

Real Zero Carbon Buildings by 2050

or

*"Building like
we're listening to Greta..."*

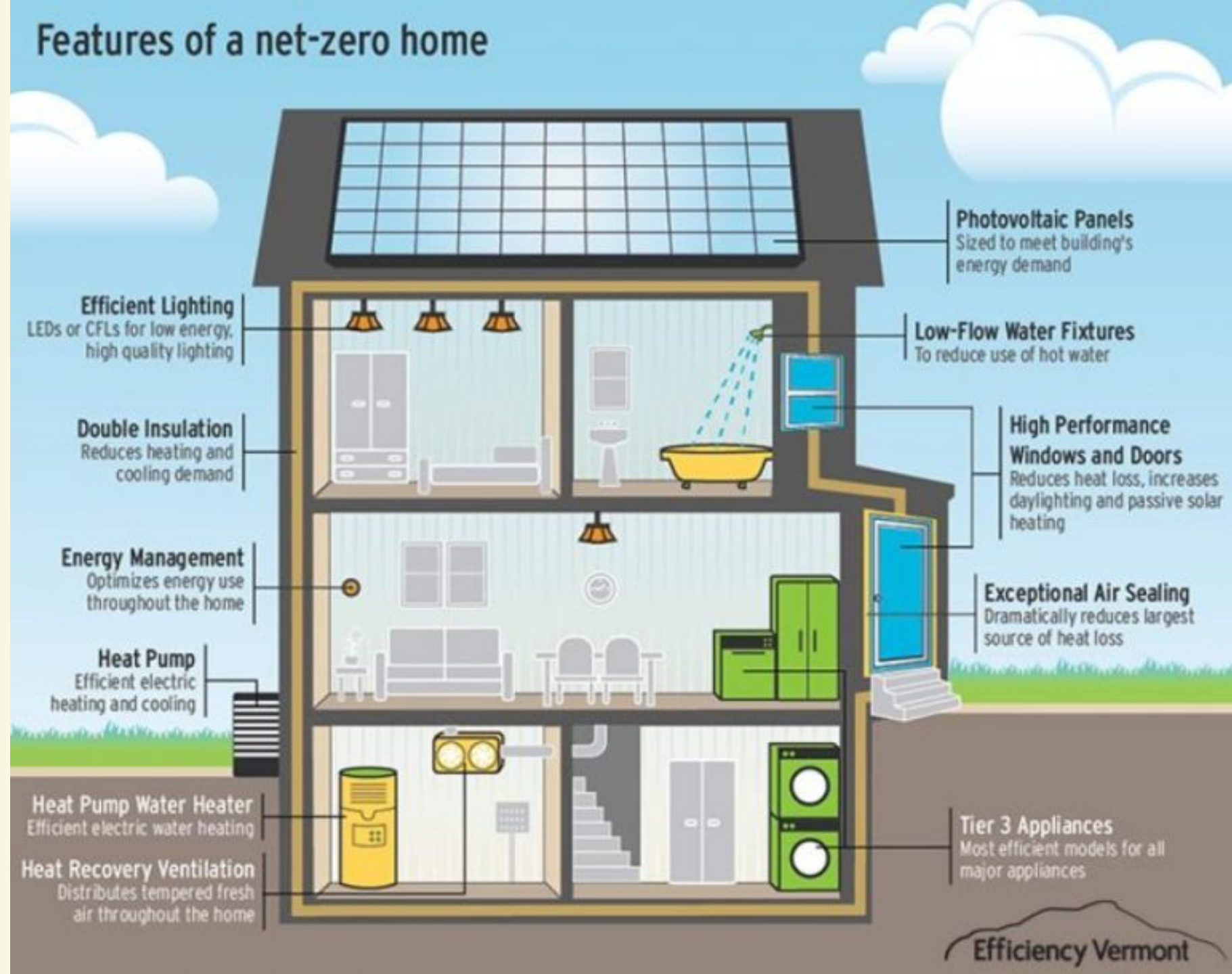


No more numbers games.
We need to make *real zero*
carbon buildings, and we
need to start *now*.



"Net zero building"

Does a net zero energy building help solve climate change?



