ET Summit 2019

Presented by

ET CC EMERGING TECHNOLOGIES COORDINATING COUNCIL

The ZNE Elephants in the Room & Reaching AB32 Goals

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CEO
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Meeting AB32 goals with ZNE & ZNC buildings + EVs

- ✓ *ZNE - key success & key issues*
- ✓ *DC microgrids to integrate digital world - Buildings with ZNE + EV charging + battery storage*
- ✓ *ZNC buildings = embodied + operational carbon*

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ZNE – Are we really back to all electric homes?

ZNE Successes

- ZNE is cost effective in most cases
- ZNE can be achieved by efficiency & purchasing 100% green power
- ZNE communities provide potential for microgrids
- AB32- leads to electrification and ZNE integration with EV charging and battery storage

ZNE Key Issues

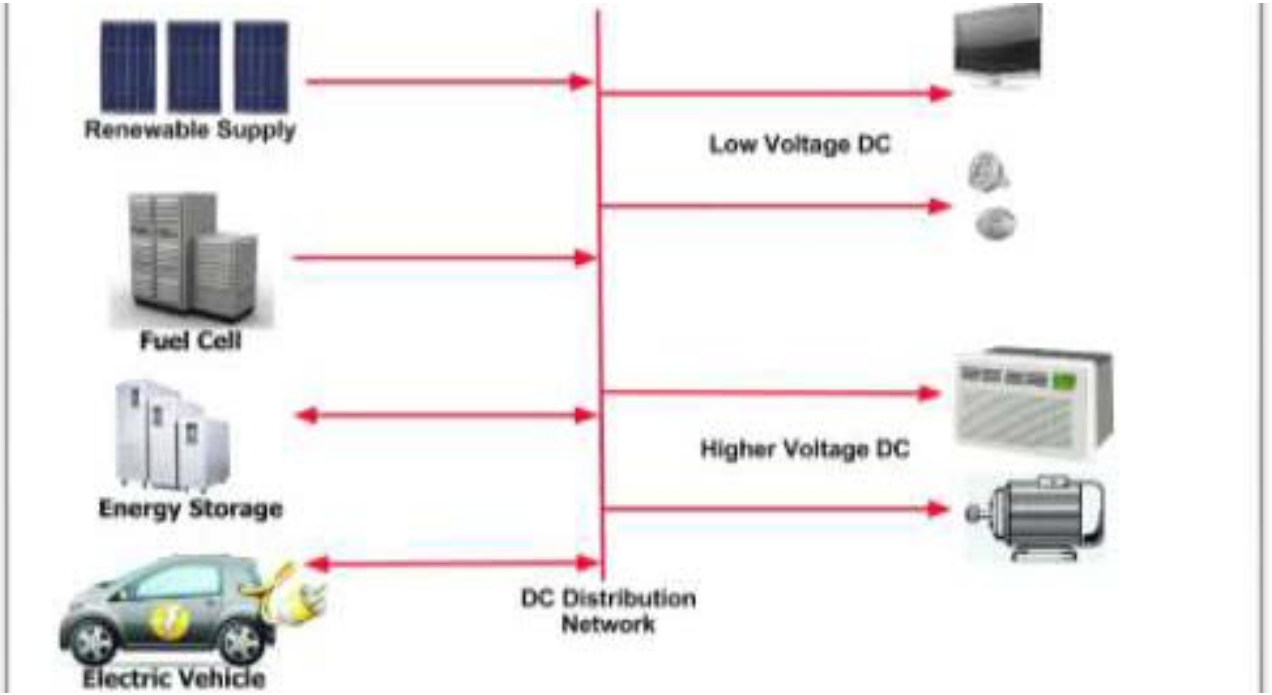
- ZNE Retrofits - electric service & asbestos issues
- Better refrigerants – CO2 and ?
- Shift from energy to GHG impacts
- ELEPHANTs –
  - HP leaks can = decades of savings
  - O&M – After the ZNE is born?
  - Emergency PV power circuits

DC and AC-DC Hybrid Analysis of ZNE + EV charging + battery storage

What's DC got to do with it …?

