ATTENTION USER: Please read before using these slides.

The Applied Building Technology Group (ABTG) is committed to using sound science and general accepted engineering practice to develop research supporting reliable design and installation of foam plastic insulating sheathing (FPIS). This presentation was designed by ABTG to accompany and enhance the following resources, which were developed with support from the Foam Sheathing Committee (FSC) of the American Chemistry Council, in educational programs and outreach efforts by FSC members:

- CI FACTS Sheet on Building Decarbonization Insights
- ABTG Research Report No. 2312-01: Decarbonization of Buildings
- Sustainability & Decarbonization Applications of FPIS

DISCLAIMER: While reasonable effort has been made to ensure the accuracy of the information presented, the actual design, suitability, and use of this information for any particular application is the responsibility of the user. Where used in the design of buildings, the design, suitability and use of this information for any particular building is the responsibility of the Owner or the Owner's authorized agent.

PERMISSION: This content may be used without alteration for educational purposes if proper attribution is provided to ABTG and/or its Continuous Insulation website (continuousinsulation.org). Please contact us through the website at continuousinsulation.org/contact-us with any questions or additional permissions requests you may have.

Building Decarbonization

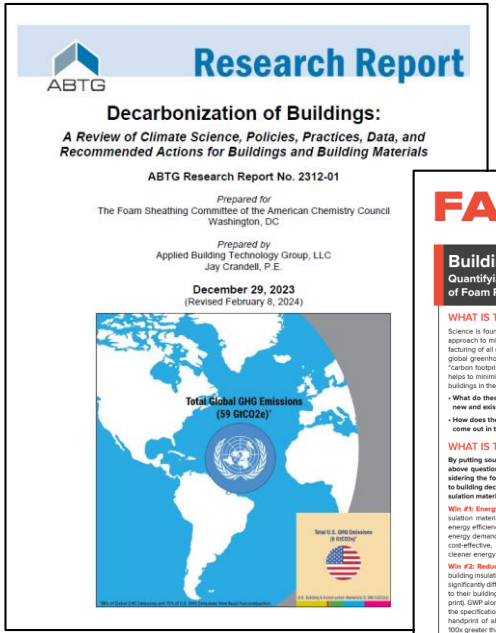
FACTS | Foam Plastic Applications for Better Building

PRESENTED BY:

[insert company name or logo here]

Introduction

- Building decarbonization is an important component to the overall decarbonization of the U.S. economy.
- All modern insulation materials are a solution to help decarbonize buildings by reducing their carbon emission impact to the global climate.
- All modern building insulation materials produced in the U.S. each year, including foam plastics, account for a small amount (about 0.01%) of annual total global greenhouse gas (GHG or CO2e) emissions.
- Yet, when insulation materials are used in buildings to conserve energy, they help offset the annual operational carbon emissions of all buildings in the U.S., which is 300 times greater than the annual emissions from the manufacturing of insulation.


ABTG

Research Report

Decarbonization of Buildings:

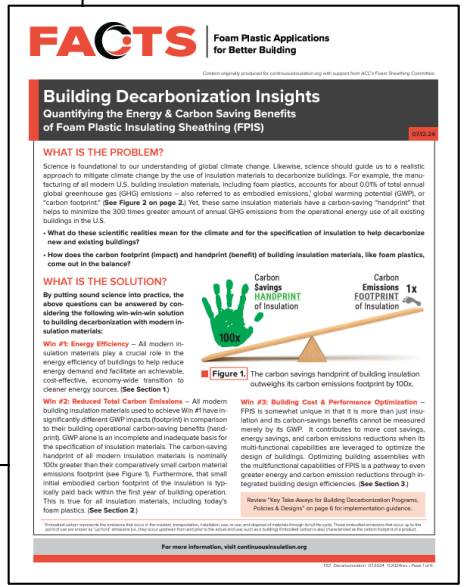
A Review of Climate Science, Policies, Practices, Data, and Recommended Actions for Buildings and Building Materials

ABTG Research Report No. 2312-01

Prepared for
The Foam Sheathing Committee of the American Chemistry Council
Washington, DC

Prepared by
Applied Building Technology Group, LLC
Jay Crandell, P.E.

