Product Comparison

powered by cove

GAF Products vs Industry-standard Products

GAF

Jeff Terry
jeff.terry@gaf.com

04/29/2025

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Comparison

01

Polyiso Insulation + Roofing Membrane

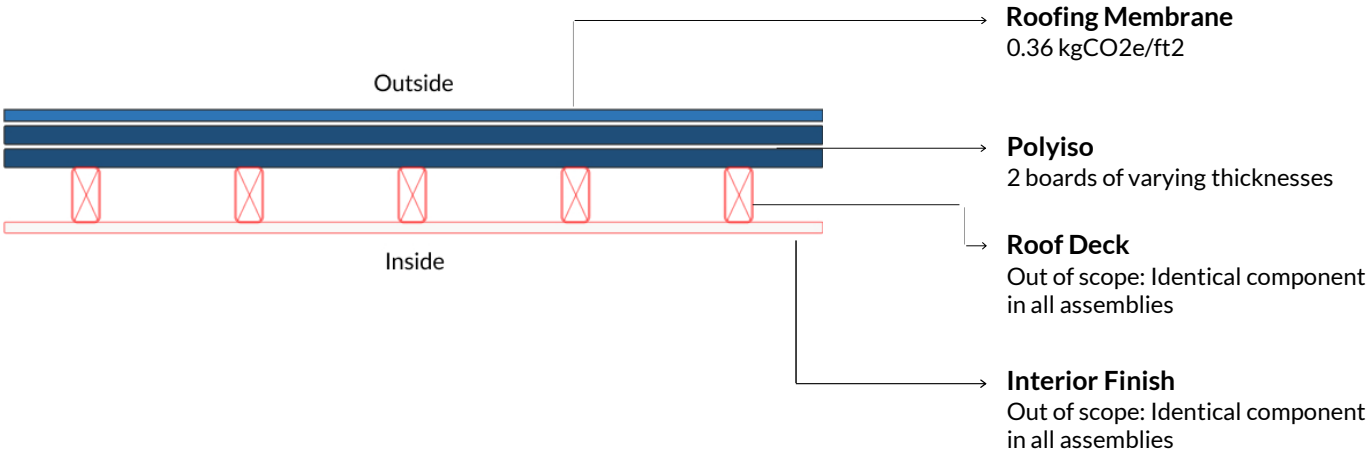
40.50%
Average Savings in Embodied Carbon

<4%
Average Savings in Energy Use Intensity (EUI)

This section of the report outlines the comparison of a wall assembly that includes
1. Two layers of polyiso insulation and
2. A roofing membrane.

The chapter provides a detailed comparison of such an industry standard assembly against 3 similar GAF Assemblies across five distinct building types and six different climate zones, examining their performance and efficiency in various environmental conditions.

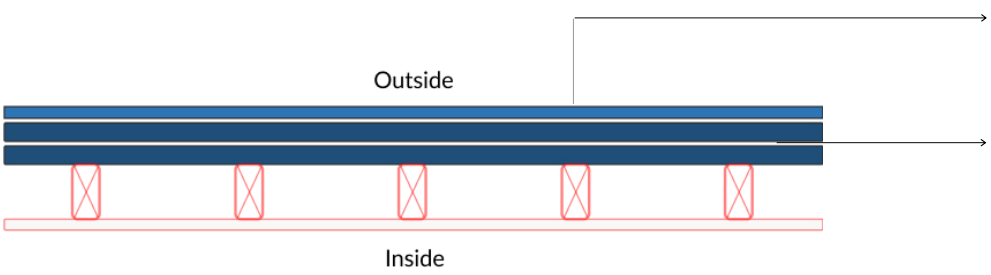
Industry-Standard Assembly being compared



GAF Assemblies

Rigid Insulation thicknesses are adjusted based on climate zone and Roof (Insulation Entirely Above Deck) U-factor requirements to comply with ASHRAE 2019 standards. The manufacturer offers specific thicknesses, and the one that best aligns with ASHRAE specifications is selected.

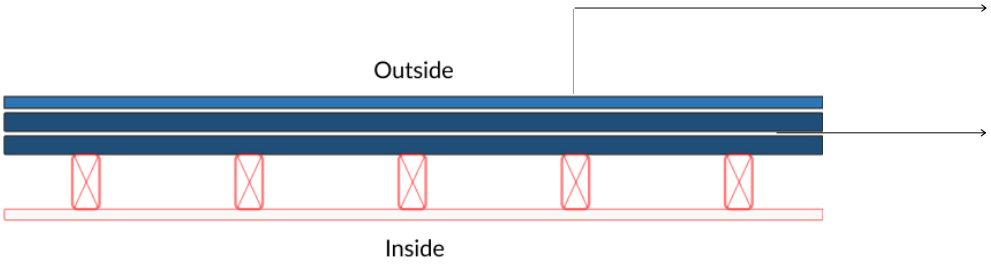
GAF PVC Good Assembly



EverGuard PVC Smooth 50 mil
0.38 kgCO2e/ft2

EnergyGuard Polyiso (GRF Facer)
0.871 kgCO2e/ft2
(2 x 2.6" except for Climate Zone 7)

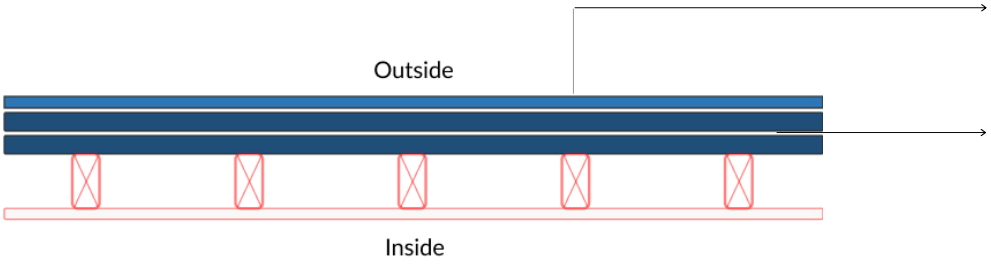
GAF PVC Better Assembly



EverGuard PVC Smooth 60 mil
0.45 kgCO2e/ft2

EnergyGuard NH Polyiso (GRF Facer)
0.871 kgCO2e/ft2
(2 x 2.6" except for Climate Zone 7)

GAF TPO Good Assembly



EverGuard TPO 60 mil
0.404 kgCO2e/ft2

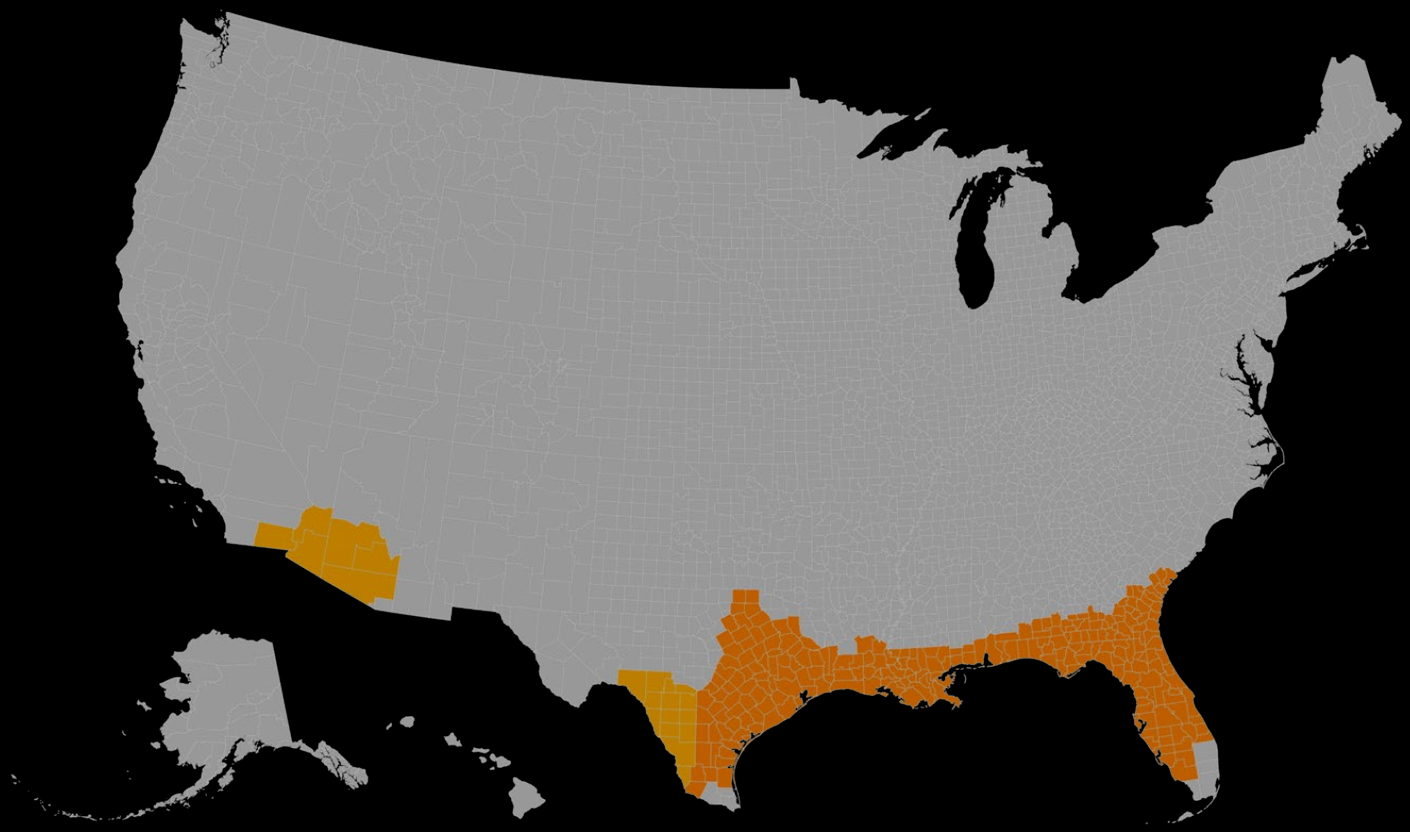
EnergyGuard Polyiso (GRF Facer)
0.871 kgCO2e/ft2
(2 x 2.6" except for Climate Zone 7)

** For Climate Zone 7, the thickness has been increased to 3.2" because 2 boards of 2.6" do not satisfy the minimum R-value requirements of ASHRAE 2019*

Climate Zone

02

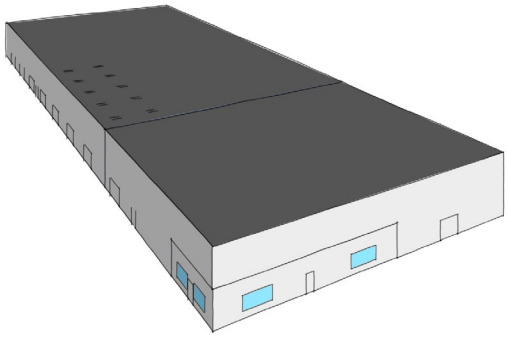
ASHRAE Climate Zone 2 is classified as a **hot-dry climate**, according to the guidelines set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone is characterized by having **fewer than 4500 heating degree days** and **more than 4500 cooling degree days** (based on a base of 10°C). The hot-dry conditions are prevalent with very low annual precipitation and high temperatures that demand extensive cooling measures. Regions typically falling within this climate zone include areas of the **Southwestern United States such as portions of Arizona and Texas**. Buildings in this zone benefit from strategies aimed at reducing cooling loads, such as high thermal mass, adequate insulation, and ventilation that maximizes nighttime cooling.



Houston, Texas

Data Center- Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

38.86%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

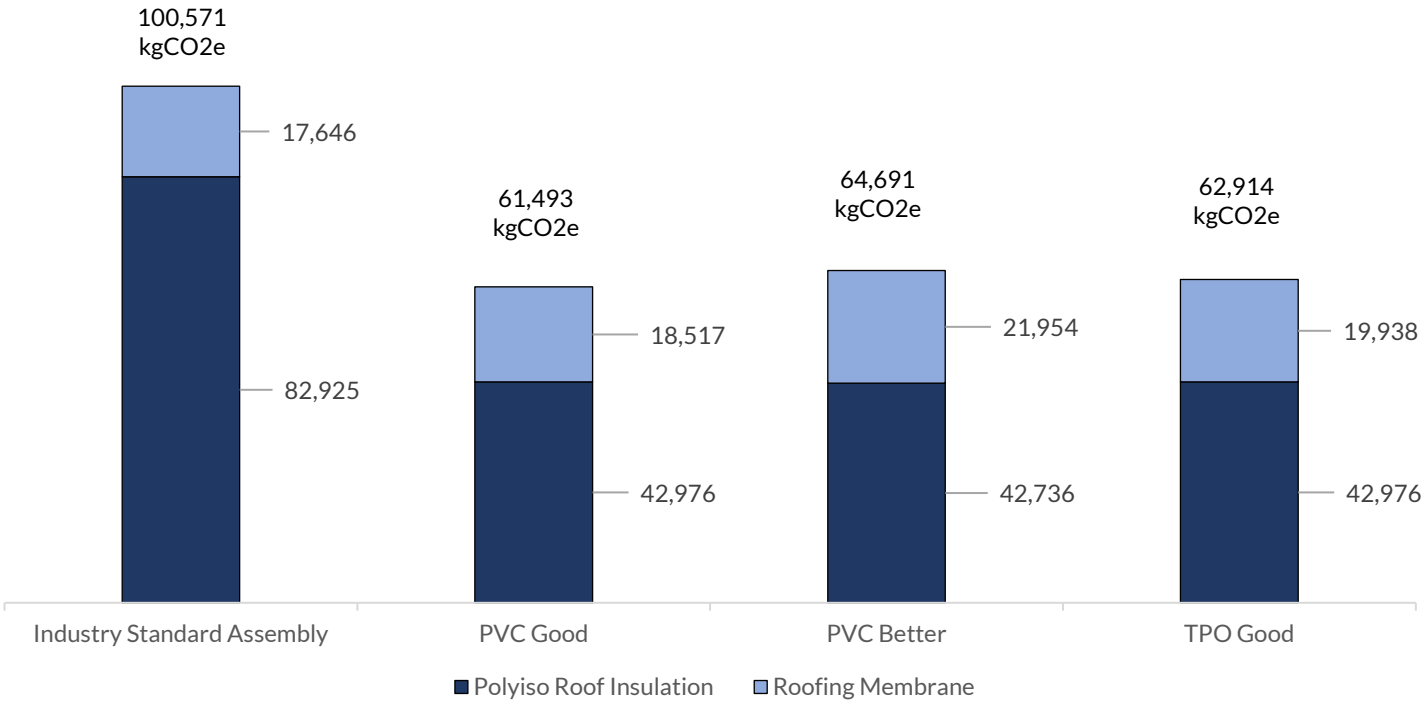
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

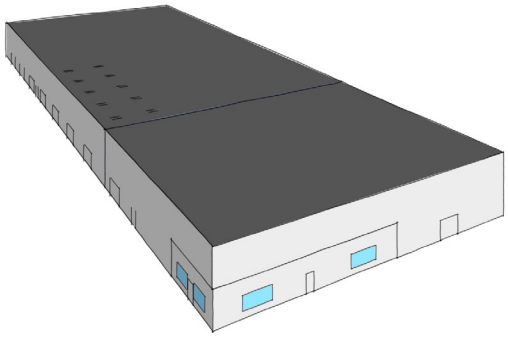
37.44%

Savings in Embodied Carbon



Data Center- Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

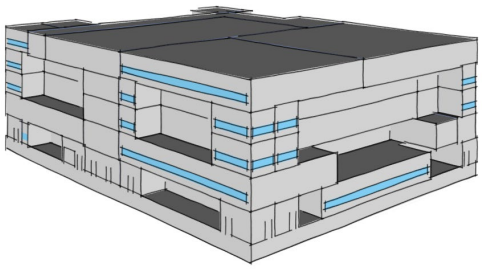
-0.01%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 2A (Houston, TX)

Embodied Carbon



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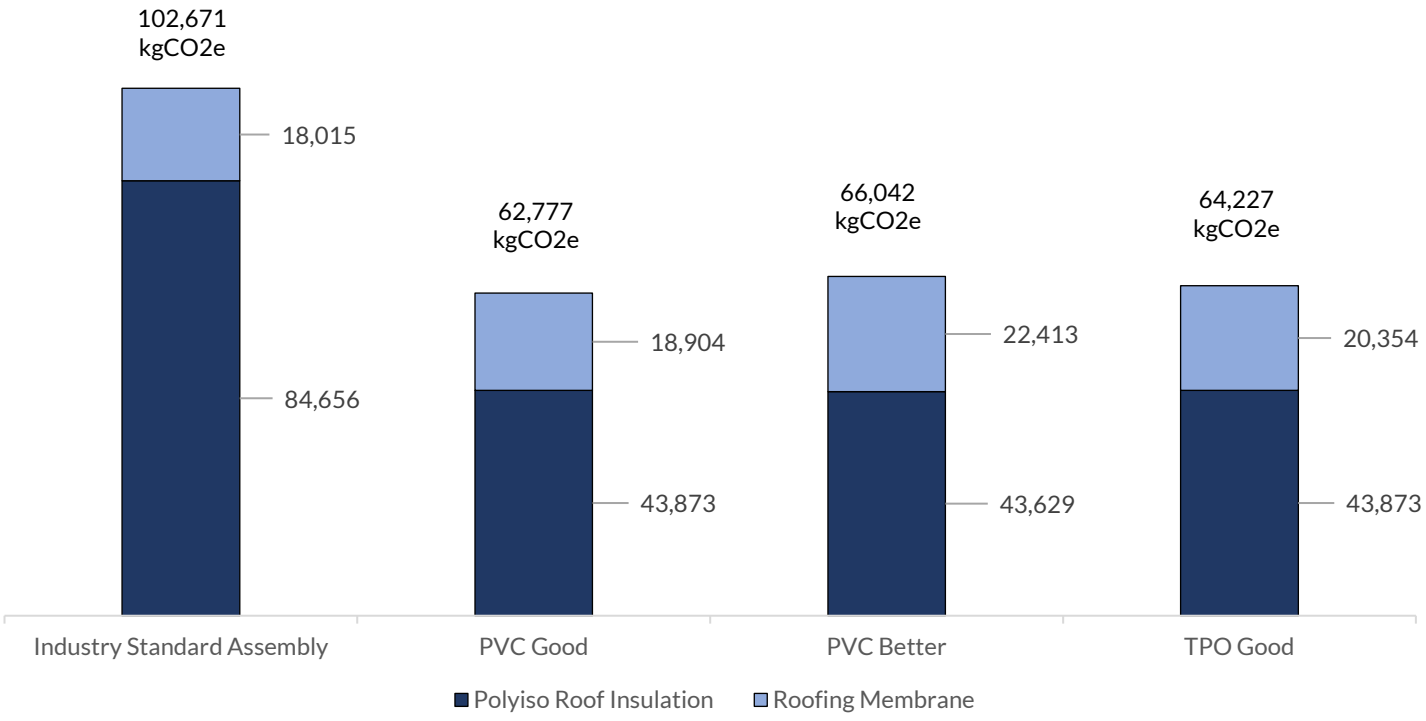
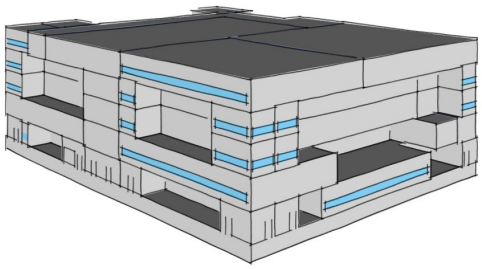


Hospital - Zone 2A (Houston. TX)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-0.04%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

-0.04 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

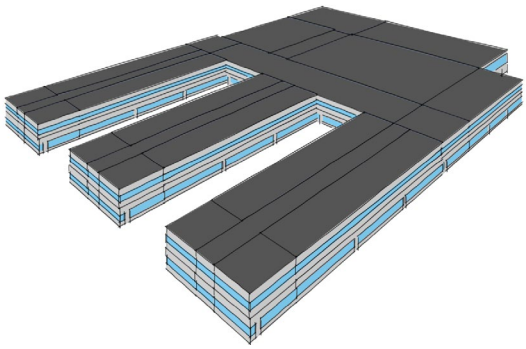
-0.04 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 2A (Houston, TX)

Embodied Carbon



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GAF TPO Good vs Industry-standard Assembly