ZNE Maritage Homes

ZNE IBEW/NECA Training Center



Elephant :DC to DC building systems with ZNE + EV + storage Save up to 15% of Building + EV + Storage

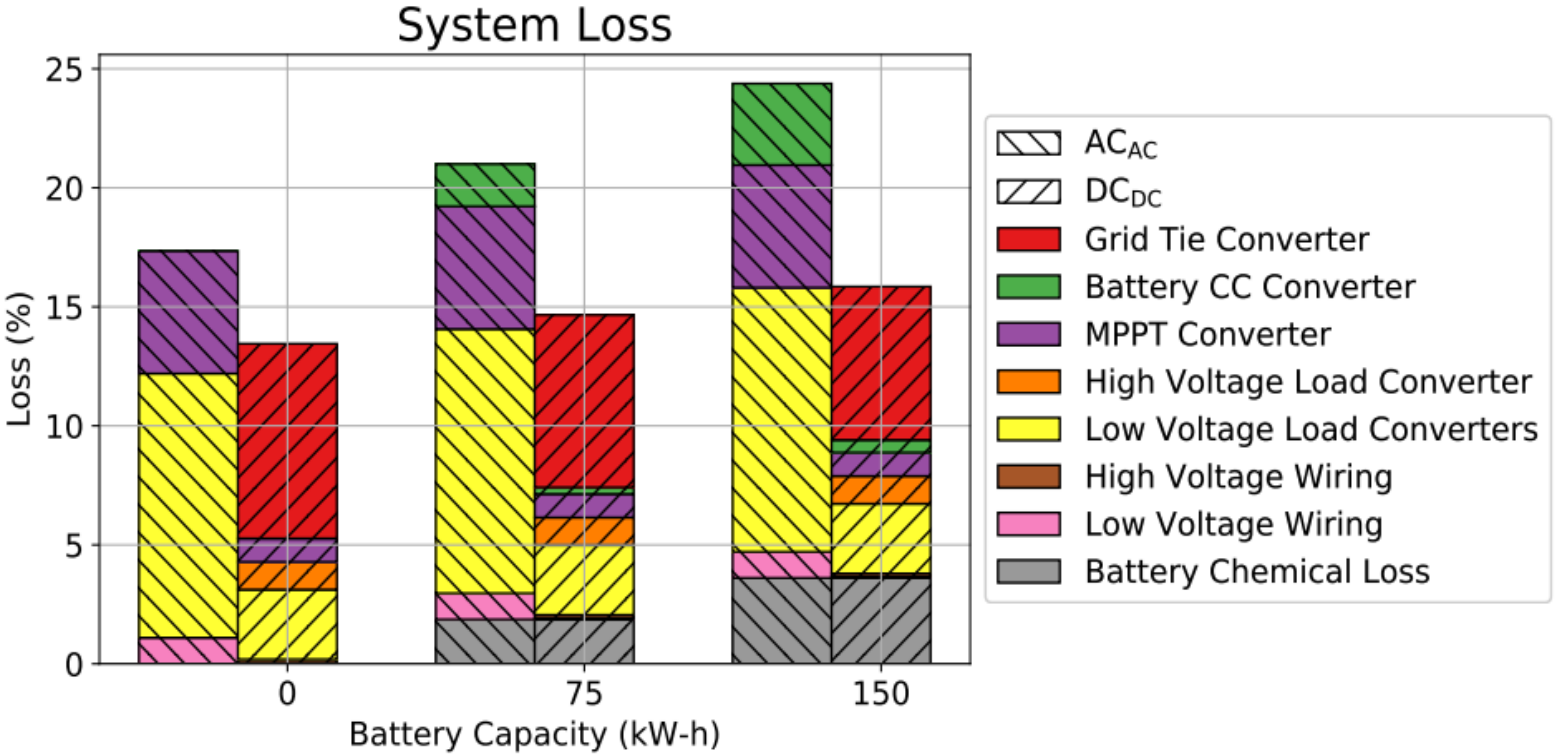
in

DC to DC to integrate digital world - Buildings with ZNE + EV charging + battery storage