December 29, 2023
(Revised February 8, 2024)


FACTS Foam Plastic Applications for Better Building

Building Decarbonization Insights

Quantifying the Energy & Carbon Saving Benefits of Foam Plastic Insulating Sheathing (FPIS)

WHAT IS THE PROBLEM?

Science is foundational to our understanding of global climate change. Likewise, science should guide us to a realistic approach to mitigate climate change by the use of insulation materials to decarbonize buildings. For example, the manufacturing of all modern U.S. building insulation materials, including foam plastics, accounts for about 0.01% of total annual global greenhouse gas (GHG) emissions – also referred to as embodied emissions,' global warming potential (GWP), or "carbon footprint." (See Figure 2 on page 2.) Yet, these same insulation materials have a carbon-saving "handprint" that helps to minimize the 300 times greater amount of annual GHG emissions from the operational energy use of all existing buildings in the U.S.

- What do these scientific realities mean for the climate and for the specification of insulation to help decarbonize new and existing buildings?
- How does the carbon footprint (impact) and handprint (benefit) of building insulation materials, like foam plastics, come out in the balance?

WHAT IS THE SOLUTION?

By putting sound science into practice, the above questions can be answered by considering the following win-win-win solution to building decarbonization with modern insulation materials:

Win #1: Energy Efficiency – All modern insulation materials play a crucial role in the energy efficiency of buildings to help reduce energy demand and facilitate an achievable, cost-effective, economy-wide transition to cleaner energy sources. (See Section 1.)

Win #2: Reduced Total Carbon Emissions – All modern building insulation materials used to achieve Win #1 have insignificantly different GWP impacts (footprint) in comparison to their building operational carbon-saving benefits (handprint). GWP alone is an incomplete and inadequate basis for the specification of insulation materials. The carbon-saving handprint of all modern insulation materials is nominally 100x greater than their comparatively small carbon material emissions footprint (see Figure 1). Furthermore, that small initial embodied carbon footprint of the insulation is typically paid back within the first year of building operation. This is true for all insulation materials, including today's foam plastics. (See Section 2.)

Figure 1. The carbon savings handprint of building insulation outweighs its carbon emissions footprint by 100x.

Win #3: Building Cost & Performance Optimization – FPIS is somewhat unique in that it is more than just insulation and its carbon-savings benefits cannot be measured merely by its GWP. It contributes to more cost savings, energy savings, and carbon emissions reductions when its multi-functional capabilities are leveraged to optimize the design of buildings. Optimizing building assemblies with the multifunctional capabilities of FPIS is a pathway to even greater energy and carbon emission reductions through integrated building design efficiencies. (See Section 3.)

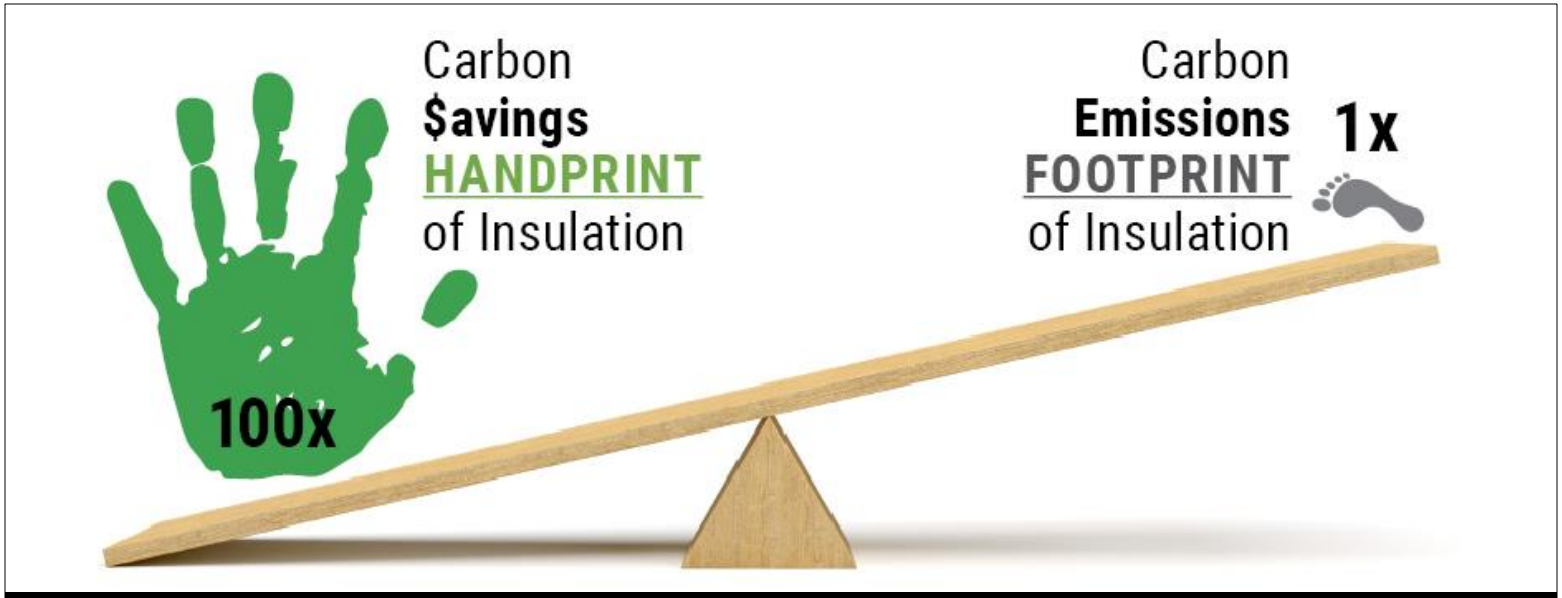
Review "Key Take-Aways for Building Decarbonization Programs, Policies & Designs" on page 6 for implementation guidance.

