Carbon Drawdown Now!

Turning Buildings into Carbon Sinks

New Frameworks & Endeavour Sustainable Building School

NESEA BuildingEnergy Boston, Mar 14, 2019

Our Message

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Our simple message:

Making carbon-storing buildings is the most impactful action the building community can undertake to address climate change.

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Our “life cycle” message:

Truly addressing climate change requires us to **change our thinking**, and move beyond a narrow, mechanistic view of issues to an **interconnected style** of thinking.

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Our “life cycle” message:

Lots of humans single-mindedly pursue a fossil-fuel economy to the exclusion of all other impacts: including human health, mass extinction, loss of biodiversity, climate change, racism, classism, sexism.

Buildings & Climate Change

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Our “life cycle” message:

Material substitutions in a business-as-usual scenario **isn't sufficient.**
We need to think outside our silos as building and design professionals and **connect our work** to that of other trades such as **sustainable forestry, eco-agriculture** and to movements for **social & climate justice**.

Climate Injustice

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Climate Justice

- Reconnect people across socially-reinforced divides for our common cause
- Create accountability
- Build political power to redirect resource control to the many

We see carbon action around buildings as an opportunity to decolonize our industry.

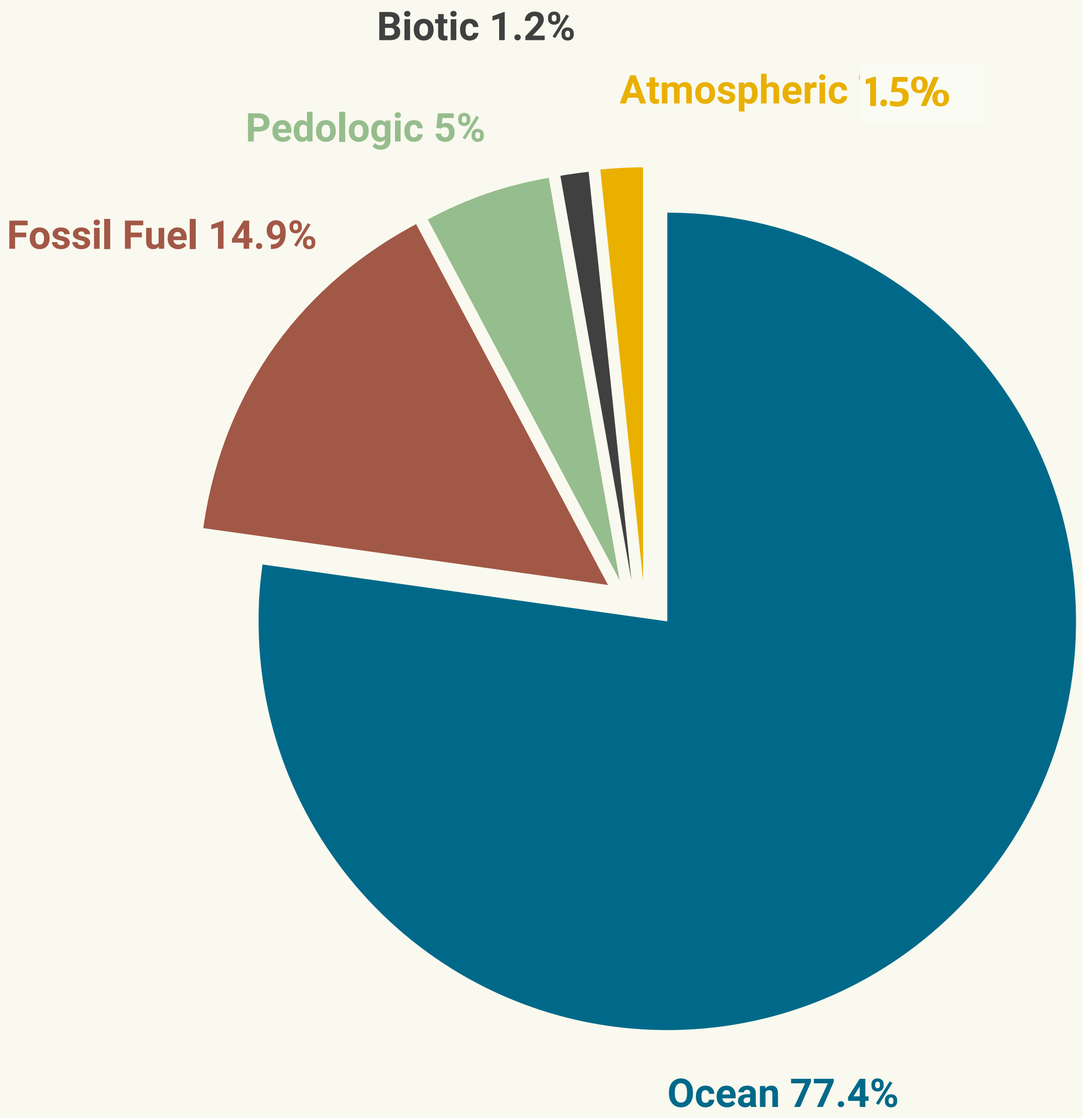
"**Organic matter in soils** on the plains **plummeted** by 50% in only one generation of **white settler colonialism**.... I realized that all our efforts to heal the soil entailed the **restoration of organic matter** and was, in effect, a decolonization of the soil. **We were inviting our non-human relations back onto the land and back into relationship with us.**"

Leah Penniman,
Author of Farming While Black

Soil! The connector...

Connects agriculture, forestry, building materials. All industries & trades that interface with and harvest resources from soil are connected through soil.

It is **the meeting place**, the liminal space between organic and inorganic life. In ecology, all the action happens at the edges.



Adapted from Lal, "Managing Soils and Ecosystems..."

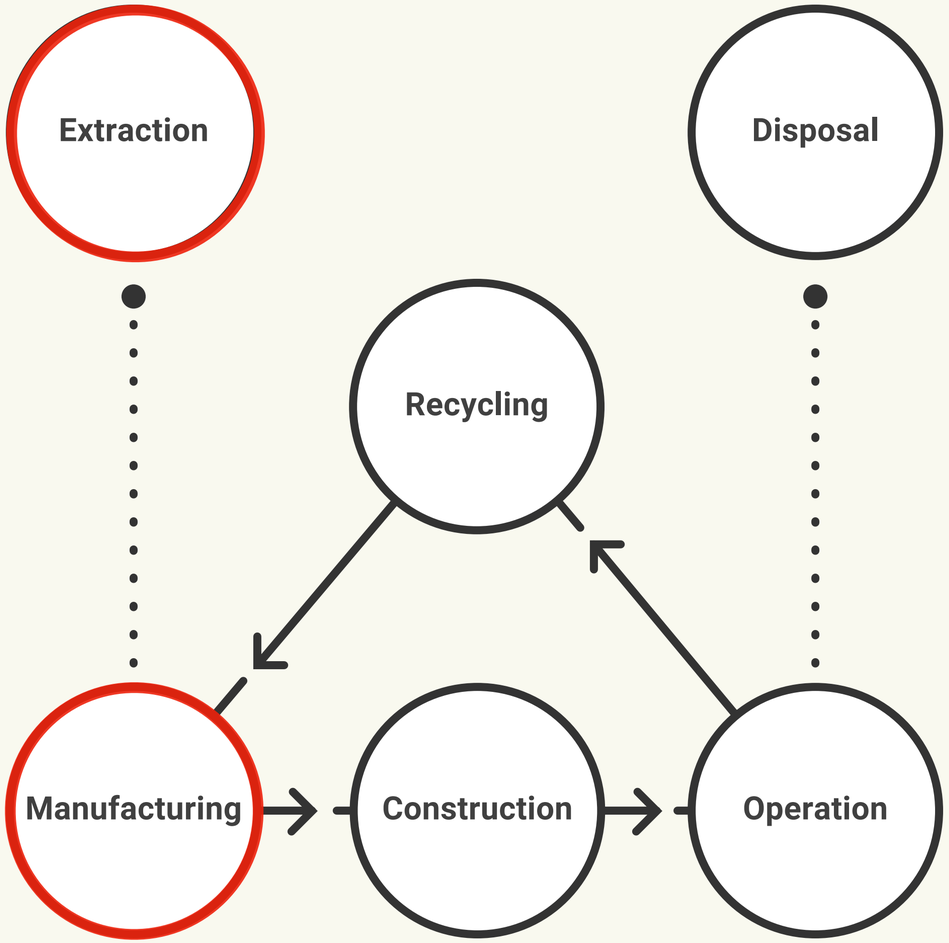
Oh wow, you mean as a builder or designer I need to understand earth science?

Yeah probably.

Embodied Carbon

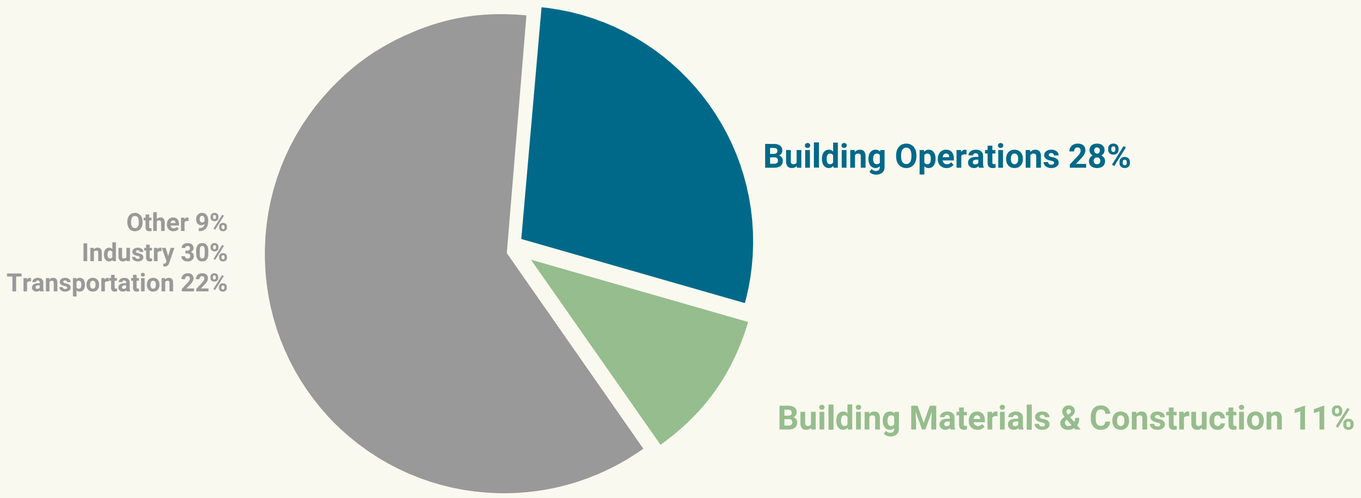
What is **embodied carbon?**

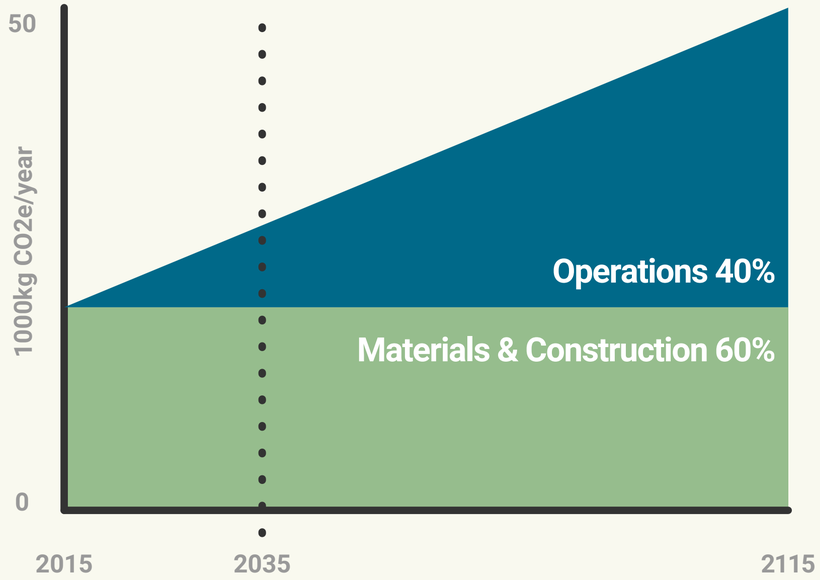
The amount of CO_2 and other Greenhouse Gases (GHGs) released into the atmosphere as a result of the extraction and manufacturing of building materials.