Study of two
common low-
rise buildings
with different
materials

And different
levels of energy
efficiency



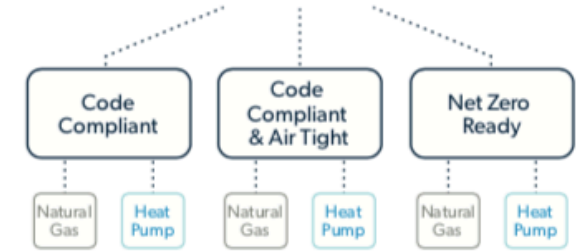
Single Family Home



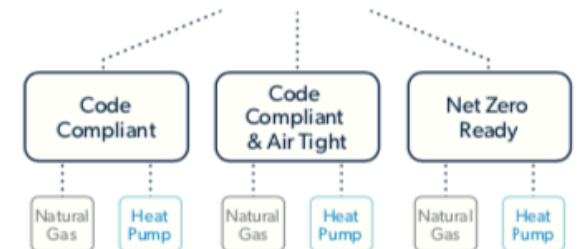
Multi-unit Building



Single Family Home

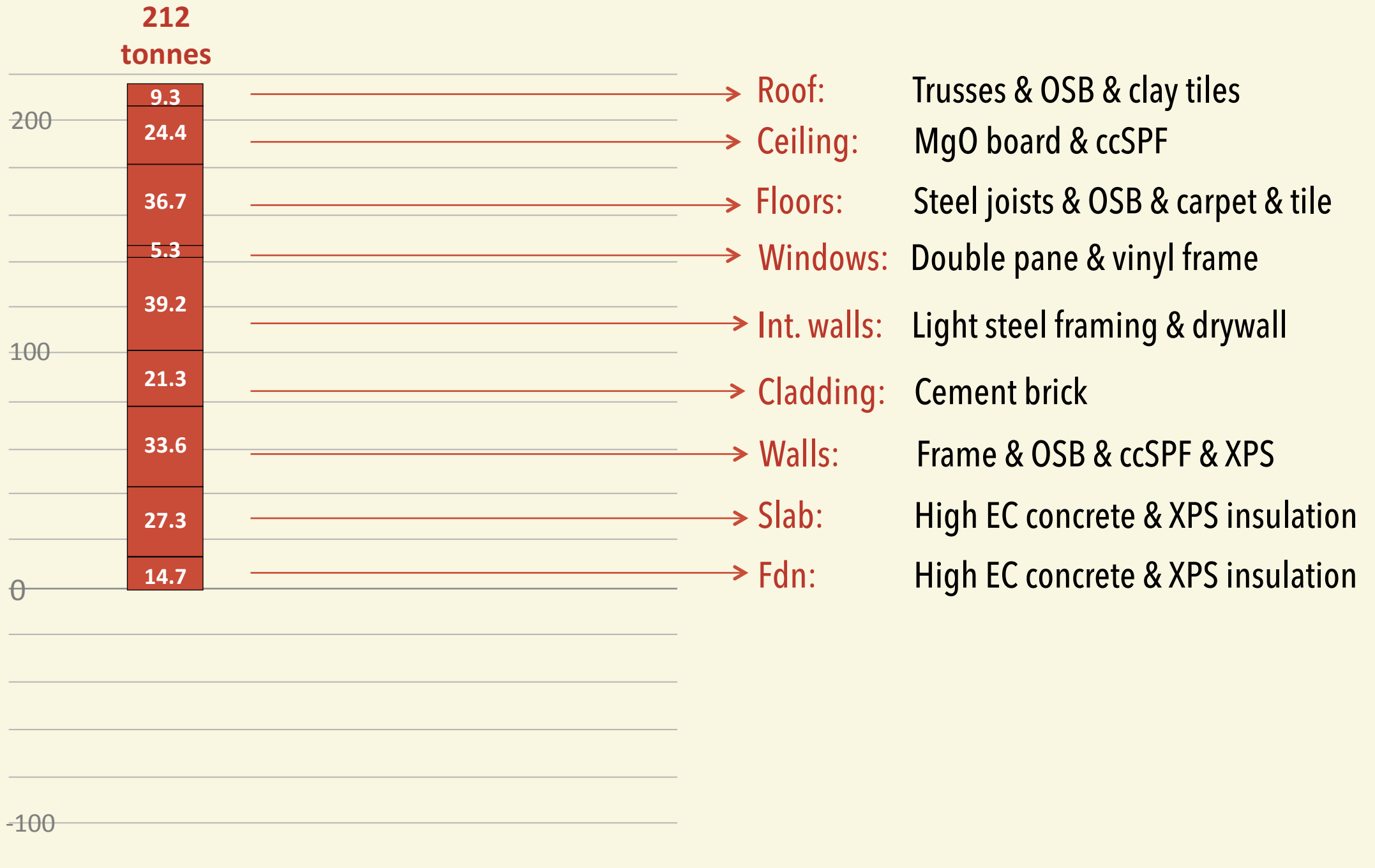


Multi-unit Building

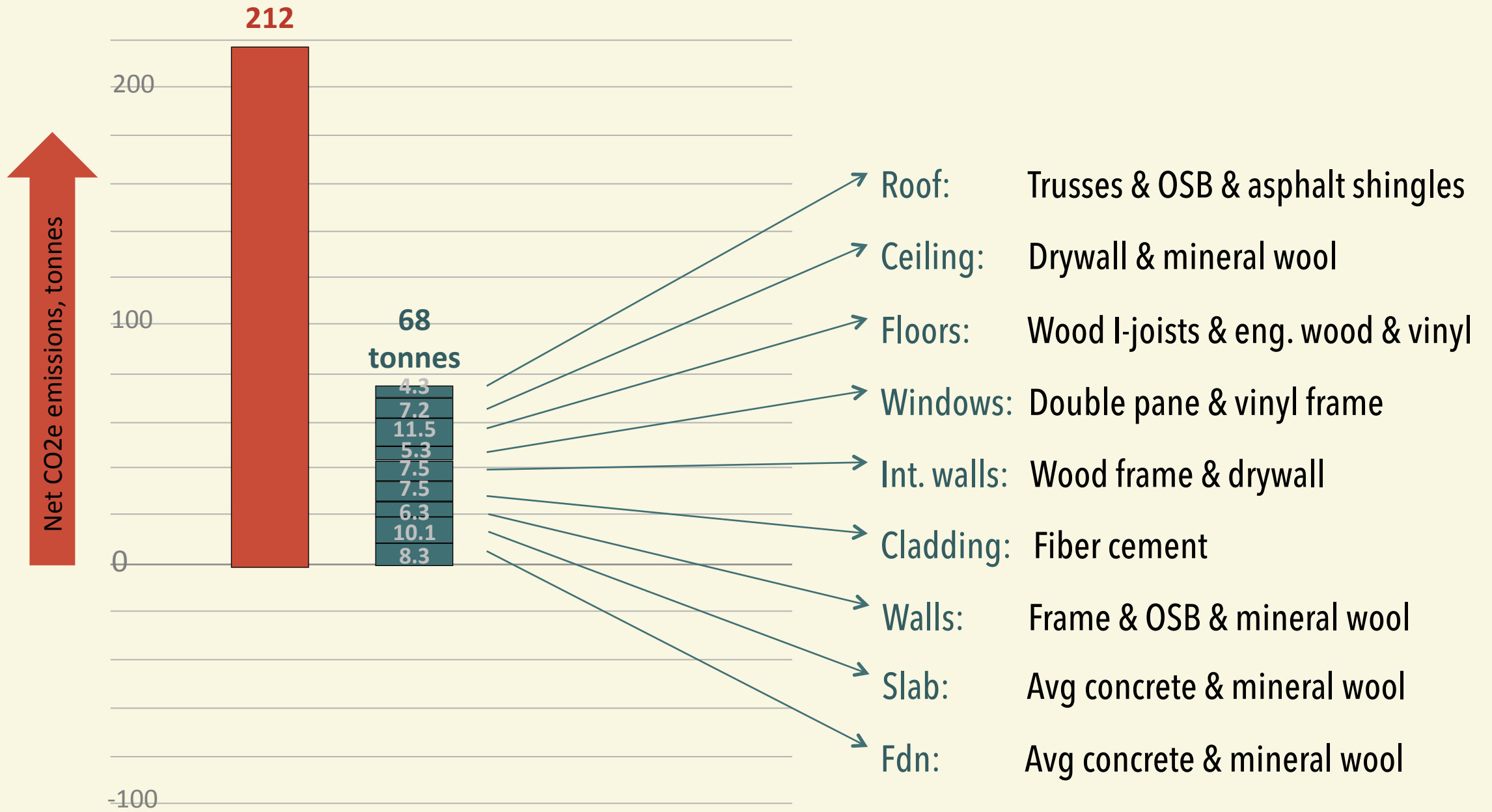


Upfront embodied carbon comparison

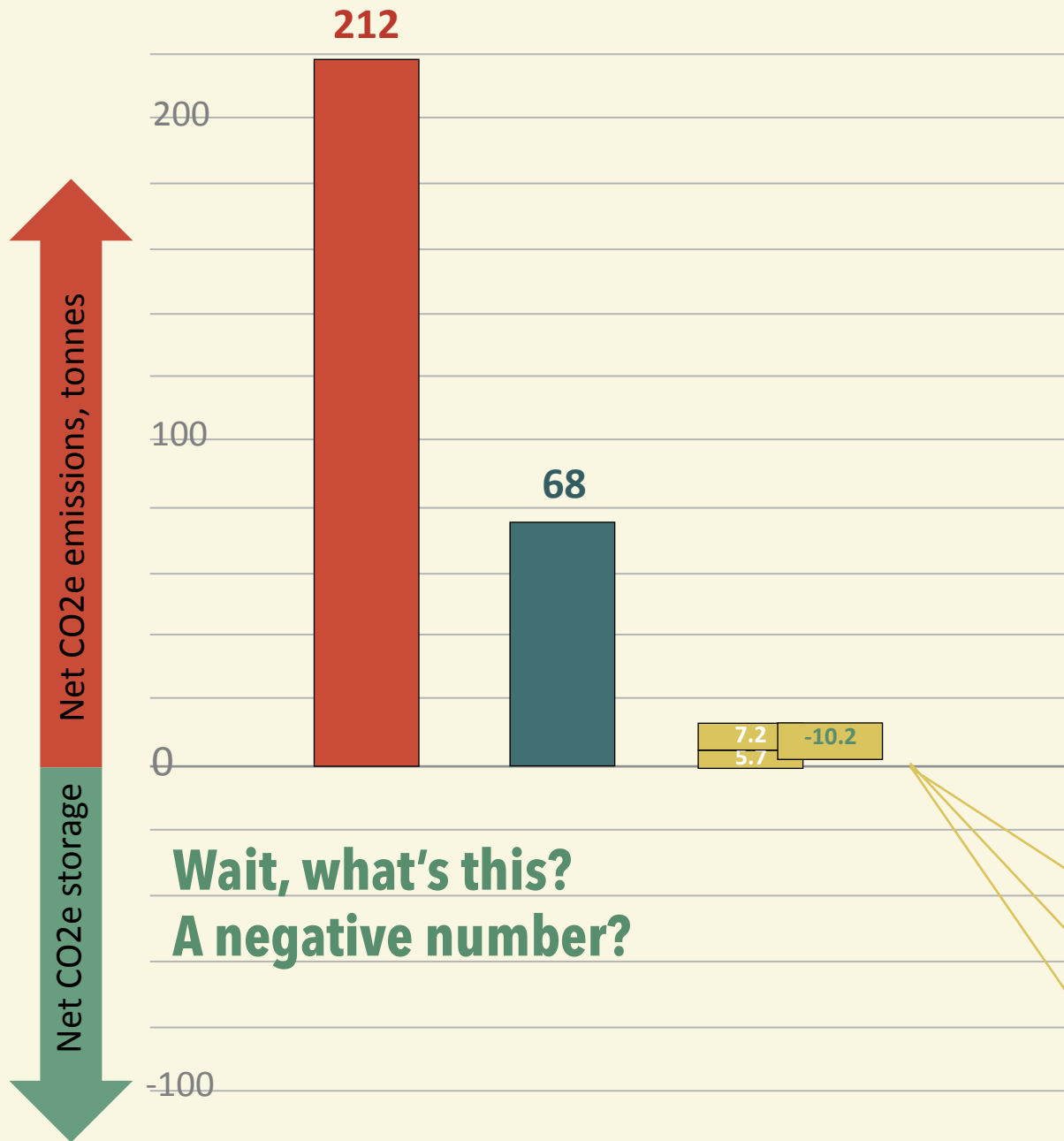
Net CO2e emissions, tonnes



Upfront embodied carbon comparison



Upfront embodied carbon comparison



Walls: Frame + cellulose + wood fiberboard

Slab: High SCM concrete + EPS

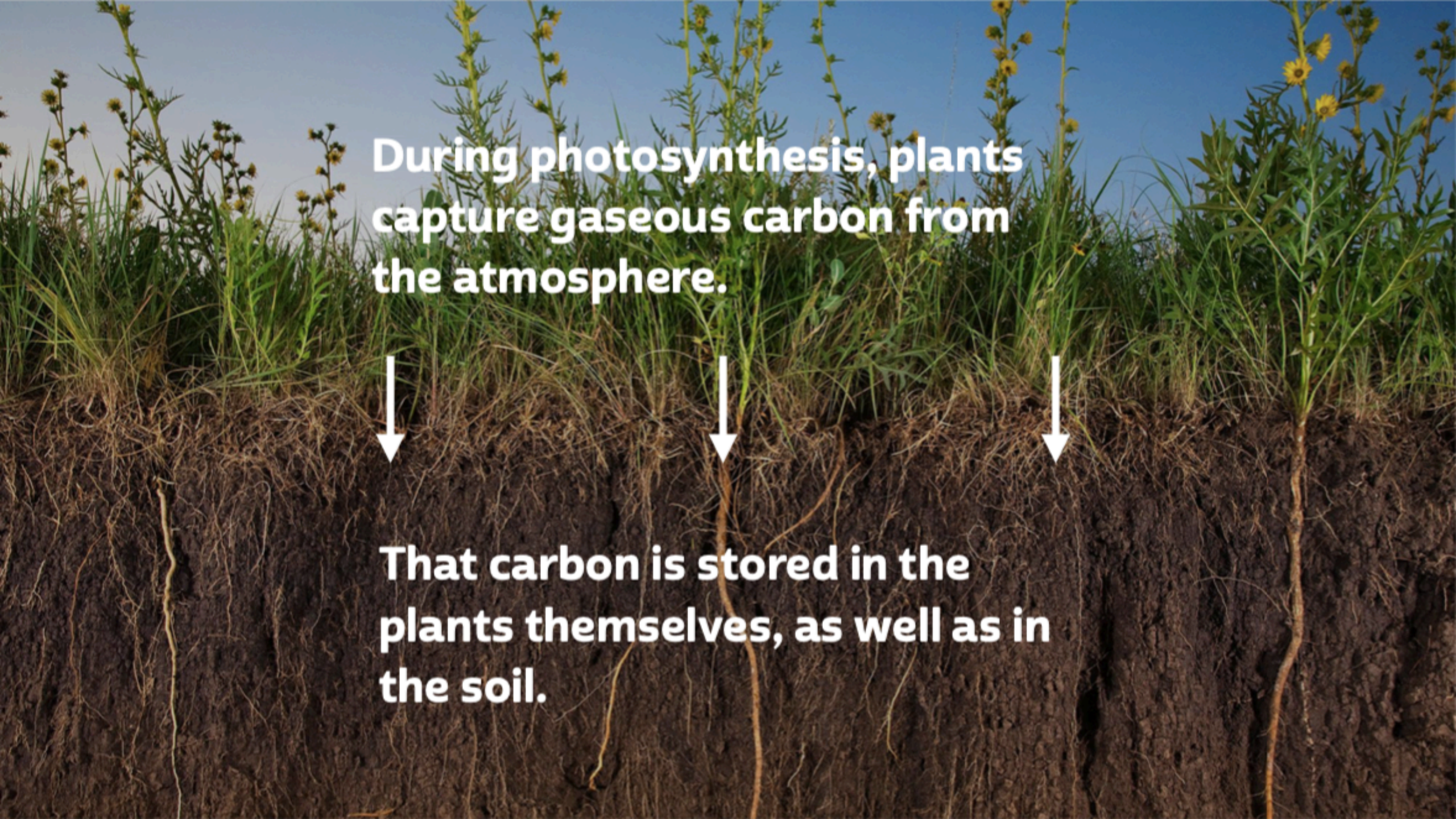
Fdn: High SCM concrete + EPS