For more information, visit continuousinsulation.org

Key resources available at:
continuousinsulation.org/sustainability

Introduction

- Similarly, for an individual new building, insulation provides a typical lifetime carbon payback (handprint) of 100x the initial embodied carbon (footprint) of the insulation package for the building (see image).



When used in a typical new building, the carbon savings "handprint" of building insulations, like foam plastics, outweighs its carbon emissions "footprint" by 100x.

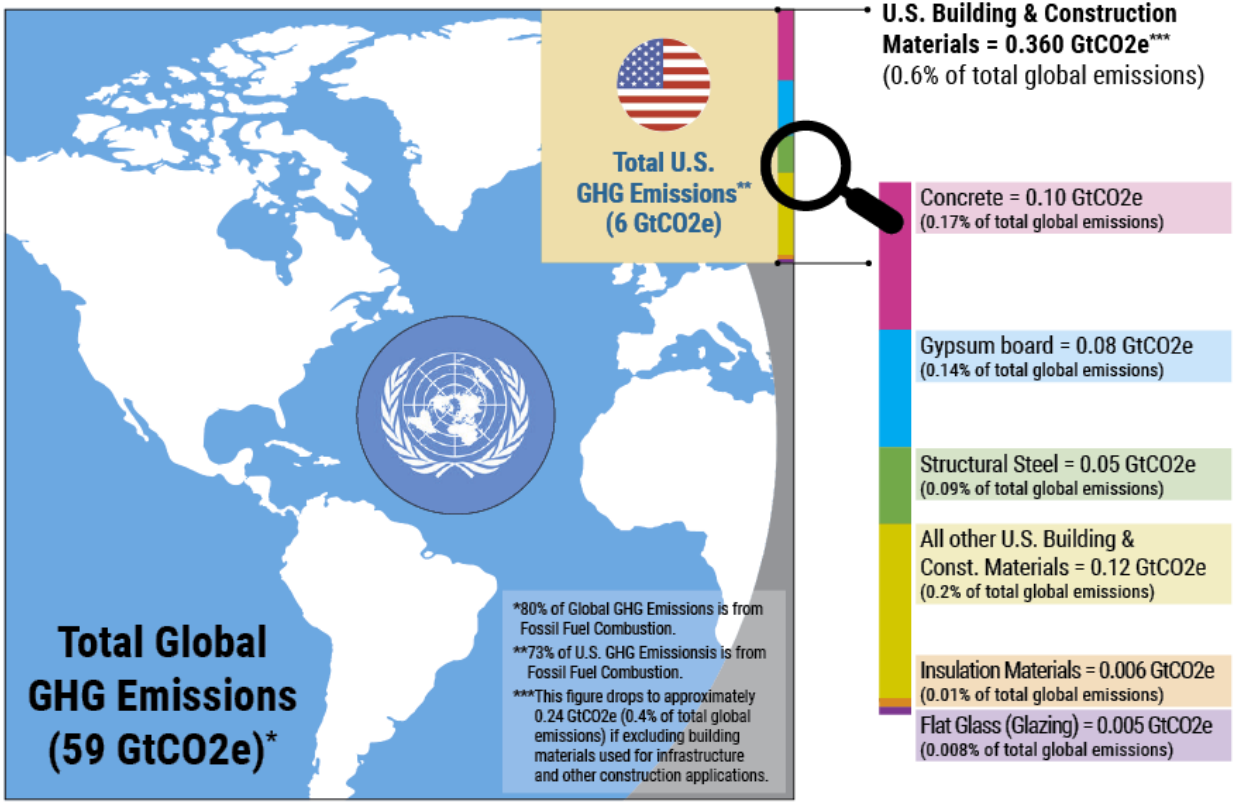
The Big Picture

- Global total - **59 Gt CO2e**
- U.S. total - **6 Gt CO2e** (~10% of global total)
- U.S. Bldg & Const Mat'ls – **0.36 Gt CO2e** (~0.6% of global total) attributed to:
  - Concrete - 28%
  - Gypsum – 22%
  - Steel – 14%

  - Insulation – 1.7%
  - Glass/glazing – 1.4%

  - All other – 33%

1 Gt = 1 billion metric tons = 1 trillion kg = 2.2 trillion lbs
1 Gt CO2e is equivalent to the combustion of 110 billion gallons of gasoline



Magnitude of total global and U.S. GHG emissions, and contribution of U.S. Building & Construction Materials to total global GHG emissions.

SOURCE: ABTG Report: Decarbonization of Buildings, Figure A & Table A.