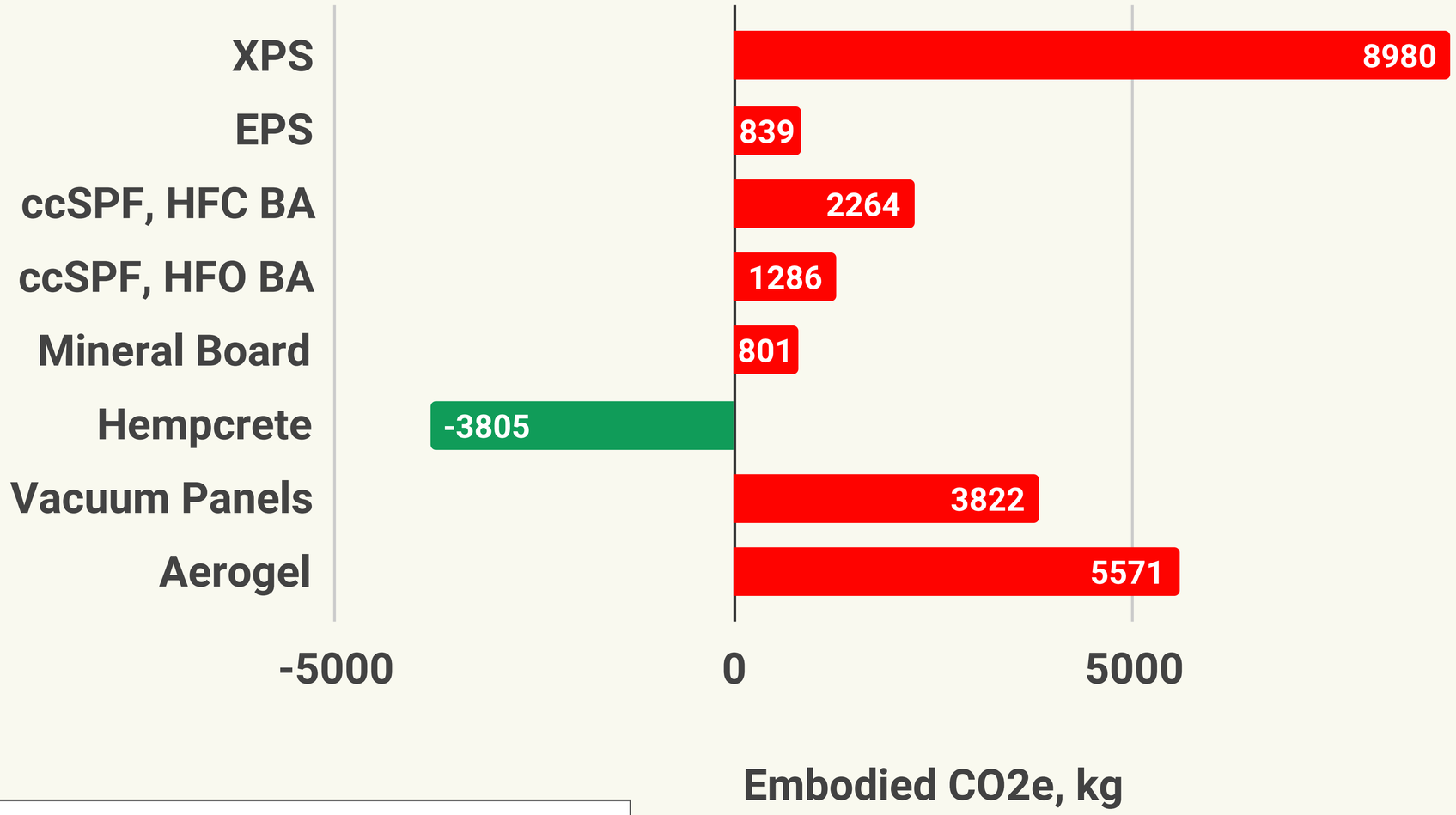
Global C02 Emission by Sector

Data Source: Architecture 2030





We cannot “net zero energy” our way out of the climate crisis.

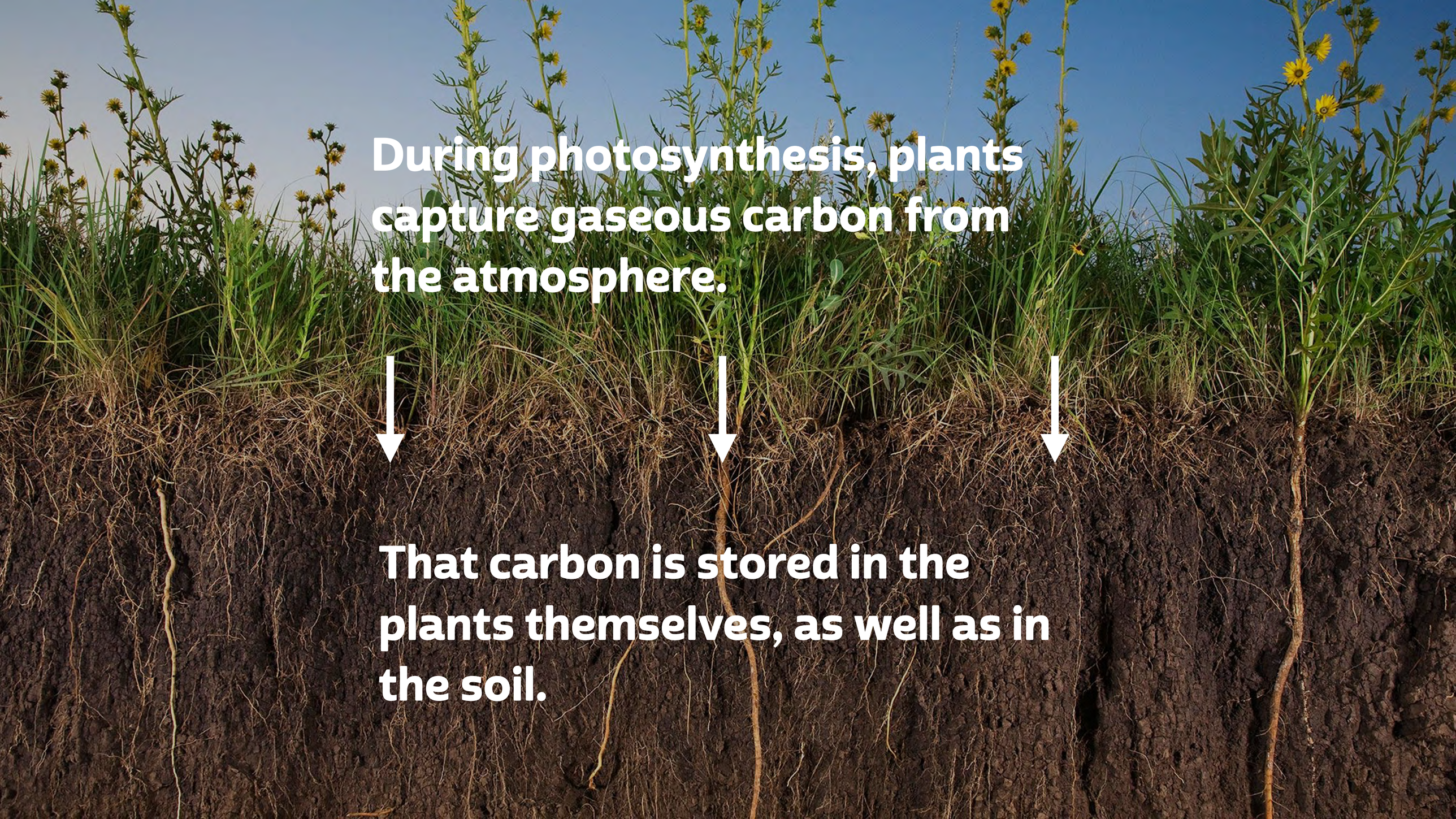


Embodied CO2e of Foundation Wall Insulation
R-20, 233 m2

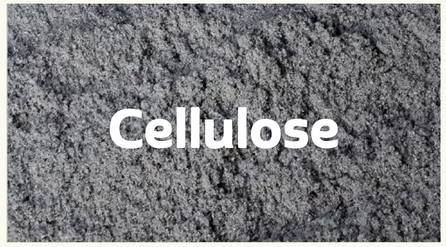
Wait! What’s this? A negative number?

Yes, a material that stores more atmospheric carbon than was emitted in harvesting & manufacturing! This opens up a whole new paradigm — **materials with carbon capture and storage potential!**

How does this work?


During photosynthesis, plants capture gaseous carbon from the atmosphere.
That carbon is stored in the plants themselves, as well as in the soil.

There are lots of **plant-based, carbon-storing building materials**

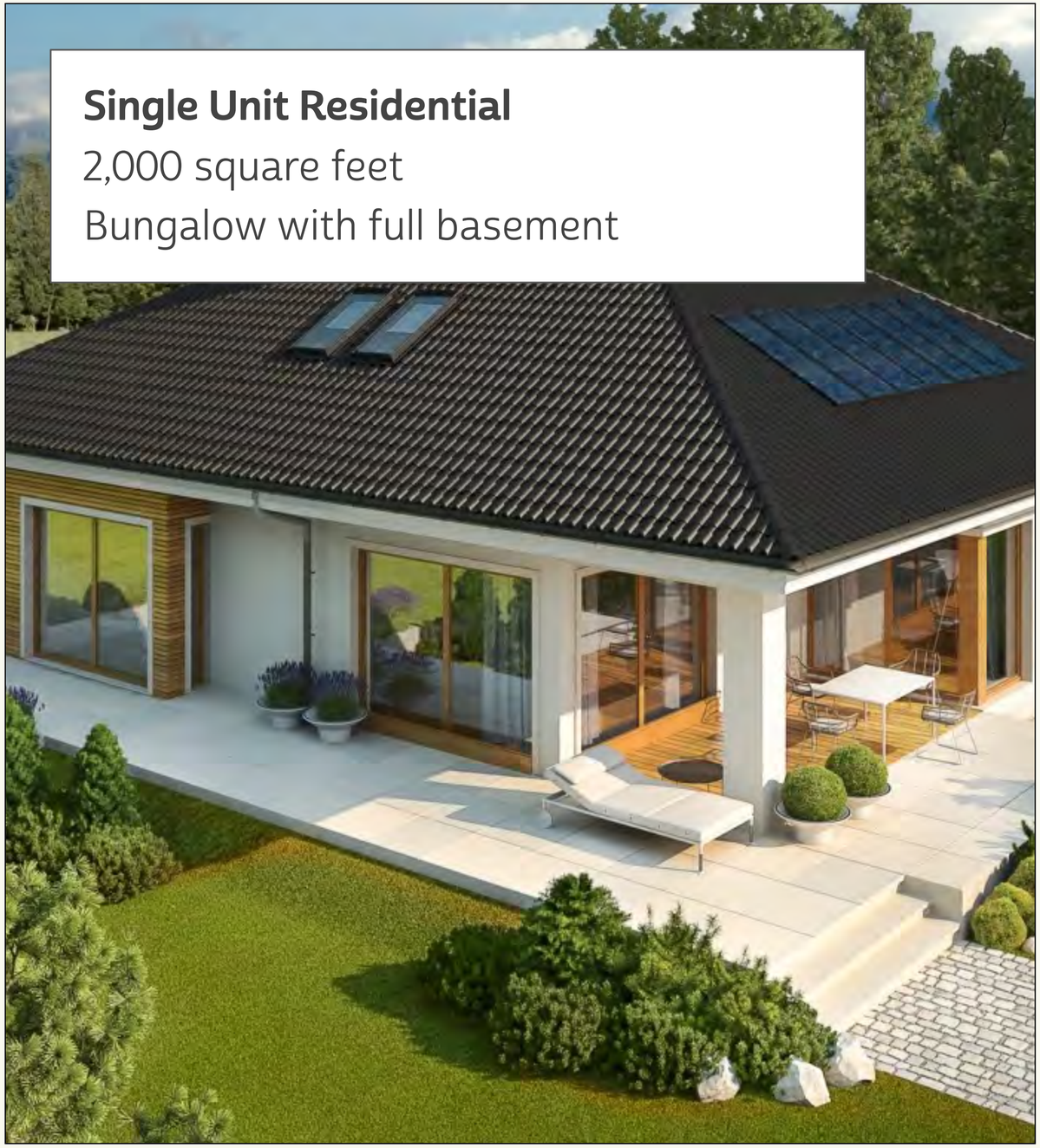


and no red list chemicals!