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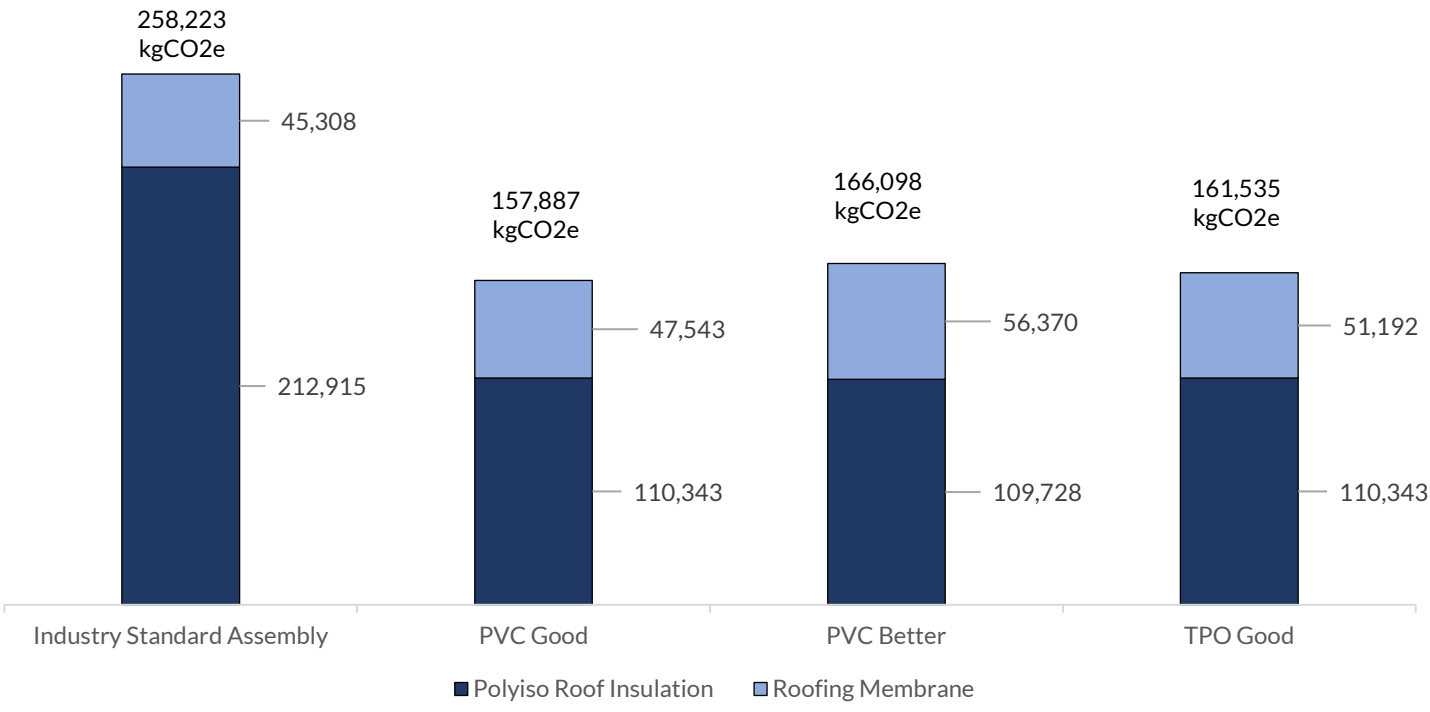
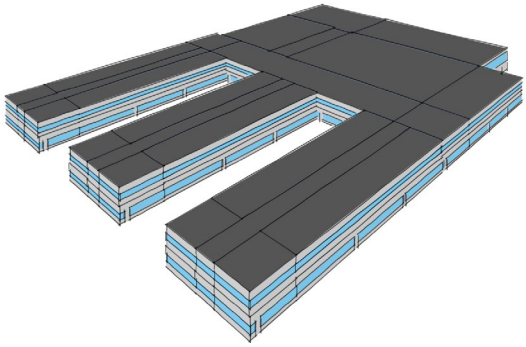
Savings in Embodied Carbon



Secondary School - Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-0.30%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

- 0.30 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

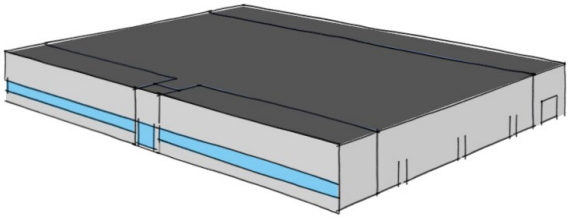
- 0.30 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

38.86%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

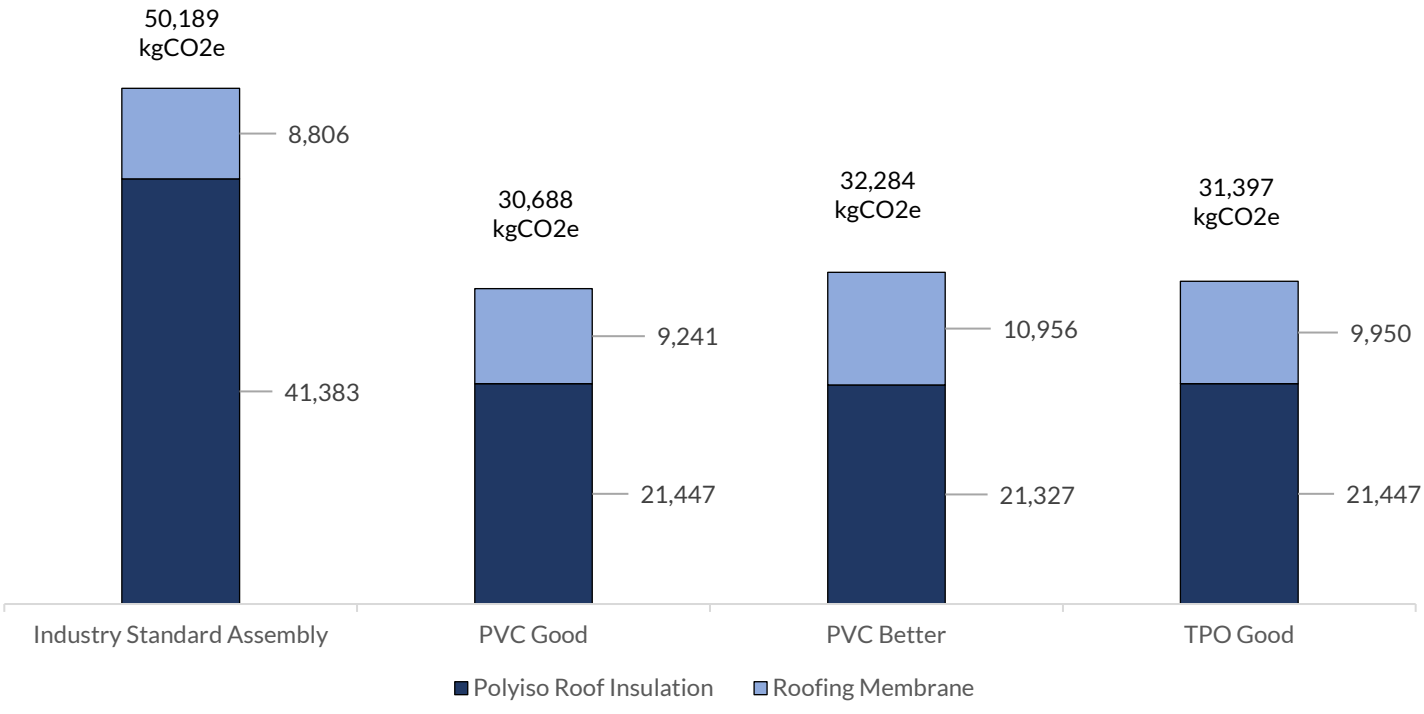
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

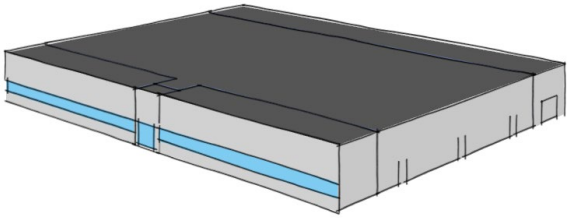
37.44%

Savings in Embodied Carbon



Retail - Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.88%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.88 %

Savings in Energy Use Intensity

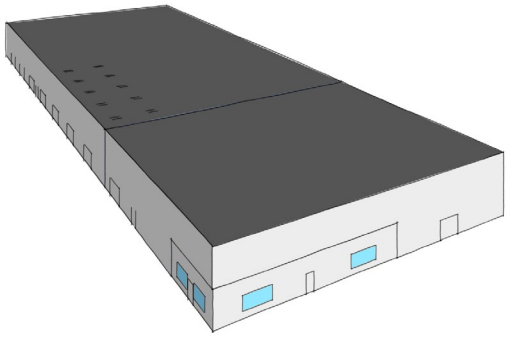
GAF TPO Good vs Industry-standard Assembly

0.88 %

Savings in Energy Use Intensity

Warehouse - Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

38.86%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

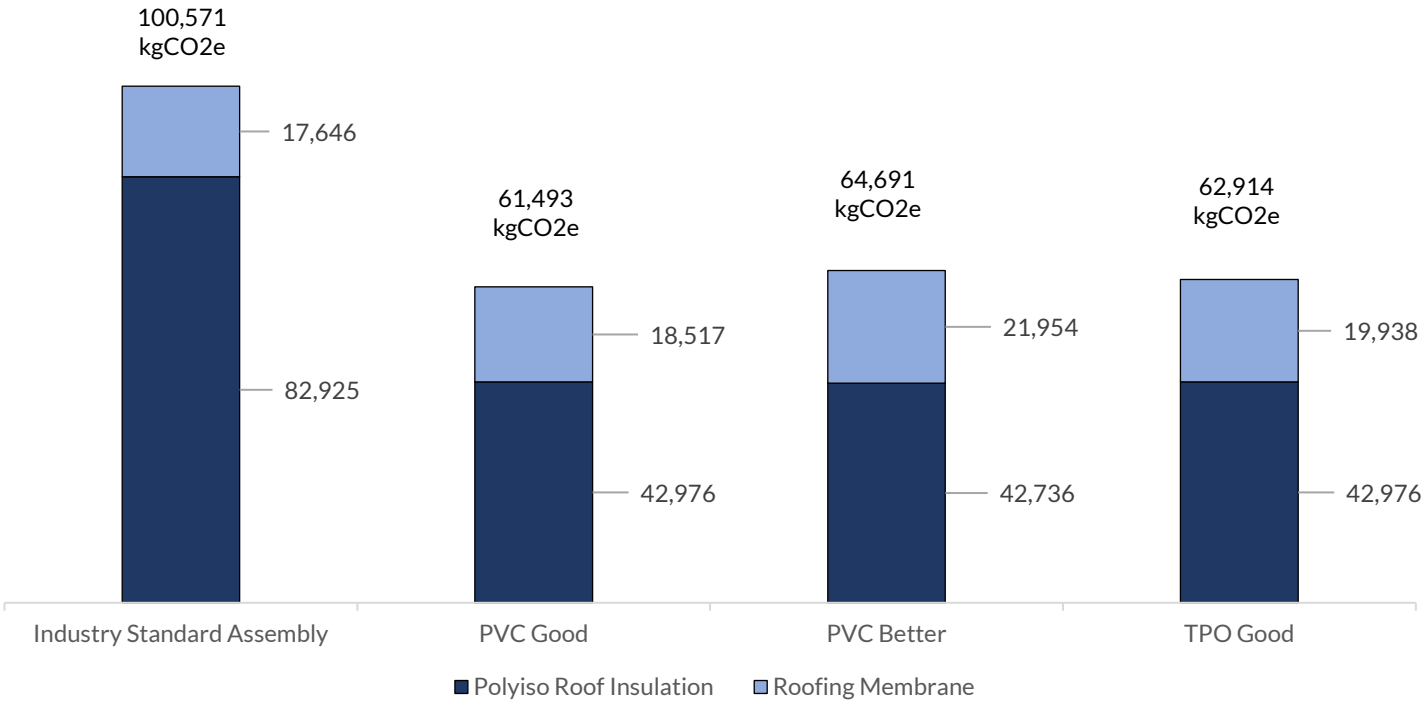
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

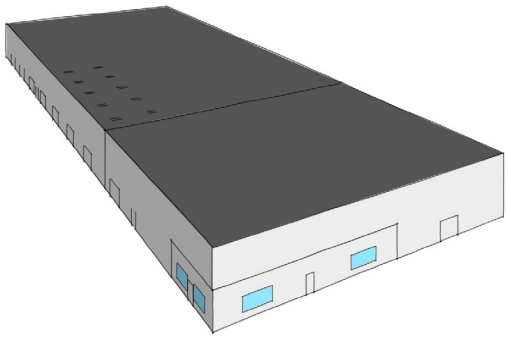
37.44%

Savings in Embodied Carbon



Warehouse - Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

2.57%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

2.57 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

2.57 %

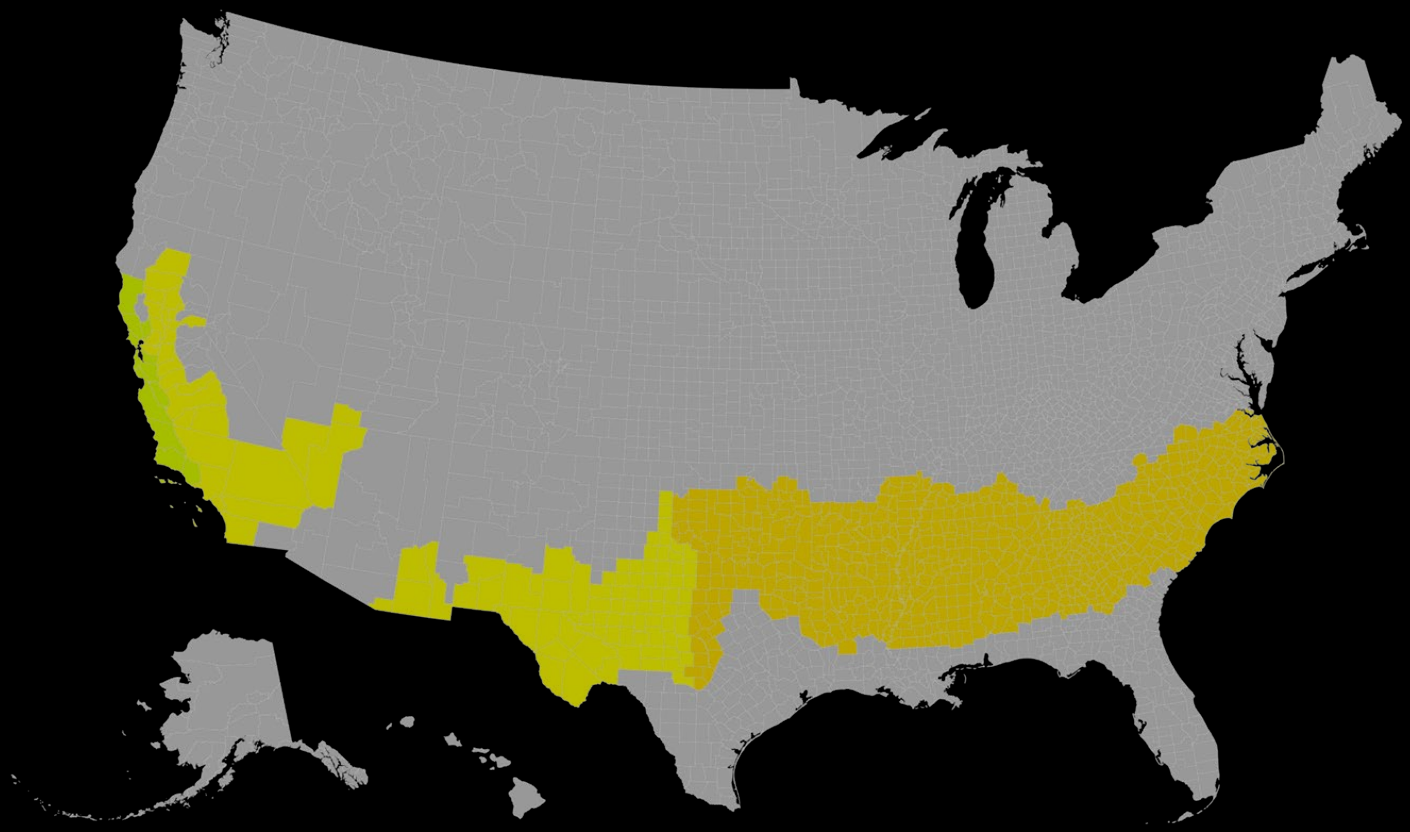
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

03

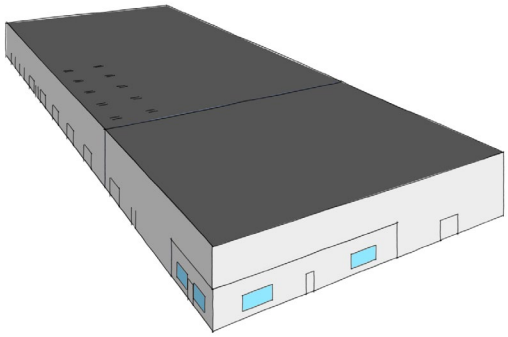
ASHRAE Climate Zone 3 is defined as a **warm-humid climate** according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **fewer than 4500 heating degree days** and **between 4500 to 9000 cooling degree days** (based on a base of 10°C). The warm-humid conditions in this zone necessitate strategies for managing both cooling and humidity control. It covers many **southeastern U.S. states including regions of Texas, Louisiana, Mississippi, Alabama, Georgia, and South Carolina**. Architectural design in this area focuses on optimizing air sealing and insulation to maintain comfortable indoor environments while minimizing the reliance on energy-intensive air conditioning systems. Features such as overhangs, shaded areas, and vapor barriers are commonly utilized to enhance building performance in this climate.



Atlanta, Georgia

Data Center- Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

38.86%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

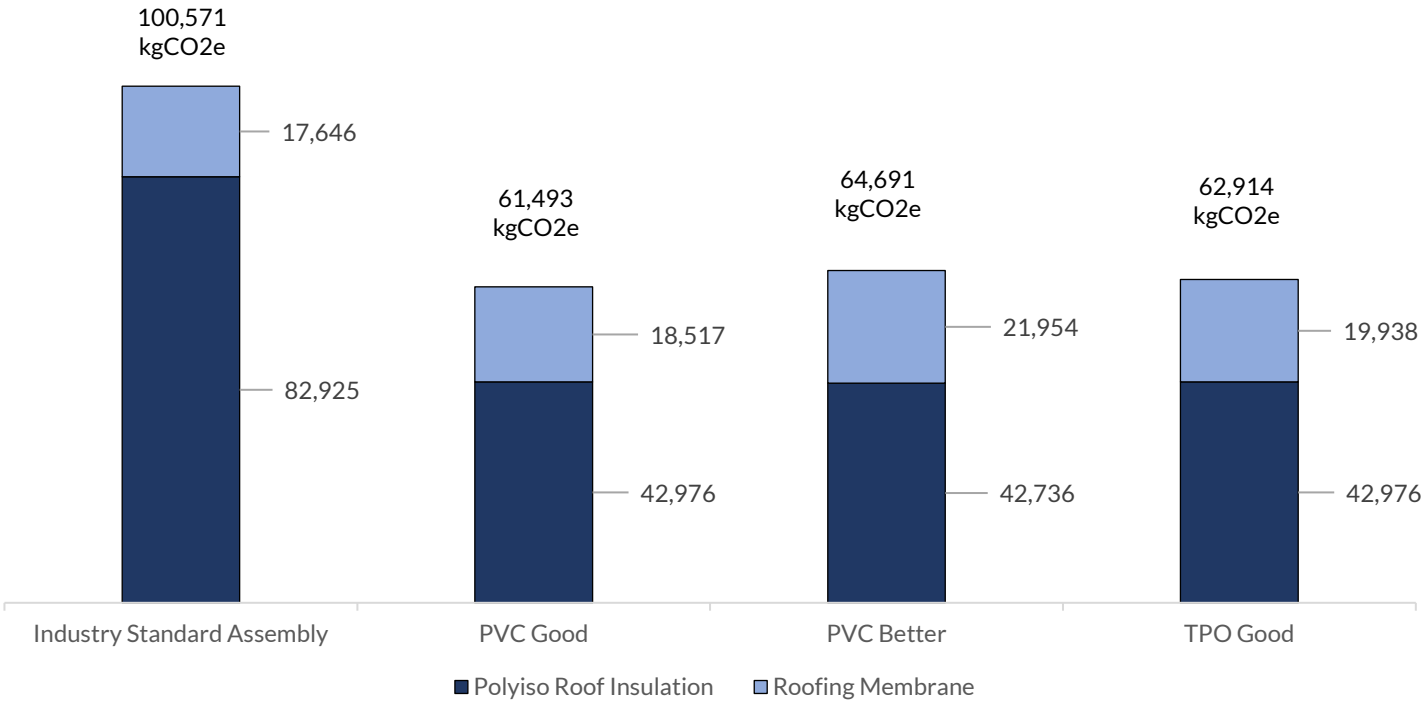
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

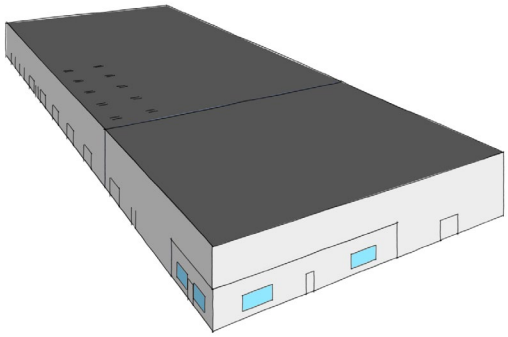
37.44%

Savings in Embodied Carbon



Data Center- Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

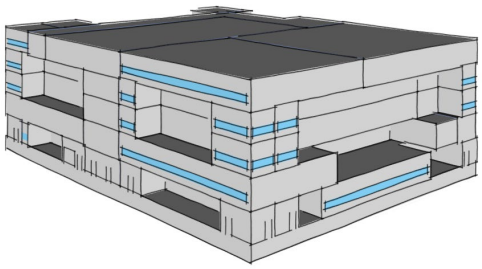
-0.01%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

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Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