What Is the Problem?

- **THE PROBLEM:** A focus only on the embodied carbon or global warming potential (GWP) of insulation materials, as often considered by policy developers and decarbonization programs, is misdirected.
- It is counter-productive to effective building decarbonization decisions and insulation material specification, especially multi-functional insulations like foam sheathing.
- Unlike most other building materials, insulation must be viewed from a “total carbon” perspective, considering both its small carbon “footprint” (embodied carbon or GWP) and its large “handprint” (operational carbon emission savings due to improved building energy conservation).
- Simply put, the building decarbonization role of insulation materials must be based on sound science put to practical use.

What Is the Solution?

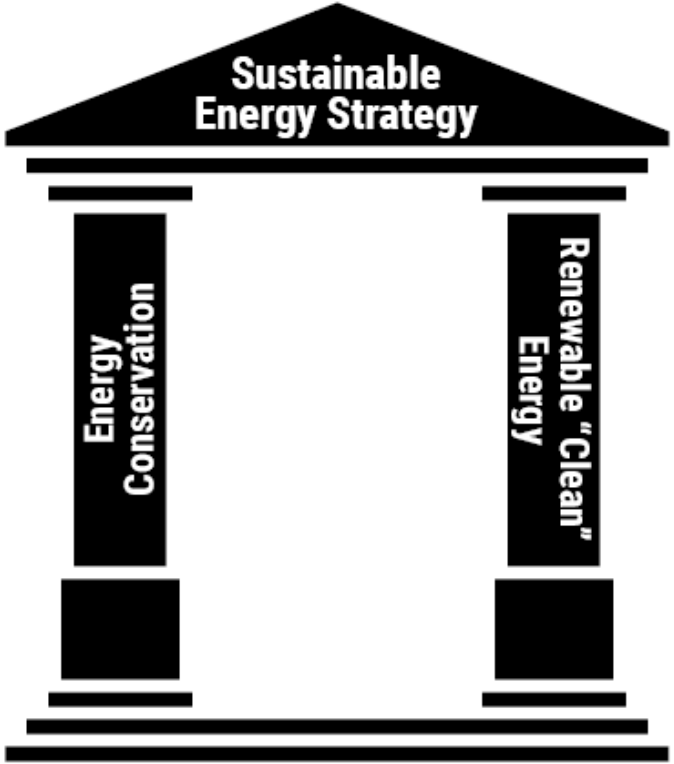
Successful building decarbonization comes in three categories of "WINS" made possible by the use of modern insulation materials, like foam plastics:

- ✓ **WIN #1:** Energy efficiency
- ✓ **WIN #2:** Reduced total carbon emissions
- ✓ **WIN #3:** Building cost & performance optimization

WIN #1: Efficiency First!