Wait! What's this?

A negative number?



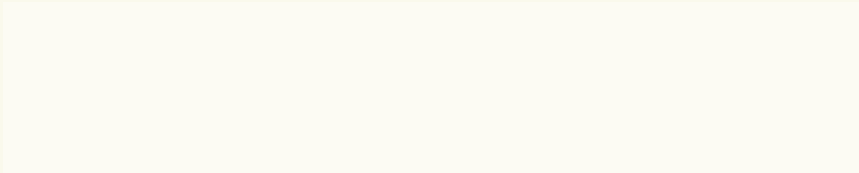
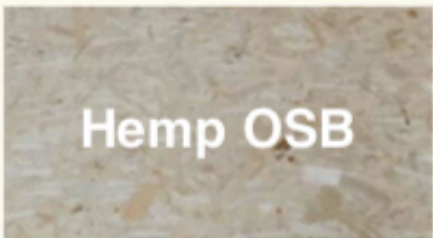
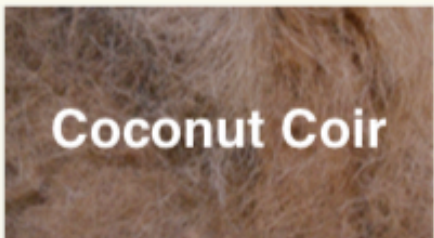
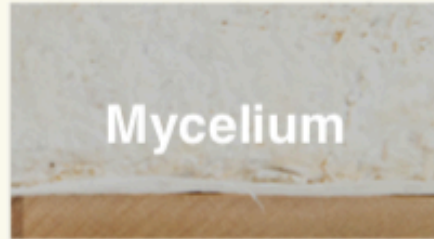
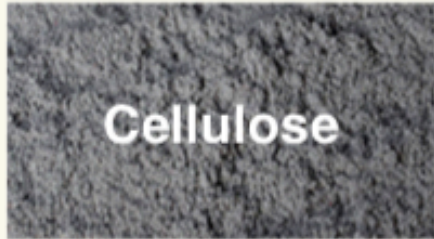
Yes, a material that stores more atmospheric carbon than was emitted in harvesting & manufacturing! This opens up a whole new paradigm — **materials with carbon capture and storage potential!**



**During photosynthesis, plants
capture gaseous carbon from
the atmosphere.**

**That carbon is stored in the
plants themselves, as well as in
the soil.**

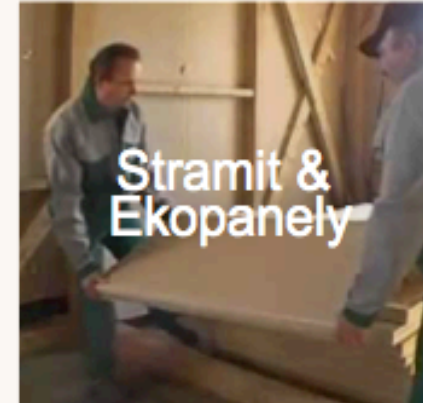
There are lots of plant-based, carbon-storing building materials