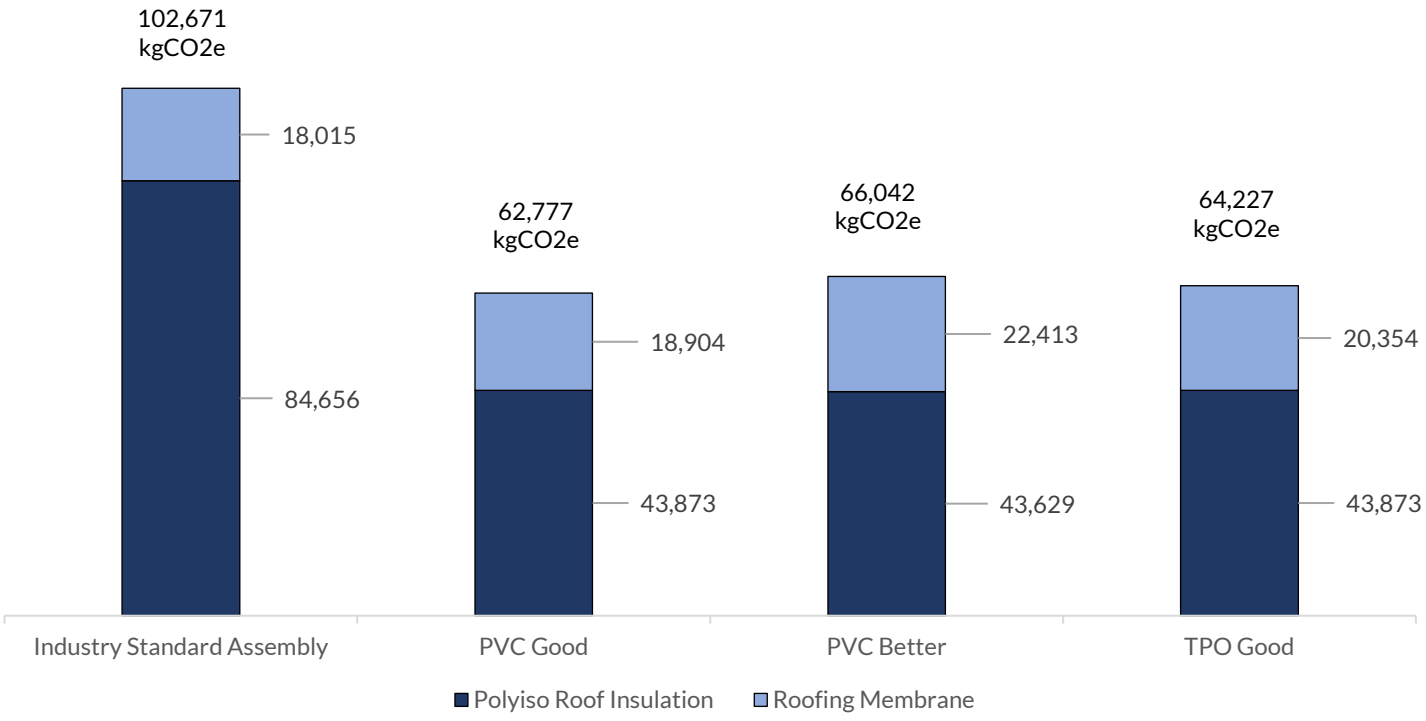
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

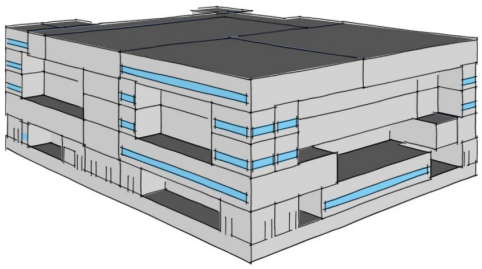
37.44%

Savings in Embodied Carbon



Hospital - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.19%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.19 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

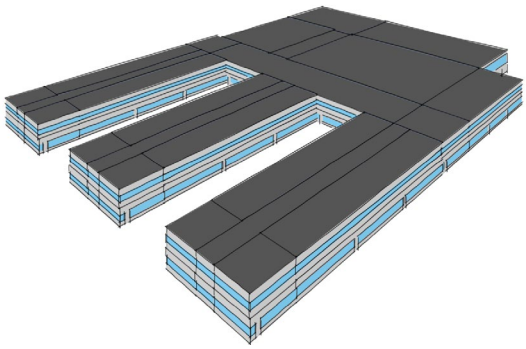
0.19 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

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GAF PVC Better vs Industry-standard Assembly

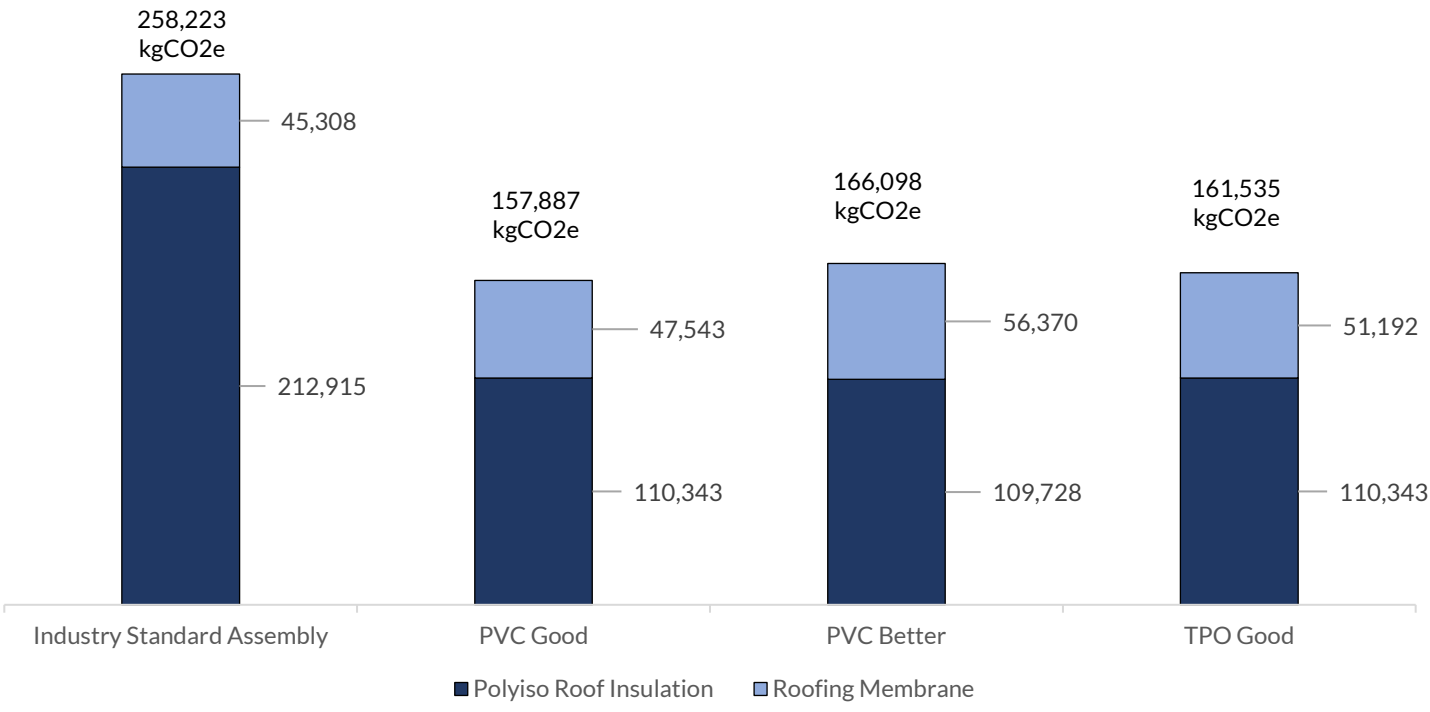
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

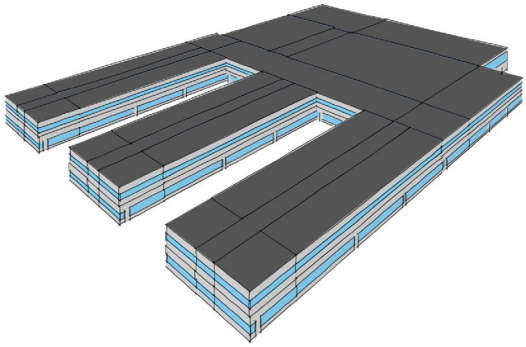
37.44%

Savings in Embodied Carbon



Secondary School - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-0.11%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

- 0.11 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

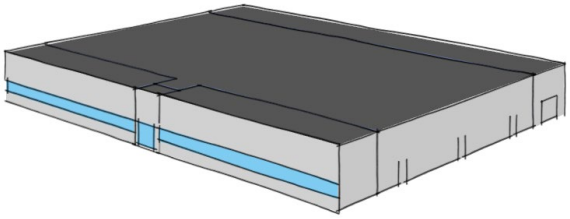
- 0.11 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

38.86%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

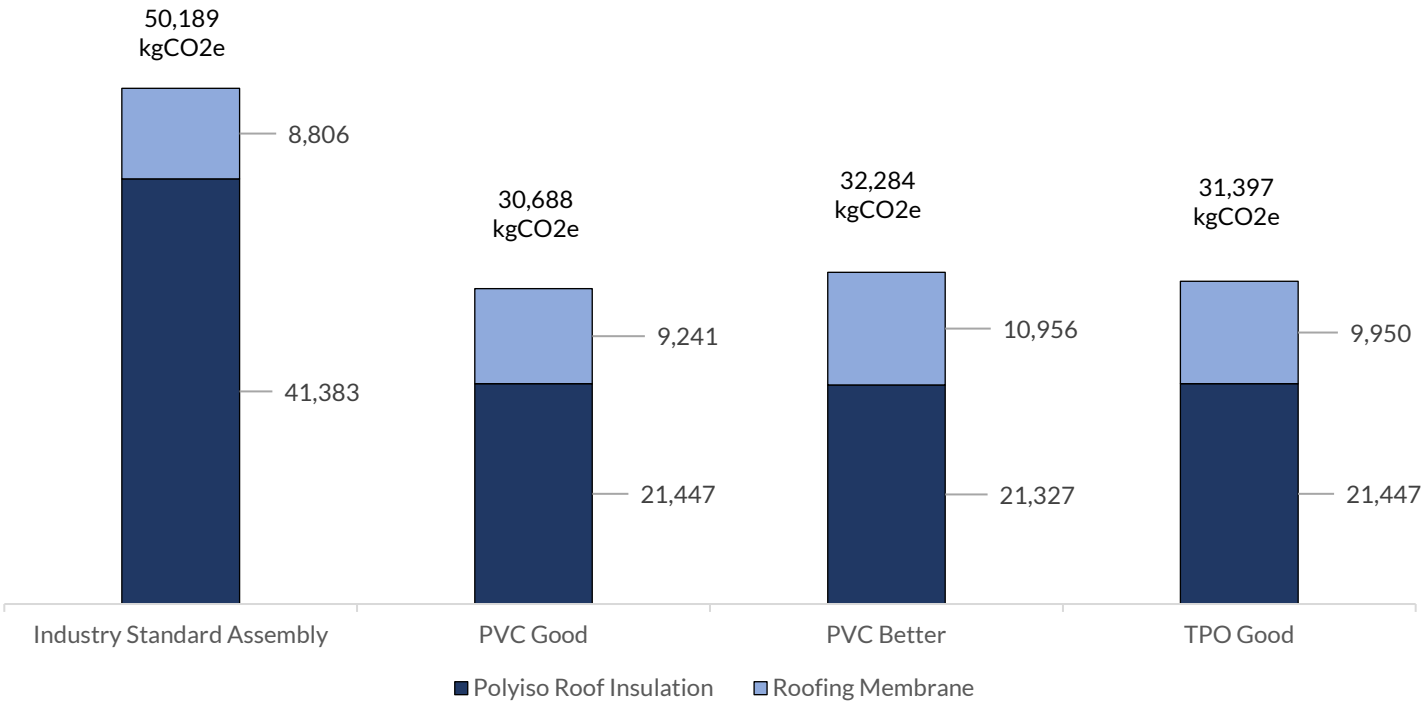
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

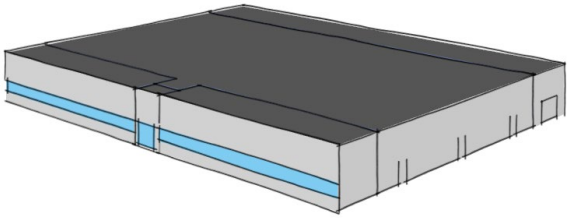
37.44%

Savings in Embodied Carbon



Retail - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

1.75%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

1.75 %

Savings in Energy Use Intensity

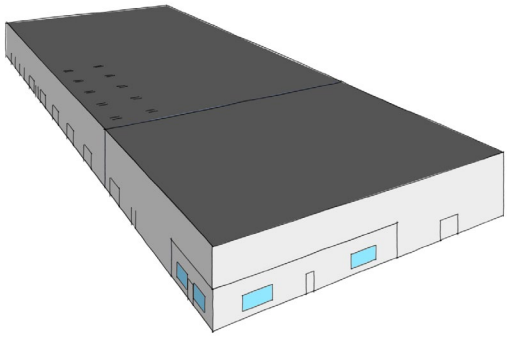
GAF TPO Good vs Industry-standard Assembly

1.75 %

Savings in Energy Use Intensity

Warehouse - Zone 3A (Atlanta, GA)

Embodied Carbon



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Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

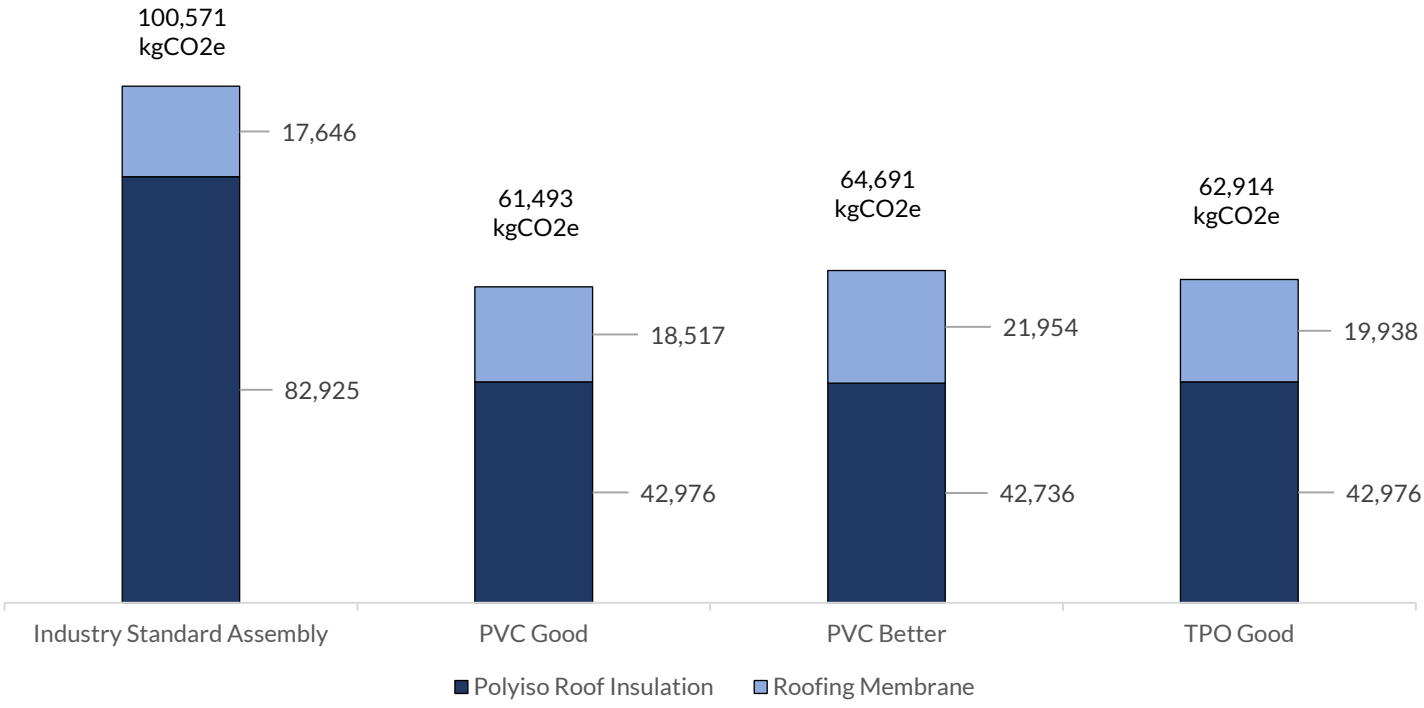
35.68%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

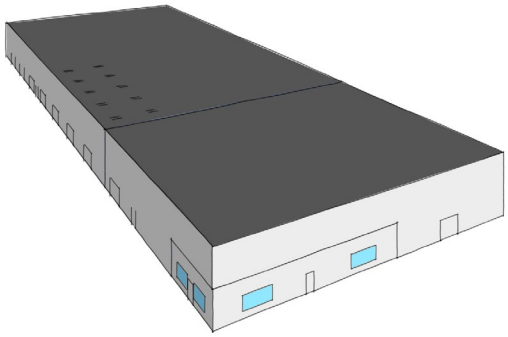
37.44%

Savings in Embodied Carbon



Warehouse - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

4.08%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

4.08 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

4.08 %

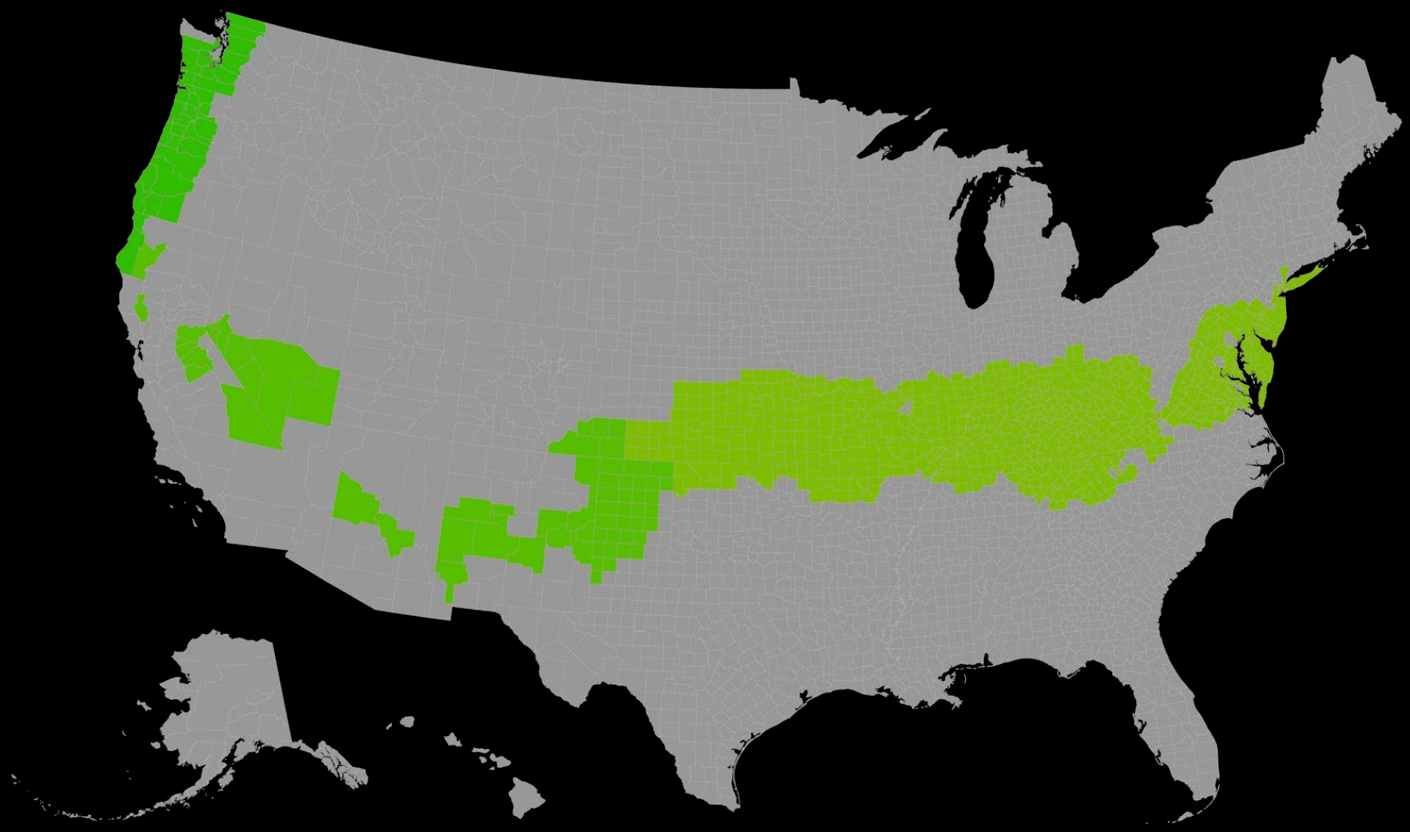
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

04

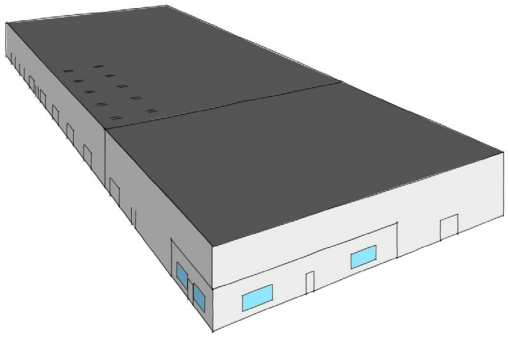
ASHRAE Climate Zone 4 is designated as a **mixed-humid climate**, according to the standards established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **fewer than 4500 heating degree days** and **between 4500 to 9000 cooling degree days** (based on a base of 10°C). The climate here includes distinct seasonal variations with both moderate heating in winter and significant cooling requirements in the summer, necessitating versatile climate control solutions in buildings. Zone 4 covers parts of the **Mid-Atlantic, including some regions of Virginia, North Carolina, Tennessee, and as far west as parts of Kansas and Oklahoma**. Effective strategies in this climate typically involve balanced insulation, energy-efficient windows, and moisture control systems to handle the relatively high humidity and varying temperatures throughout the year.