Building energy efficiency is many things…

- The lowest-cost, zero-carbon “fuel” because energy not used has no cost and no emissions
- One of two key “pillars” of a sustainable energy strategy by conserving energy and reducing the demand for energy of all types, including renewable “clean” energy.
- The foundation of increased energy productivity to deliver building function with less energy consumption.



Twin pillars of a sustainable energy strategy.

SOURCE: ABTG Report: Decarbonization of Buildings, Figure 39.

WIN #1: Efficiency First!

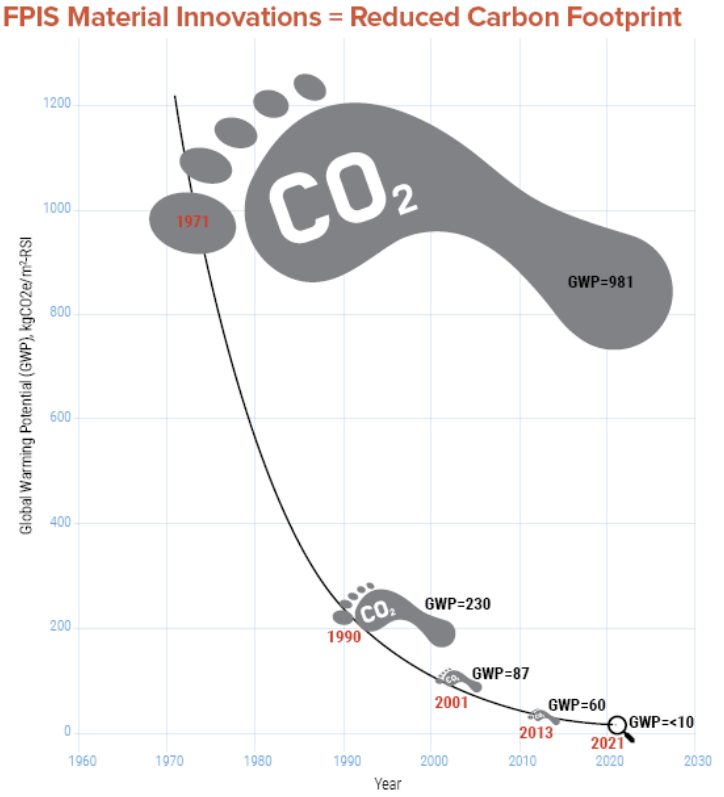
Building energy efficiency is many things…

- Affordable because it reduces energy bills and provides continual “pay-back” over the life of a building and all its owners and uses.
- Lowers peak demand on the electric grid enabling efficient transition to renewable energy sources.
- Helps achieve energy security because the safest energy supply is energy that is not needed.

EXAMPLE: For mortgaged homes, the portion of the downpayment for insulation is recouped within the first year of building use after which there is a net positive cash flow for the insulation portion of the initial building cost. Consequently, a $400 downpayment for improved energy efficiency features of a typical home can yield $14,500 savings over the period of a 30-year mortgage based on ACC Fact Sheet “Energy Efficiency = Healthy Return on Investment.”