- ✓ 1st design the sustainable Electric system – End goal
- ✓ DC to DC systems enable unique savings and advantages
- ✓ DC microgrids –best sustainable power systems & emergency power

- ➢ AB32 envisions integrating homes with EVs and the grid
- ➢ Engineering optimization dictates DC systems
- ➢ DC systems are 1 of 10 key EPIC Strategic Emerging technologies

Figure 2. Commercial System Losses in AC vs. DC Systems with EV for Various Battery Sizes

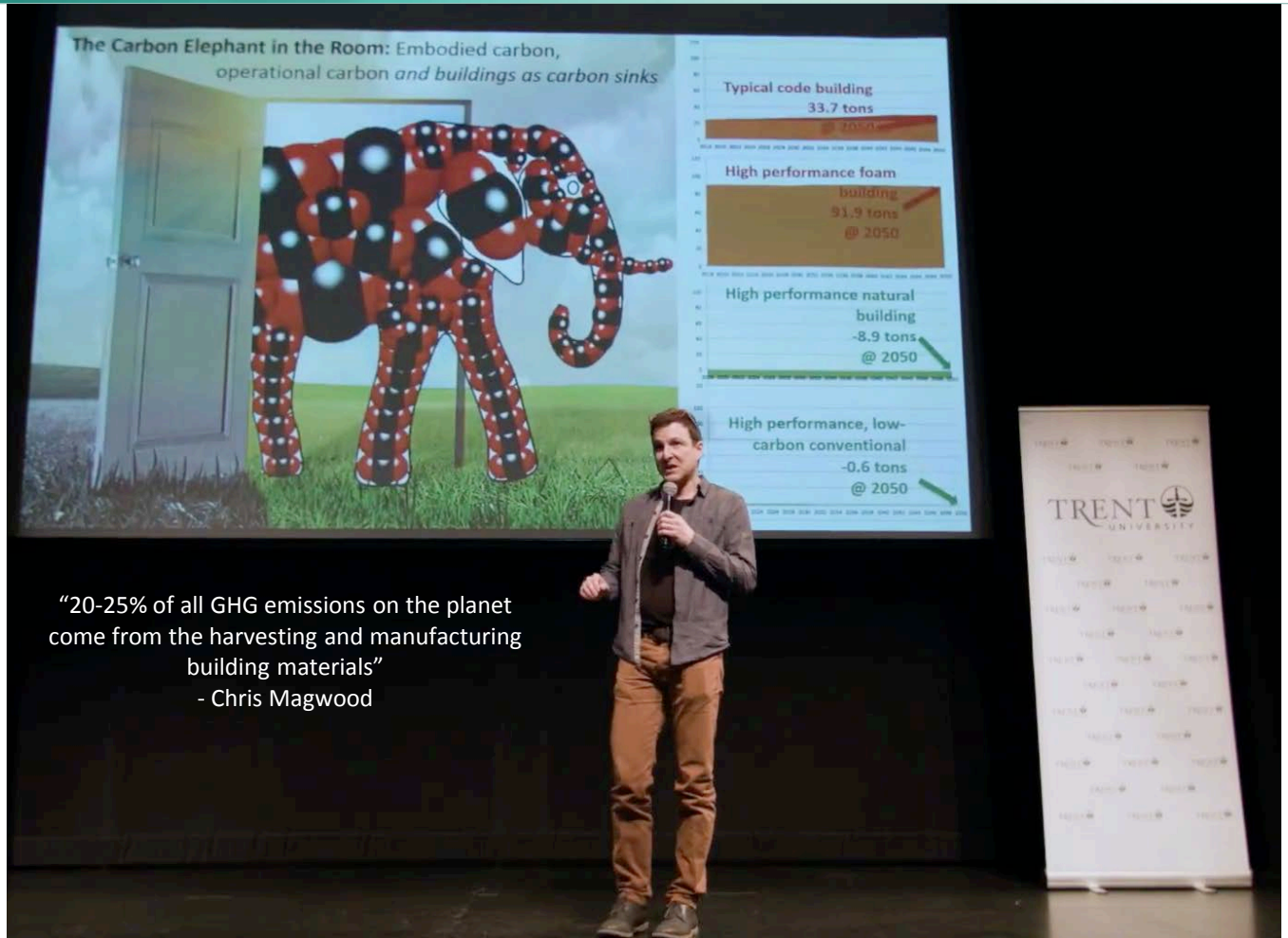


Direct Current as an Integrating and Enabling Platform for Zero-Net Energy Buildings, June 2018 CEC

DC emerging globally as the best practices for many building systems

Direct Current as an Integrating and Enabling Platform for Zero-Net Energy Buildings