Baltimore, Maryland

Data Center- Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

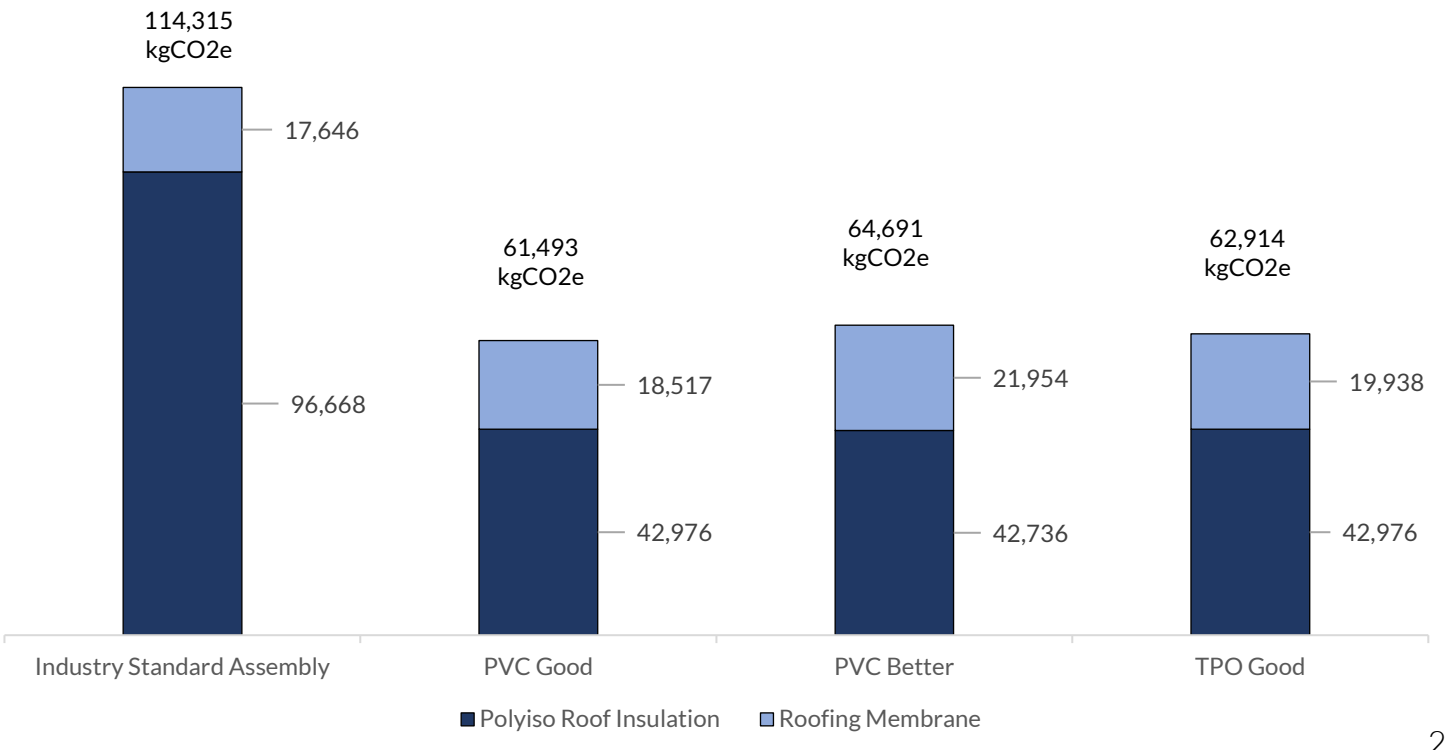
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

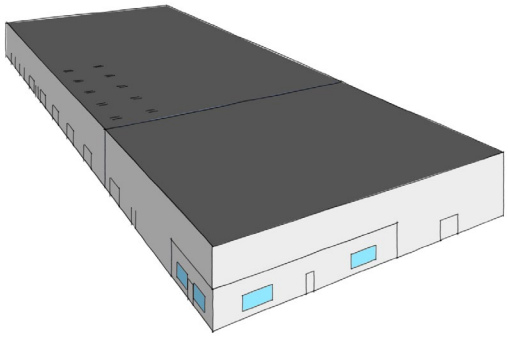
44.96%

Savings in Embodied Carbon



Data Center- Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

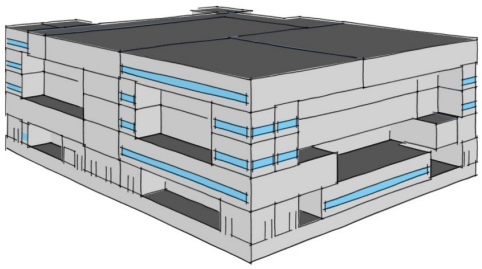
0.00%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

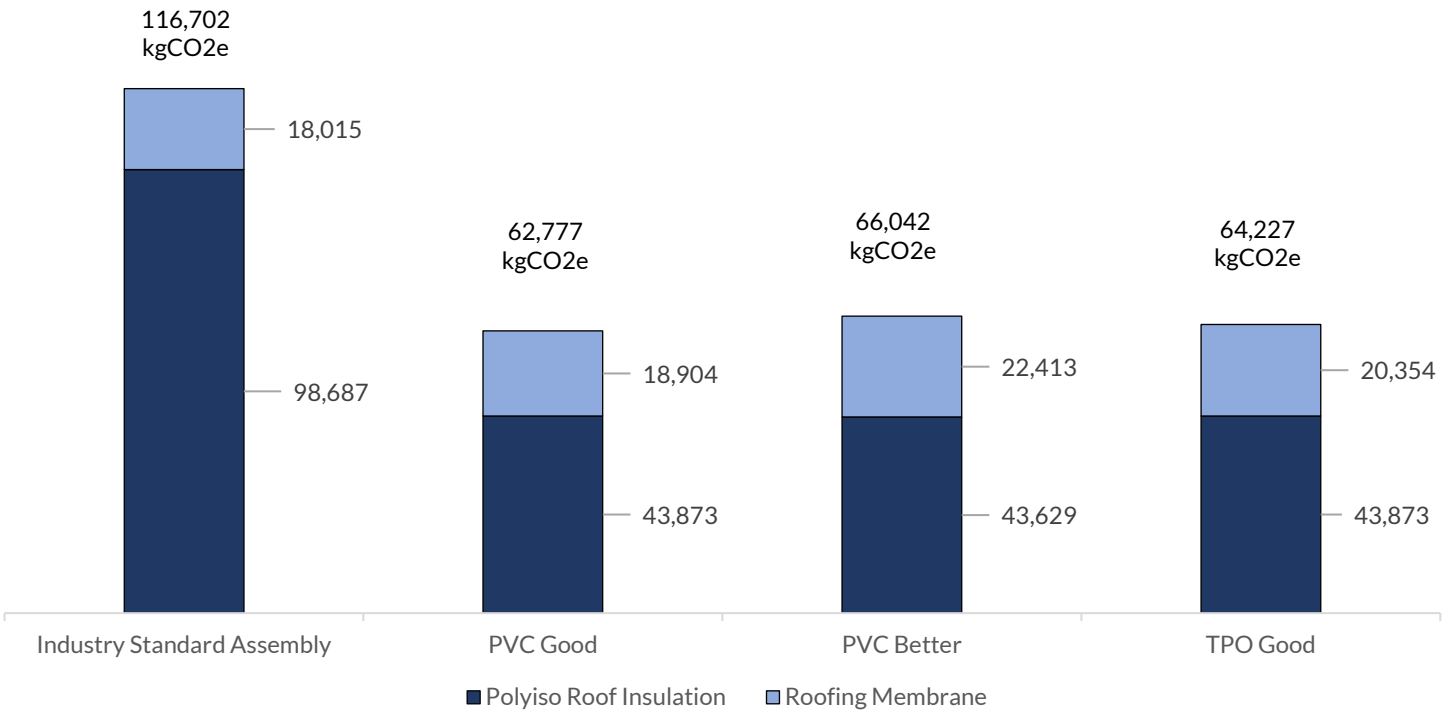
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

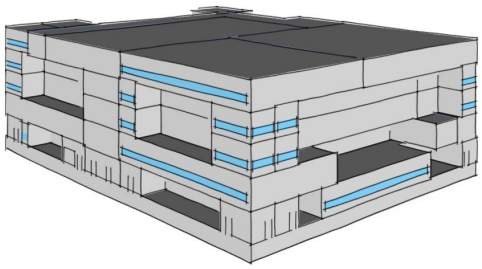
44.96%

Savings in Embodied Carbon



Hospital - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

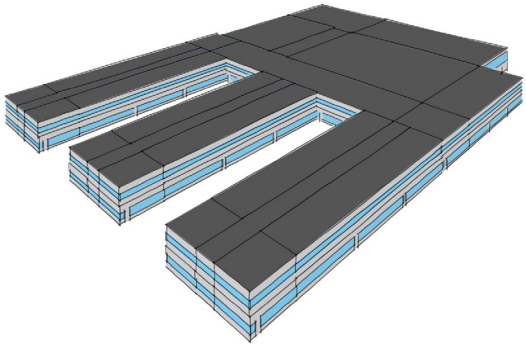
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

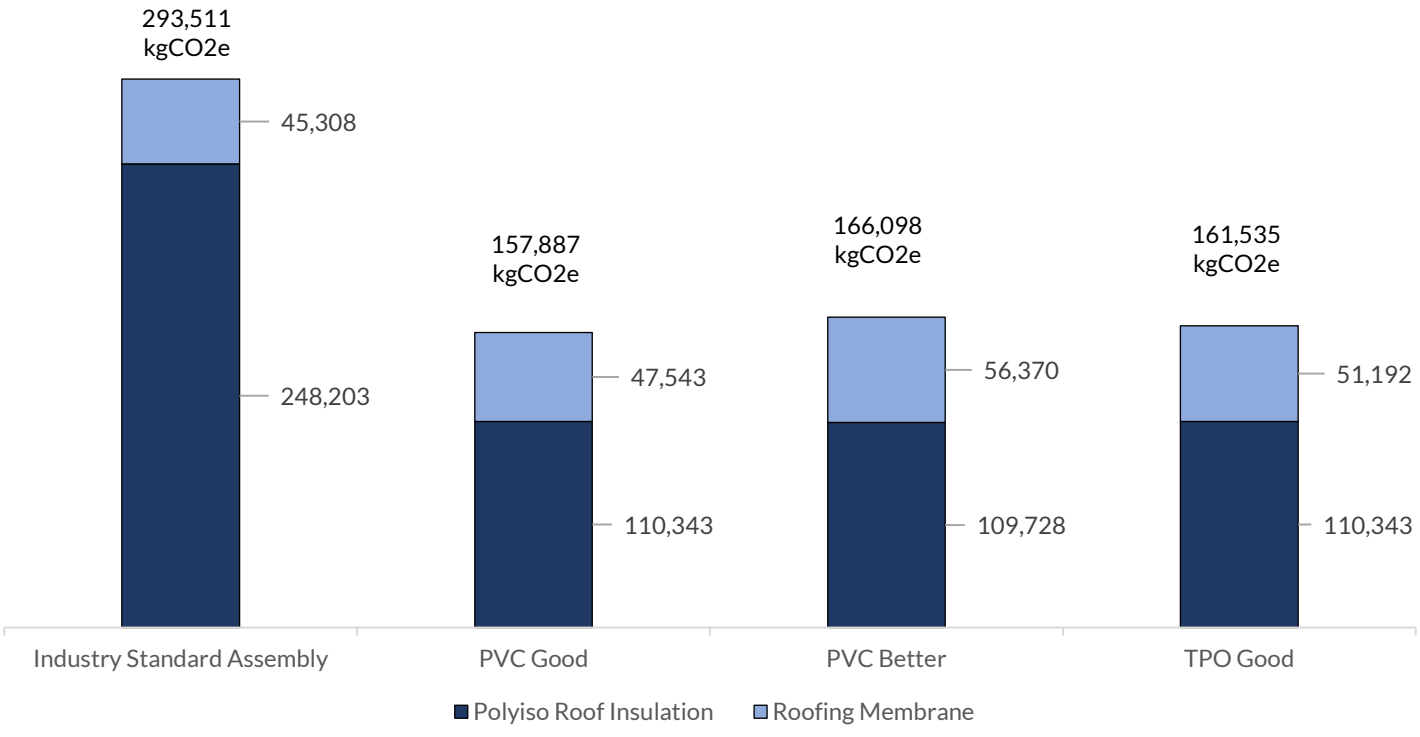
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

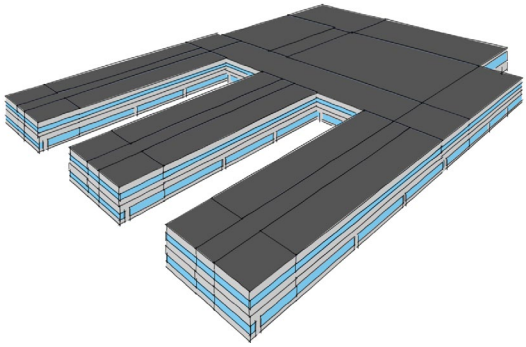
44.96%

Savings in Embodied Carbon



Secondary School - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

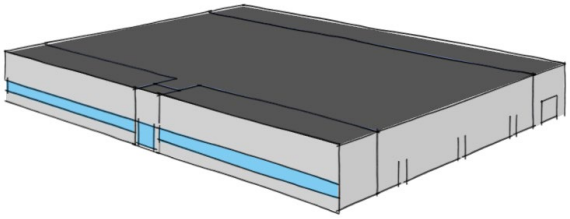
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

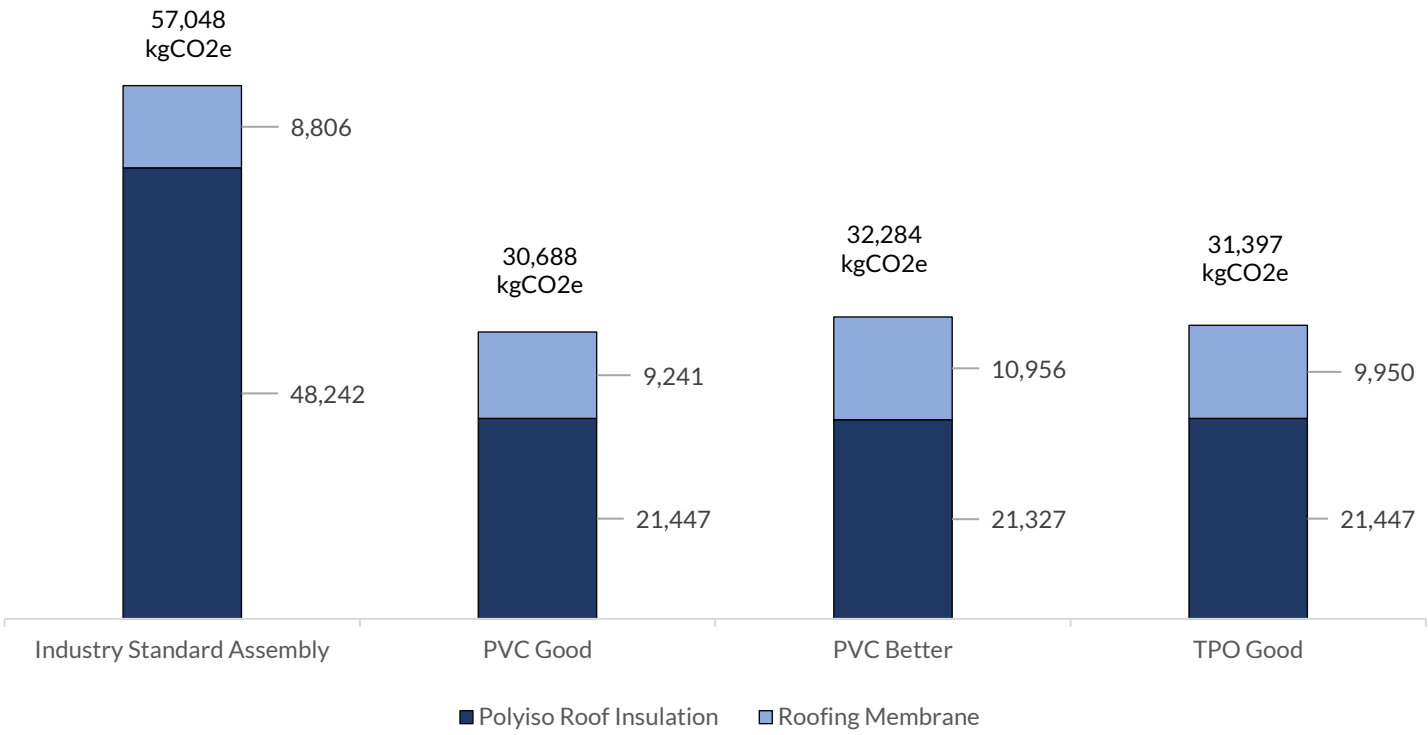
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

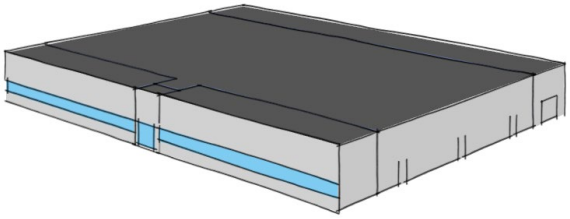
44.96%

Savings in Embodied Carbon



Retail - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-3.32%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

-3.32 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

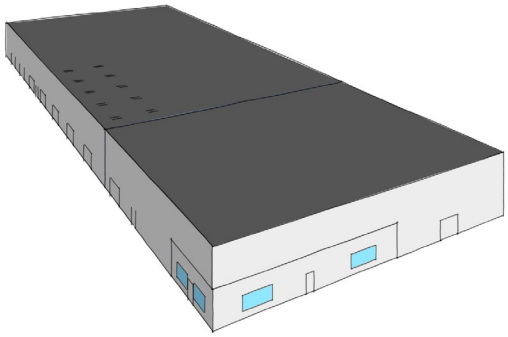
-3.32 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

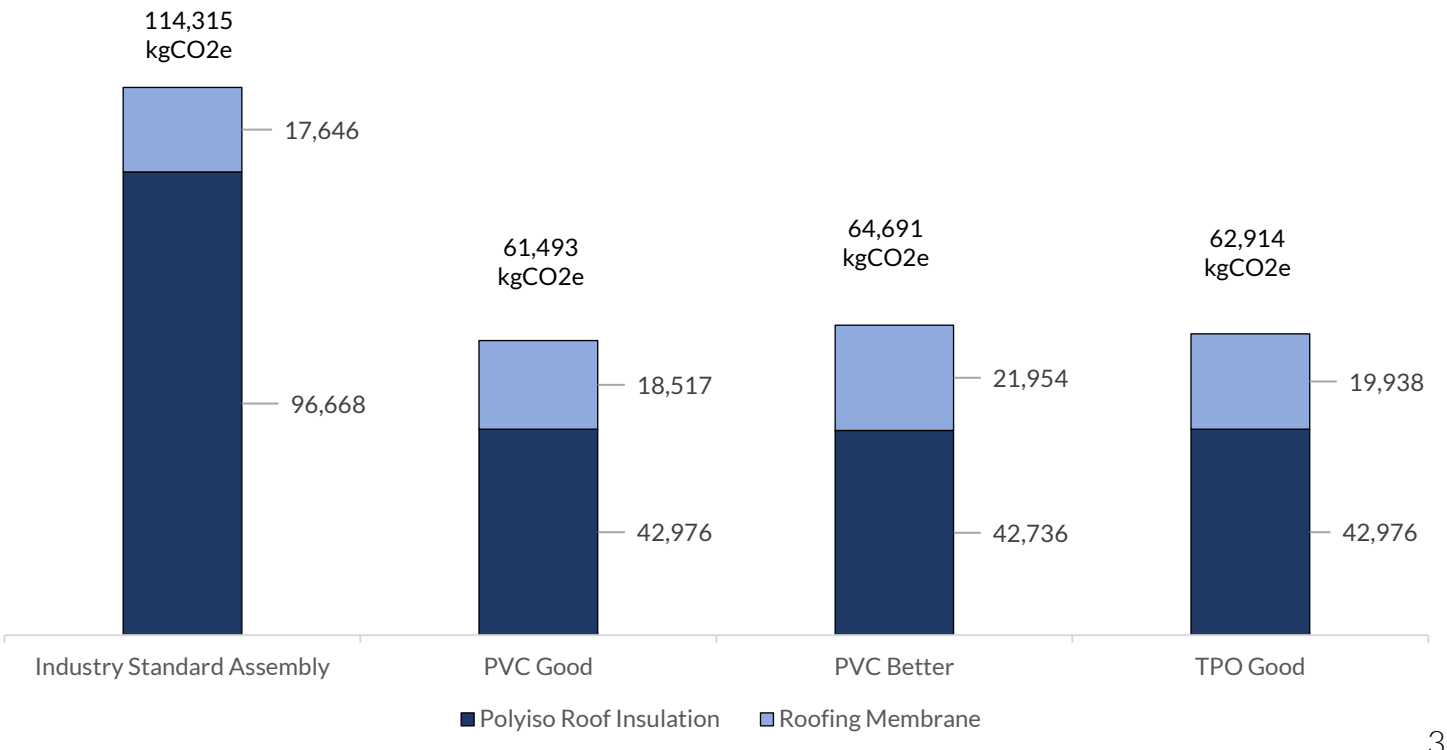
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