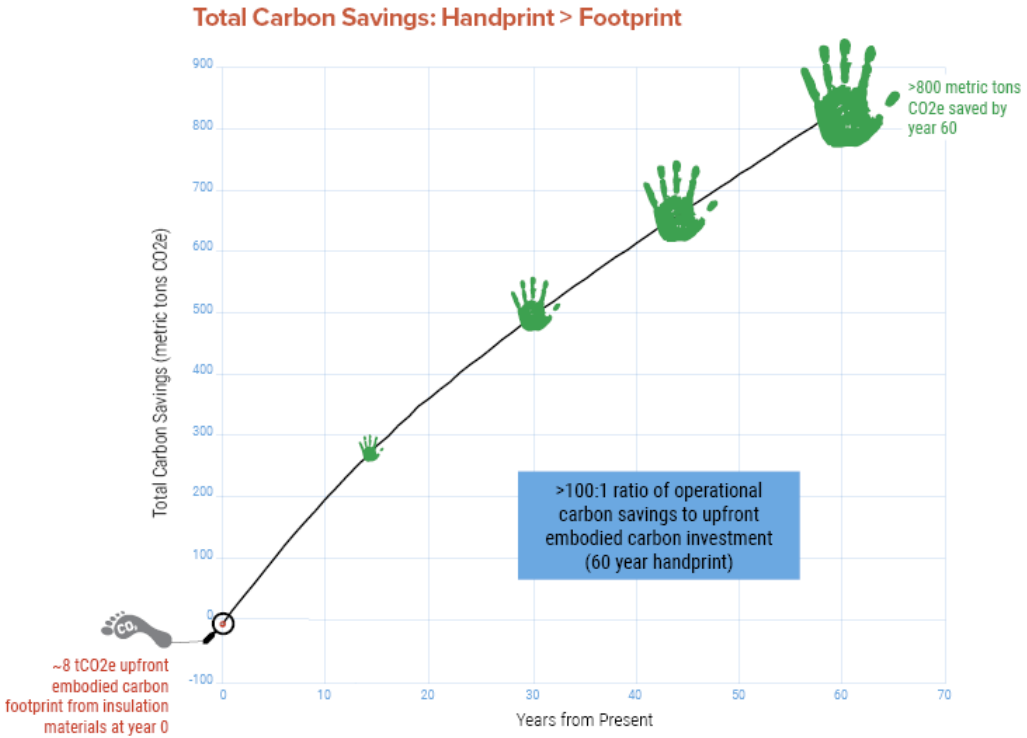
WIN #2: Reduce Total Carbon Emissions

- Insulation materials, like other building materials, have an embodied carbon footprint (albeit small in comparison)
- But, unlike other materials, insulation materials have a “handprint” that saves energy and carbon emissions over the life of a building.
- We will review the data to confirm:
  - First, U.S. manufacturers of modern foam plastic insulation materials have invested in substantial reduction of material carbon emissions over the past several decades and even the past several years. (See Figure.)



