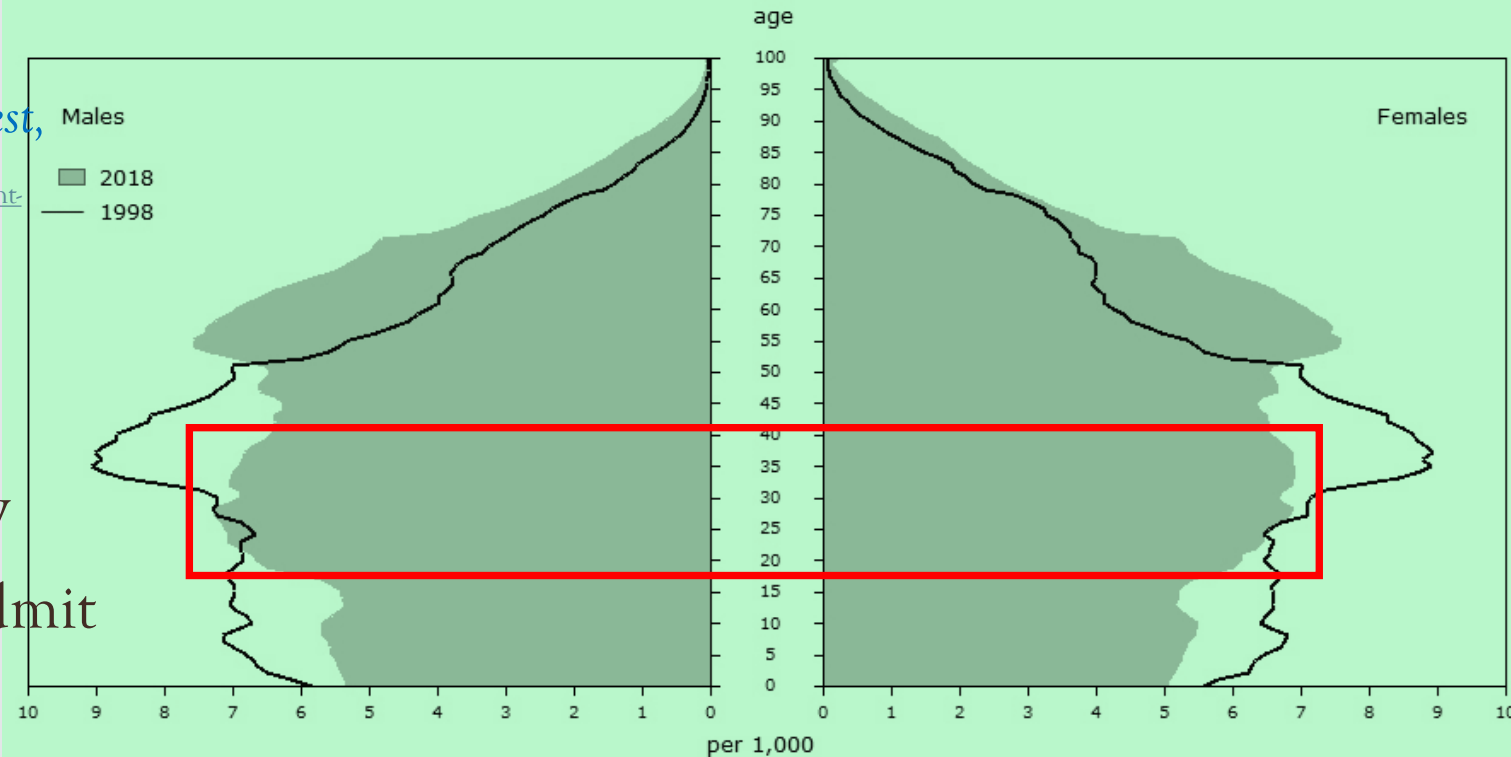
My Students: 1st year to 4th year growing engineers and designers

- Barely afford living costs
- Can't find a place to live (housing crisis)
- Can't afford to buy / live in their city
- Constantly asked to donate...*wealthiest*

Americans donate 1.3% of their income; the poorest, 3.2% <https://www.theatlantic.com/magazine/archive/2013/04/why-the-rich-dont-give/309254/>

How do I teach them about housing standards? How can we chat about VAV reheat like it's no big deal? How do I admit to them that we just replaced gas-fired boilers with gas-fired boilers?

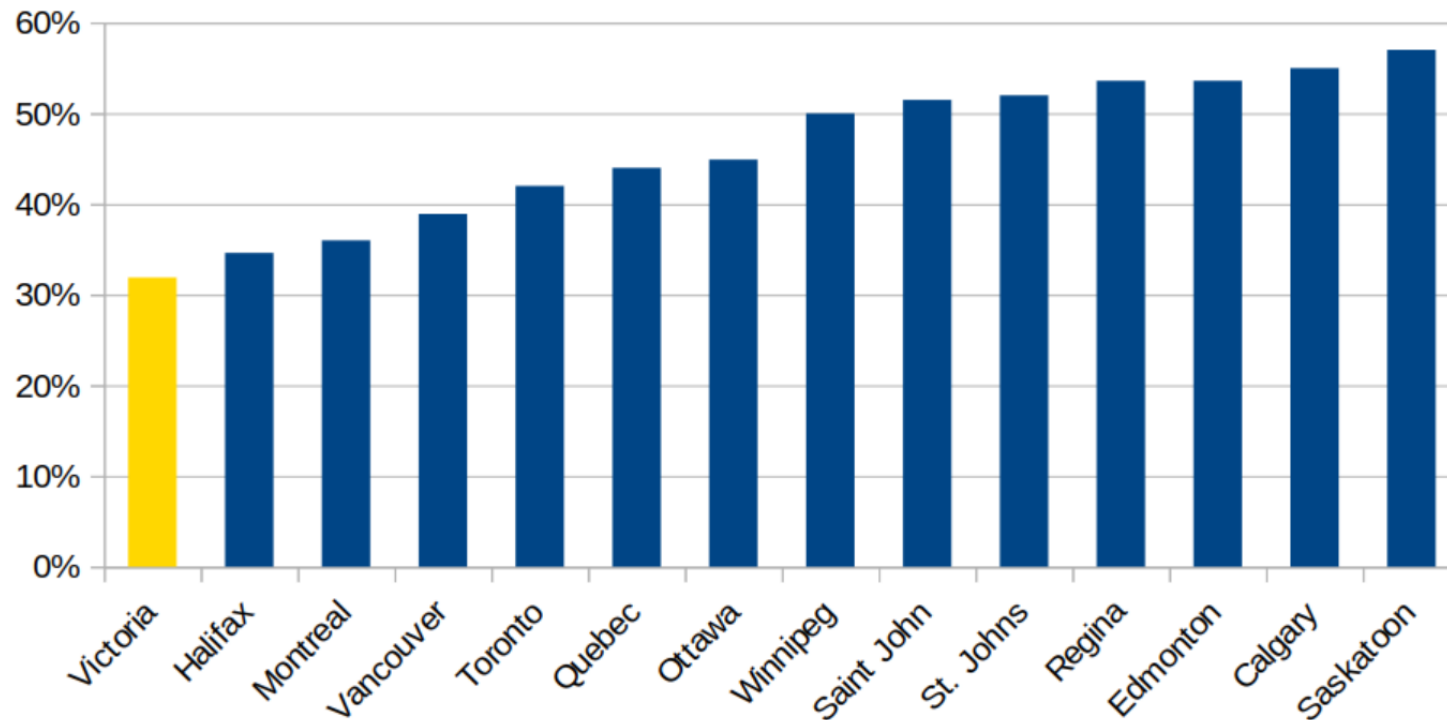
Figure 2.1
Age pyramid of population estimates as of July 1, 1998 and 2018, Canada



Source: Statistics Canada, Demography Division.