- ✓ Commercial Buildings 5% to 14% with battery storage can go to 30% with large battery systems
- ✓ Techno-Economic Analysis of DC Power -Results show that DC distribution systems are cost-effective in most scenarios that include large capacities of PV and battery storage
- ✓ EPIC Initiative 1.6.1 - DC Building Distribution Systems to Enable ZNE Buildings by 2030



"20-25% of all GHG emissions on the planet come from the harvesting and manufacturing building materials"
- Chris Magwood

ZNC building GHG Impacts
= embodied + operational carbon

What is Embodied Carbon?

Finding raw materials

Harvesting raw materials

Processing raw materials

Manufacturing - turning processed raw materials into useful products

Energy used to transport and install the product

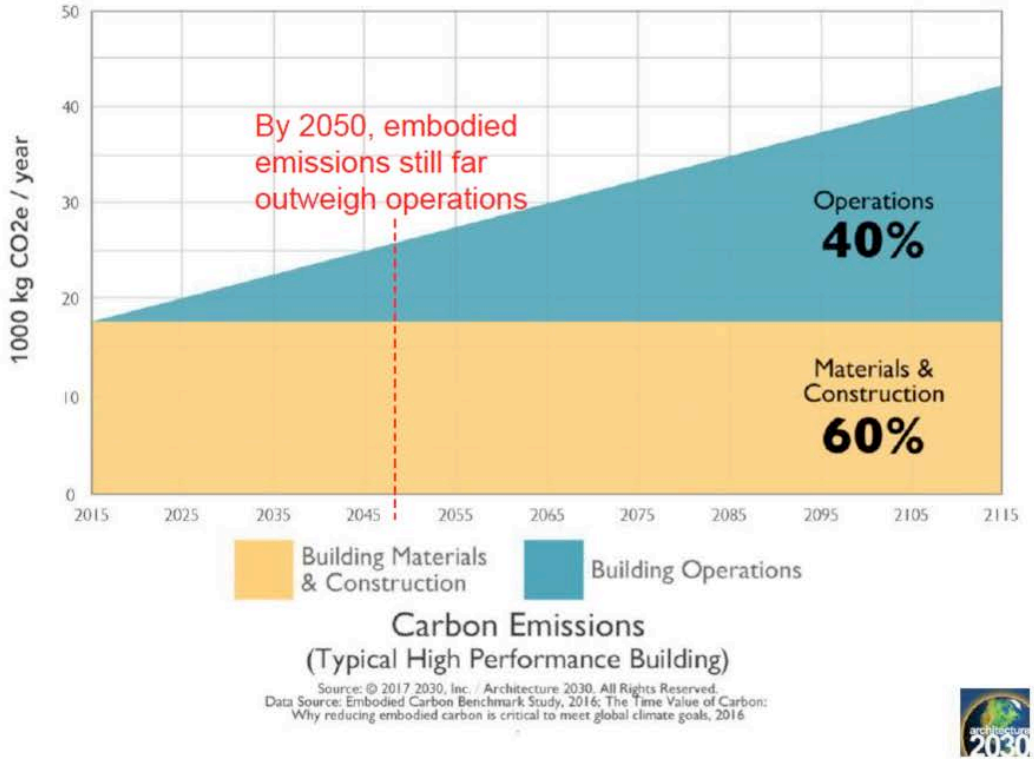
What is Operational Carbon Savings?