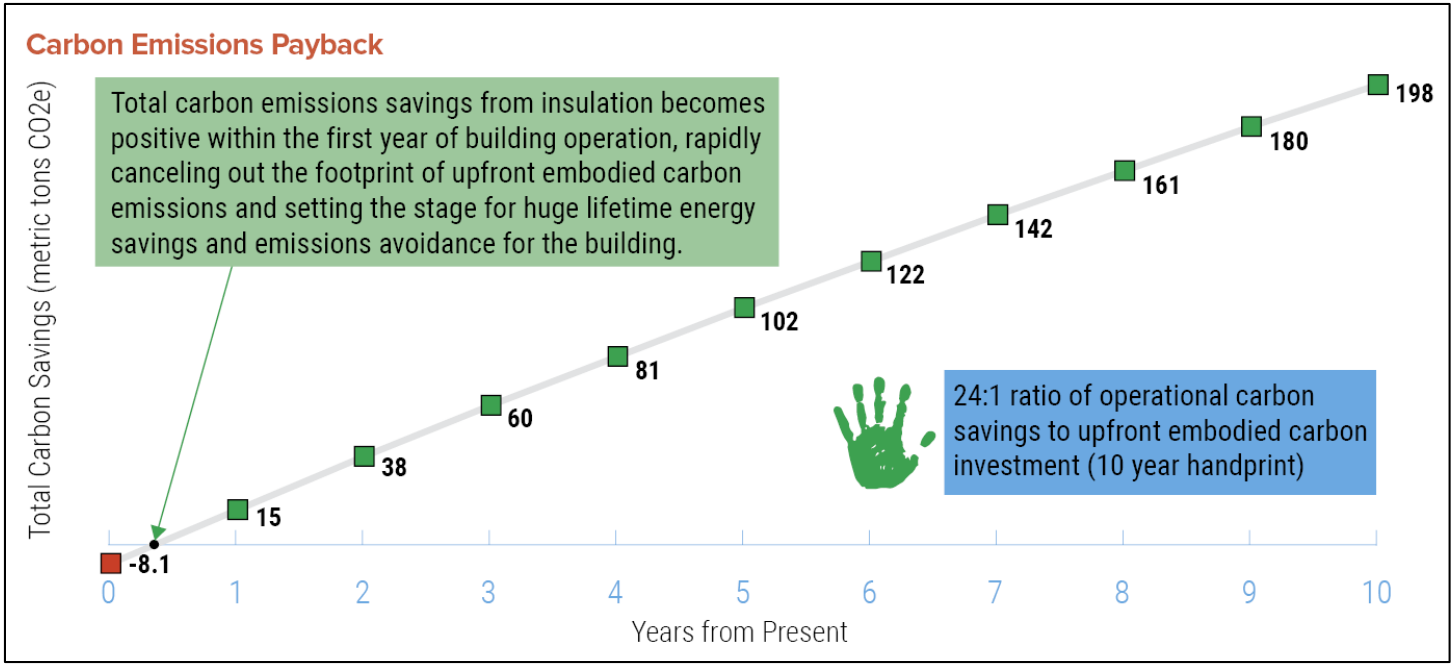
WIN #2: Reduce Total Carbon Emissions

In a typical new building complying with modern U.S. energy conservation codes, the use of foam plastic insulation materials results in GHG emissions savings that is more than 100x the embodied carbon footprint of the whole insulation package for the building's thermal envelope.



WIN #2: Reduce Total Carbon Emissions

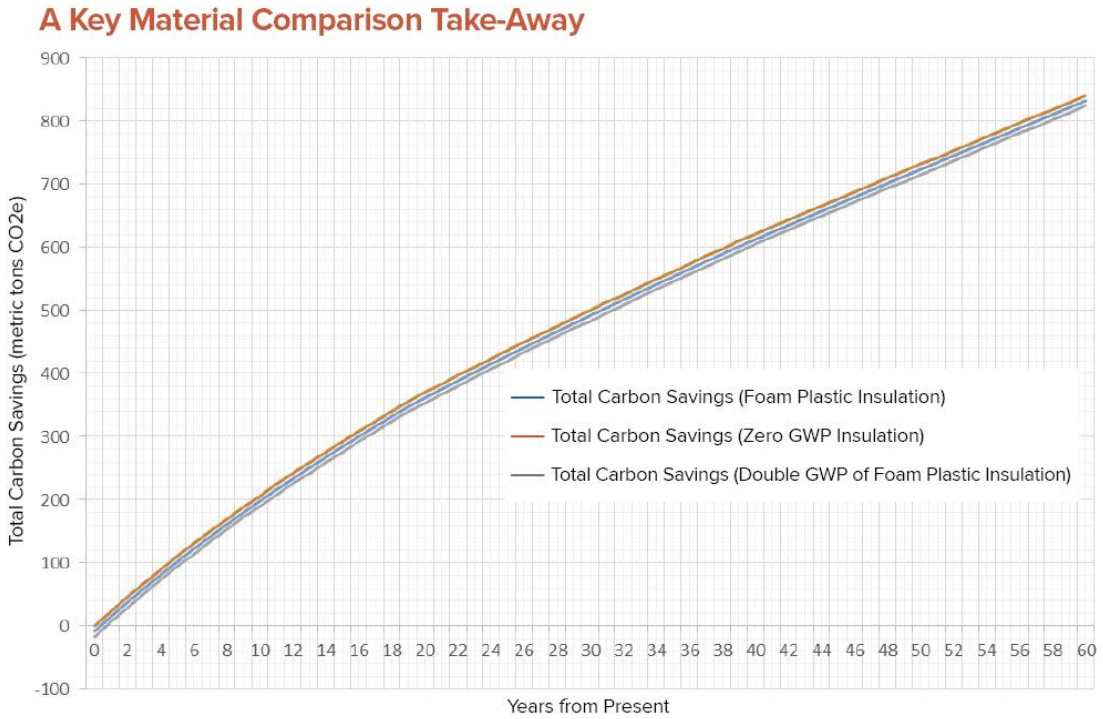
The carbon payback is almost immediate in typical building applications – within one year the insulation provides a net savings in total carbon emissions!



FPIS and other foam plastic building insulations pay back the initial upfront embodied carbon within the first year of building operation (see green arrow). This payback period is comparable to that of wind turbines for renewable electricity generation. Within 10 years, the operational to embodied emissions savings ratio of the building insulation materials reaches 24:1 for immediate climate change mitigation with continued savings for additional long-term benefits.