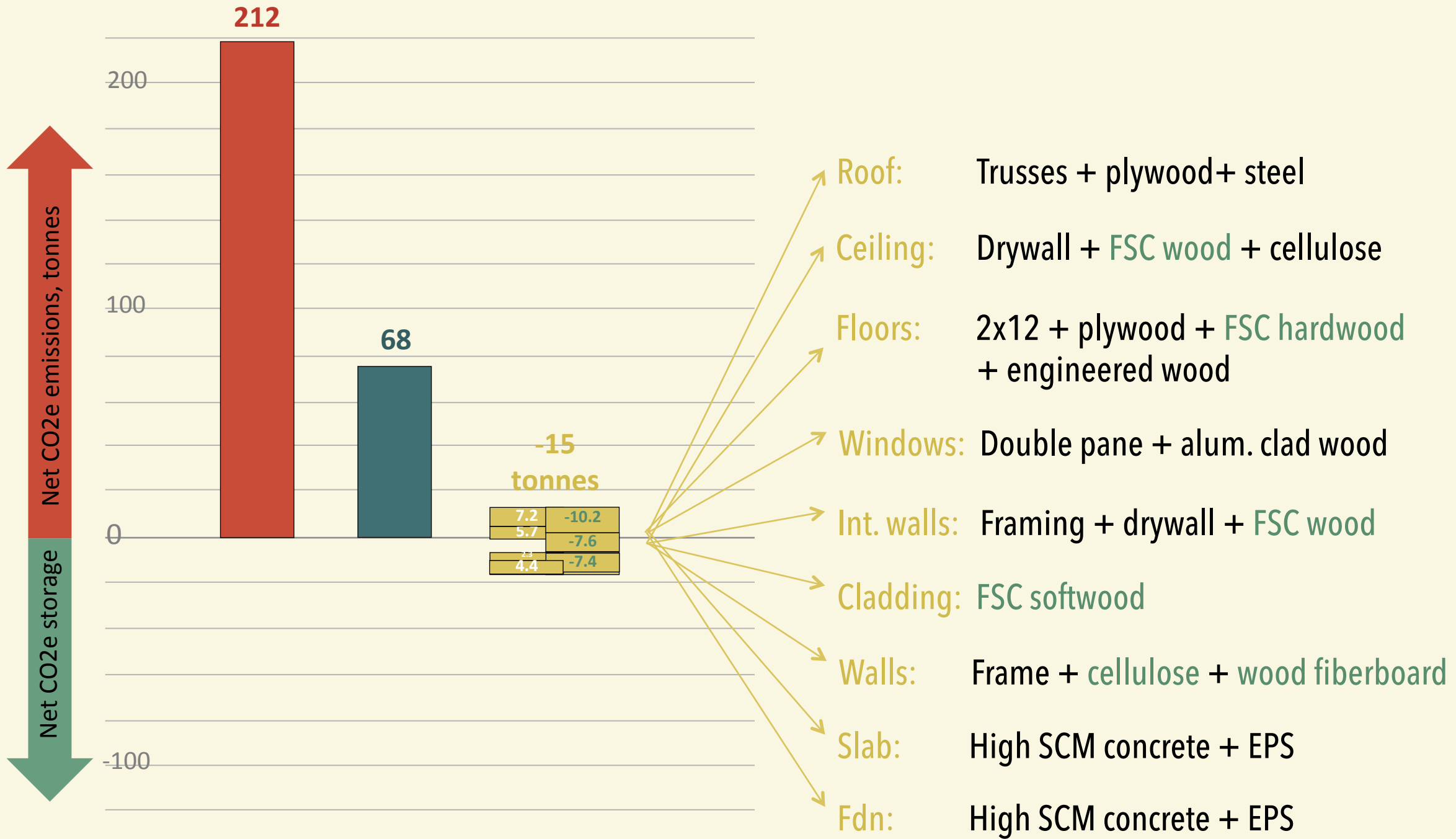
In 2016, there were 2.16 billion tonnes of grain straw produced globally, drawing down 8 billion tonnes of CO₂.
That's almost ¼ of all annual GHG emissions.

It's also enough to replace all insulation materials and still leave 20% to return to soils.

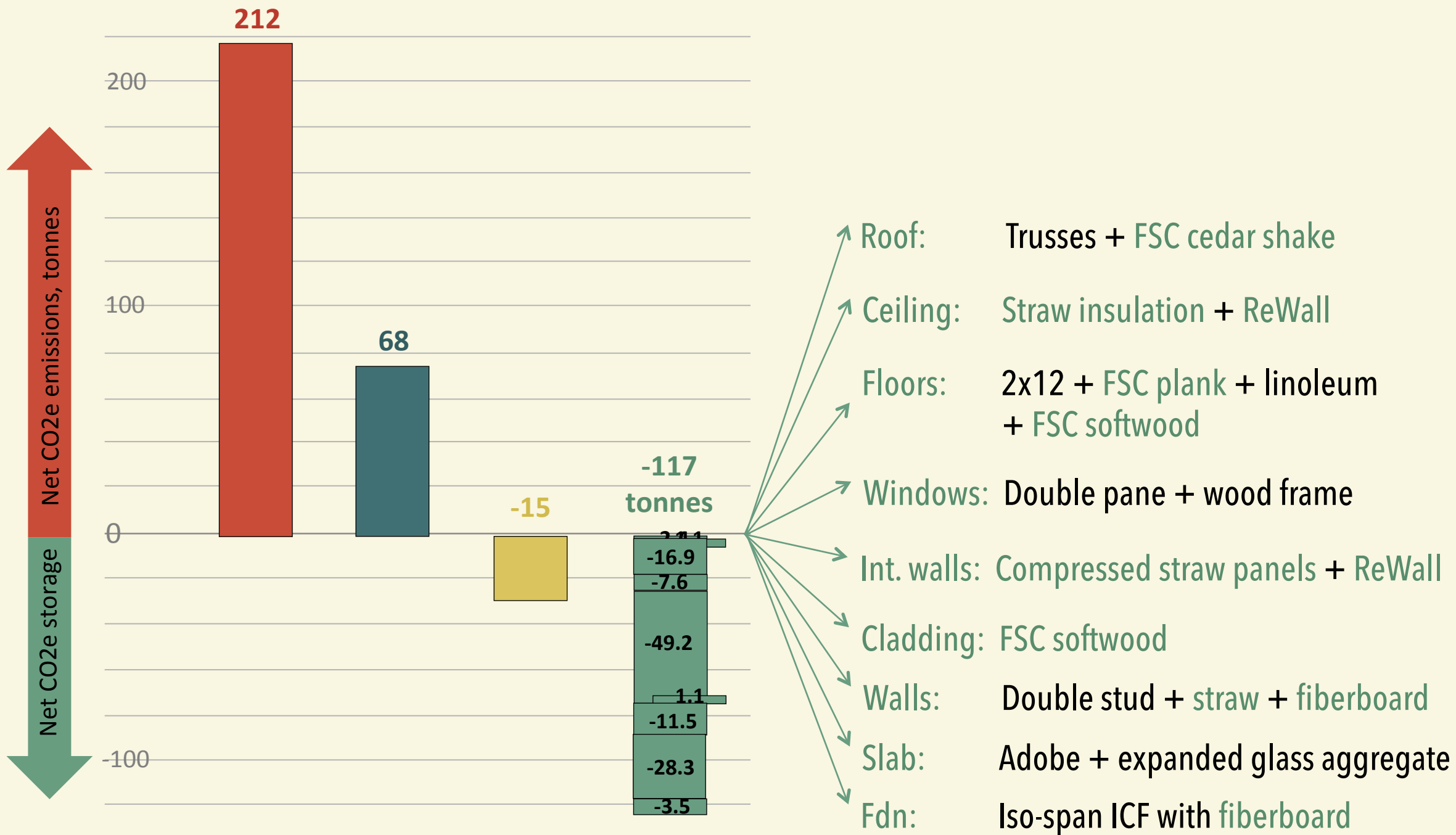
And we already have the manufacturing know-how to produce viable building materials.