...some that are **mineral-based**

...and some **interesting hybrids.**

Greenhouse Gas (GHG) Evaluation Study



Single Unit Residential

2,000 square feet

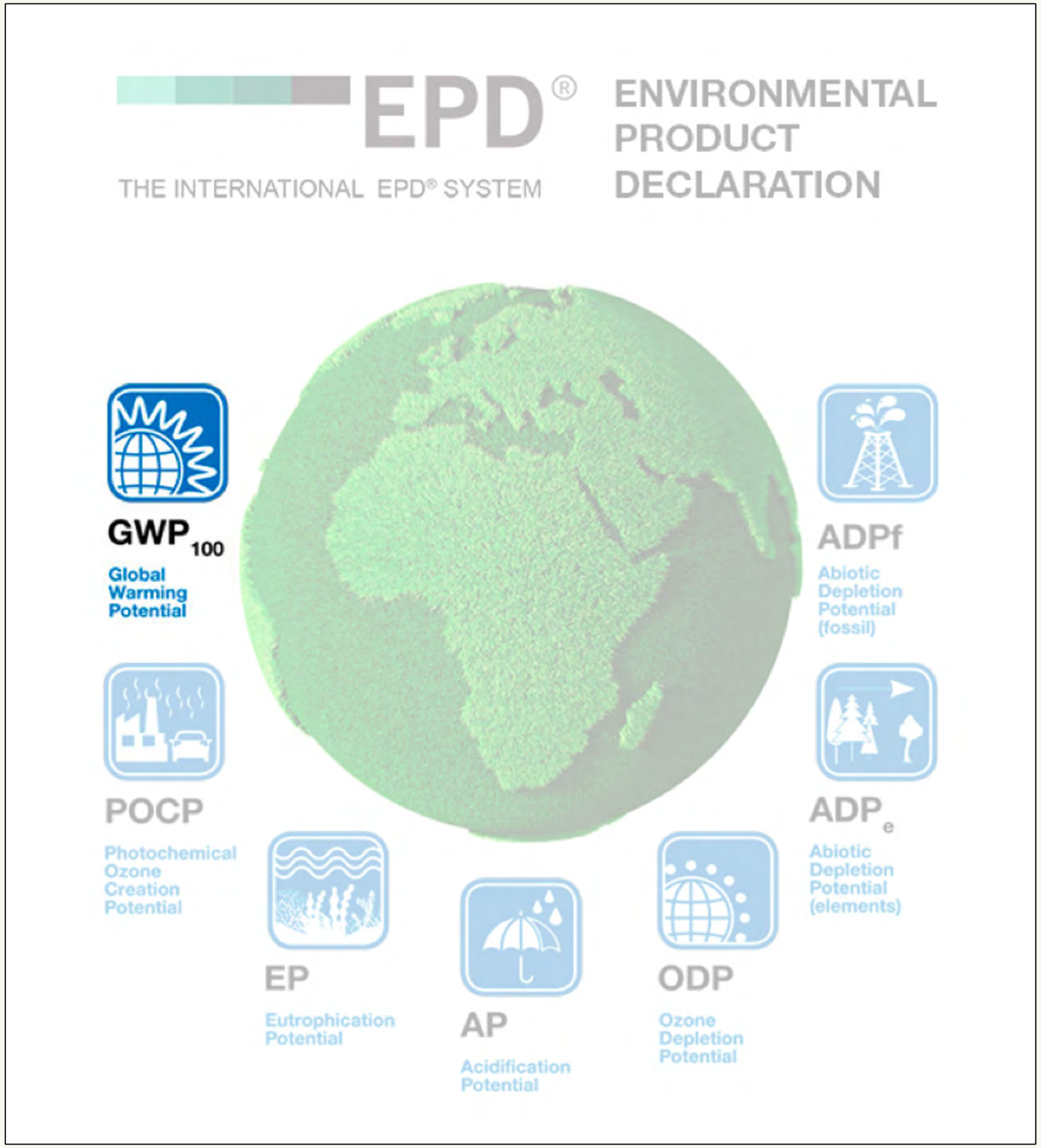
Bungalow with full basement

Eight Unit Residential

10,300 square feet

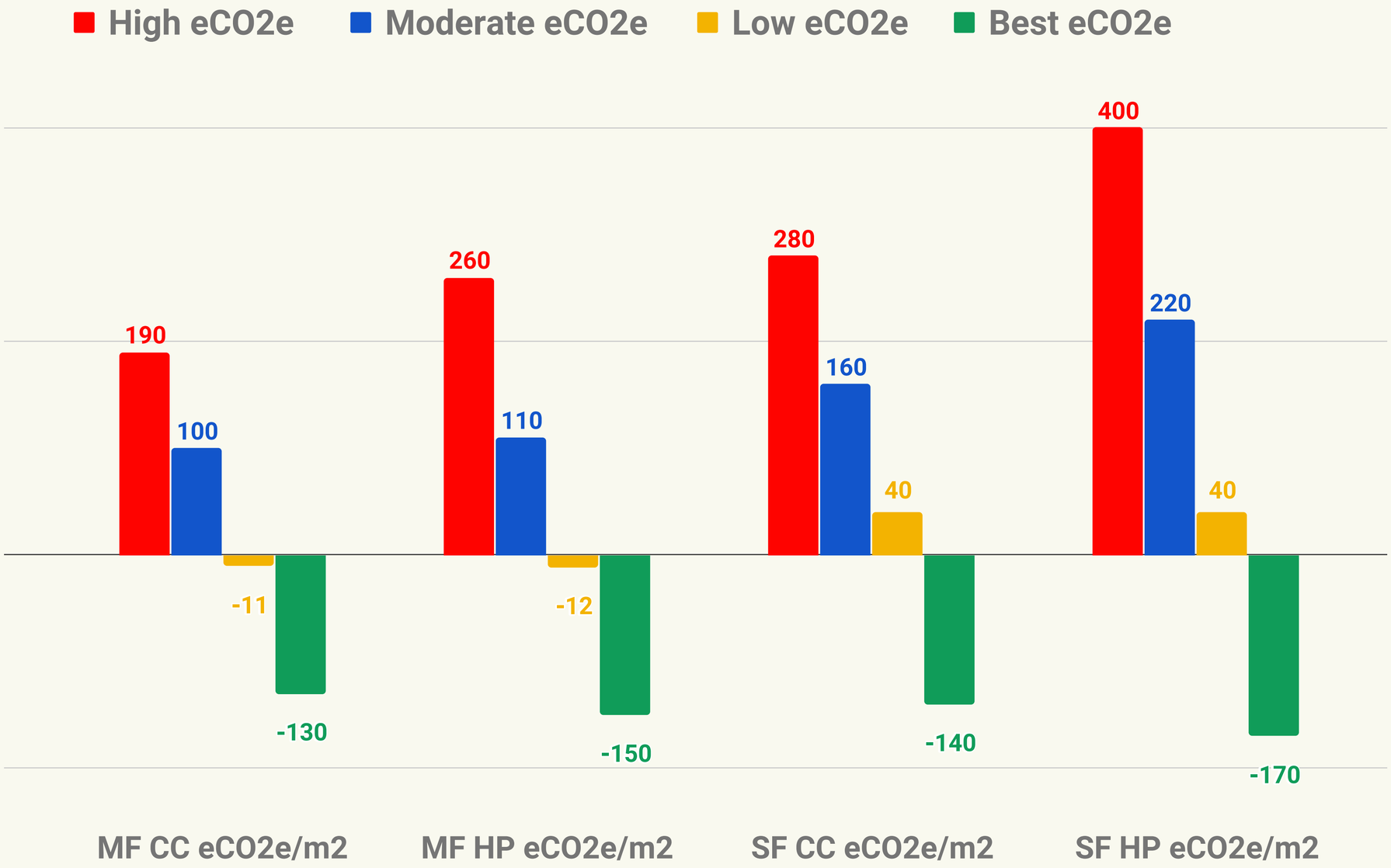
Four story

Embodied GHG Emissions



Our sources of data:

- Industry average EPD for North America
- Product specific EPD for North America
- Industry average EPD for Europe
- Product specific EPD for Europe
- LCA data from peer reviewed sources
- ICE database



Eight Unit Residential	**Single Unit Residential**
Embodied CO_2e emissions, kg per square meter	Embodied CO_2e emissions, kg per square meter

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Worst Case Scenario at +345.9 kg/m^2

= **+83.4 million tonnes** of CO2e

= Adding emissions of **23 coal plants***

Best Case Scenario at -150.7 kg/m^2

= **-36.3 million tonnes** of CO2e

= Removing emissions of **10 coal plants***

*500 MW Plant with 3.5 million tons of CO2e Emissions Annually
241.1 million square meters new low-rise residential construction in US, 2017
U.S. Census Bureau/U.S. HUD, CB19-21

2.16 billion tons of grain straw were grown globally in 2016. That's enough carbon storage to **offset all current transportation GHG emissions** and more than **replace all current insulation materials**.