I've written in the past about the [wealthy buyers](#) in Victoria, with data showing that while Victoria as a retirement destination has more all cash buyers than most cities and we certainly are influenced [Vancouver overflow](#), our high house prices seem to be [fueled by a proportionate level of mortgage debt](#). However recently I was [interviewed](#) about why millennial home ownership rates in Victoria are the lowest in the country, a topic we [discussed a couple years ago](#). While there isn't an obvious answer, my theory is that we have an unfortunate combination of high house prices and relatively low levels of wealth which contributes to our low ownership rate for millennials. Toronto and Vancouver both have more expensive houses and higher millennial ownership rates, but they're also both global cities and likely have access to greater wealth or at least have longer tails in the wealth distribution.

Older millennial (25-34) ownership rate



<https://househuntvictoria.ca/2021/05/25/do-high-priced-cities-attract-the-wealthy/>

The demographic dependency ratio represents the number of children (0 to 14 years) and seniors (65 years and older) per 100 working-age people (15 to 64 years). On July 1, 2018, the ratio was 49.9. This indicator has been rising steadily since 2009 (44.1), and more prominently since 2011 (44.6) when the first baby boomers started turning 65. It will continue to rise until 2031 and even beyond. According to the medium growth (M1) scenario in the most recent population projections, the demographic dependency ratio should be 64.2 in 2031.

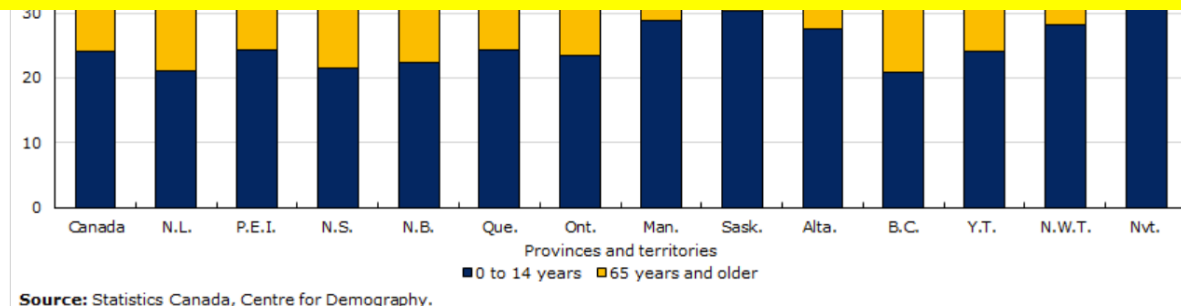
Chart 2.3
Demographic dependency ratio, 1973 to 2018, Canada
 per 100 persons aged 15 to 64 years



The demographic dependency ratio of the provinces and territories sometimes influenced by younger populations, sometimes by older populations

“On July 1, 2019, there was less than one labour market potential entrant (0.9) for each person potentially leaving. By comparison, in 1984, Canada had two people aged 15 to 24 per person aged 55 to 64. Subsequent years were marked by a steady decrease in this ratio, such that starting in 2013, the number of people potentially leaving outnumbered the number of those potentially entering the labour market.”

This is why everyone is low-staffed. How do we entice the next generation into HVAC?



A: We need creative push-back against chasing the bottom dollar, and we need to find a way to afford real change.

- The purpose of life – procreation and proliferation.
- What if we had....

UBI: Universal Basic Income – a living wage to every human.

Reduced crime

Reduced work-related illnesses.

Reduced poor quality jobs => less to the billionaires.

Reduced make-work projects (designed to ensure people have jobs)

Reduced rat race – living paycheck to paycheck

Reduced employees at a workplace => reduced commercial real estate

Increase real estate now allocated to housing => **Reduced “housing crisis”**



B: One Housing Solution

- There are plenty of buildings, but why are we needing two: a house and a place of work?
- Why are we building more buildings? To provide jobs? But we don't need jobs; we need to be able to afford our life: housing, food, medicine. => UBI aka **simplified social security**

Reduced “work places” => reduced emissions due to travel
=> reduced infrastructure
=> reduced policing



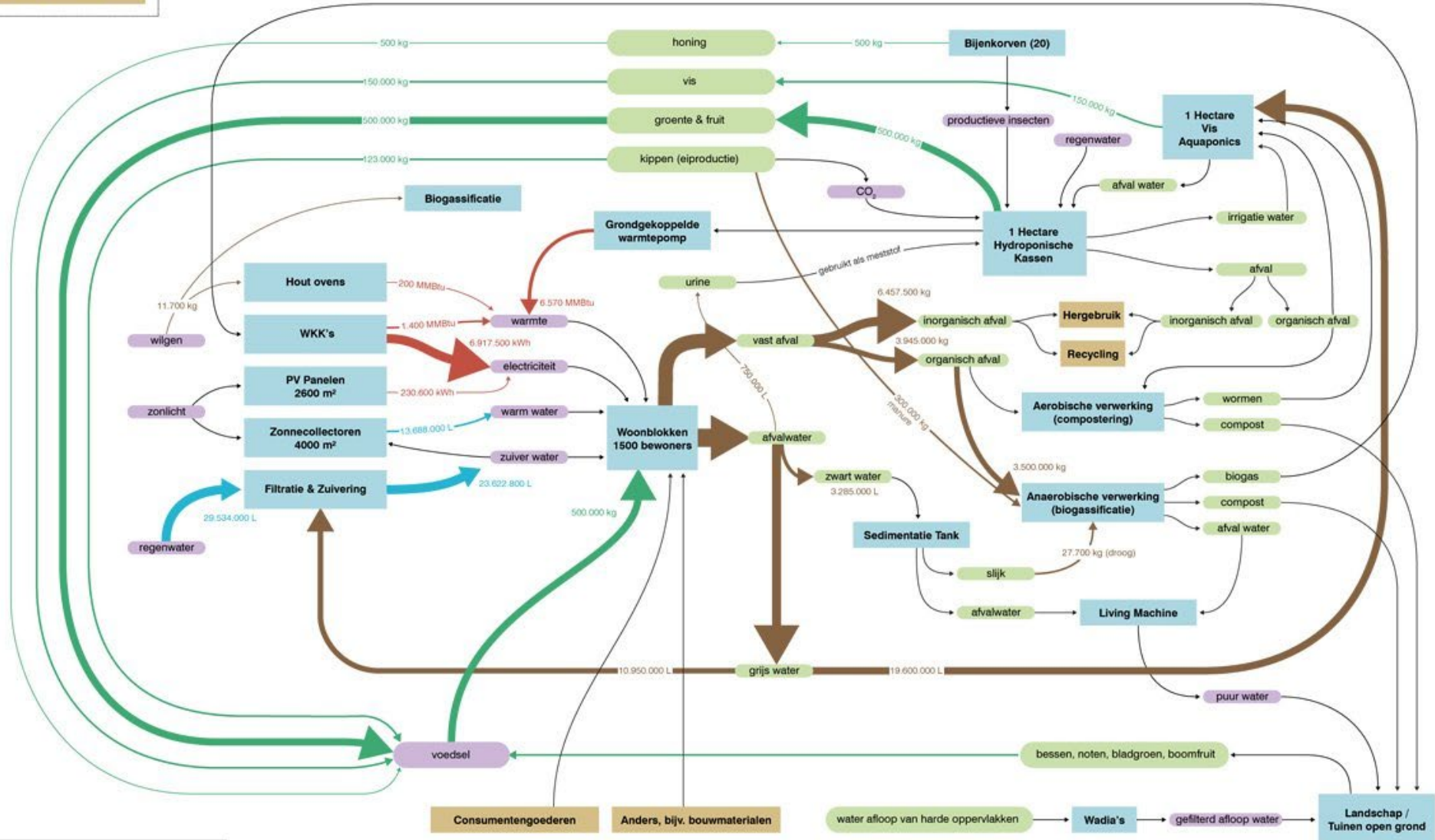
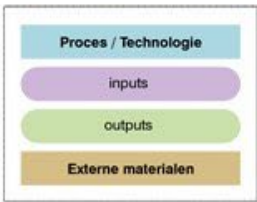
Elmsbrook, UK

C: What does a sustainable “eco-village” look like, from an urban planning standpoint?