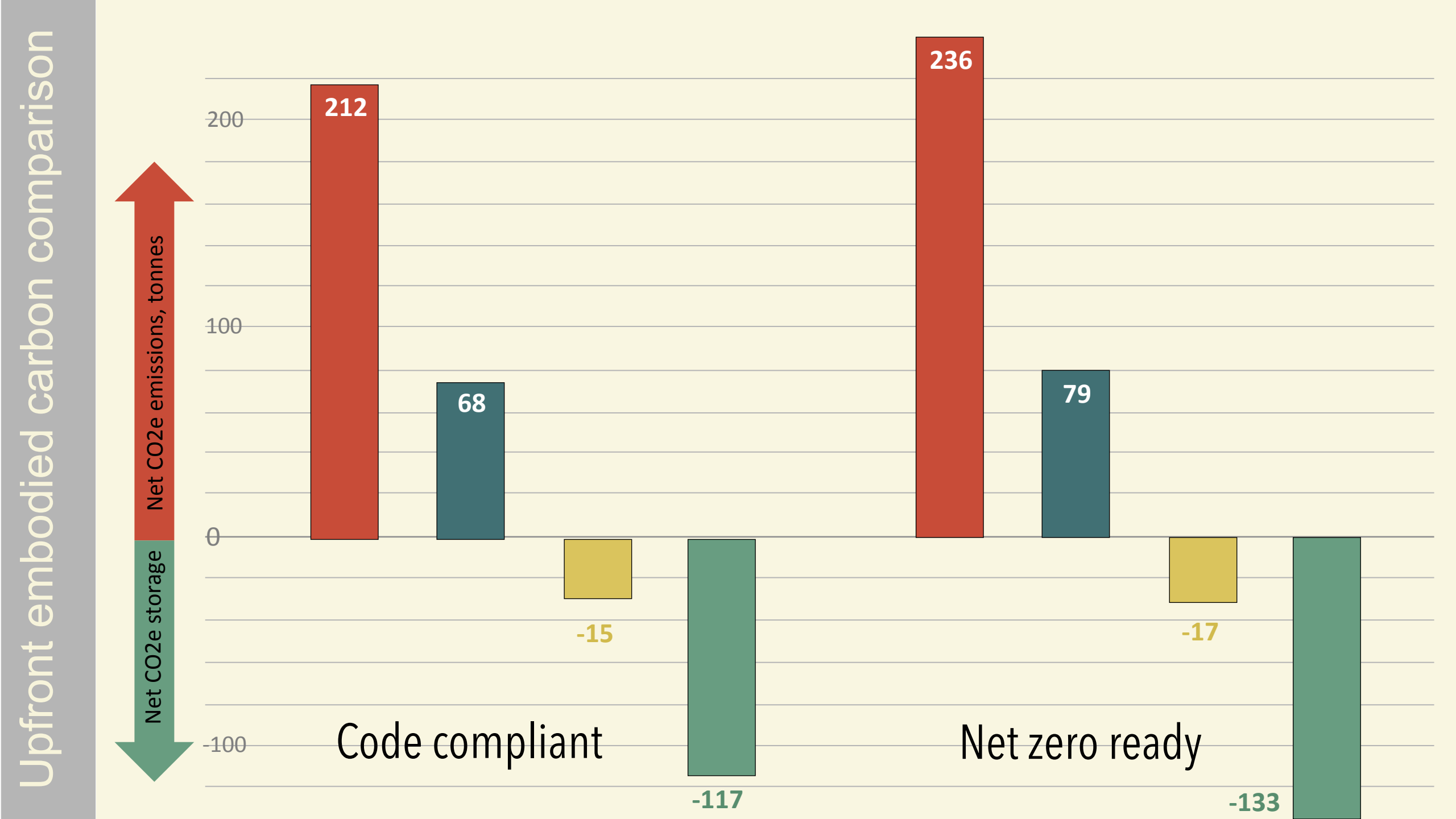


Upfront embodied carbon comparison



Upfront embodied carbon comparison







+ Adding emission
equivalent of
15 coal plants

=

54 million tonnes
of carbon **emissions**

What This Means at Scale

Total 2017 U.S.
Low-rise Construction:
241 million m² of new low-rise
residential construction*

Business-as-usual will result in massive
annual up-front emissions.

Carbon-storing buildings eliminate all
up-front emissions and can result in
meaningful carbon drawdown.