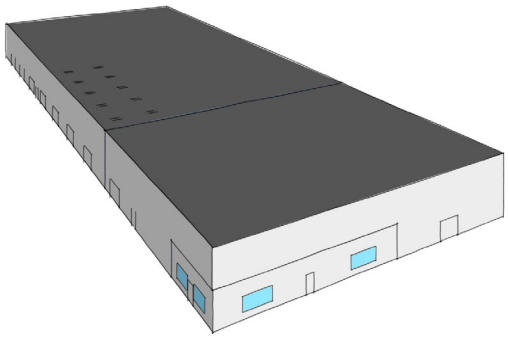
44.96%

Savings in Embodied Carbon



Warehouse - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

0.00 %

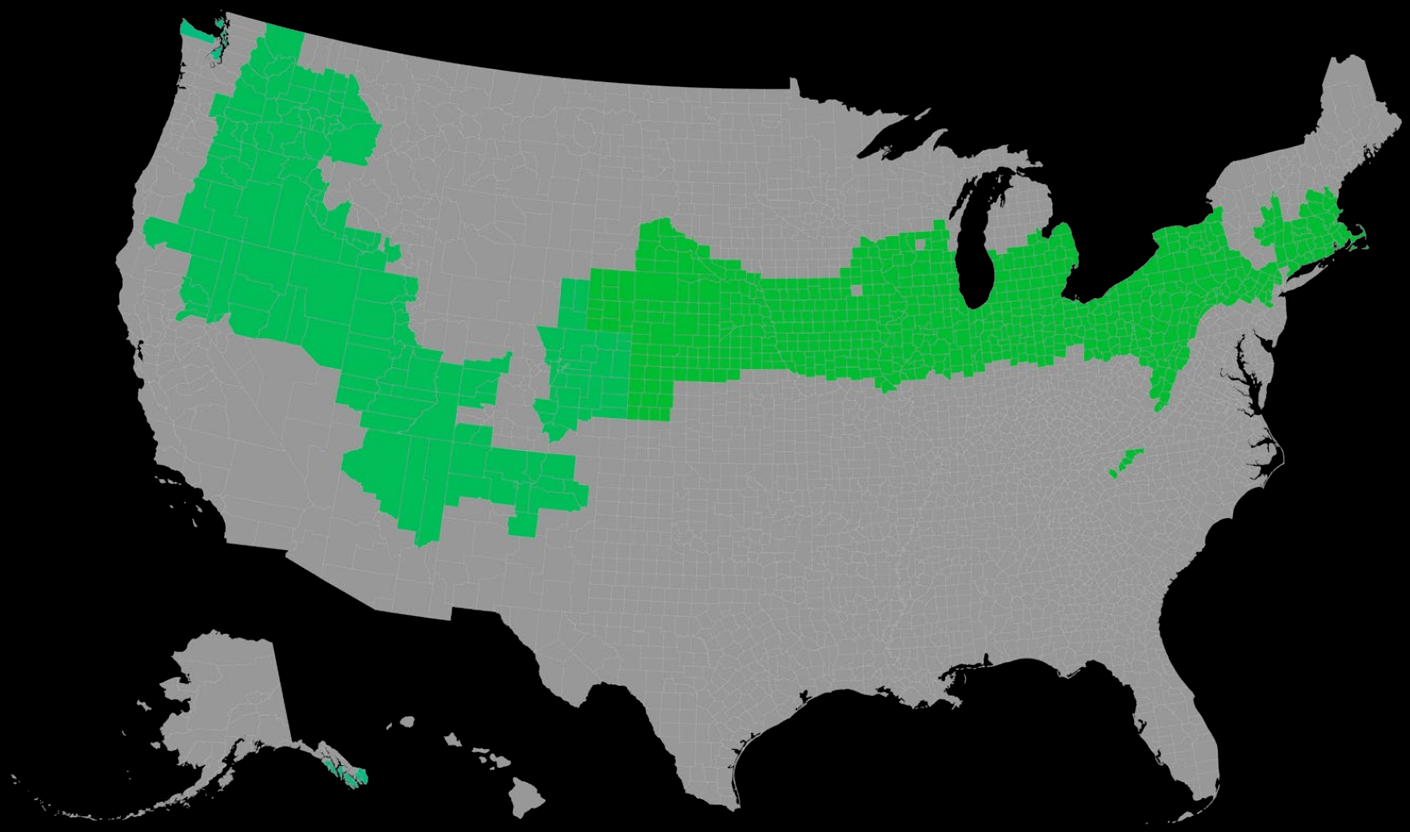
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

05

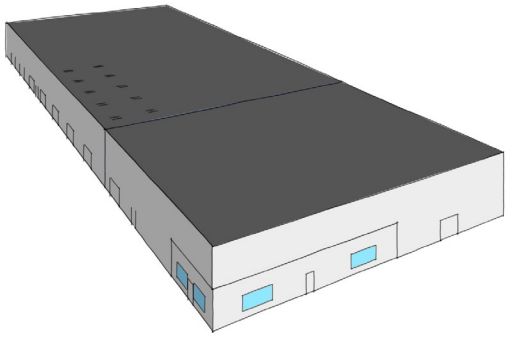
ASHRAE Climate Zone 5 is classified as a **mixed-dry climate**, according to the standards of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **between 4500 and 9000 heating degree days** and **fewer than 4500 cooling degree days** (based on a base of 10°C). The climate in this zone features significant seasonal temperature swings, with cold winters and moderately warm summers, necessitating diverse heating strategies and moderate cooling approaches. Zone 5 encompasses parts of the **interior United States, including regions such as parts of Colorado, Nebraska, and Missouri**. Building strategies in this area often focus on maximizing insulation, utilizing solar heat gain in the winter while minimizing it in the summer, and incorporating efficient heating systems to cope with the colder months while using less extensive cooling systems for the summer.



Chicago, Illinois

Data Center- Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

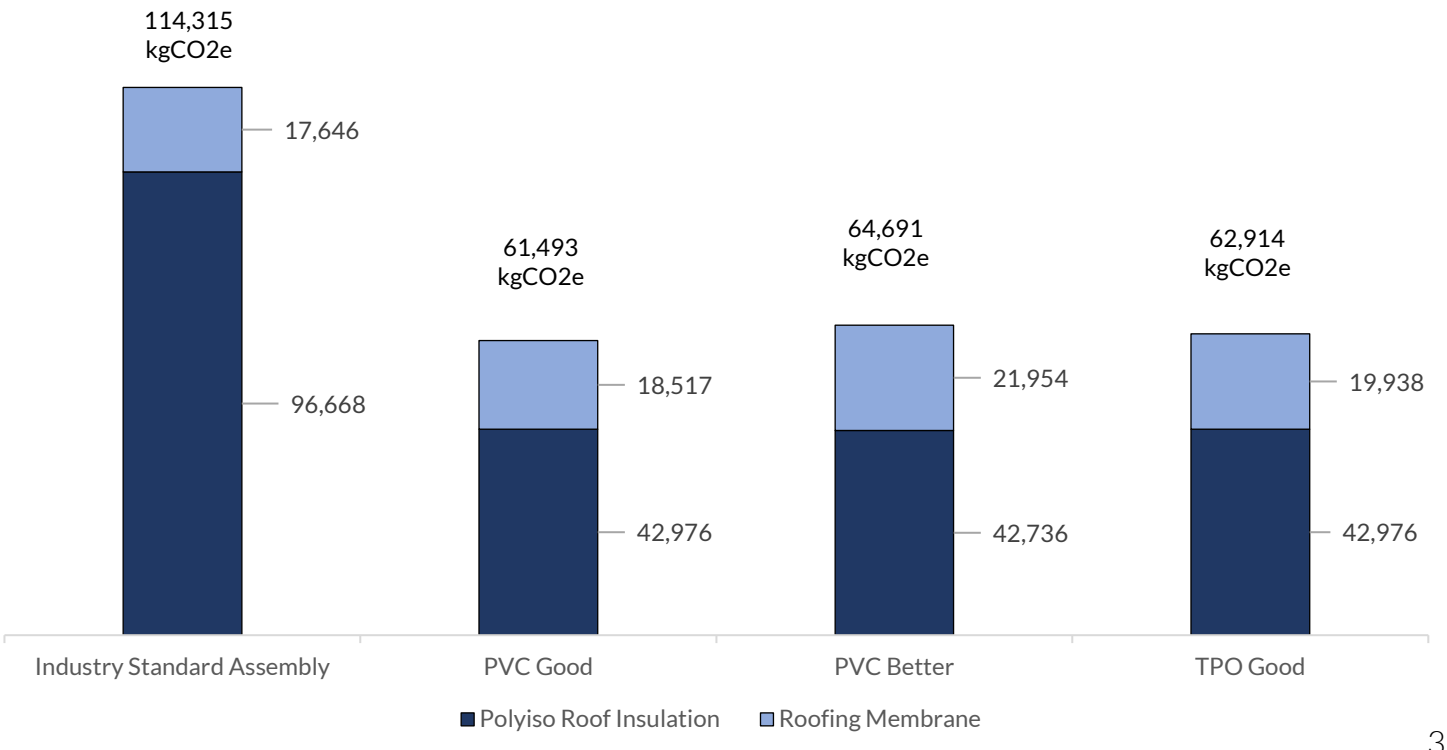
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

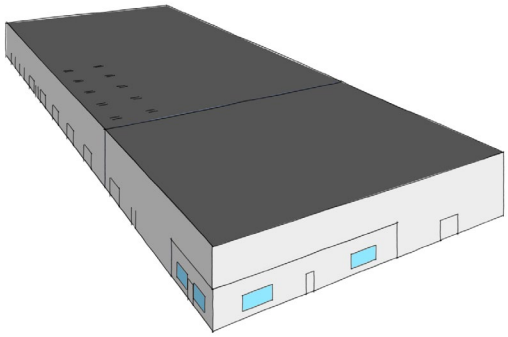
44.96%

Savings in Embodied Carbon



Data Center- Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

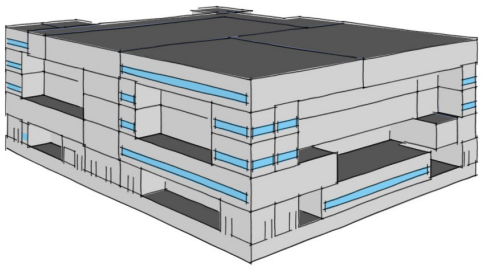
0.00%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 5A (Chicago, IL)

Embodied Carbon



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43.41%

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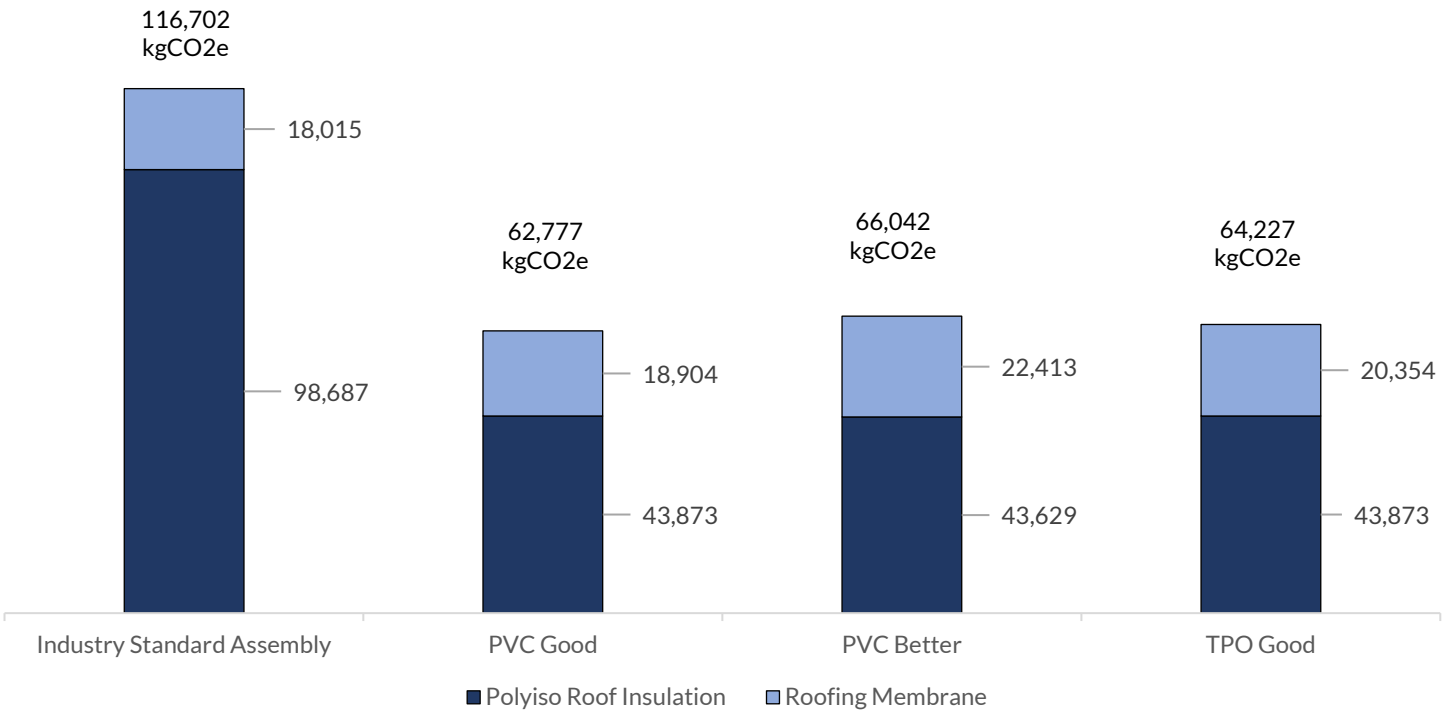
GAF TPO Good vs Industry-standard Assembly

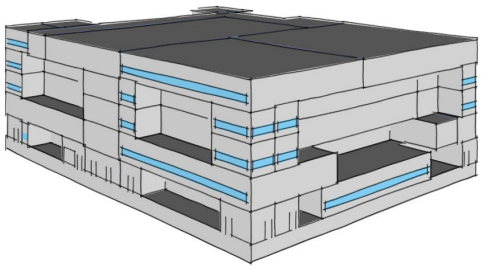
44.96%

Savings in Embodied Carbon



Hospital - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

-0.05%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

-0.05 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

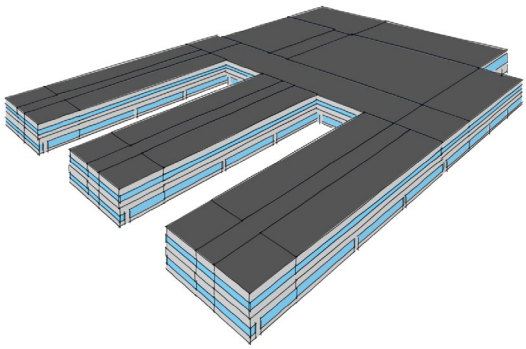
-0.05 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

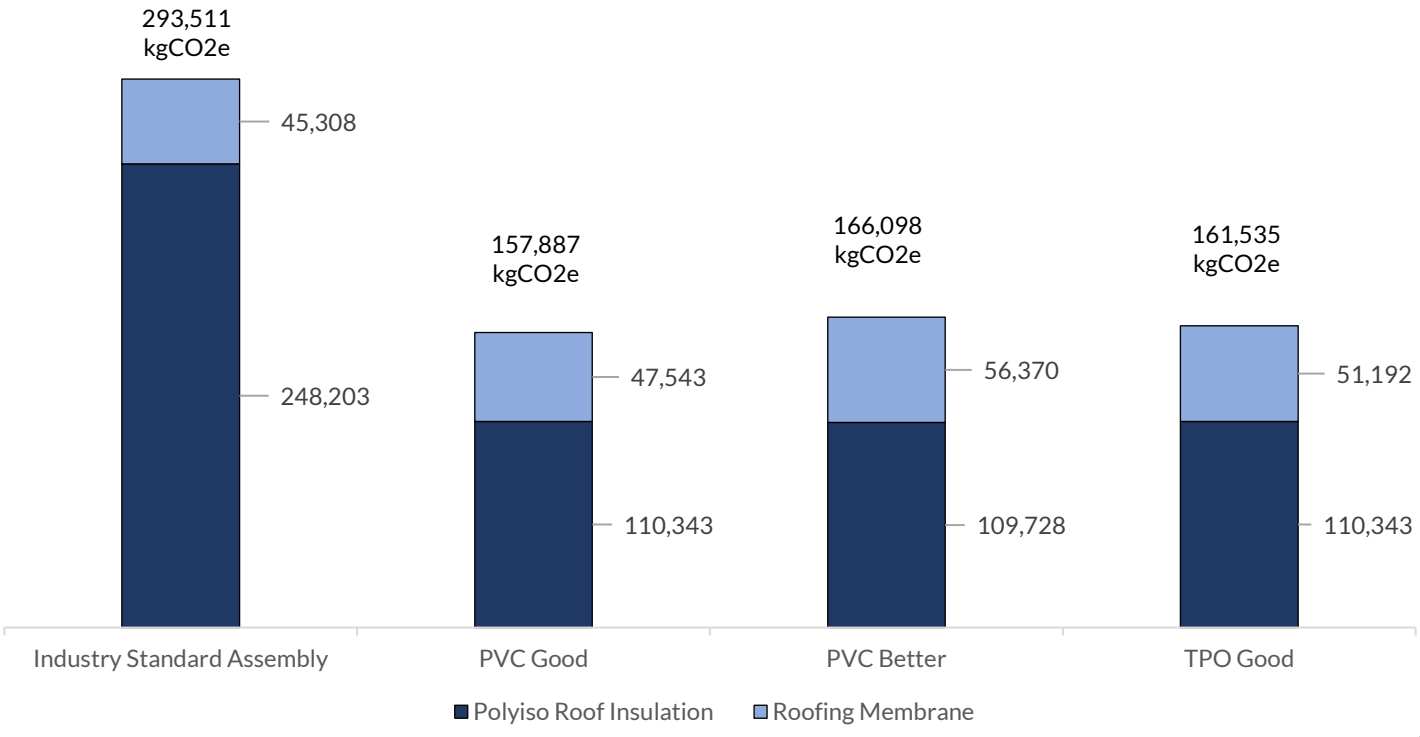
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

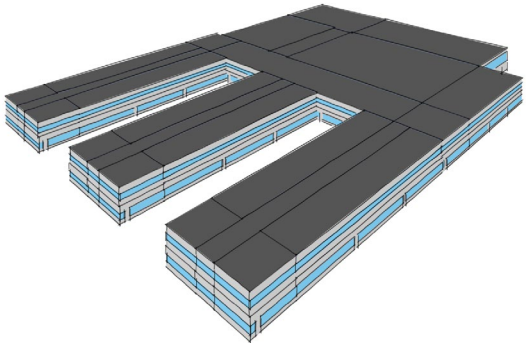
44.96%

Savings in Embodied Carbon



Secondary School - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

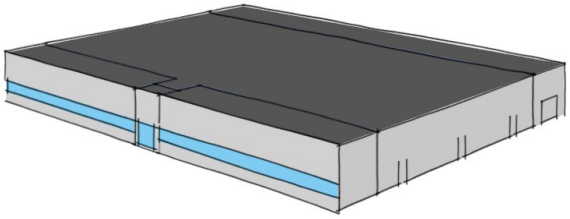
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 5A (Chicago, IL)

Embodied Carbon



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Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

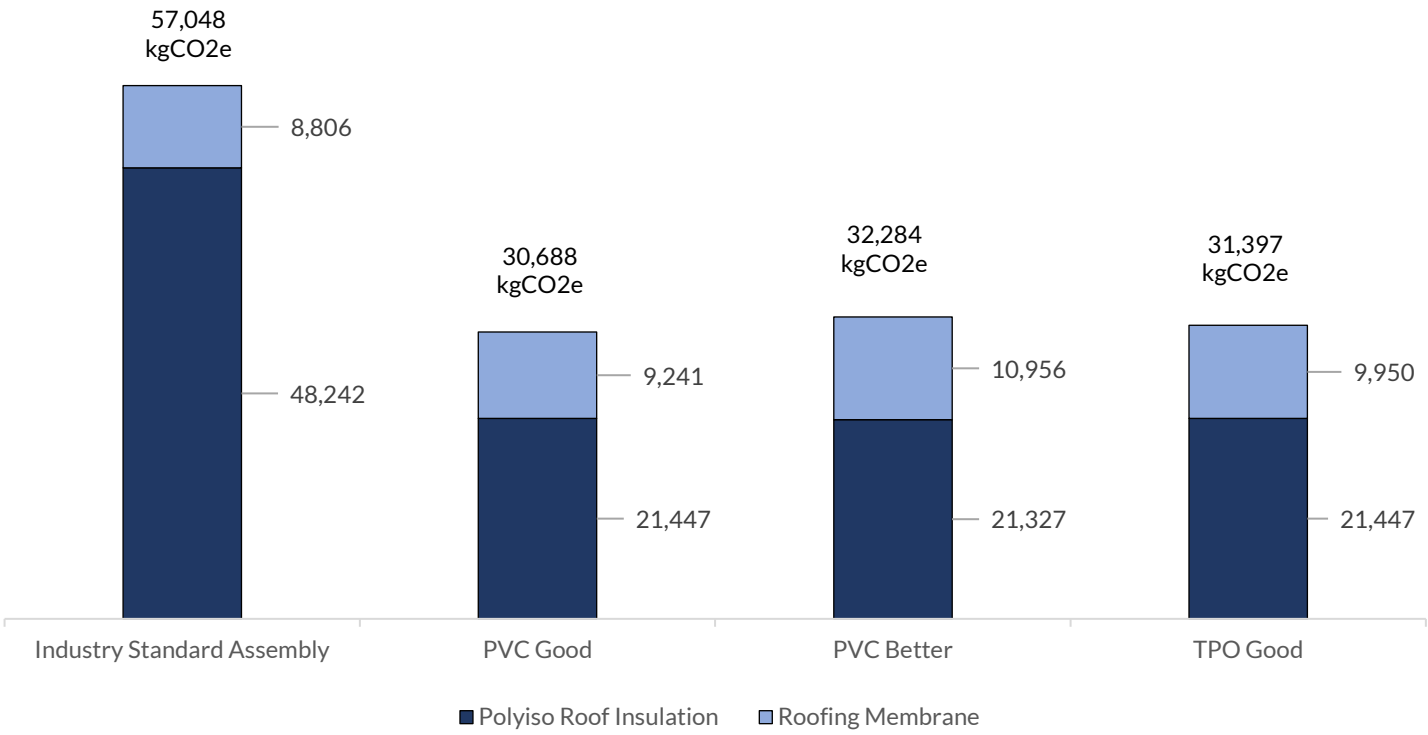
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