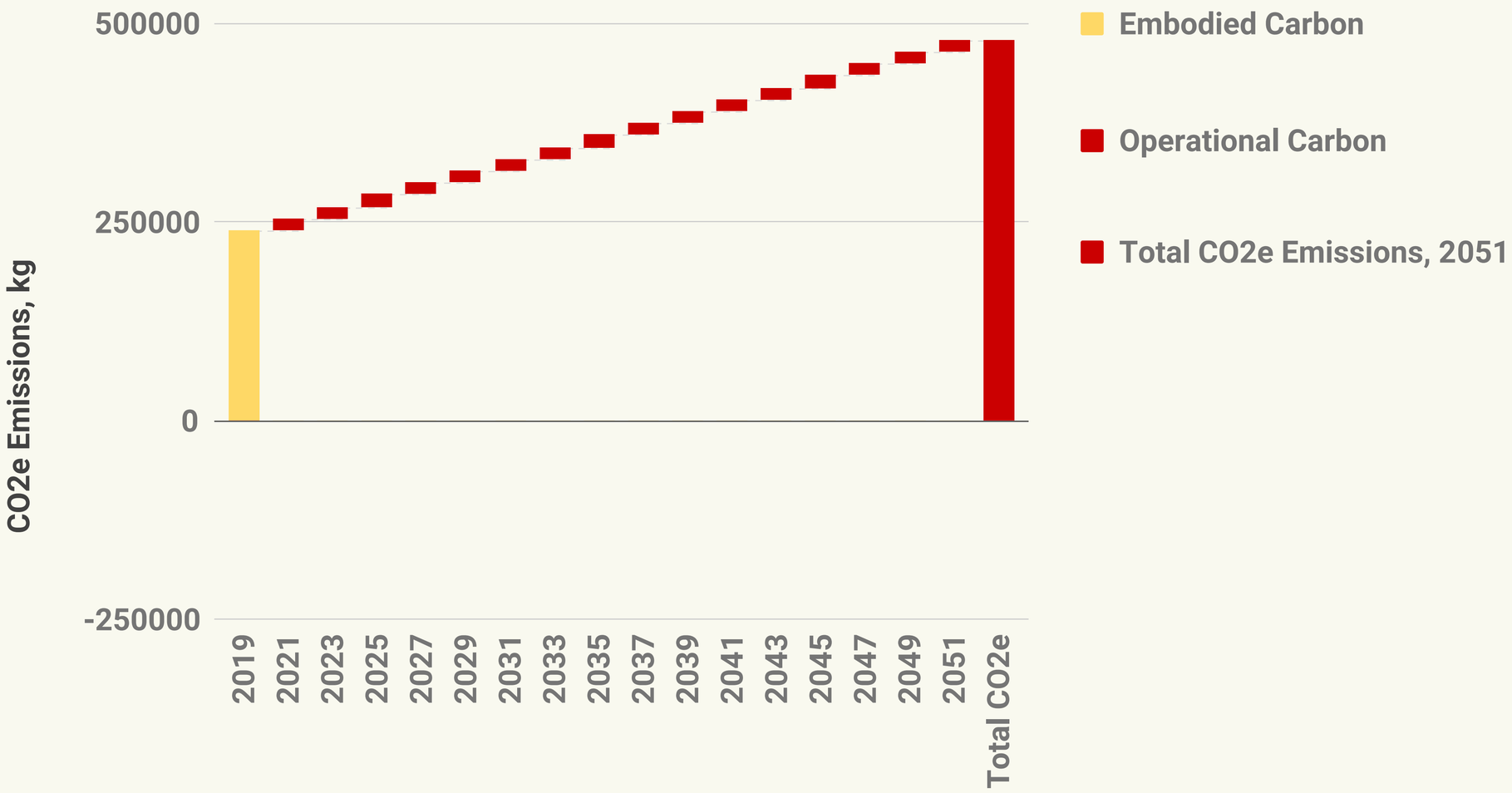
Operational GHG Emissions

Okay, but embodied emissions are only part of the story.
What happens when we add operational emissions?

Embodied Emissions + Operational Emissions

= **Overall Climate Impact**

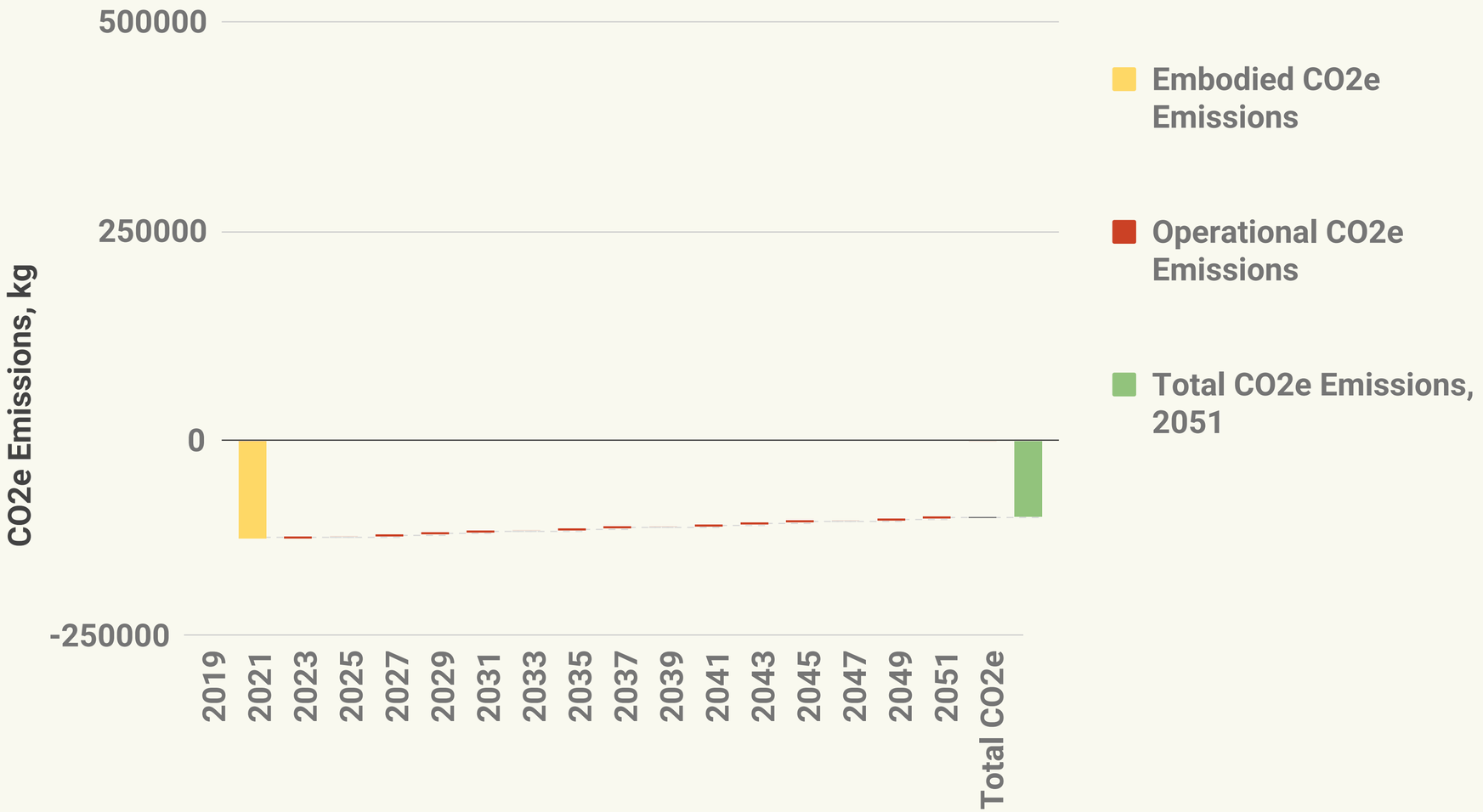
There is bad news...



Eight Unit Residential

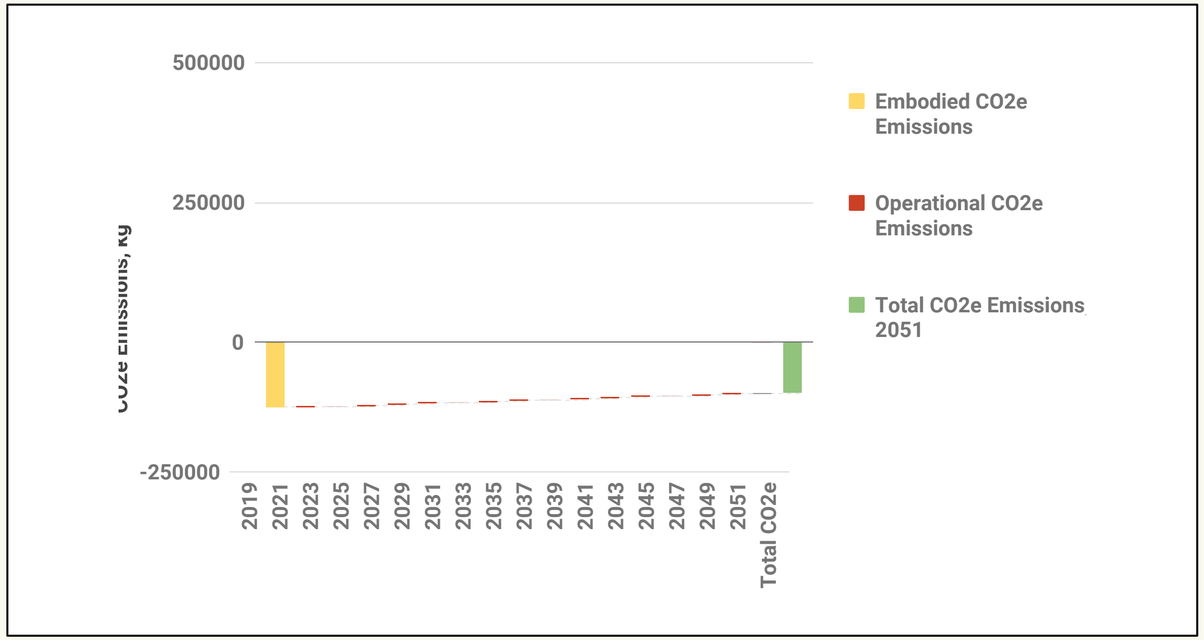
High eCO2e Building, Code Compliant, NG + ISO-NE Grid

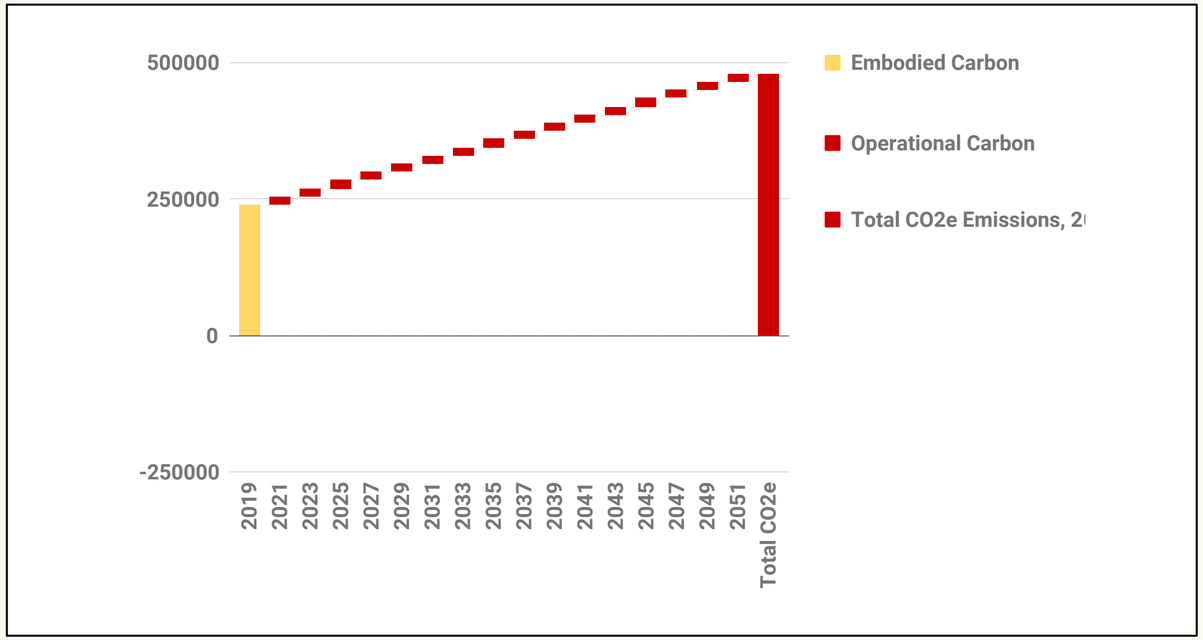
and there is good news.