Contextual Development Framework - Closed Loop Material and Energy Flows
 Mooi & Duurzaam Schiebroek-Zuid

<http://www.except.nl/en/projects/56-sustainable-schiebroek-zuid>



What happened to social housing?

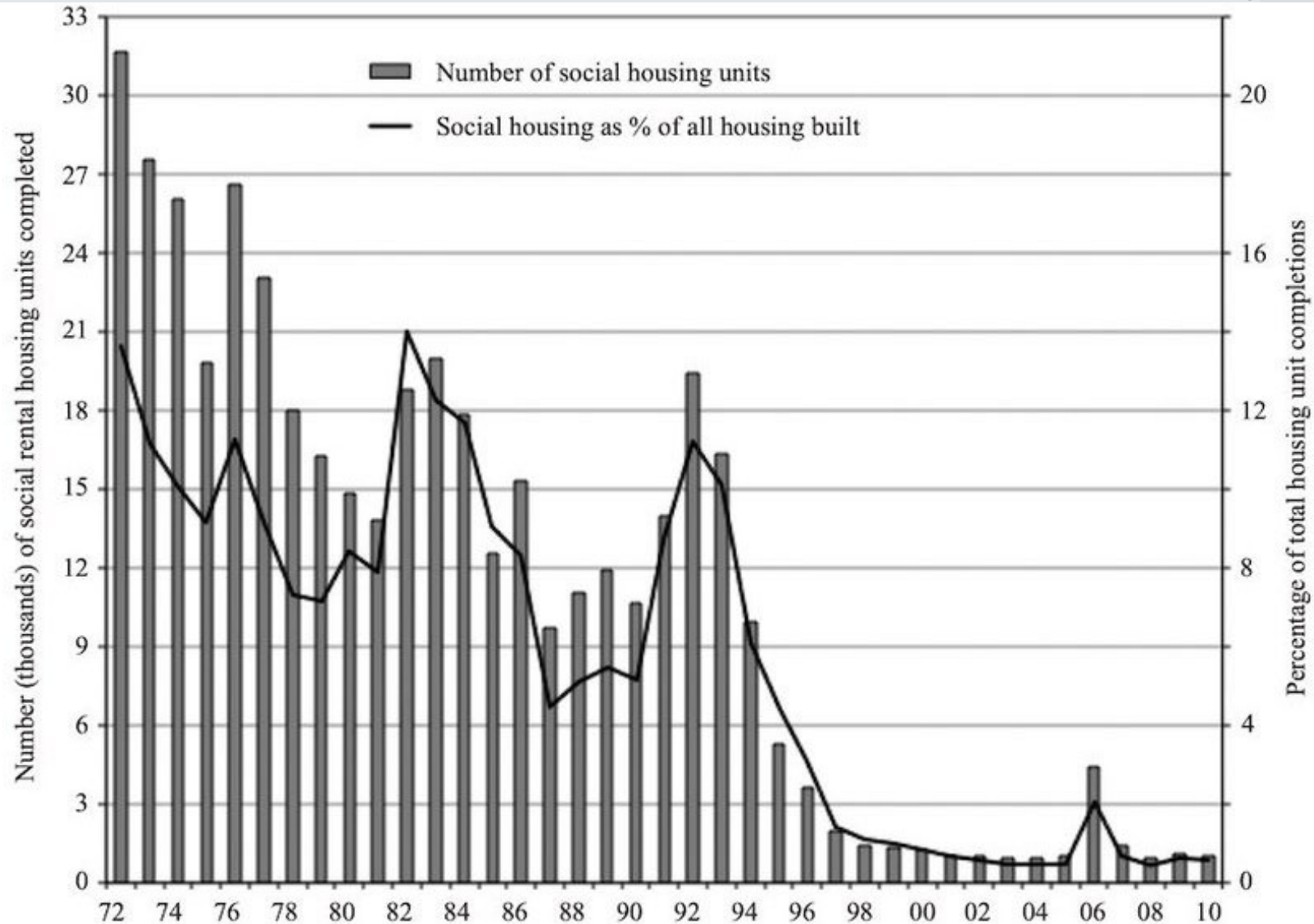


Figure 2. Social housing units built, by year, Canada 1972–2010 (source: calculated by the first author from CMHC *Canadian Housing Observer*, various years).

D: Social Housing – 1,000 per year in Victoria

Assume 20% of all housing built is social housing

= (housing starts and under construction in Canada last year 442,000)*20%

= 88,400 units per year in Canada (5,000 per year promised by Gov't - 1%)

= (housing starts and under construction in BC last year 85,000)*20%

= 17,000 units per year in BC

= (housing under construction in 2021 in Victoria 5,000)*20%

= 1,000 units per year in Victoria

Statistics Canada. Table 34-10-0135-01 Canada Mortgage and Housing Corporation, housing starts, under construction and completions, all areas, quarterly

<https://www.globenewswire.com/en/news-release/2022/03/08/2399357/0/en/CPABC-Greater-Victoria-housing-starts-surge-past-previous-record.html>

<https://pm.gc.ca/en/news/news-releases/2022/01/21/over-10000-new-affordable-homes-canadians>



D: Social Housing - Costs

Assuming 20% of all housing built is social housing:

= 88,400 units per year in Canada

= 17,000 units per year in BC

= 1,000 units per year in Victoria



An average home size in BC could be $[1950 \text{ ft}^2 \text{ (detached)} + 880 \text{ ft}^2 \text{ (condo)}] / 2 = 1,400 \text{ ft}^2$

Assume building cost similar to Vancouver: \$150 - \$275 / sq.ft. (Altus Group's 2022 Canadian Cost Guide)

⇒ \$210,000 - \$385,000 per residential unit

⇒ \$210,000,000 - \$385,000,000 for 1000 units in Victoria

⇒ \$18.6 B - \$34.0 B in Canada (based on the above assumptions)