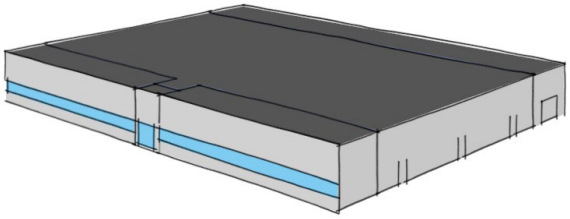
44.96%

Savings in Embodied Carbon



Retail - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

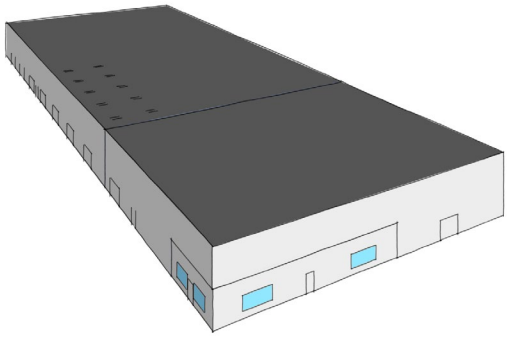
GAF TPO Good vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

Warehouse - Zone 5A (Chicago, IL)

Embodied Carbon



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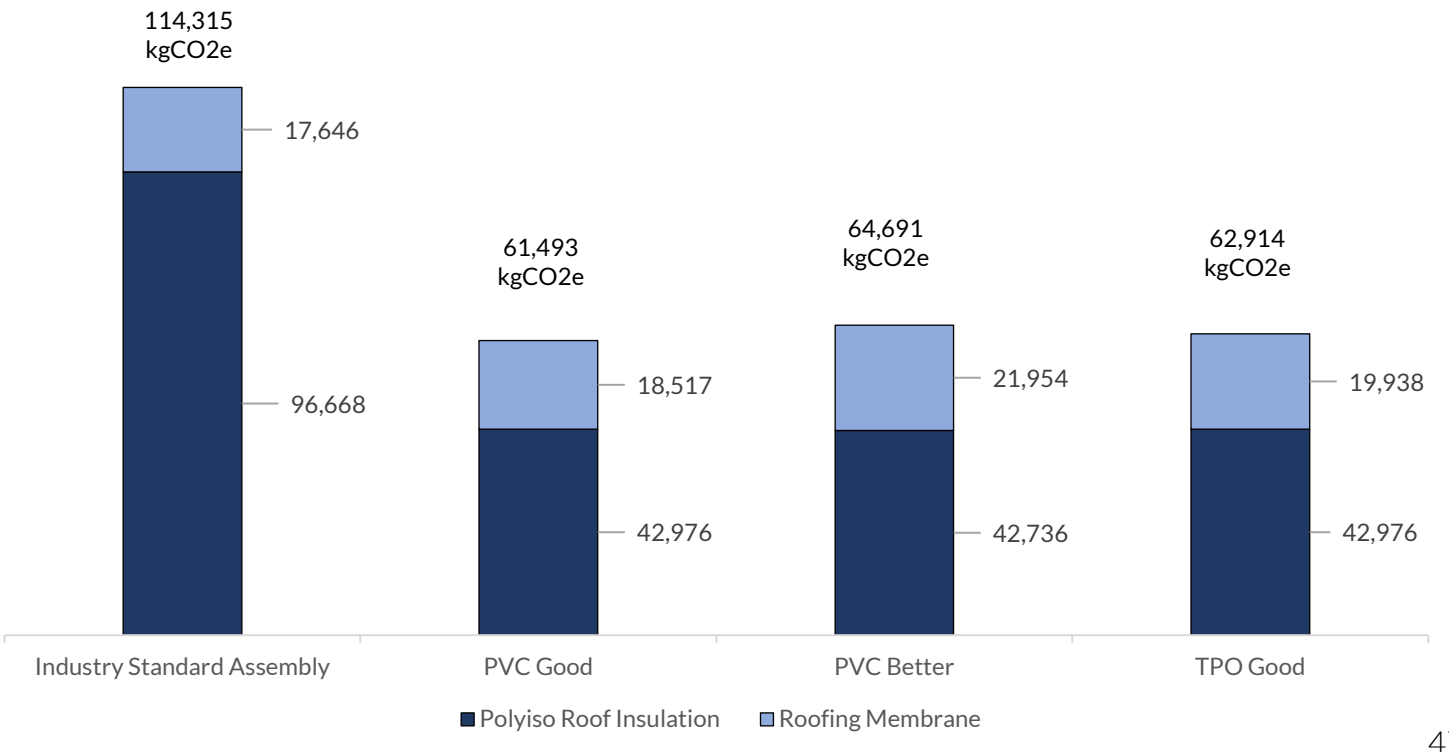
Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

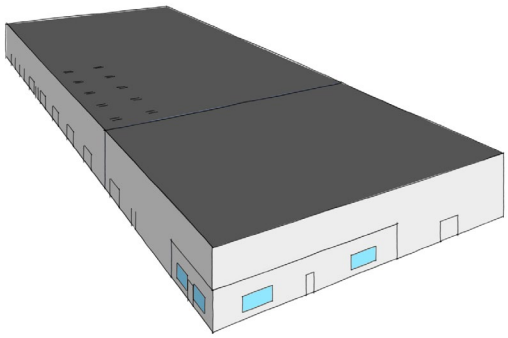
44.96%

Savings in Embodied Carbon



Warehouse - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

0.00 %

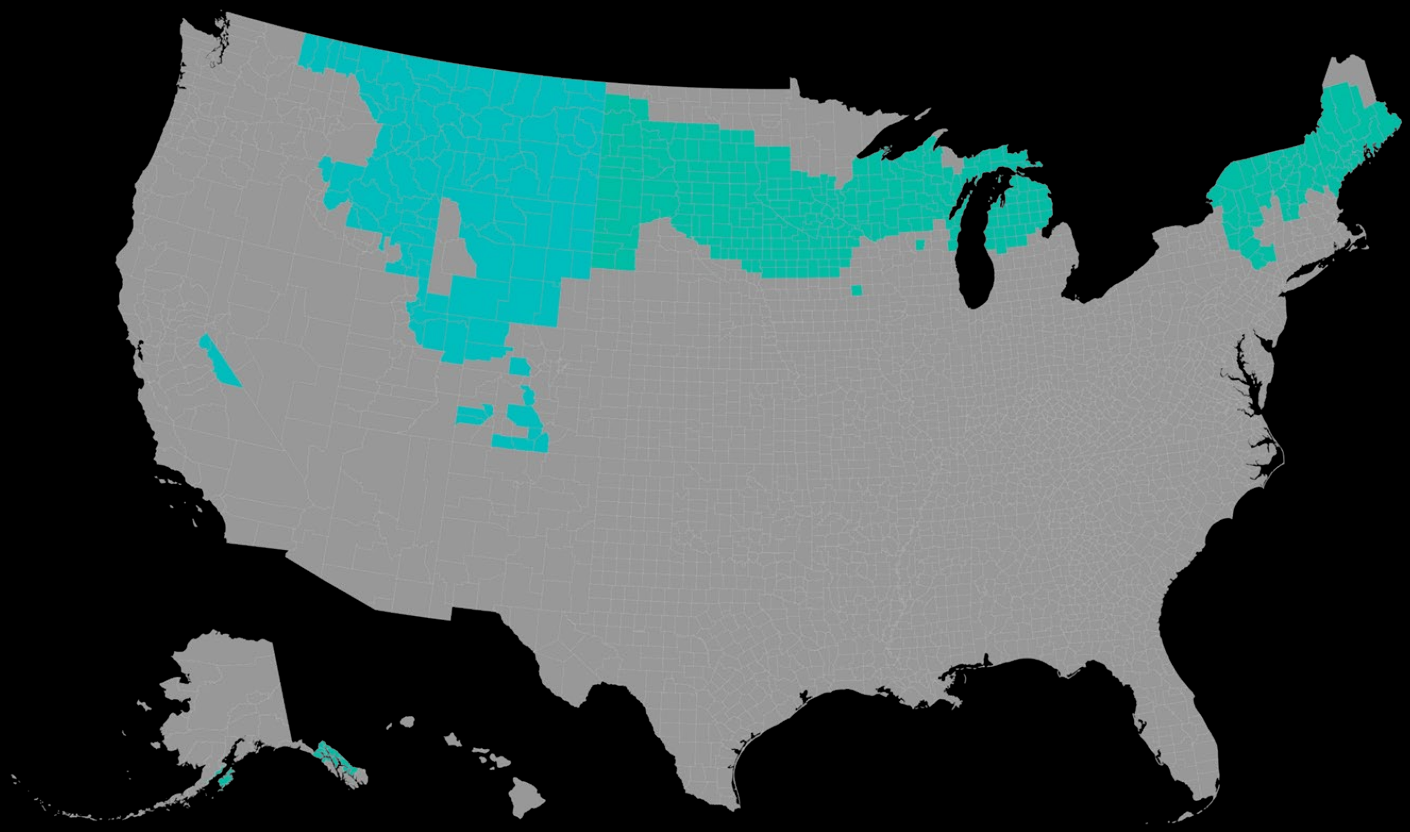
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

06

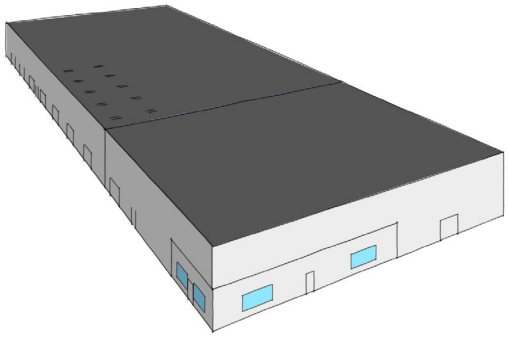
ASHRAE Climate Zone 6 is categorized as a **cold climate**, according to the specifications set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone is defined by having **9000 to 12,000 heating degree days** (based on a base of 10°C) and **fewer than 4500 cooling degree days**, indicating significant heating needs due to the cold winters and only moderate cooling requirements during the short summers. Zone 6 includes much of the **northern United States, covering areas such as parts of Massachusetts, Michigan, and as far west as Idaho**. In this climate, building designs typically emphasize robust insulation, high-performance windows, and controlled ventilation to prevent heat loss during the long, cold winter months, while cooling strategies remain relatively simple due to the mild summer conditions.



Minneapolis, Minnesota

Data Center- Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

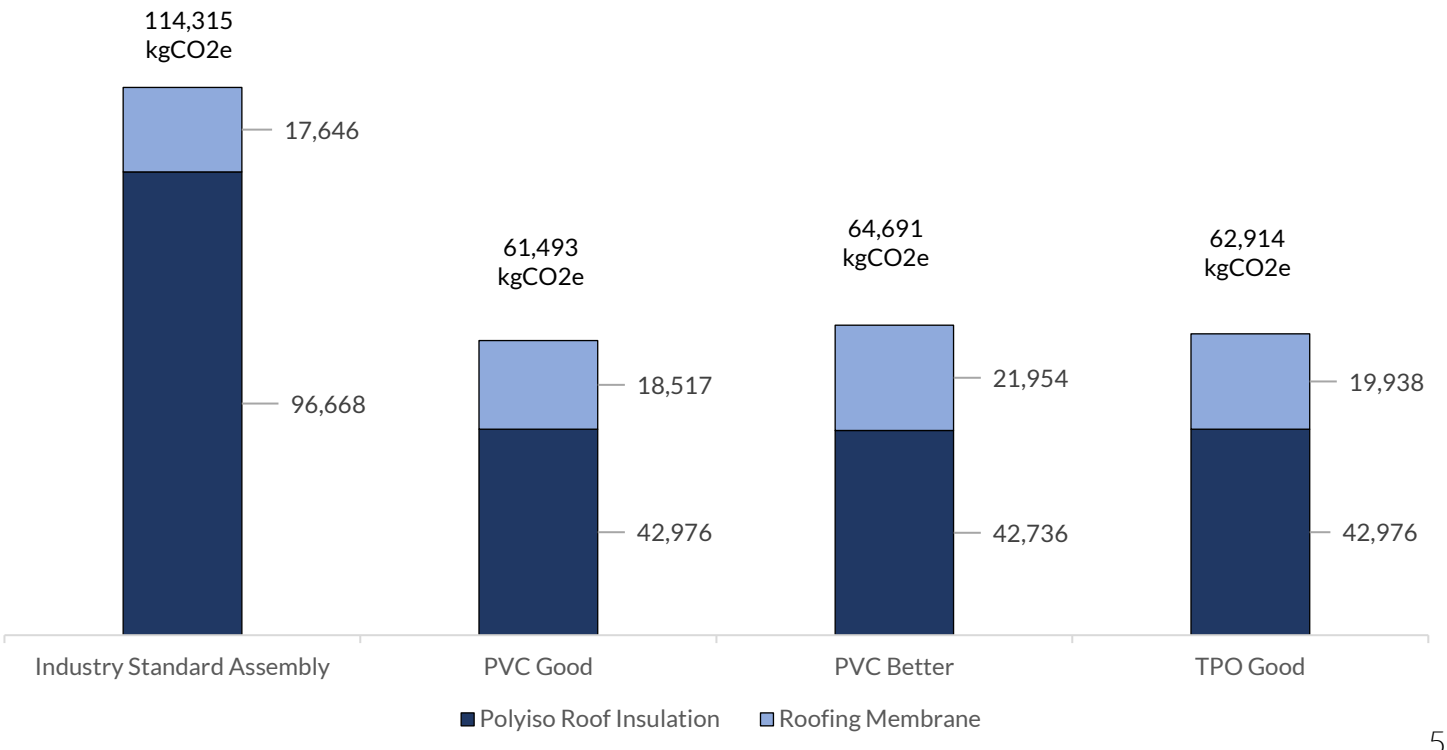
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

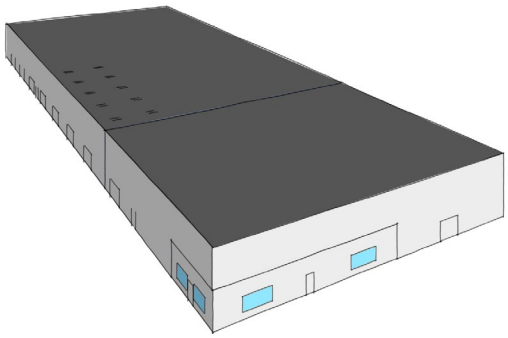
44.96%

Savings in Embodied Carbon



Data Center- Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

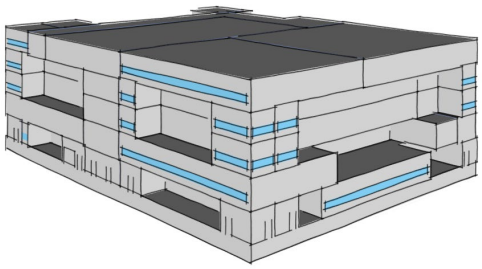
0.00%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 6A (Minneapolis, MN)

Embodied Carbon



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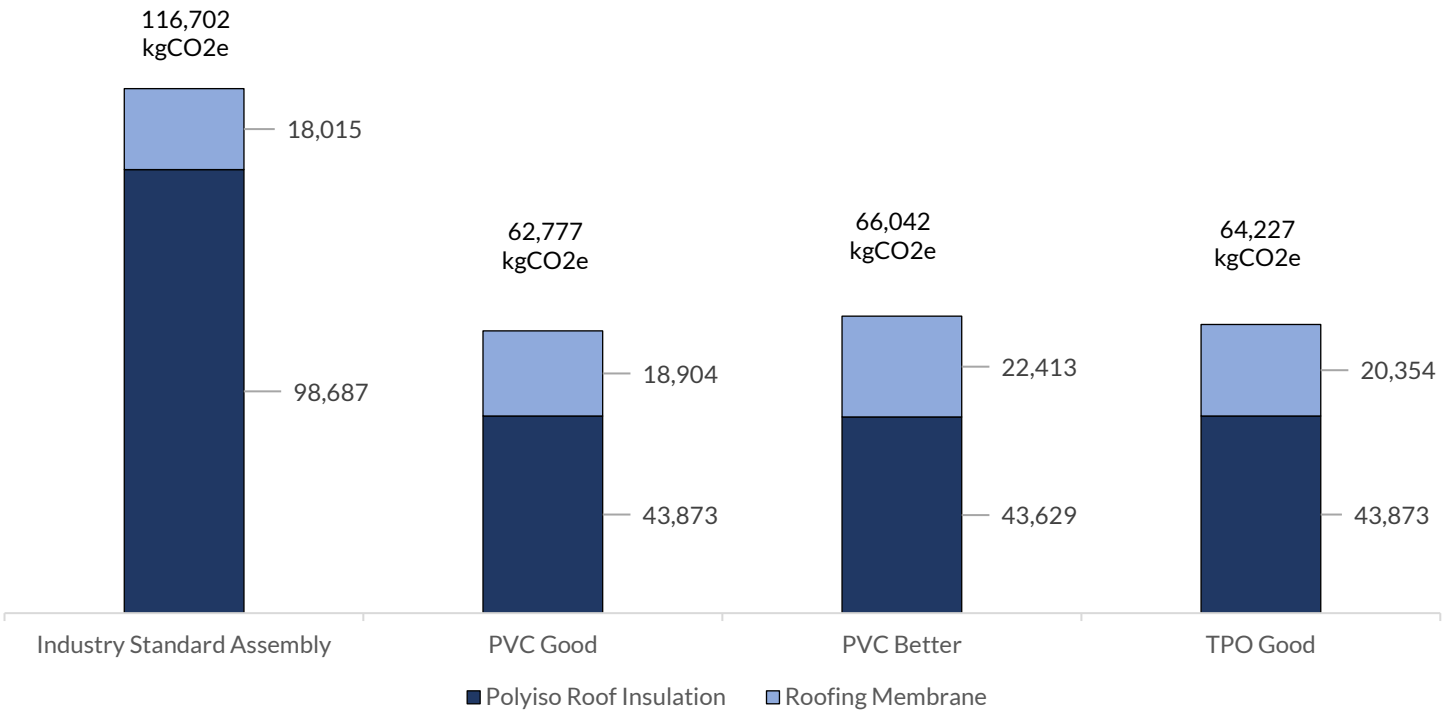
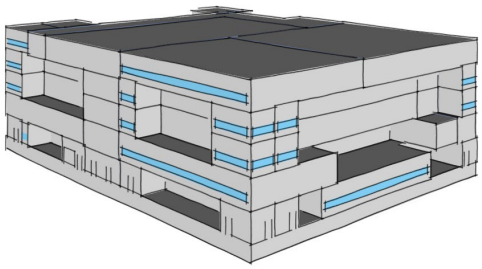
Savings in Embodied Carbon



Hospital - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

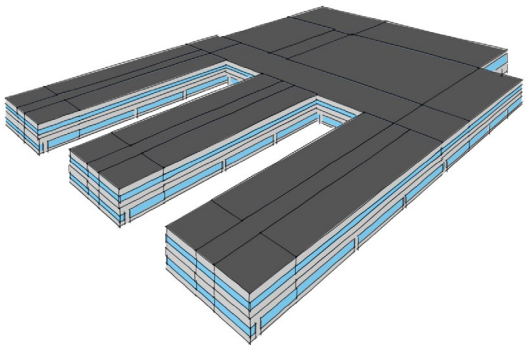
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 6A (Minneapolis, MN)

Embodied Carbon



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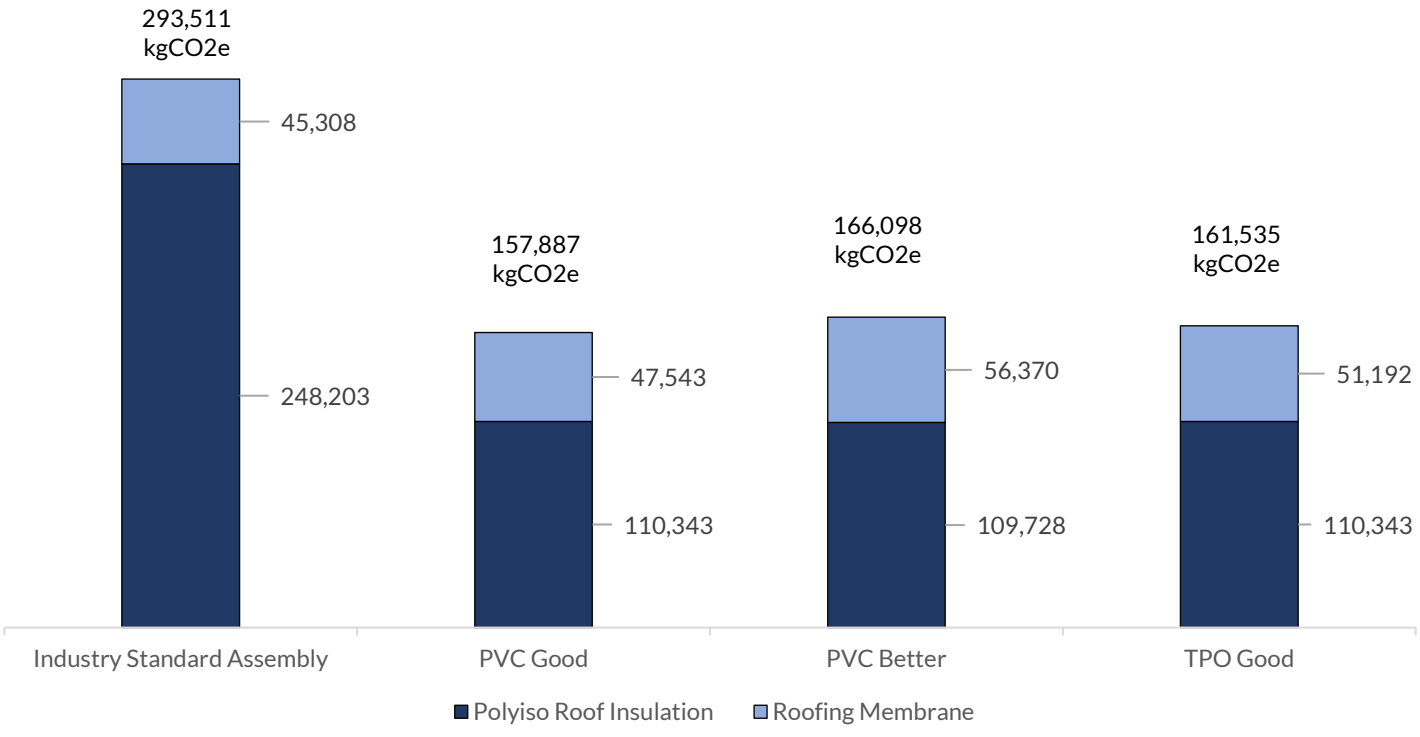
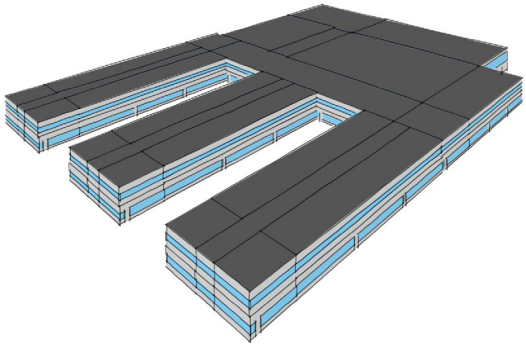
44.96%