- ***Put simply, it is energy efficiency***
- Efficiency does NOT always equal carbon savings depending on carbon impact of grid energy
- Elephant: Why put on 50 lbs first?
  - Time Value of Carbon means carbon sequestered upfront is worth a lot more

Why does embodied carbon matter?

Embodied emissions are large, and immediate.

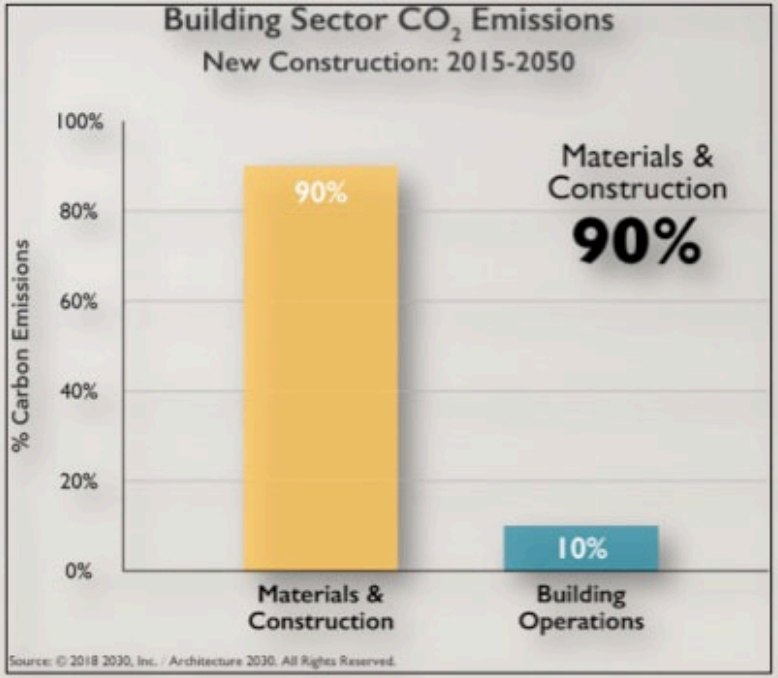
Although operational emissions may eventually outweigh embodied emissions, the initial value of embodied emissions will be the most significant impact until well after 2050.