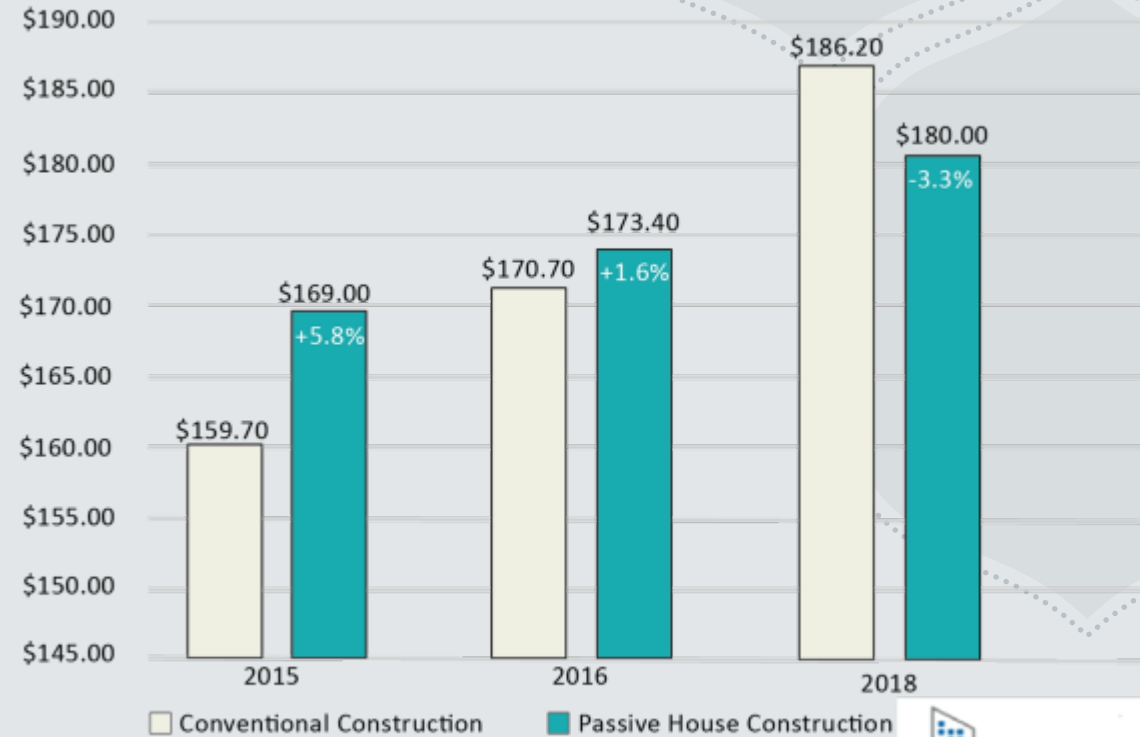
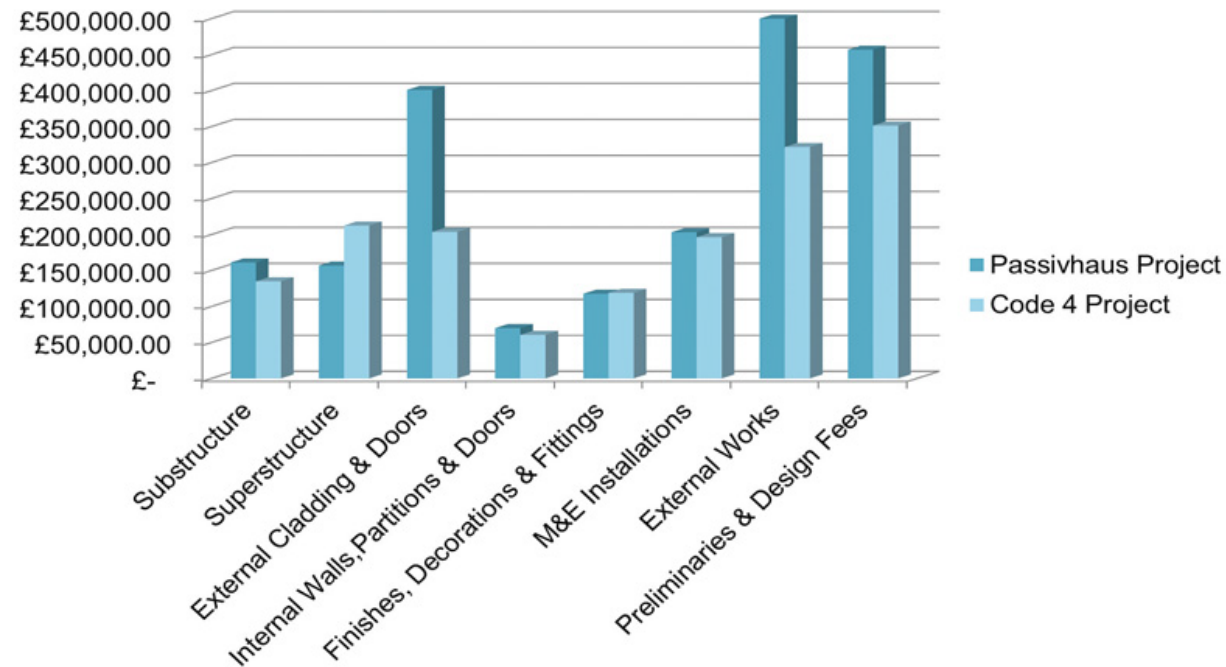
⇒ This is roughly equivalent to low estimates of Fossil Fuel Subsidies in Canada in 2022 (\$18B - \$81B)

E: Natural Ventilation + Passive House Builds

Passive house builds have become more cost comparable

Passive House Costs Less with Experience (Cost per Square Foot)

Passive house compared to Code 4



Note: Low-income housing tax credits were not awarded in 2017

Source: "How a PA affordable housing agency is molding ultra-efficient buildings mainstream" Pittsburgh Post-Gazette December 31, 2018 & Pennsylvania Housing Finance Agency (PHFA)



References: <https://passivehouseplus.ie/magazine/insight/the-cost-of-building-passive>

<https://www.phius.org/resources/policy-work/cost-data>

E: Natural Ventilation + Passive House Builds

If not served by heating or cooling equipment, no mechanical ventilation system is required (ASHRAE 62.1).

“6.4 Natural Ventilation Procedure. Natural ventilation systems shall be designed in accordance with this section and shall include mechanical ventilation systems designed in accordance with Section 6.2 and/or Section 6.3. **Exceptions:** 1. An engineered natural ventilation system, when approved by the authority having jurisdiction, need not meet the requirements of Section 6.4. 2. The mechanical ventilation systems are not required when a. natural ventilation openings that comply with the requirements of Section 6.4 are permanently open or have controls that prevent the openings from being closed during periods of expected occupancy or b. **the zone is not served by heating or cooling equipment.”**

E: Natural Ventilation + Passive House Builds

Studies have shown that in some milder climates, such as the Maritimes or Vancouver Island, passive houses with natural ventilation can provide adequate ventilation and avoid the demands of a mechanical ventilation system.

A Natural Ventilation Alternative to the Passivhaus Standard for a Mild Maritime Climate