Eight Unit Residential

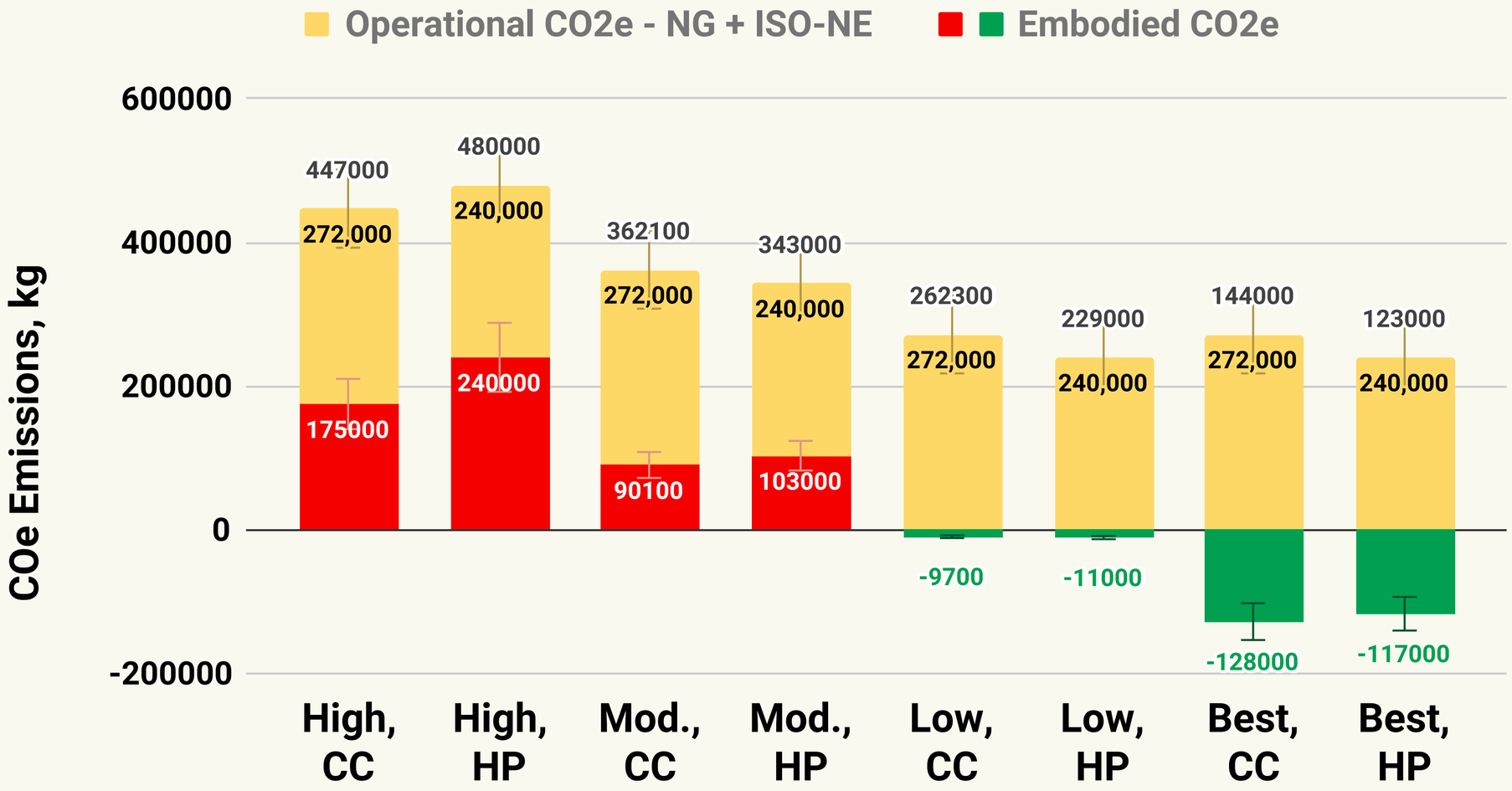
Lowest eCO2e Building, High Performance, Ontario Grid





This building can be a drawdown building!