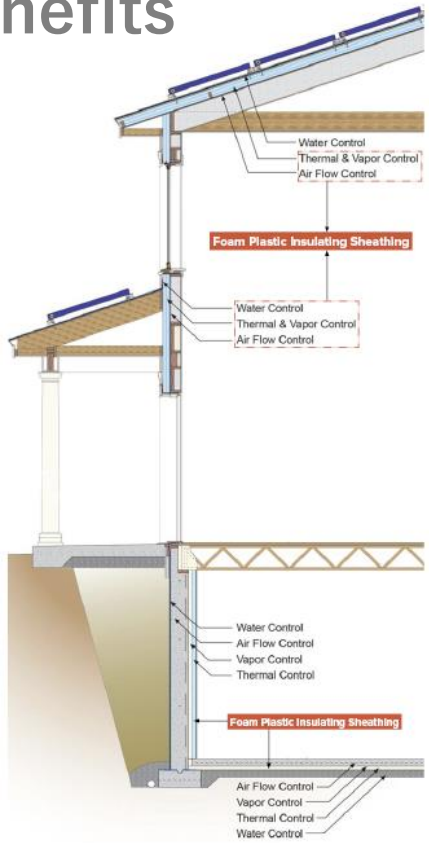
WIN #2: Reduce Total Carbon Emissions

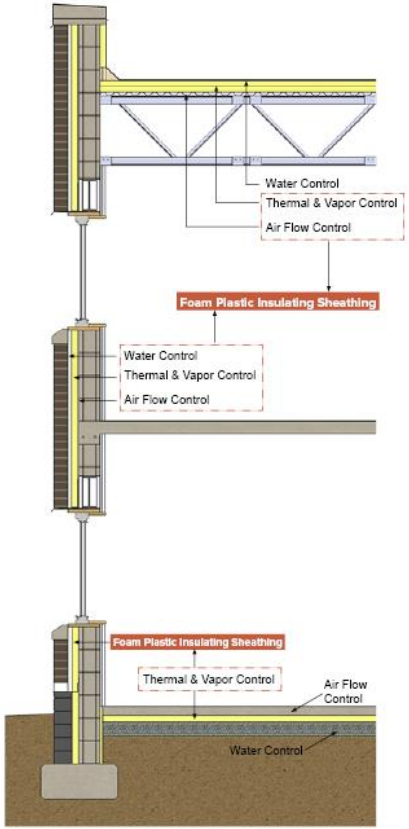
- The total carbon emissions savings benefit of modern insulation materials is negligibly different because they all have relatively small embodied carbon in comparison to the huge operational carbon savings they deliver!
- This graph compares the difference in building total carbon emissions savings for a range of modern insulation materials with GWP ranging from 0 (i.e., bio-based) to 10 (e.g., high end of modern foam plastics), and even double that!
- The carbon savings are huge and negligibly different in all cases because all modern insulation materials have a low-range of GWP and deliver large energy and carbon emissions savings.



WIN #3: Multi-functional Benefits of FPIS = More Savings

- As an example of multi-function insulation material applications, foam sheathing delivers:
  - **Continuous insulation** (energy and carbon emissions savings)
  - **Air barrier, water-resistive barrier, and vapor control** (minimizing use of separate materials and their carbon emissions while maximizing life-expectancy of buildings to avoid repeat of initial carbon emissions from re-construction)
  - **Foundation frost-protection** (avoiding need for deep foundations to minimize concrete usage and associated carbon emissions)
- Foam sheathing protects the structure, saves energy, and reduces total carbon emissions of the building through its entire life.
- Focusing merely on the embodied carbon or GWP of insulation materials as a basis for design and specification over-looks all of these multi-functional, integrated design benefits.





Key Take-Aways

- Adopt criteria that maximizes durable energy efficiency of buildings with the use of modern, high-performance insulation materials to at least modern energy code levels.
- Acknowledge the need to value modern insulation materials on the basis of total carbon savings (footprint + handprint) and not just on embodied carbon differences that have little effect.
- Capitalize on the multi-functional benefits of many modern insulation materials, like foam plastics.
- Don't penalize the entire value chain – from manufacturer to builder to installer to homeowner – by setting embodied carbon limits that exclude valuable insulation materials, especially those that have invested in significant reductions in GWP.
    - **Essentially all modern insulation materials, including foam plastics, now have low GWP and deliver substantial total carbon savings.**