Paola Sassi

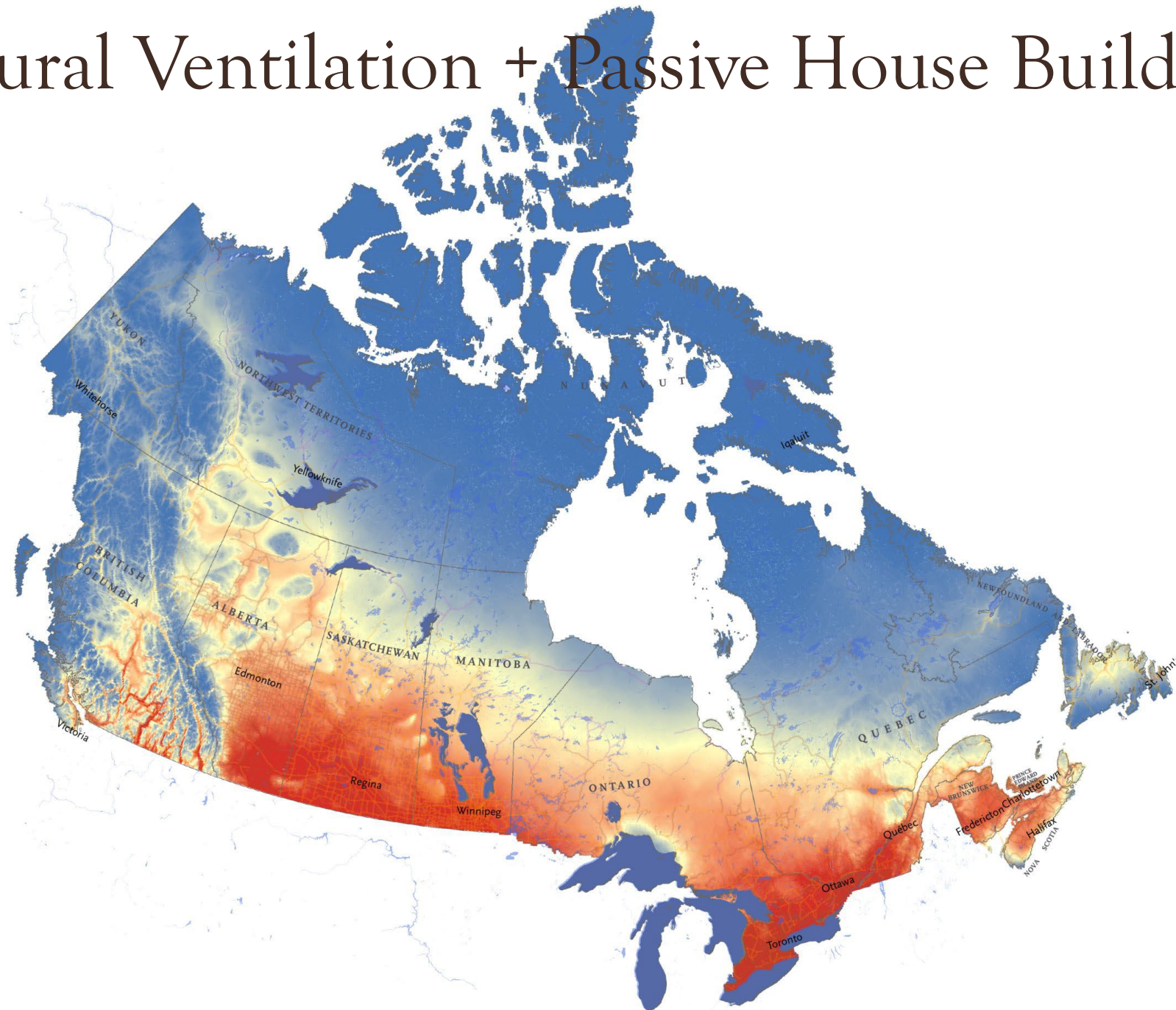
School of Architecture, Oxford Brookes University, Headington Campus, Gypsy Lane,
Oxford OX3 0BP, UK; E-Mail: psassi@brookes.ac.uk

Received: 26 November 2012; in revised form: 7 January 2013 / Accepted: 9 January 2013 /

Published: 18 January 2013

“The paper concludes that in climates with mild winters and cool summers the use of MVHR could be omitted without compromising comfort levels and achieving at least equivalent energy savings resulting from adopting the Passivhaus model and at a lower capital cost. This suggests the potential for a naturally ventilated, ultra-low energy model with lower capital investment requirements and lower disruption when applied to retrofit that would facilitate its mainstream adoption.”

E: Natural Ventilation + Passive House Builds



E: Natural Ventilation + Passive House Builds

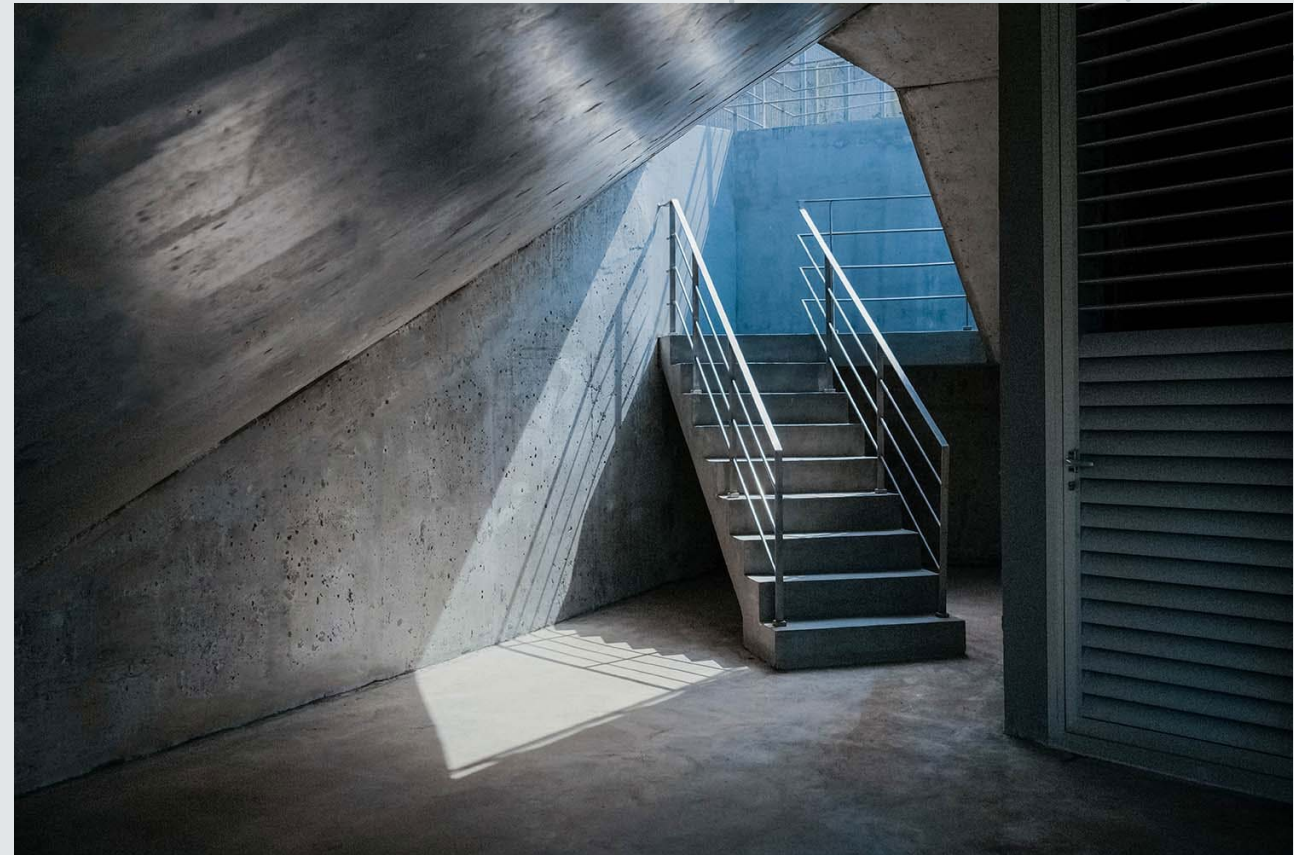
Example:

**A naturally ventilated
passive house by the
Aegean Sea**



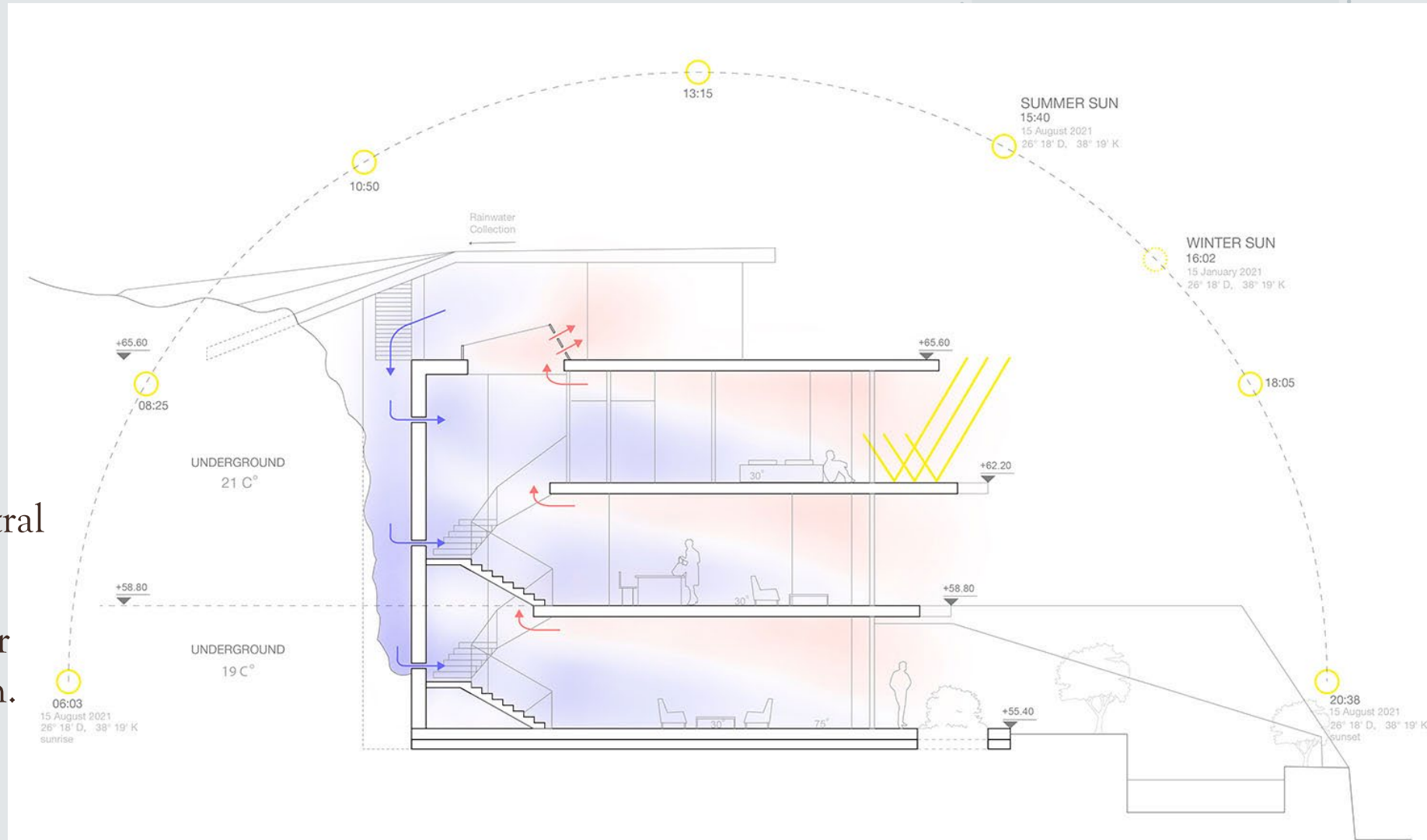
Example:

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Example: A naturally ventilated passive house by the Aegean Sea

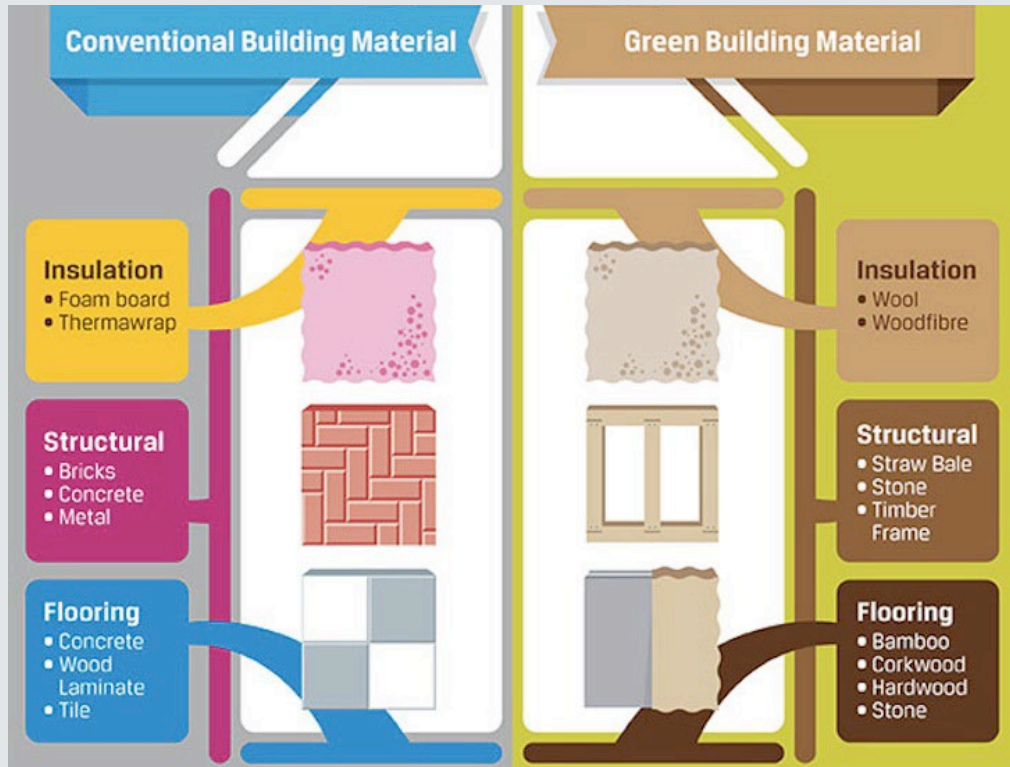
- Wind chimneys
- Thermal Mass (8 hours to fully heat to surrounding temperature)
- Earth tube precooling or preheating incoming air
- Stairwell as supply and central return
- Overhangs to block summer sun, but allow in winter sun.



Passivhaus + natvent?

- ♦ Opinions? Experiences?
- ♦ Embodied energy costs of HVAC: “The LCA results show that the embodied impact of the HVAC systems is **three times higher** than the targets provided by the Swiss Energy Efficiency Path (SIA 2040). Furthermore, it is shown that the embodied impact of HVAC systems lies in the range of **15–36% of the total embodied impact** of office buildings.” *Detailed Assessment of Embodied Carbon of HVAC Systems for a New Office Building Based on BIM*
Christina Kiamili, Alexander Hollberg and Guillaume Habert 2020