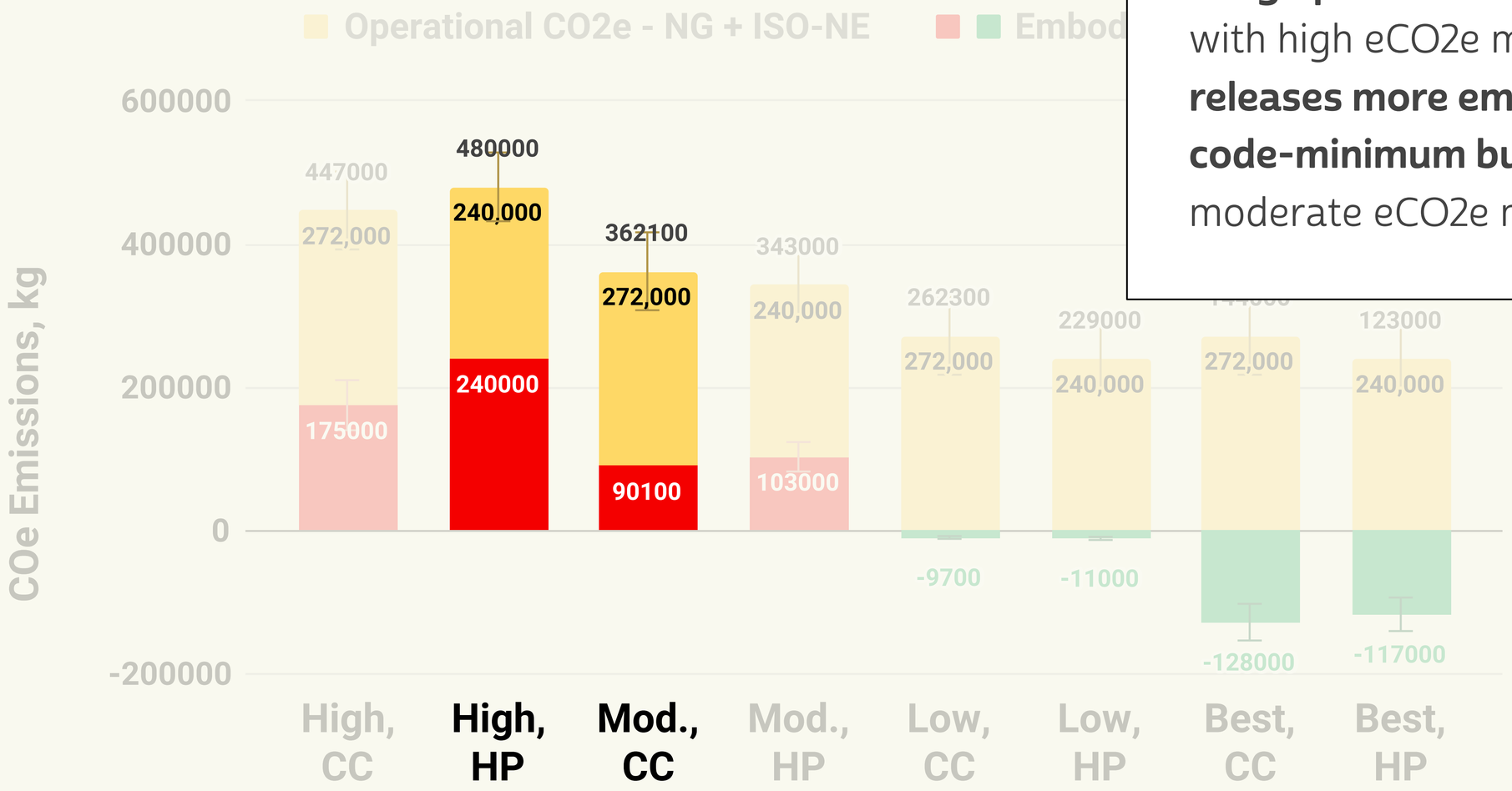
Combined GHG Emissions

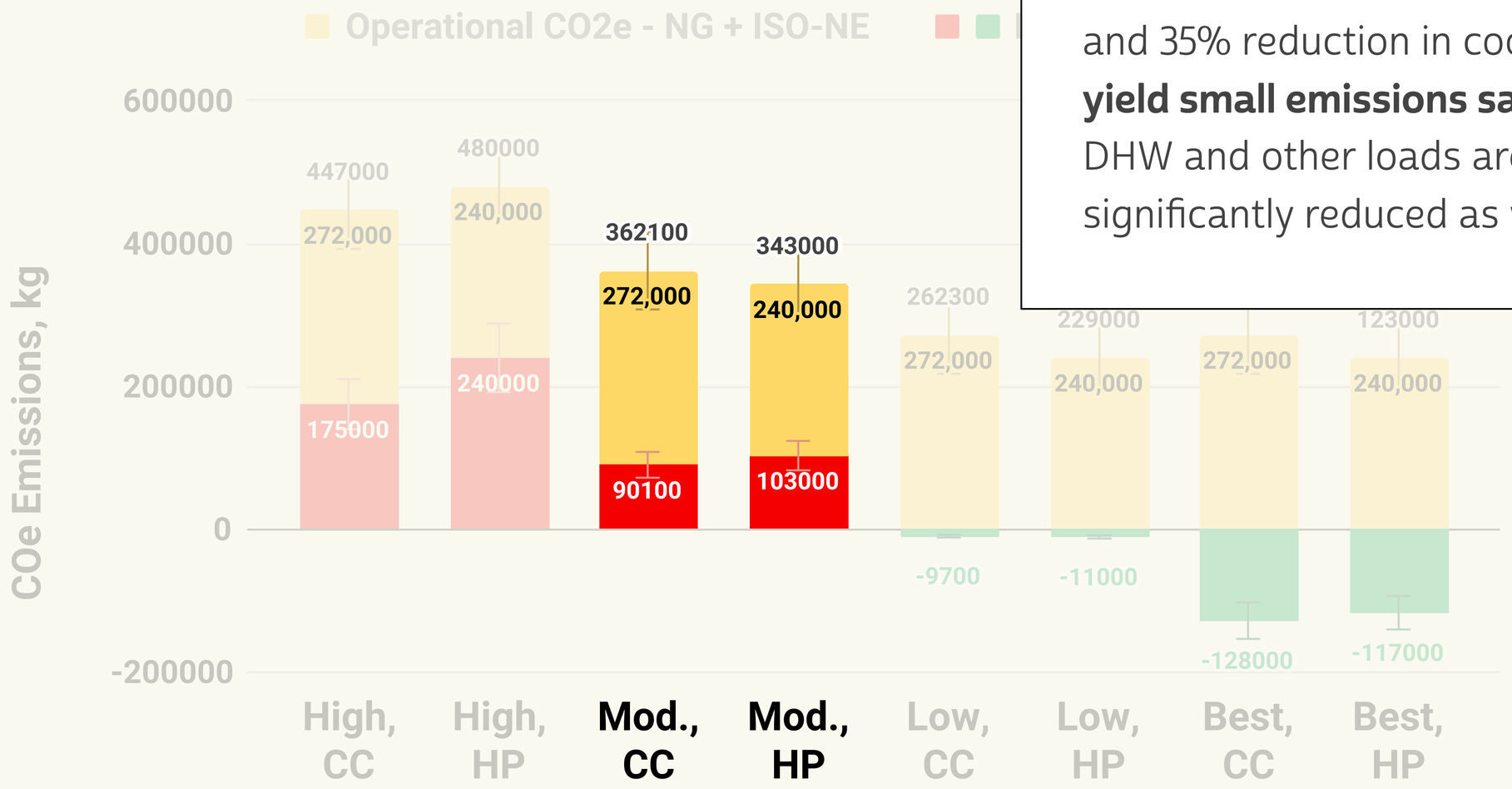


Eight Unit Residential

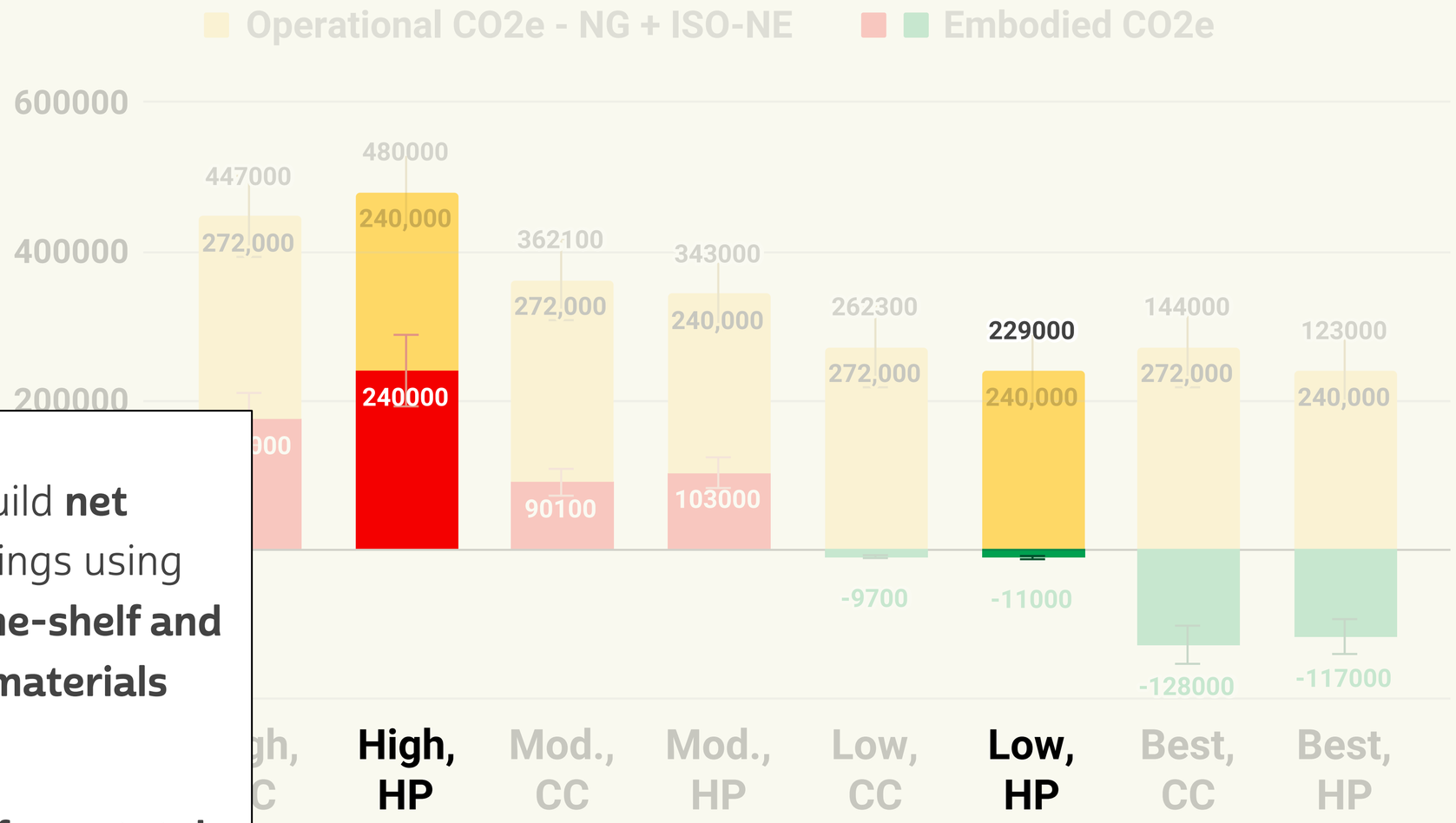
Natural Gas + ISO-NE Grid, 2019–2051

A high performance building with high eCO2e materials **releases more emissions than a code-minimum building** with moderate eCO2e materials.



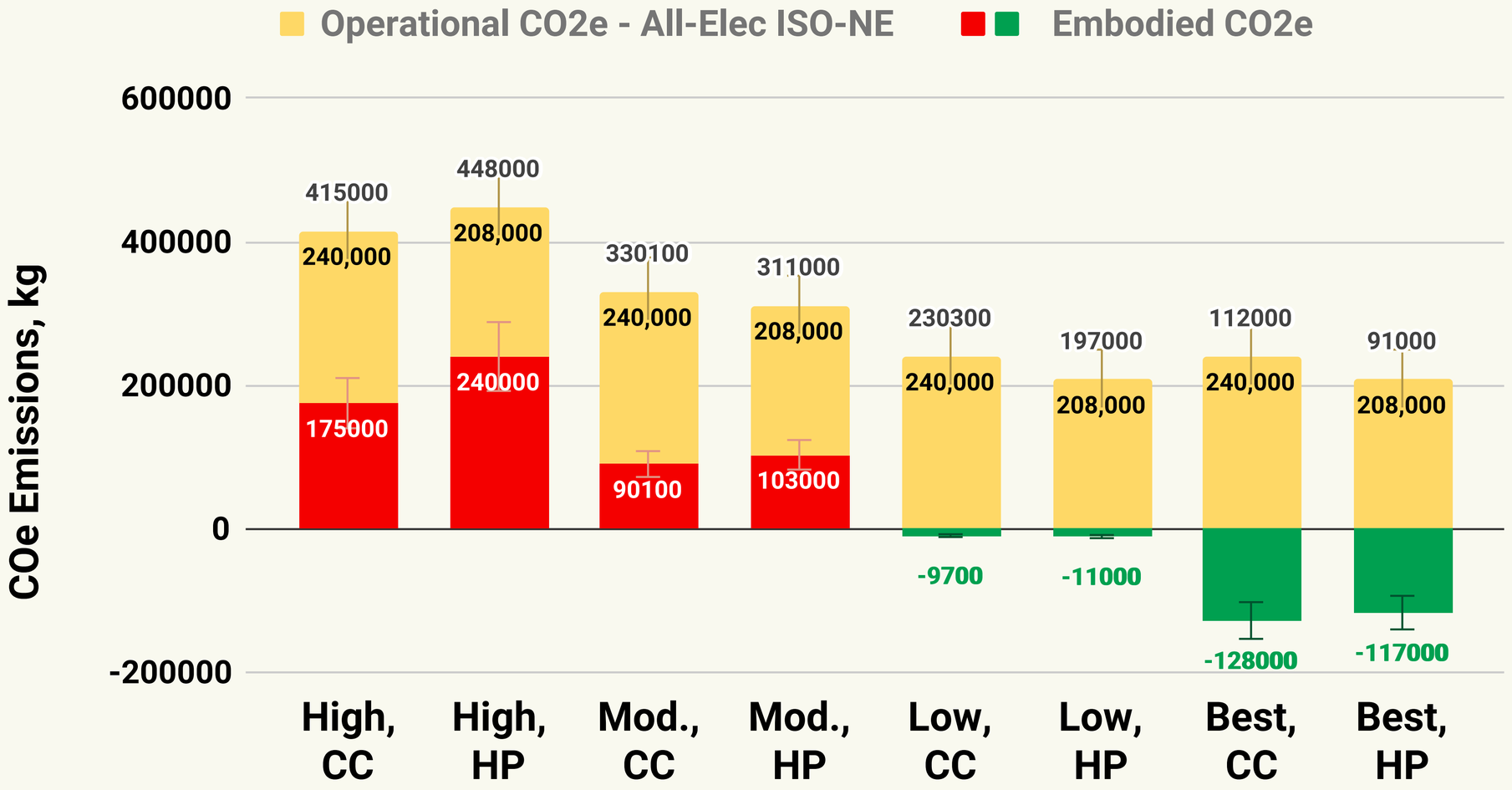


A 65% reduction in heating load and 35% reduction in cooling load, **yield small emissions savings** when DHW and other loads aren't significantly reduced as well.



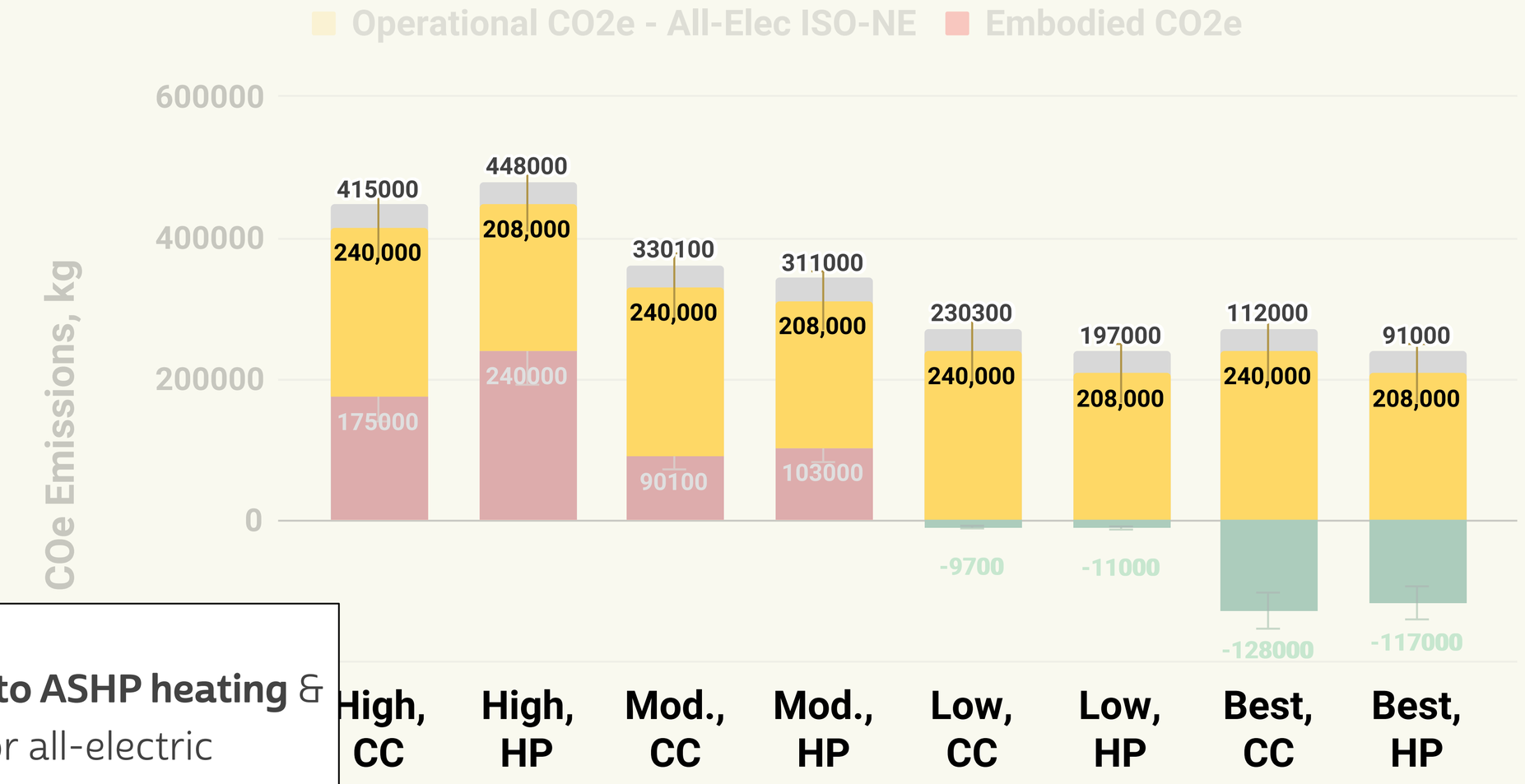
It is possible to build **net zero eCO2e** buildings using **affordable, off-the-shelf and code-compliant materials** (Low HP).

They will **release fewer total emissions** than just the eCO2e of the High HP building.