*U.S. Census Bureau/U.S. HUD, CB19-21

36 million tonnes
of carbon **storage**

=

- Removing emission
equivalent of
10 coal plants

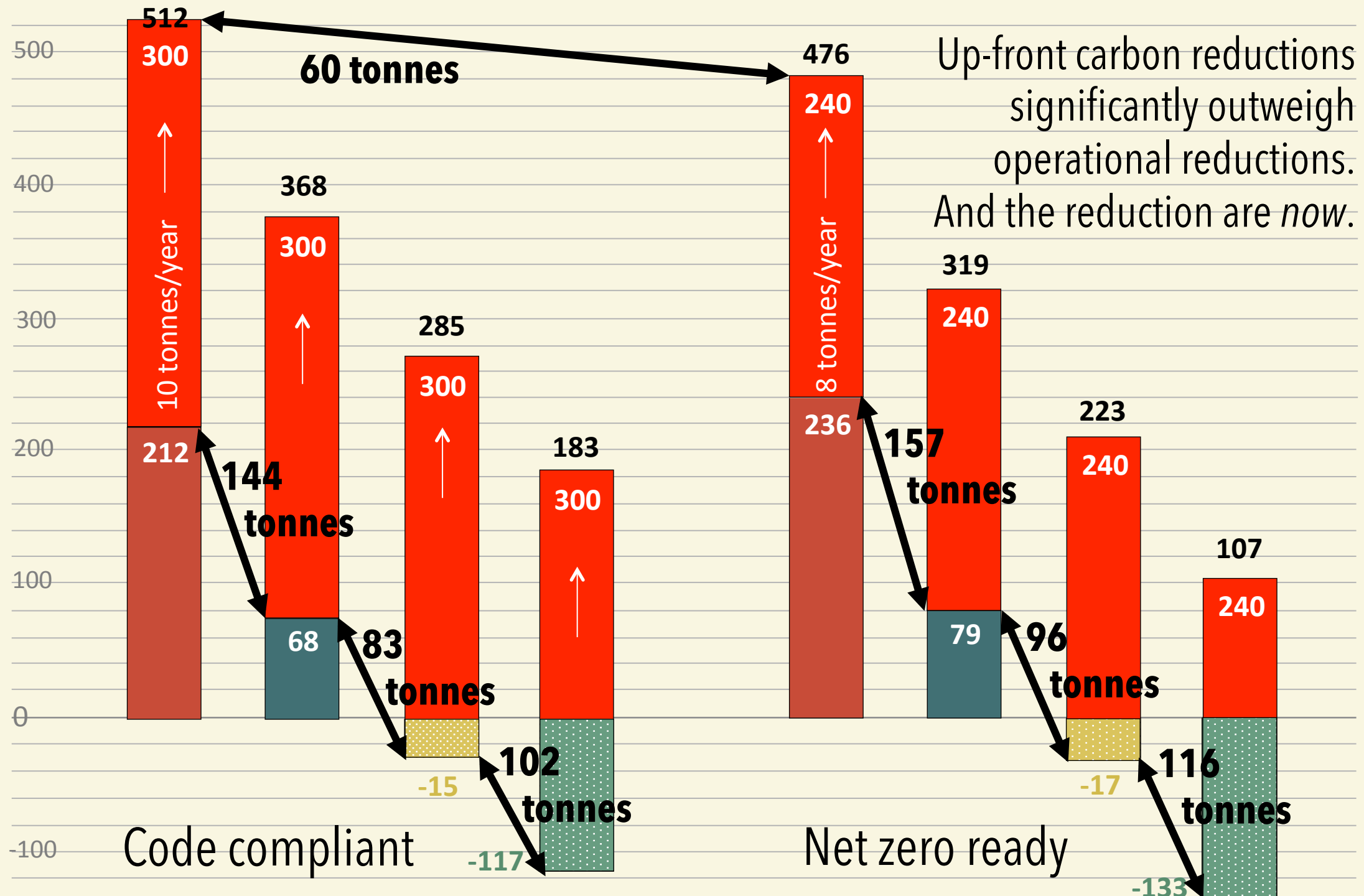


**CARBON
STORING
BUILDING**

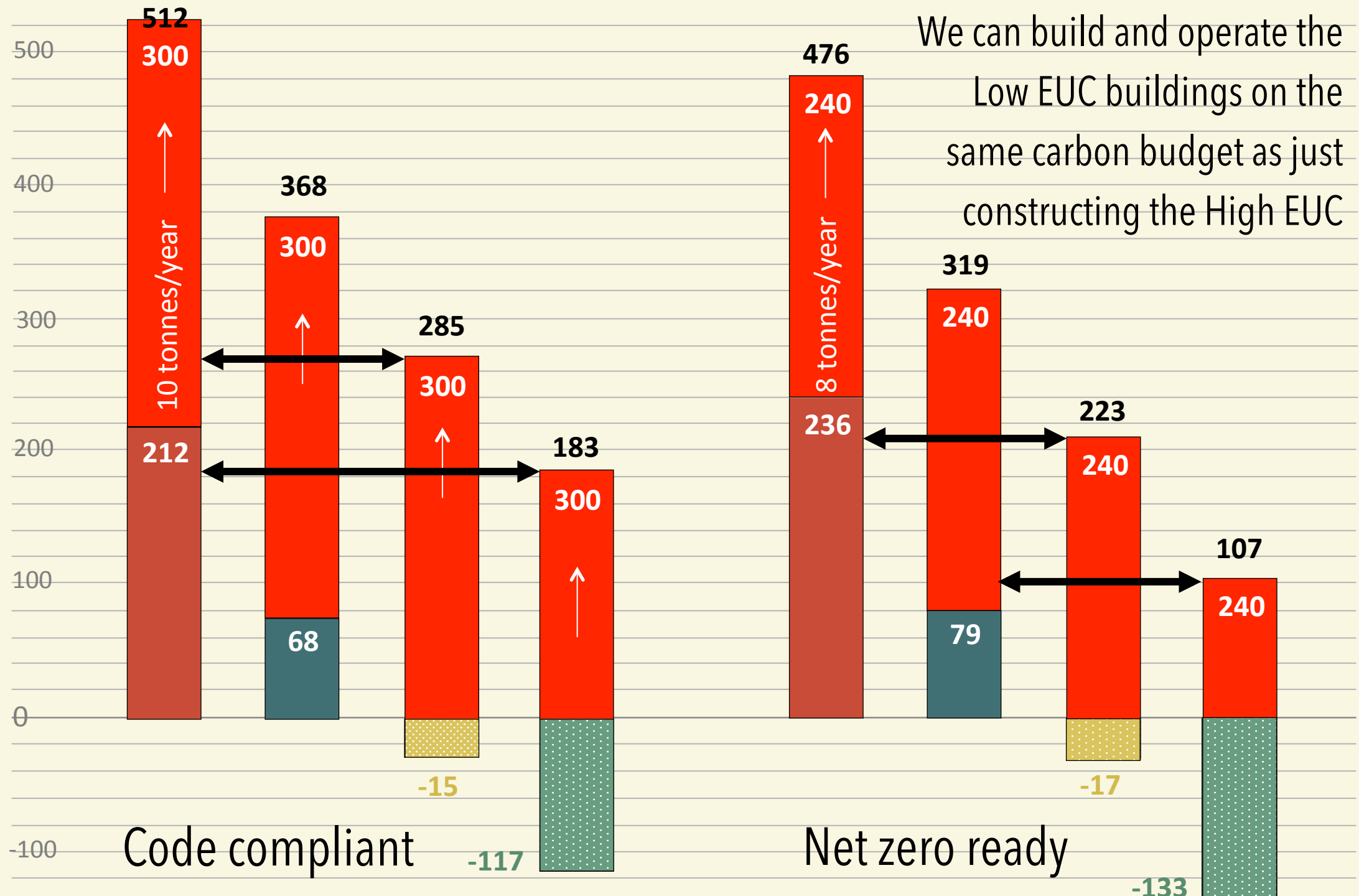
Avg of
150 kgCO₂e/m²
net storage

Adding Operational GHG Emissions

2020-2050

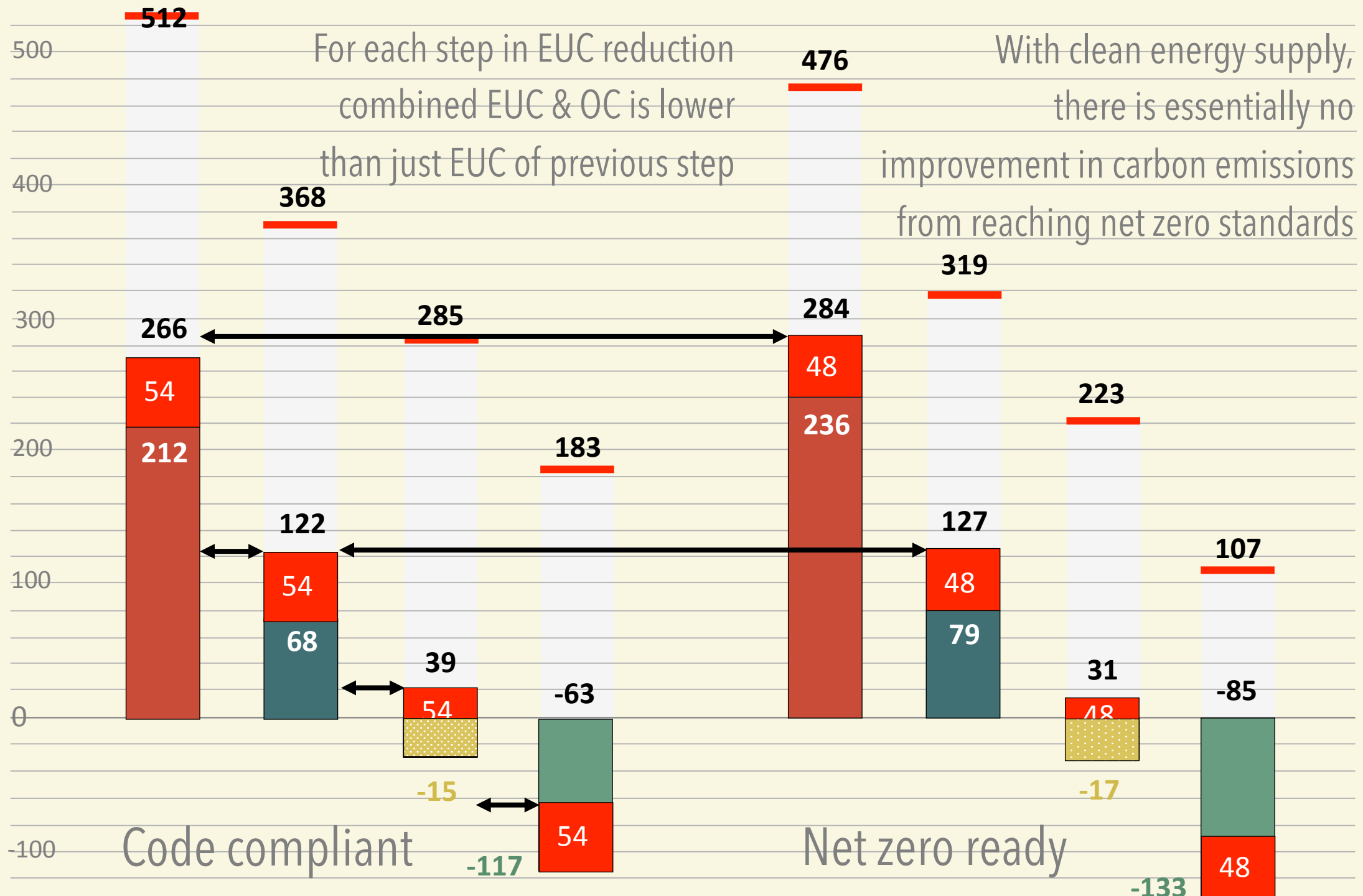


2020-2050



Operational & embodied carbon comparison
Air source heat pump, Toronto, Canada

2020-2050



TOTAL EMBODIED CARBON



EXTRACTION



MANUFACTURING



ENERGY SOURCE EMISSIONS



ENERGY EFFICIENCY

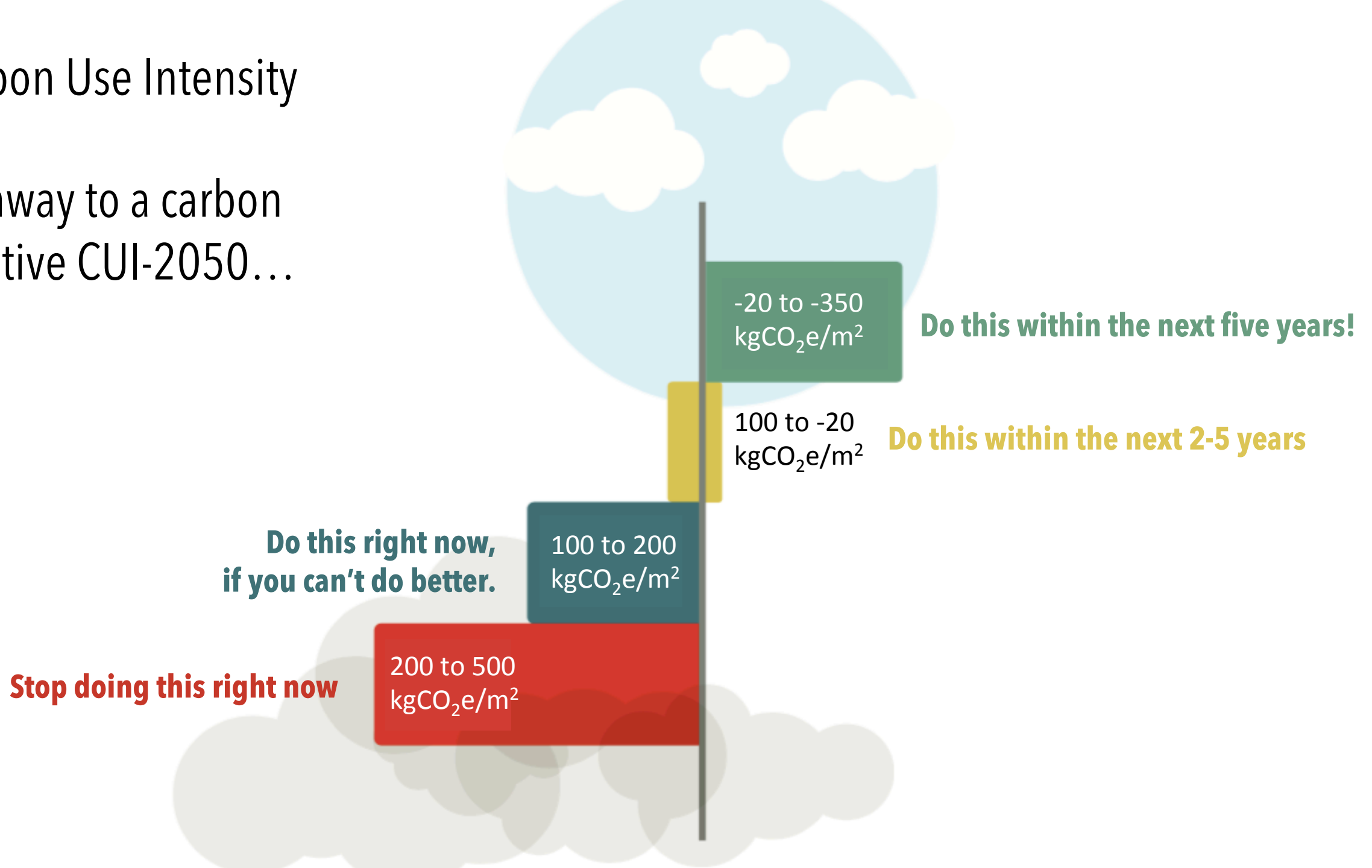


This is how we need to
think about zero carbon
buildings...

Not *Energy* Use Intensity
Carbon Use Intensity –
CUI

Carbon Use Intensity

Pathway to a carbon positive CUI-2050...



CASE STUDIES

Canada's Greenest Home - Urban infill, near net-zero design 210m² three bedroom home

- 5 tonnes net carbon storage

Key carbon storing materials: Prefab straw bale walls, cellulose roof insulation, Nexcem ICF foundation, FSC wood siding, subflooring and flooring, sustainably harvested cedar shingles, clay plaster.



*Energy: 85% on site generation
of solar electricity
0.8 ACH/50 air tightness*

24kgCO₂e/m²

Carbon Storing
-20 to -250
kgCO₂e/m²

Zero Carbon
50 to -20
kgCO₂e/m²

Moderate EC
250-50
kgCO₂e/m²

High EC
500-250
kgCO₂e/m²