F: Biodegradable / Inert Building Materials



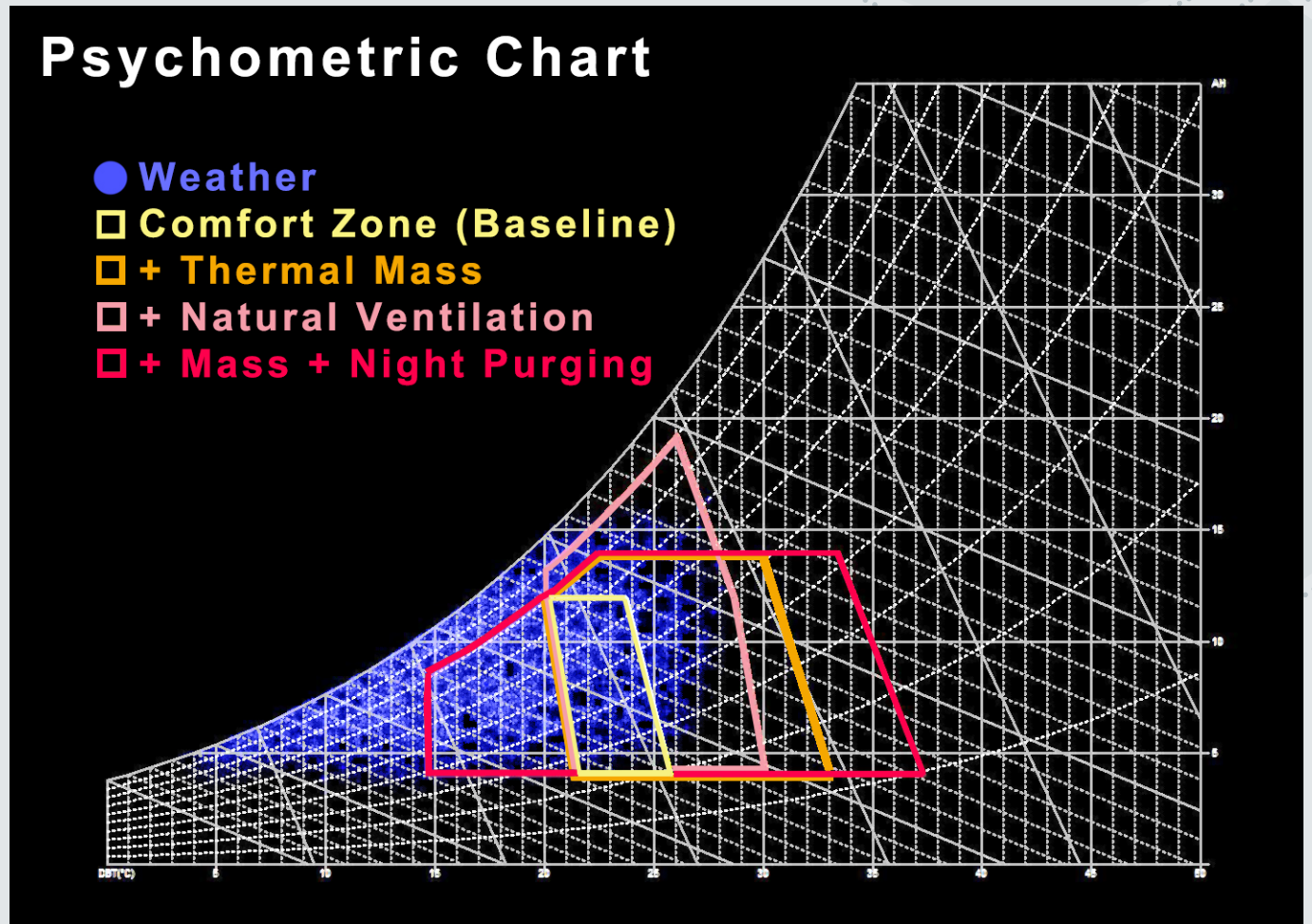
Operational Changes?

- What do I really need?
- Can I consume 80% less? 80% less coffee, 80% less food, 80% less clothing, 80% less electricity?
- Buy me once.
- Give up “fashion?”
- What does it mean to be “comfortable?”
- Turn the heat down, turn the AC off. Layer up or down as needed. Give up “fashionable” house renovations to impress your neighbours.



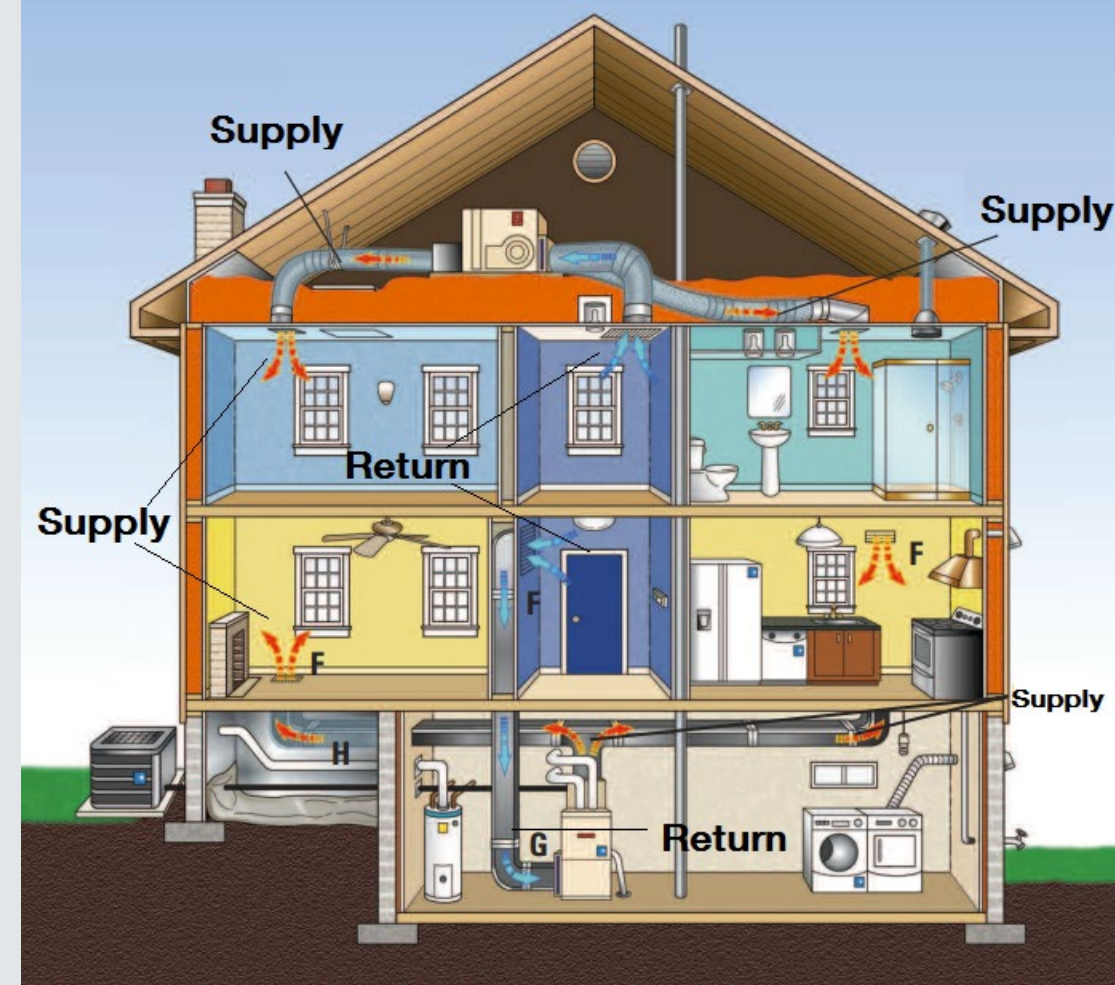
How can we do this in buildings?

- Can we achieve the same action through opening the windows?
- Can we move the heat around instead of generating more?
- Can we change our standards of comfort?



What do I teach?

- ASHRAE 62.1 and outdoor air requirements
- Diffuser selection
- Duct sizing
- Psychrometrics and sizing heating / cooling equipment
- Fan sizing
- Heat transfer (simple and extensive)
- Infiltration
- Introduction to controls
- Also: green building certifications, passive houses, heat recovery, district energy, feasibility studies, ASHRAE 90.1....
- Final Project: design a space and detail the mechanical HVAC systems



Discussion: What can we teach to the students?