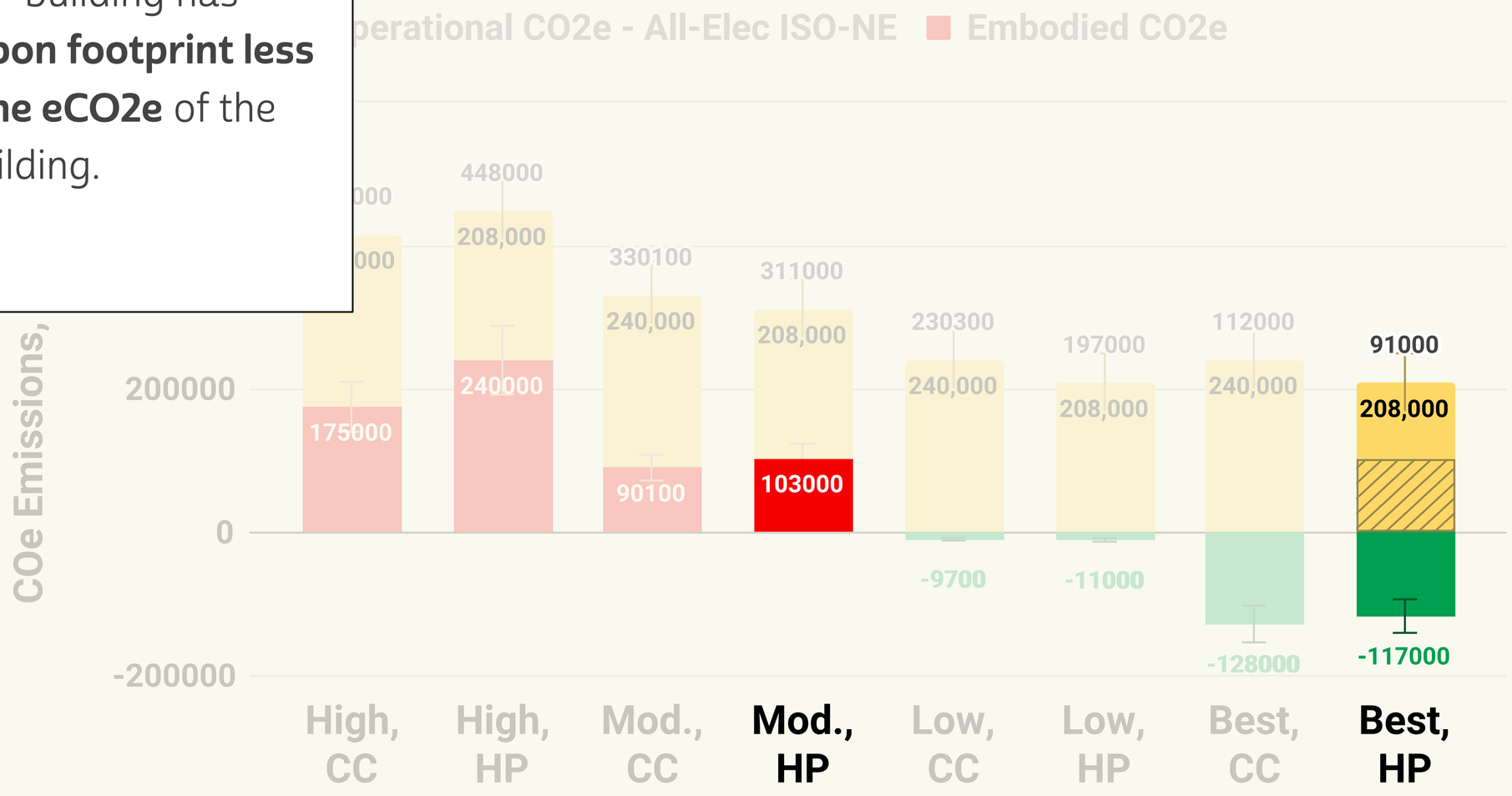
Eight Unit Residential

All Electric, ISO-NE Grid, 2019–2051

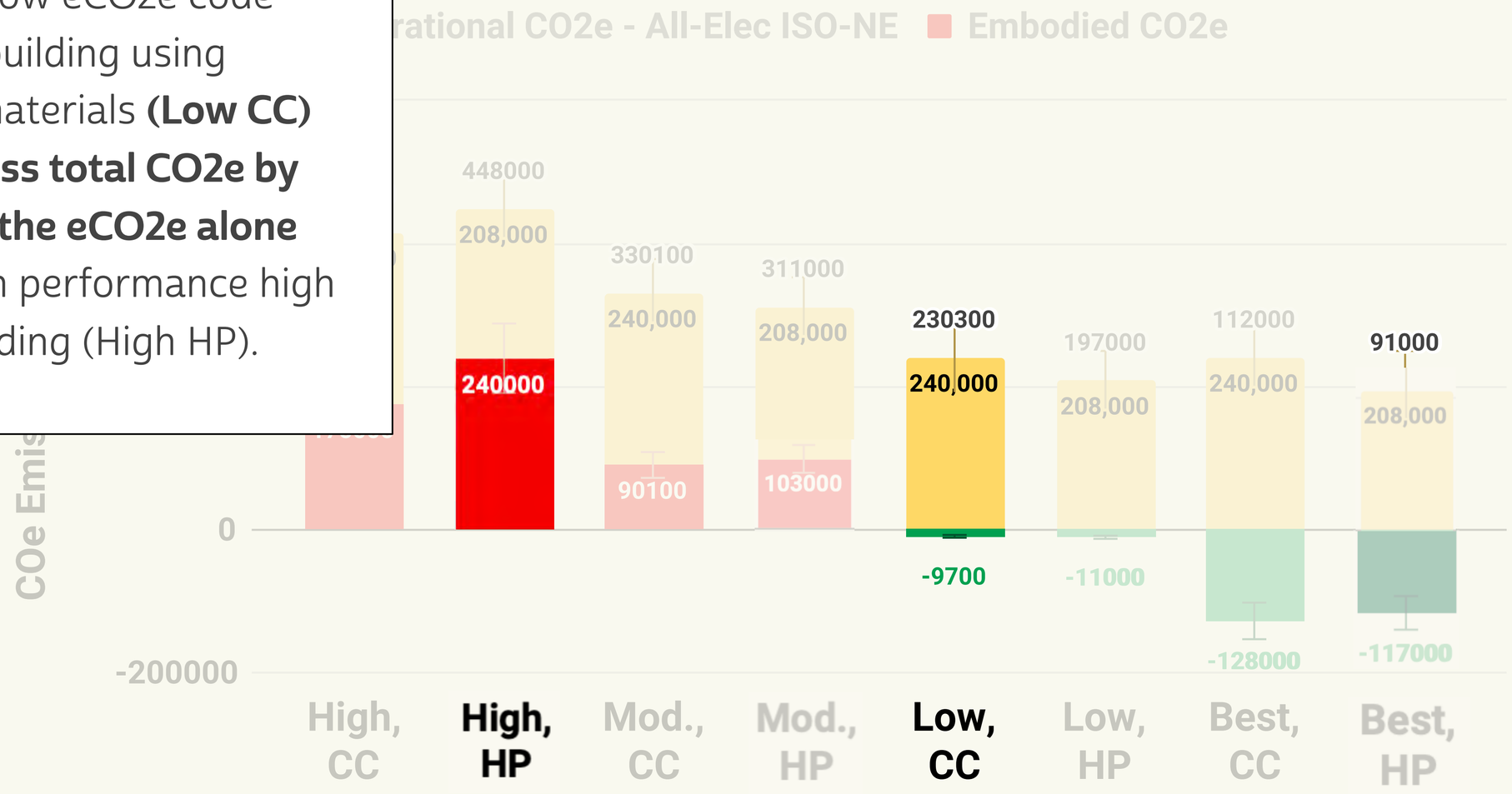


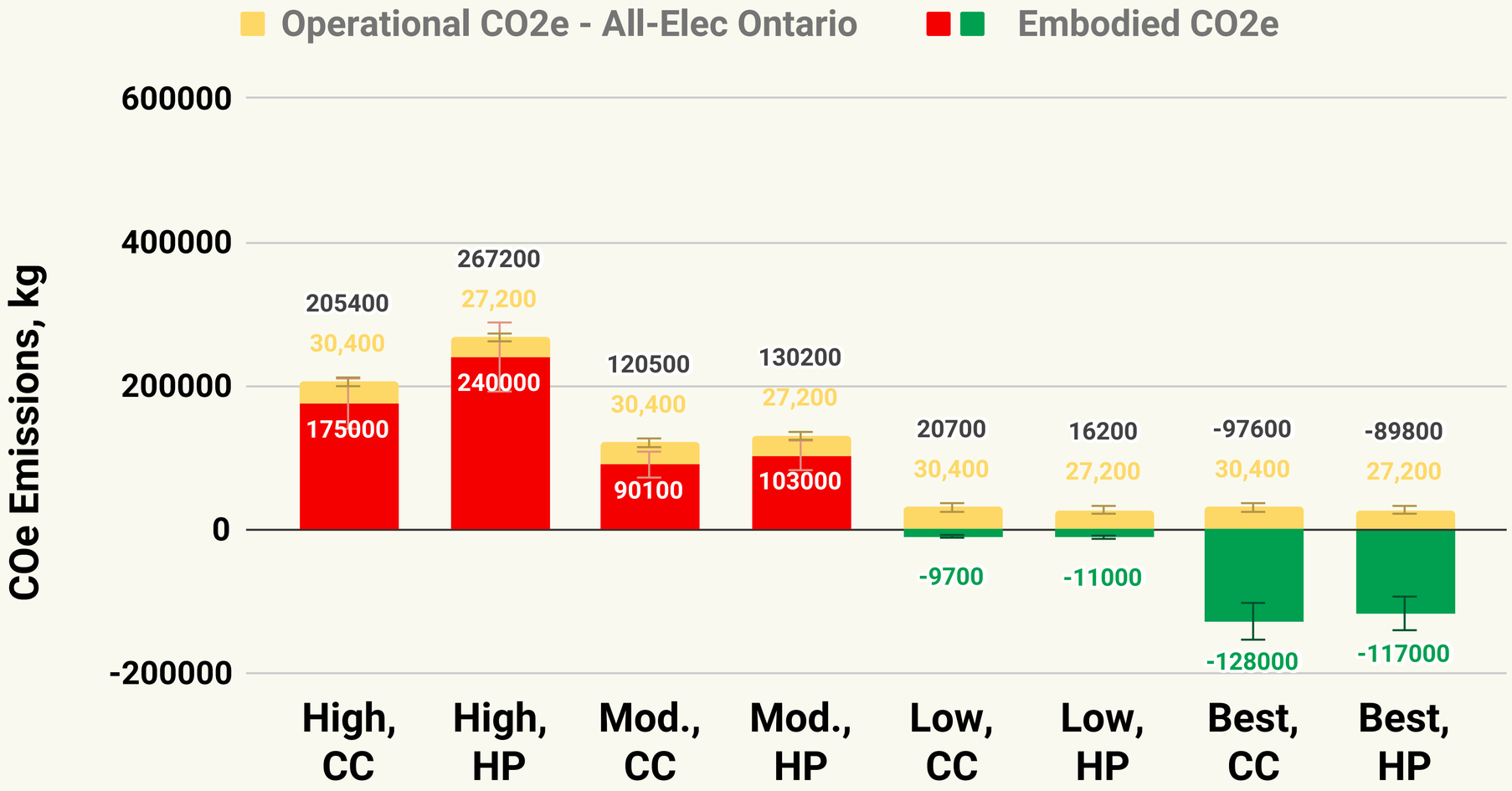
A **switch to ASHP heating** & cooling for all-electric building is **only a 13% oCO2e emissions savings** on the ISO-NE grid.

The Best HP building has a **total carbon footprint less than just the eCO2e** of the Mod HP building.