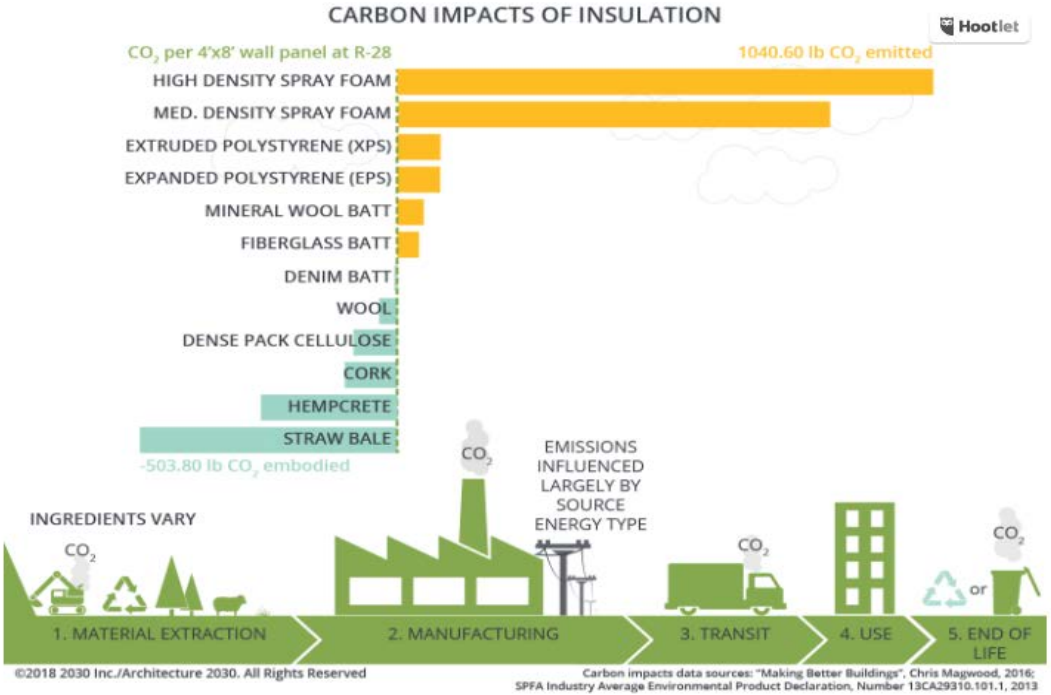
Magwood, Racusin, & McArleton 2018

WE HAVE TO ADDRESS **TODAY'S** EMISSIONS, AND THEY ARE ***EMBODIED EMISSIONS***

Embodied carbon is the ***emissions associated with the harvesting, transportation and manufacturing of building materials.*** These emissions occur before the building begins operation…
And represent the majority of emissions that will occur between now and the climate change tipping point.

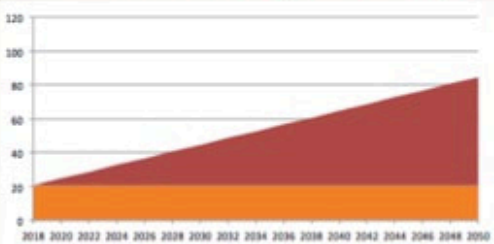


Insulation Example - Enormous Variation in Carbon Impacts

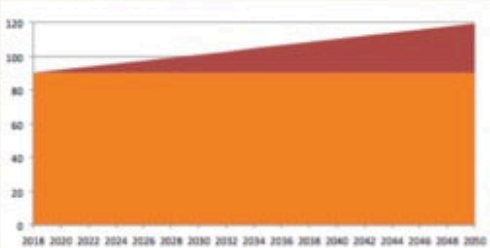


RESULTS FROM SOME EMBODIED CARBON MODELS…

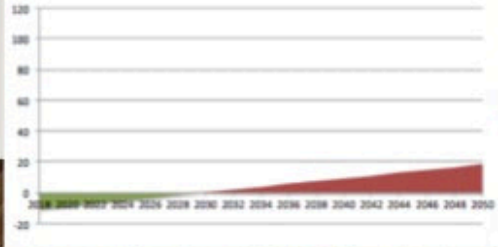
…with natural gas heating



Ontario typical code build
R-10/20/24/38
EC = 20.8 tons CO2e
Nat. gas heat = 2.0 tons/yr
84.8 tons @ 2050 total emissions

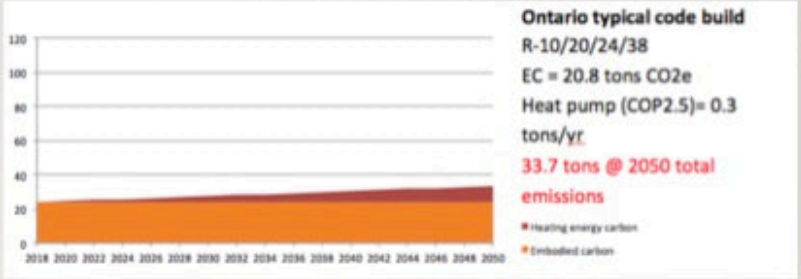


Ontario high performance build
R-20/30/40/60
EC = 90.3 tons CO2e
Nat. gas heat = 0.9 tons/yr
118.8 tons @ 2050 total emissions

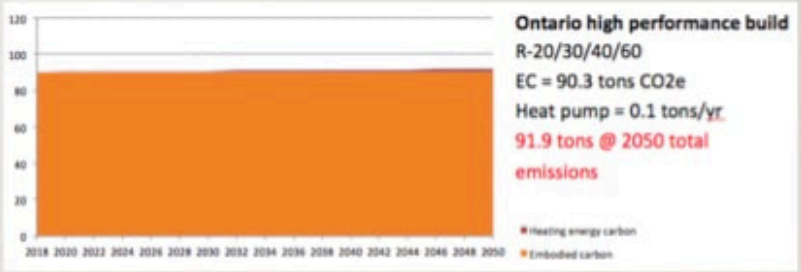


Ontario high perf. natural build
R-20/30/40/60
EC = -10.5 tons CO2e
Nat. gas heat = 0.9 tons/yr
18.3 tons @ 2050