Savings in Embodied Carbon



Secondary School - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

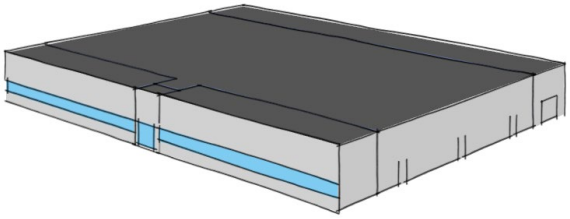
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

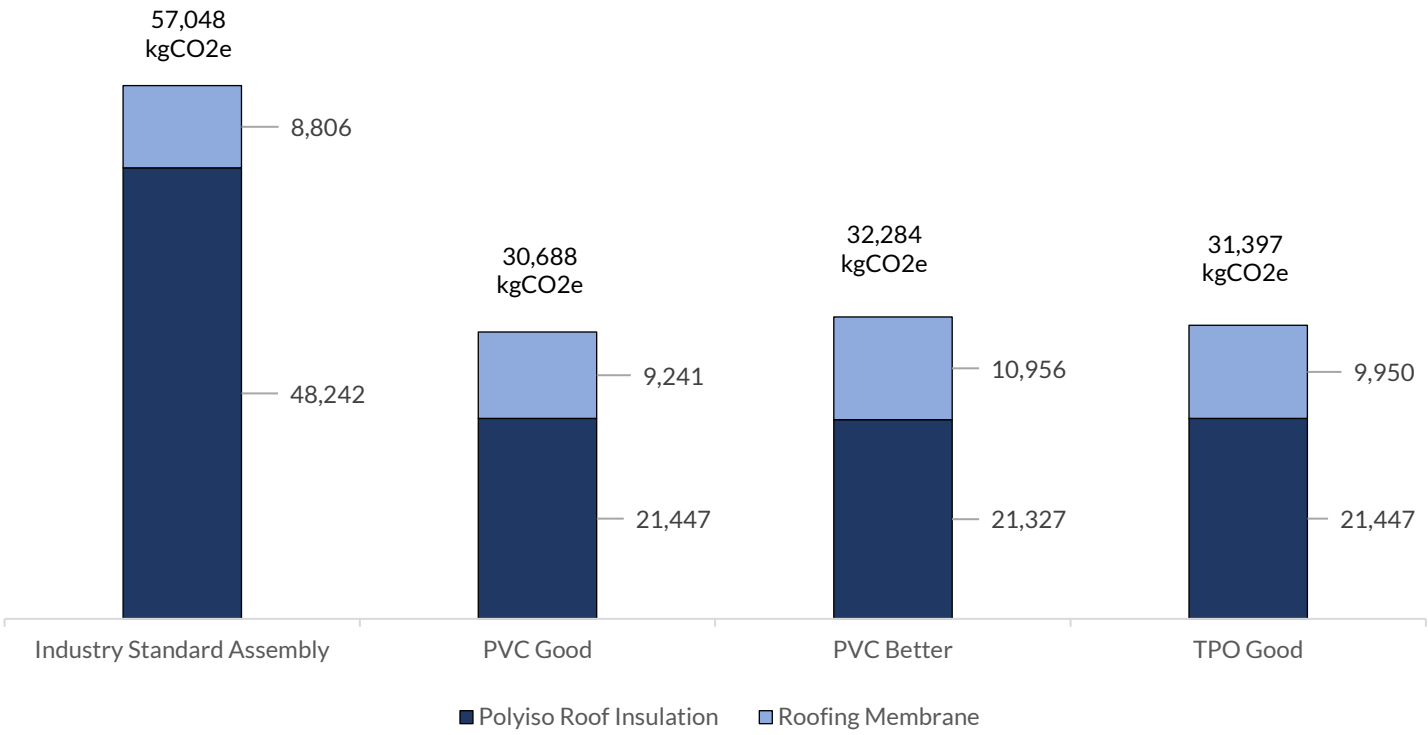
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

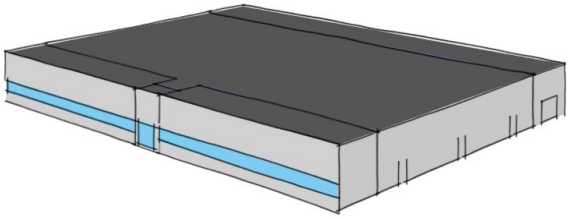
44.96%

Savings in Embodied Carbon



Retail - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

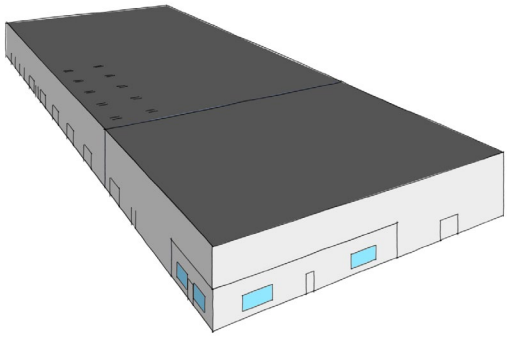
GAF TPO Good vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

Warehouse - Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

46.21%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

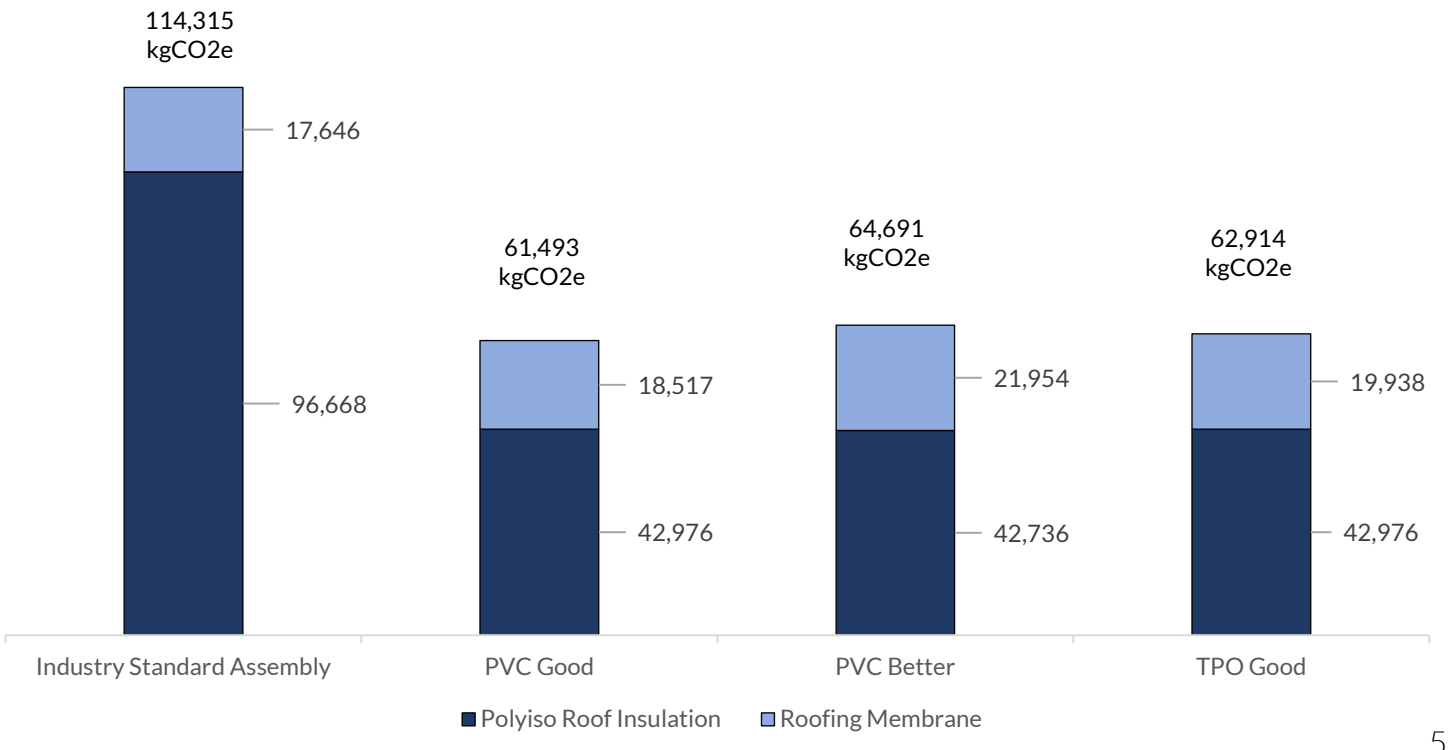
43.41%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

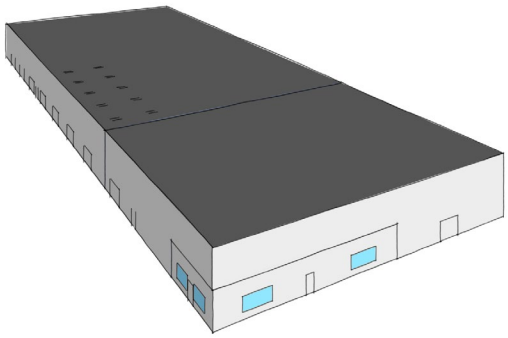
44.96%

Savings in Embodied Carbon



Warehouse - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

0.00 %

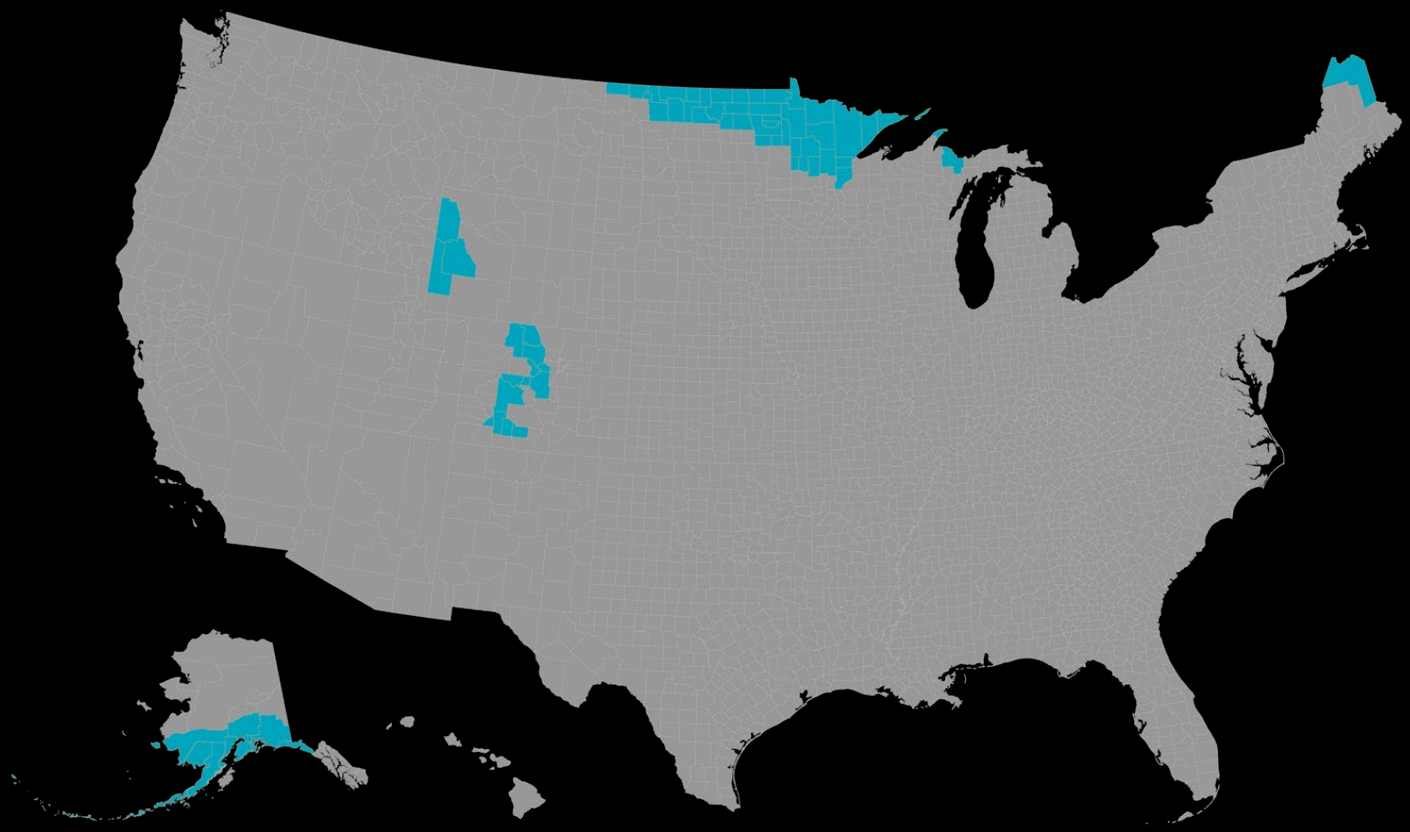
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

07

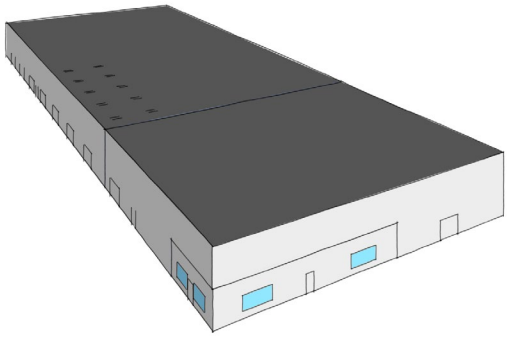
ASHRAE Climate Zone 7 is classified as a **very cold climate**, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **more than 12,000 heating degree days** (based on a base of 10°C) and **fewer than 4500 cooling degree days**, highlighting an intense need for heating solutions due to the harsh winter conditions and minimal cooling requirements during the brief, mild summers. Zone 7 is found in the **northernmost parts of the United States, including regions like northern Minnesota, parts of North Dakota, and areas in Montana**. Building strategies in this zone focus on maximizing thermal resistance with extensive insulation, triple-glazed windows, and advanced heating systems designed to operate efficiently under extreme cold. Additionally, air sealing to minimize heat leakage and incorporating energy recovery ventilation systems are crucial to maintaining indoor air quality and warmth throughout the severe winter months.



Duluth, Minnesota

Data Center- Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

45.52%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

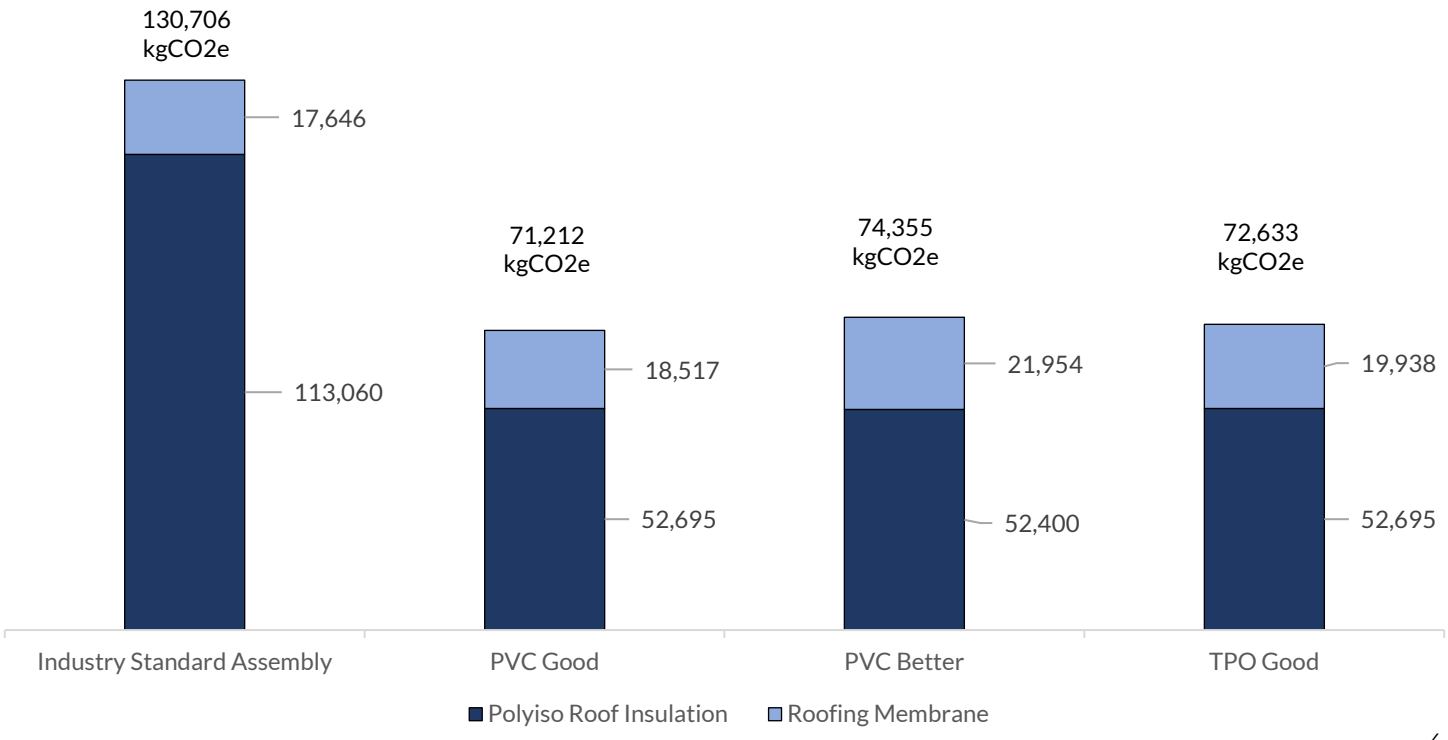
43.11%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

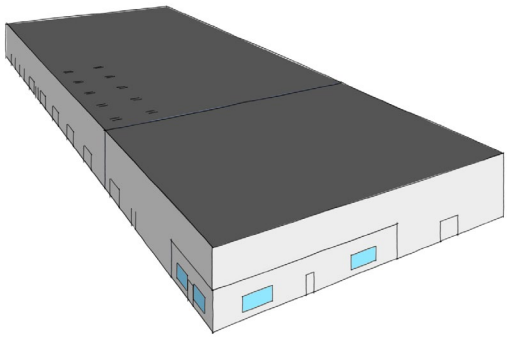
44.43%

Savings in Embodied Carbon



Data Center- Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

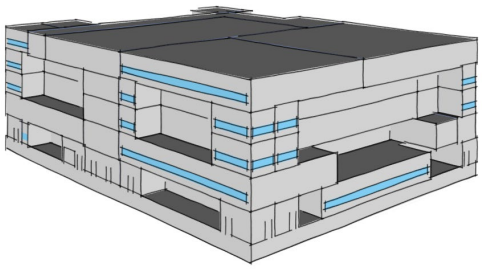
0.00%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