CASE STUDIES

Zero House - Prefab modular home, net zero design

100m² single unit. Designed to be one unit in a 16-unit development.

- 25 tonnes net carbon storage in a single unit.
- 400 tonnes storage potential in 16-unit development.

Key carbon storing materials: Prefab straw bale walls, prefab cellulose wall, roof & floor panels, MSL Fibreboard exterior insulation board, ReWall interior sheathing, Mycofoam insulation, cork sheathing panels, FSC wood floor and Columbia plywood interior wall cladding.



Energy: 75% on site solar electricity generation
1.0 ACH/50 air tightness

250kgCO₂e/m²

Carbon Storing
-20 to -250
kgCO₂e/m²

Zero Carbon
50 to -20
kgCO₂e/m²

Moderate EC
250-50
kgCO₂e/m²

High EC
500-250
kgCO₂e/m²

CASE STUDIES

Offices & Meeting Hall - urban infill, net-positive design 225m²

- 81 tonnes net carbon storage

Key carbon storing materials: Straw bale and cellulose wall insulation, cellulose floor and roof insulation, Nexcem ICF foundation, FSC wood siding and flooring, clay plaster, sustainably harvested timber frame.



CASE STUDIES

Jules Ferry Apartment Complex - carbon storage at larger scales

1350m² (Embodied carbon accounting was not performed using the same protocol of this study)

- 1100 tonnes net carbon storage

Key carbon storing materials: Prefab straw bale wall panels, sustainably harvested timber structure.