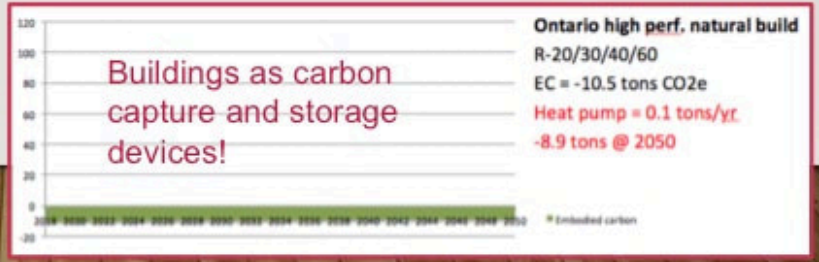
…with air source heat pump heating



Ontario typical code build
R-10/20/24/38
EC = 20.8 tons CO2e
Heat pump (COP2.5)= 0.3 tons/yr
33.7 tons @ 2050 total emissions



Ontario high performance build
R-20/30/40/60
EC = 90.3 tons CO2e
Heat pump = 0.1 tons/yr
91.9 tons @ 2050 total emissions



Ontario high perf. natural build
R-20/30/40/60
EC = -10.5 tons CO2e
Heat pump = 0.1 tons/yr
-8.9 tons @ 2050

CLIMATE CHANGE & BUILDINGS

U.S. & Canadian single family residential building in 2016:

179,600,000 m^2

High carbon building: **127.2 million tons of CO_2 emissions**

Carbon storing building: **0 net CO_2 emissions**

7.8 million tons of CO_2 stored*

135 million tons of CO_2 averted

That's the equivalent of taking 38 coal-fired power plants offline!*

*no carbon storage attributed to wood products
**500MW plant with 3.5 million tons of CO2 emissions

THIS CAN BE DONE NOW. AFFORDABLY.

Canada's Greenest Home project, 2012

Peterborough, Ontario

2,300 square feet, $170/sq.ft

39 tons of CO_2 storage

Zero toxins

85% net energy production on site

90% of materials from 250 km radius

90% less construction waste

“The house is on fire” –Take Action and drop “Greta bombs” as often as possible ……..& make up your own

"Adults keep saying we owe it to the young people to give them hope," said 16-year-old Greta Thunberg at the World Economic Forum. "But I don't want your hope. ... I want you to act as if the house is on fire, because it is."

science_to_save_the_world

science_to_save_the_world Climate change should be the most urgent problem. I usually try to inspire with positivity, but it is time to be scared. Our lives are on the line and we need action.
#climatechange

altitudearth 🔥

Some Resources

- ✓ New Buildings Institute - https://newbuildings.org/hubs/zero-energy/
- ✓ Buildings as Climate Change Solution https://www.chrismagwood.ca/embodied-carbon.html
- ✓ Architecture 2030 - https://architecture2030.org/
- ✓ Emerge Alliance – DC Codes & Standards https://www.emergealliance.org/
- ✓ EPIC DC study - http://dc.lbl.gov/epic-research-project
- ✓ ETCC --https://www.etcc-ca.com/about-etcc
- ✓ Soon– SCE ZNE Cookbook & CEC Cost Effective Com ZNE

Elephant Review & Thank You

- ✓ ***HP refrigerant leaks, O&M, all electric ZNE Emergency circuits***
- ✓ **DC to DC build ZNE + EV + storage Save up to 15% of Building + EV + Storage – can go to 30%**
- ✓ **Develop Building microgrids to use PV during power outages**
- ✓ **Embodied Emissions are 90% for new constriction 2012-2050**

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