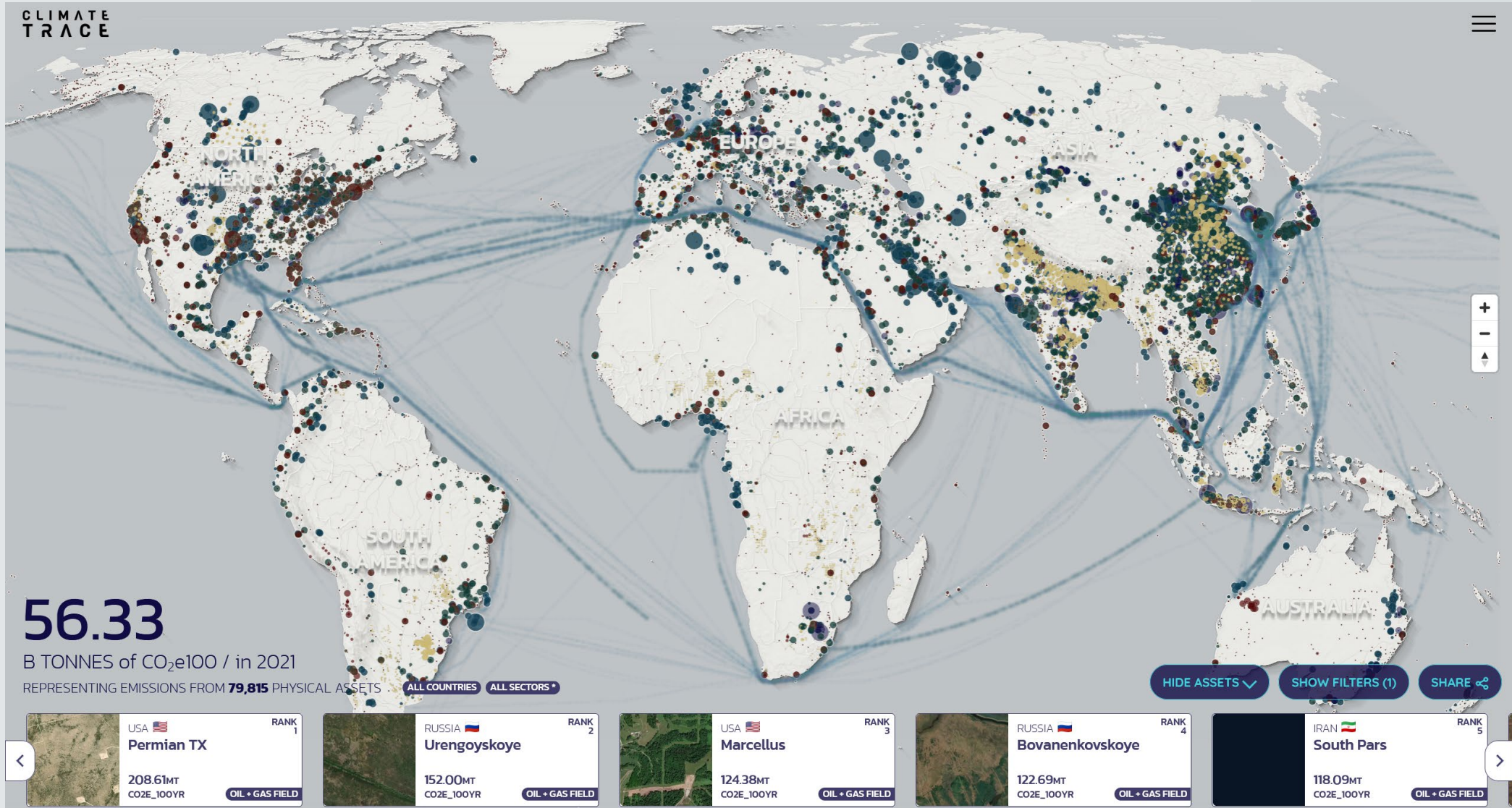
- Heat recovery strategies?
- Passive strategies?
- Building repurposing?
- Existing buildings?

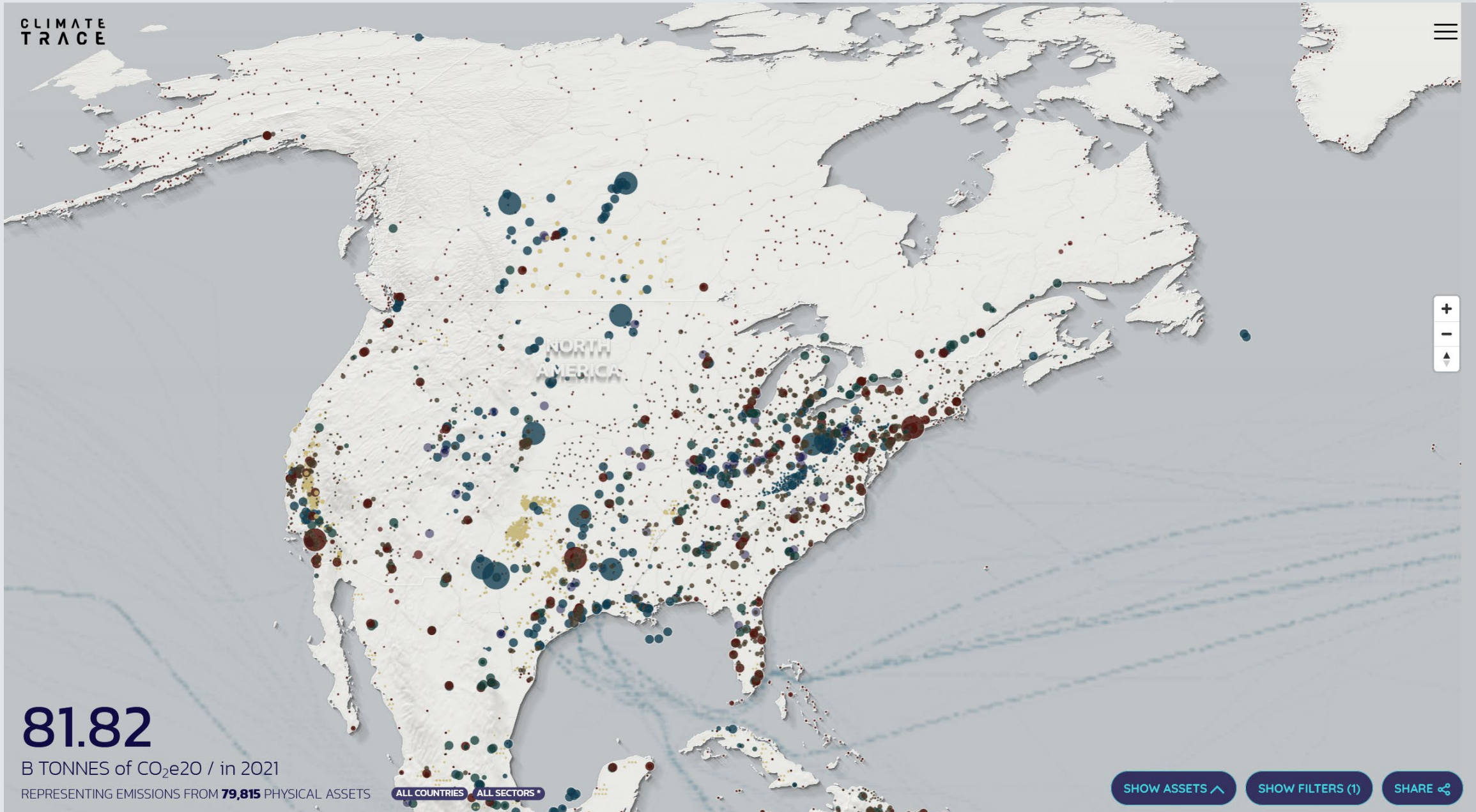


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Carbon TRACE <https://climatetrace.org/map>





81.82

B TONNES of CO₂e₂₀ / in 2021

REPRESENTING EMISSIONS FROM **79,815** PHYSICAL ASSETS

ALL COUNTRIES ALL SECTORS*

SHOW ASSETS ^

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