814 kgCO₂e/m²

Carbon Storing
-20 to -250
kgCO₂e/m²

Zero Carbon
50 to -20
kgCO₂e/m²

Moderate EC
250-50
kgCO₂e/m²

High EC
500-250
kgCO₂e/m²



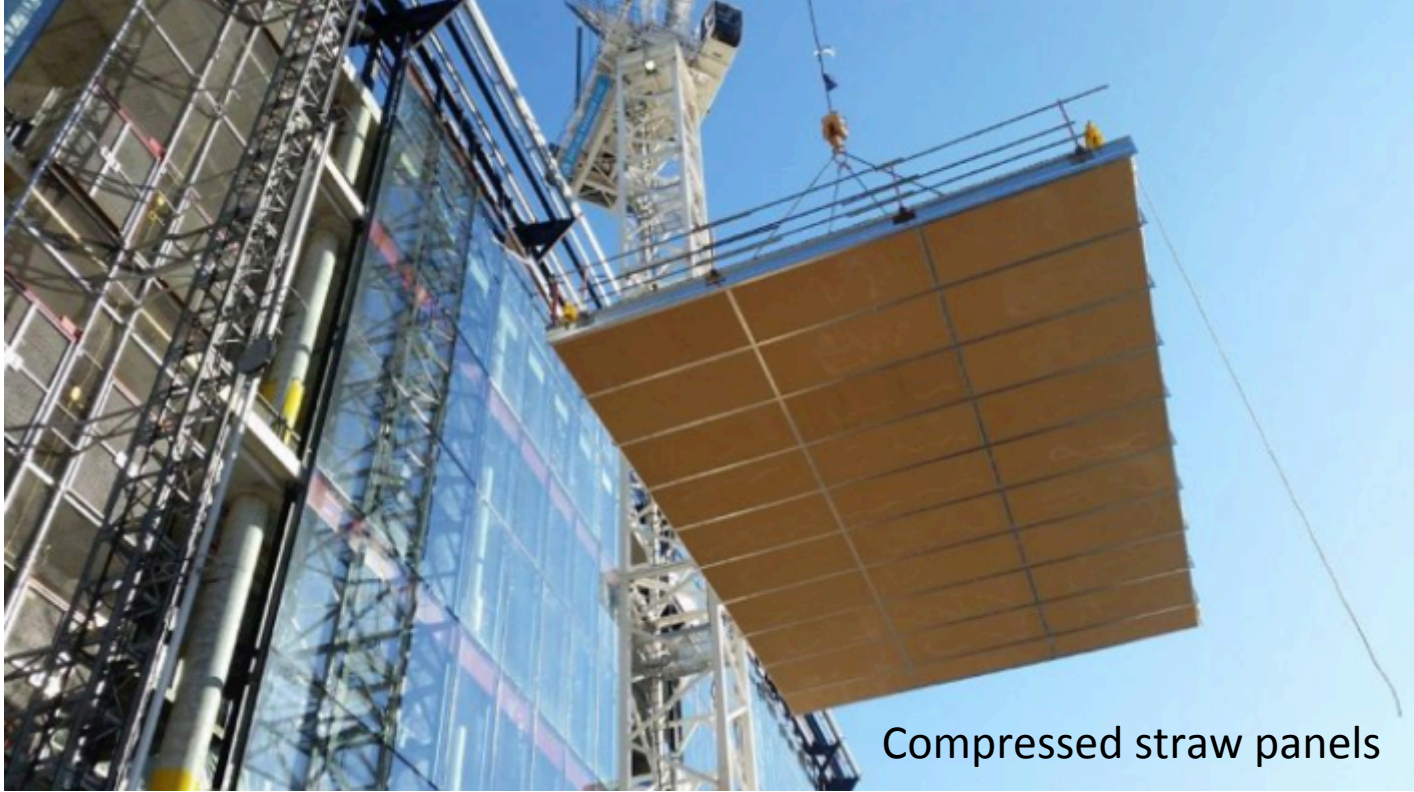
Hempcrete

Marks & Spencer Cheshire Oaks Store, UK





Wood fiberboard exterior insulation



Compressed straw panels

Continuus Rewall roof and wall sheathing



Just Biofiber structural hemp blocks



Sorghum panels

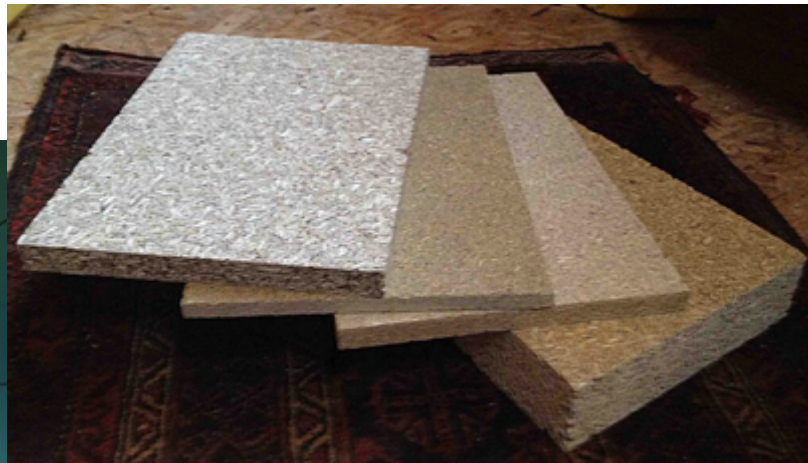
Linoleum flooring



Compressed straw panels



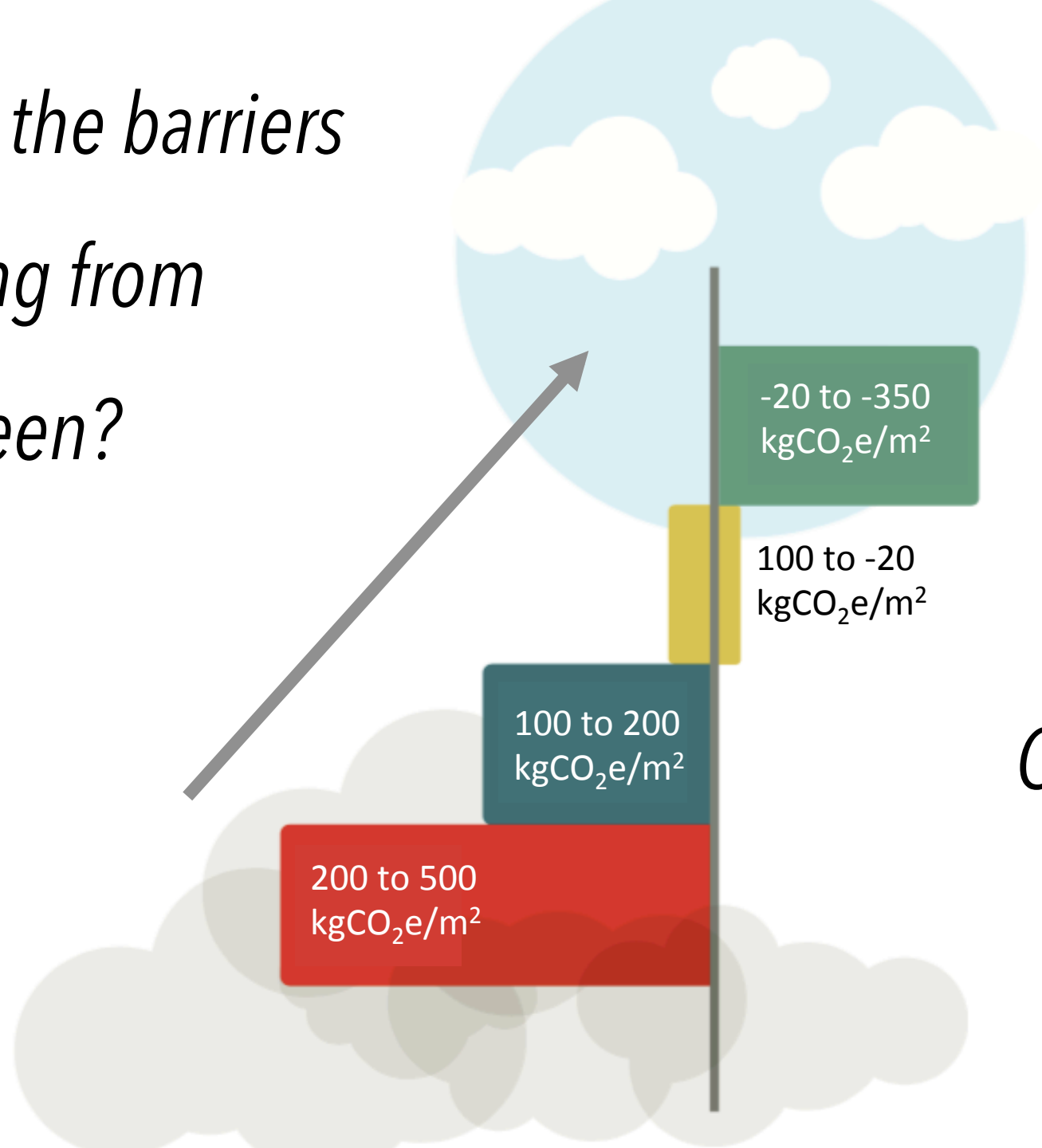
Tectum wall and ceiling panels



Hemp board & flooring



*What are the barriers
for moving from
red to green?*



*Can you explain away
the barriers to the
youth in your life?*