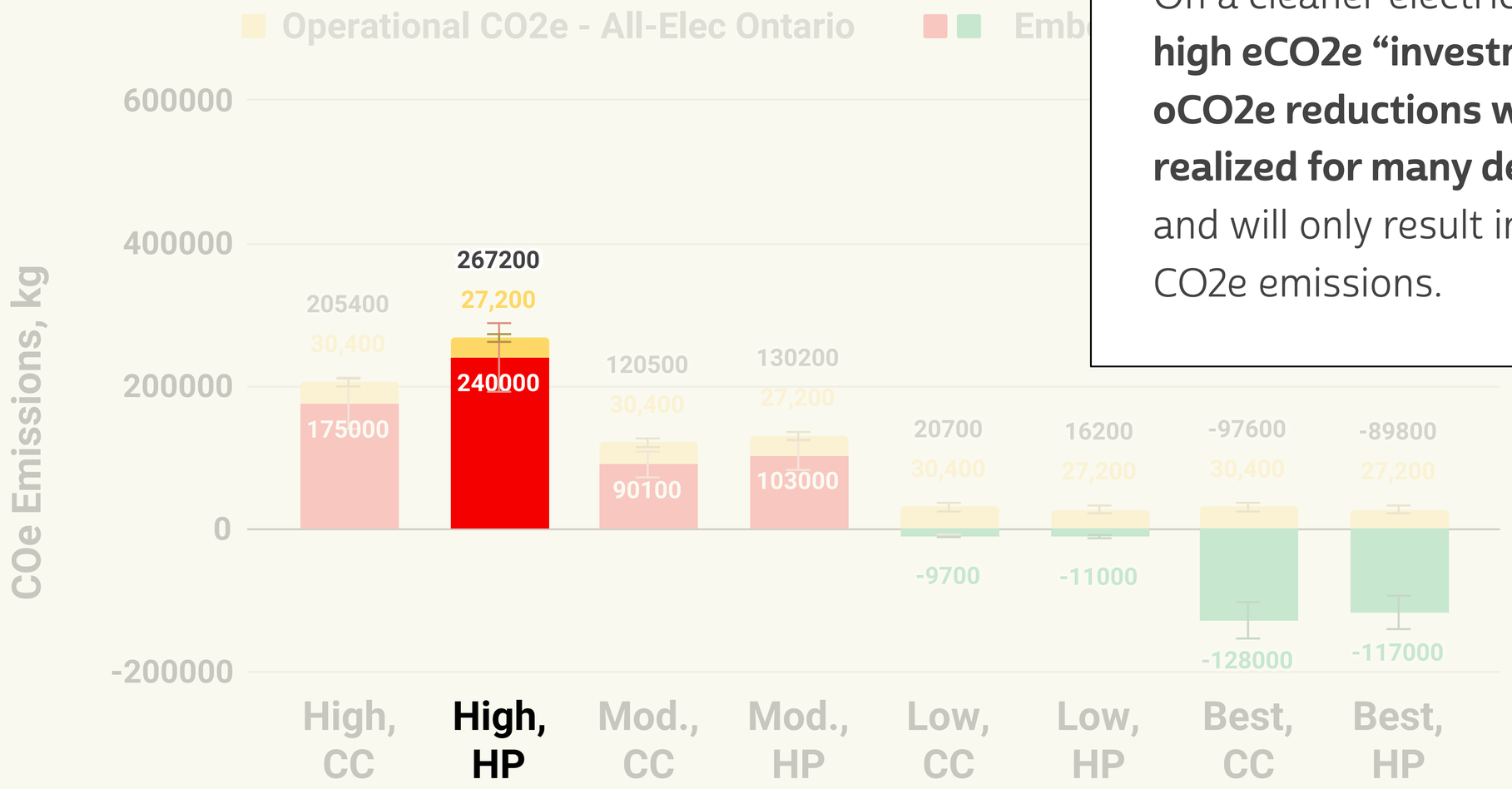
Building a low eCO2e code minimum building using common materials **(Low CC) will emit less total CO2e by 2050 than the eCO2e alone** from a high performance high eCO2e building (High HP).



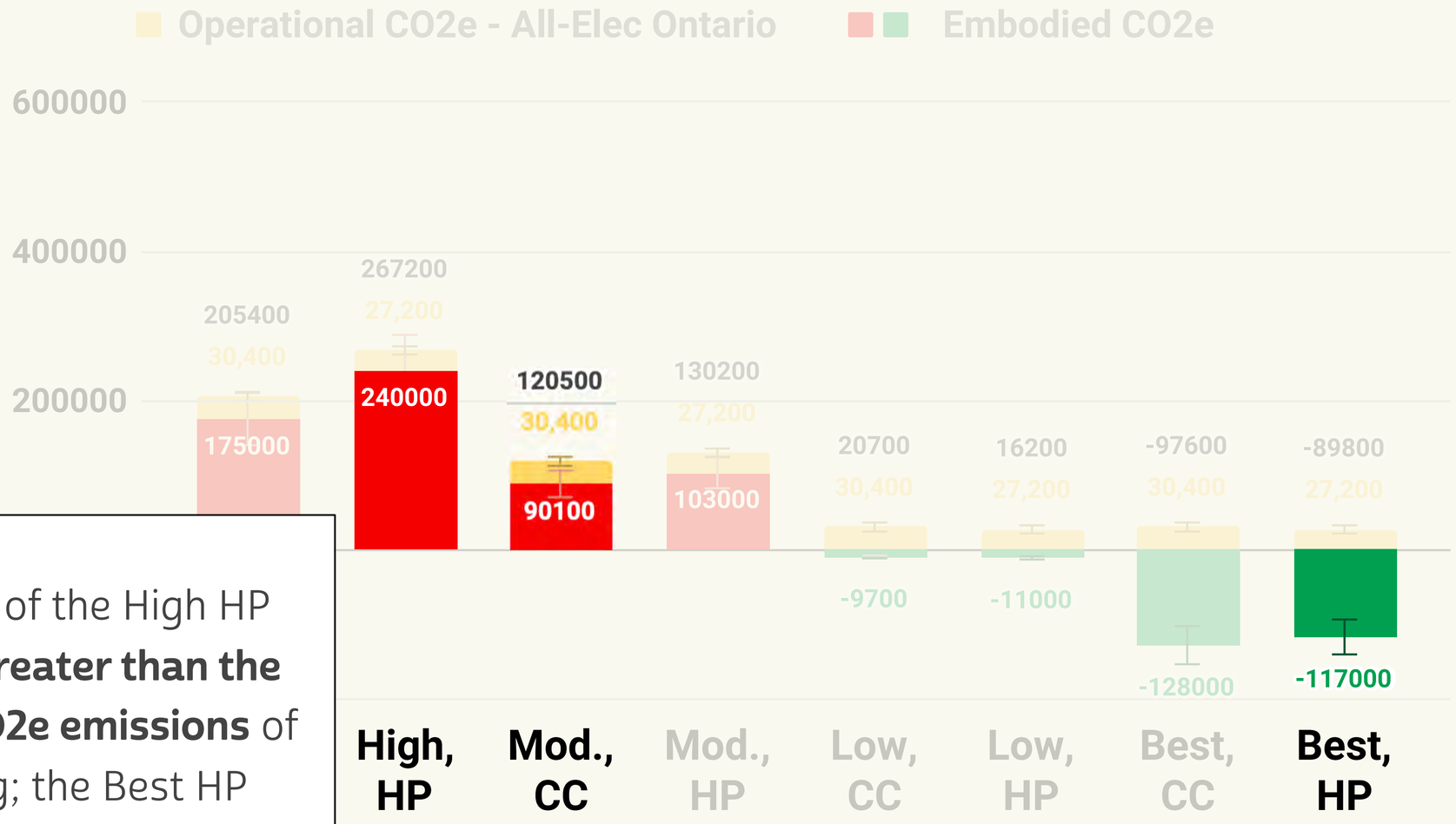


Eight Unit Residential

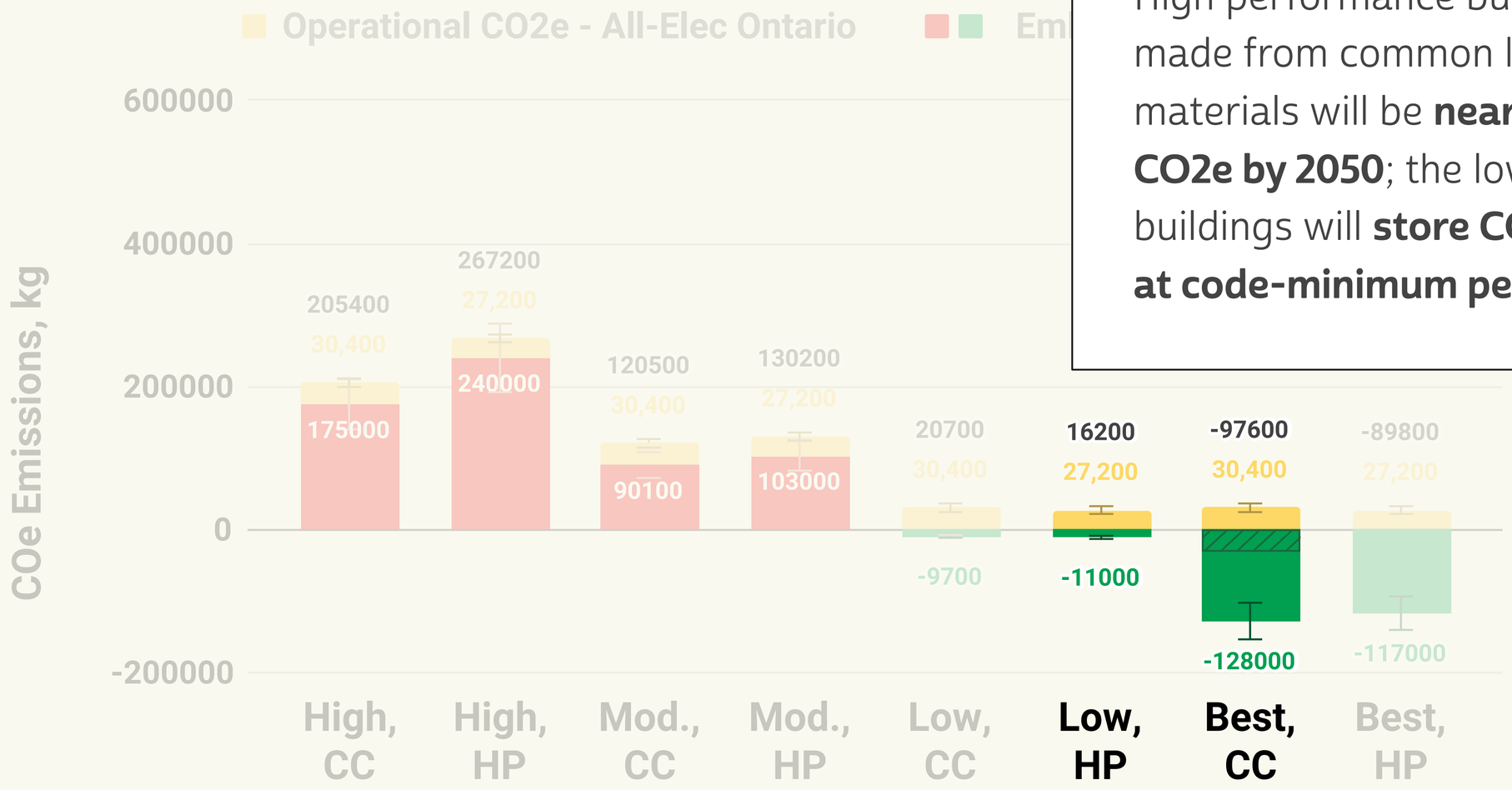
All Electric, Ontario Grid, 2019–2051



On a cleaner electric grid, **high eCO2e "investments" in oCO2e reductions will not be realized for many decades**, and will only result in increased CO2e emissions.



The **eCO2e alone** of the High HP building is **50% greater than the entire 30 year CO2e emissions** of a Mod CC building; the Best HP building **stores 75% of those emissions.**



High performance buildings made from common low eCO2e materials will be **nearly net zero CO2e by 2050**; the lowest eCO2e buildings will **store CO2e, even at code-minimum performance.**