45.52%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

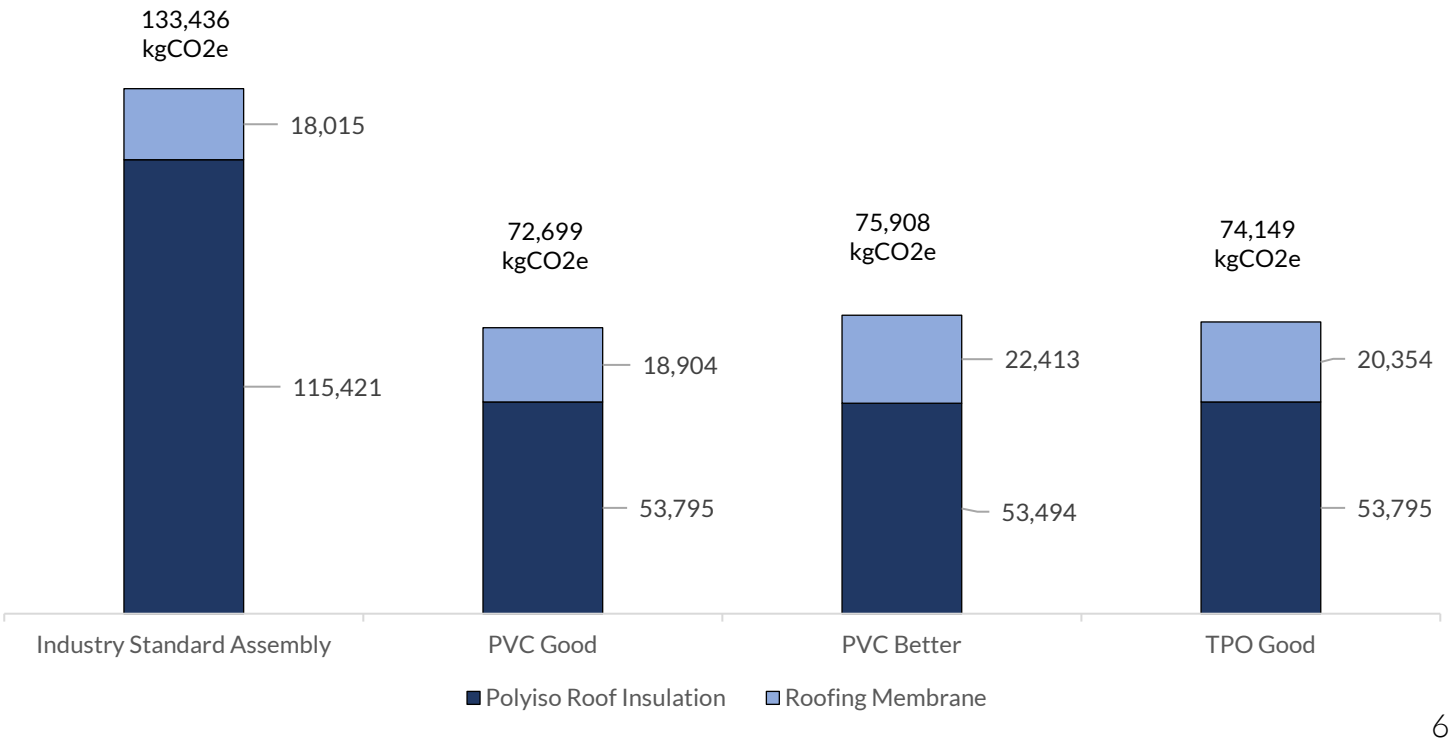
43.11%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

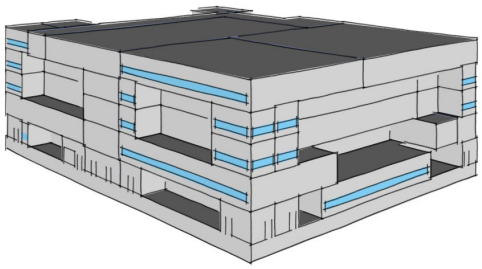
44.43%

Savings in Embodied Carbon



Hospital - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.11%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.11 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

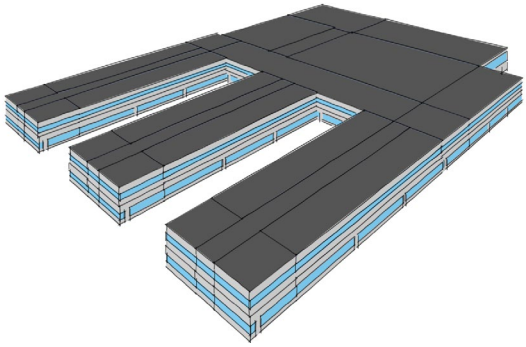
0.11 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

45.52%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

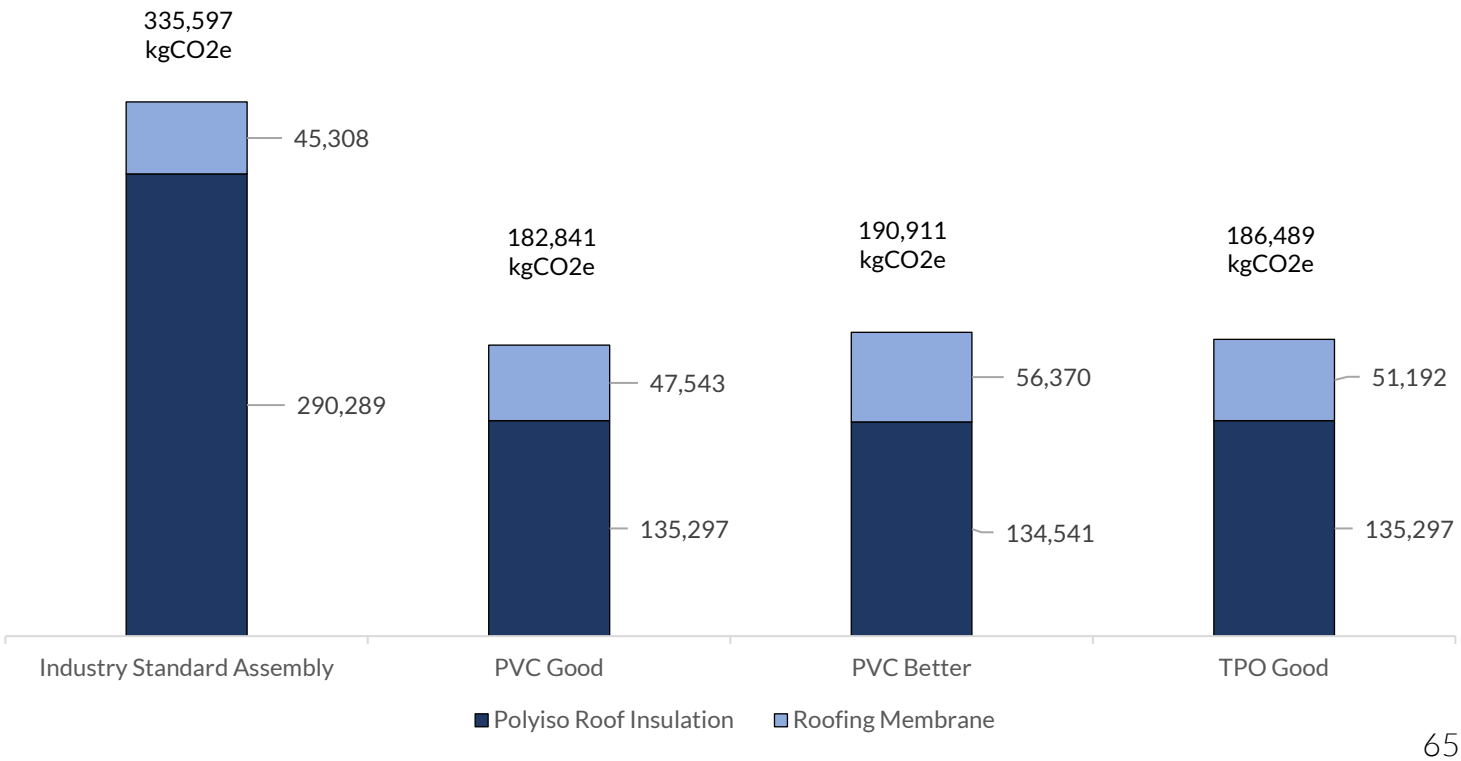
43.11%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

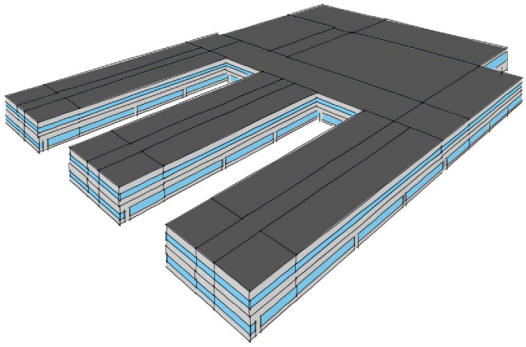
44.43%

Savings in Embodied Carbon



Secondary School - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.49%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.49 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

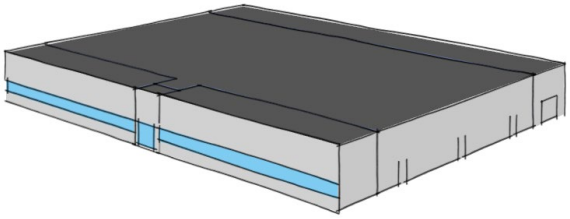
0.49 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

45.52%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

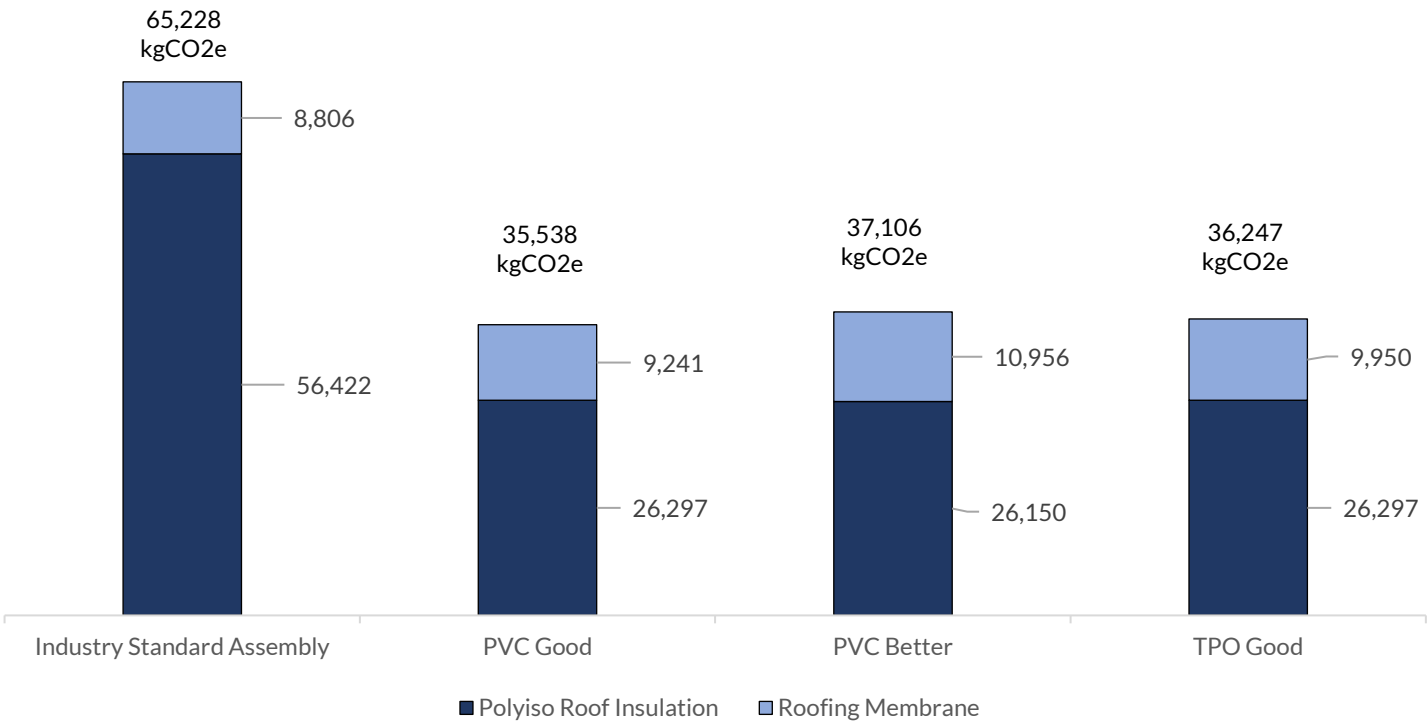
43.11%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

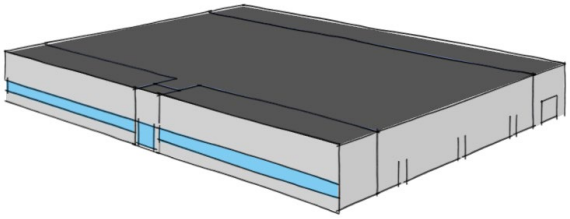
44.43%

Savings in Embodied Carbon



Retail - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

0.81%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

0.81 %

Savings in Energy Use Intensity

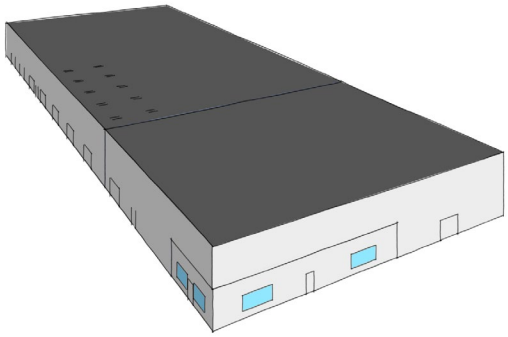
GAF TPO Good vs Industry-standard Assembly

0.81 %

Savings in Energy Use Intensity

Warehouse - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Good vs Industry-standard Assembly

45.52%

Savings in Embodied Carbon

GAF PVC Better vs Industry-standard Assembly

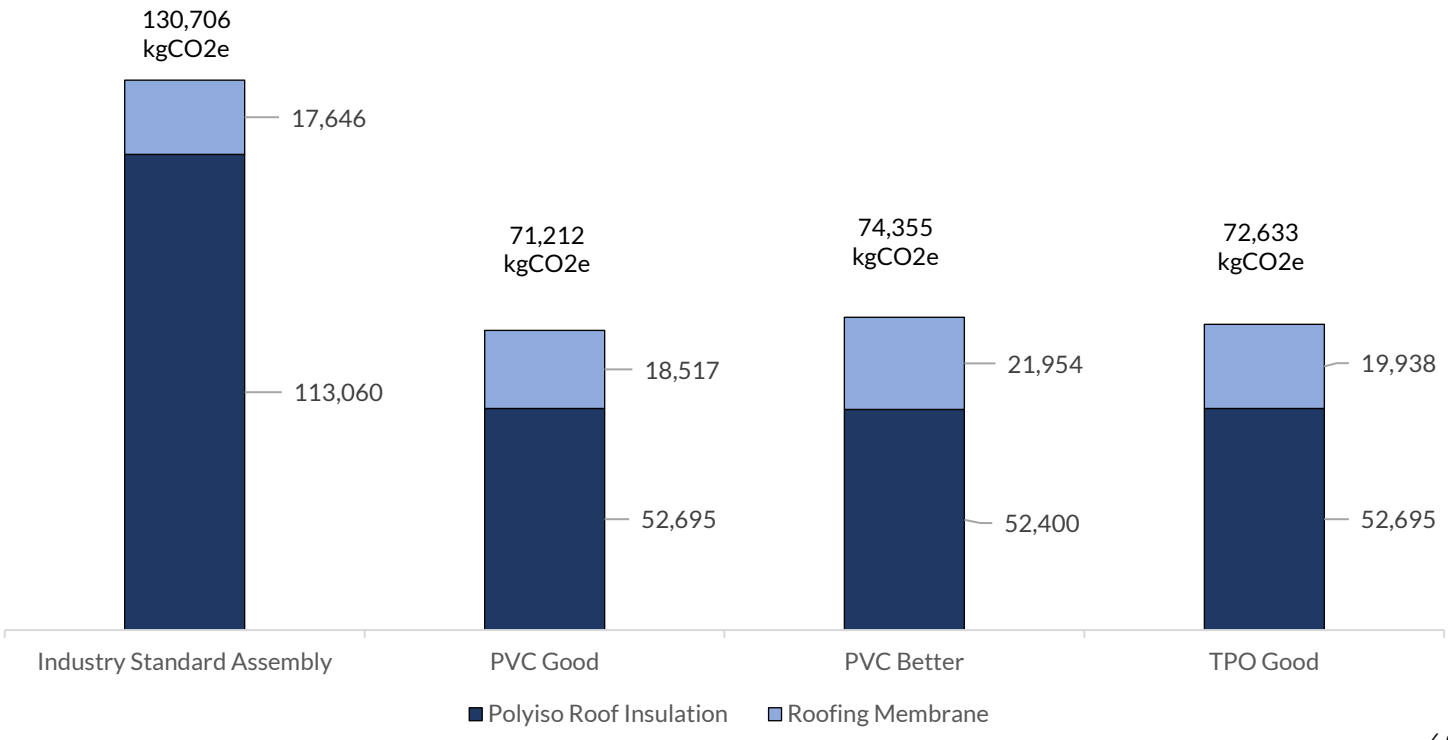
43.11%

Savings in Embodied Carbon

GAF TPO Good vs Industry-standard Assembly

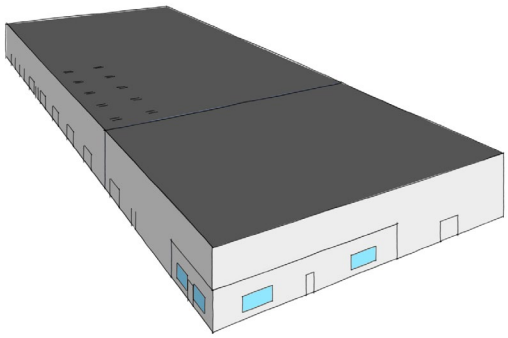
44.43%

Savings in Embodied Carbon



Warehouse - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Good vs Industry-standard Assembly

1.16%

Savings in Energy Use Intensity

GAF PVC Better vs Industry-standard Assembly

1.16 %

Savings in Energy Use Intensity

GAF TPO Good vs Industry-standard Assembly

1.16 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Comparison

02

Polyiso Insulation + Polyiso Coverboard + Roofing Membrane

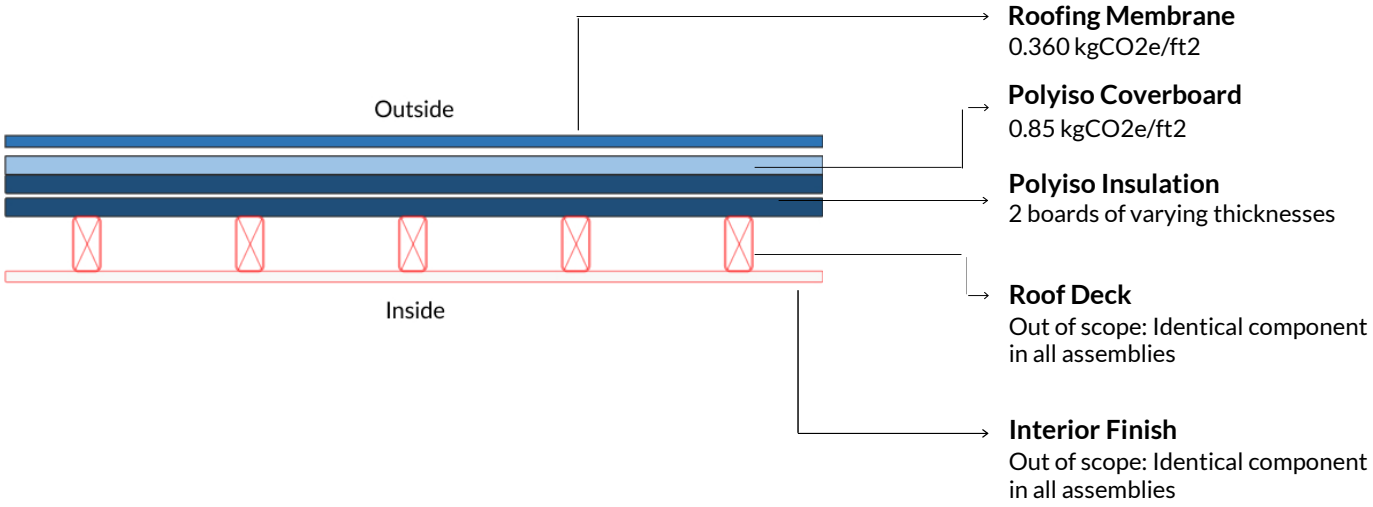
49.50%
Average Savings in Embodied Carbon

<4%
Average Savings in Energy Use Intensity (EUI)

This section of the report outlines the comparison of a wall assembly that includes
1. Two layers of polyiso insulation,
2. A Polysio coverboard and
3. A roofing membrane.

The chapter provides a detailed comparison of such an industry standard assembly against 1 similar GAF Assembly across five distinct building types and six different climate zones, examining their performance and efficiency in various environmental conditions.

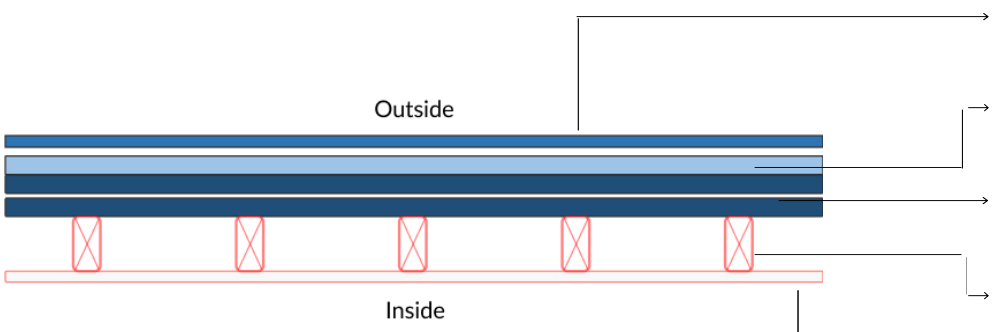
Industry-Standard Assembly being compared



GAF Assembly

Rigid Insulation thicknesses are adjusted based on climate zone and Roof (Insulation Entirely Above Deck) U-factor requirements to comply with ASHRAE 2019 standards. The manufacturer offers specific thicknesses, and the one that best aligns with ASHRAE specifications is selected.

GAF TPO Better Assembly



EverGuard TPO 60 mil
0.404 kgCO2e/ft2

EnergyGuard NH HD Cover Board
0.262 kgCO2e/ft2

EnergyGuard NH Polyiso (GRF Facer)
0.866 kgCO2e/ft2
(2 x 2.6" except for Climate Zone 7)

Roof Deck
Out of scope: Identical component in all assemblies

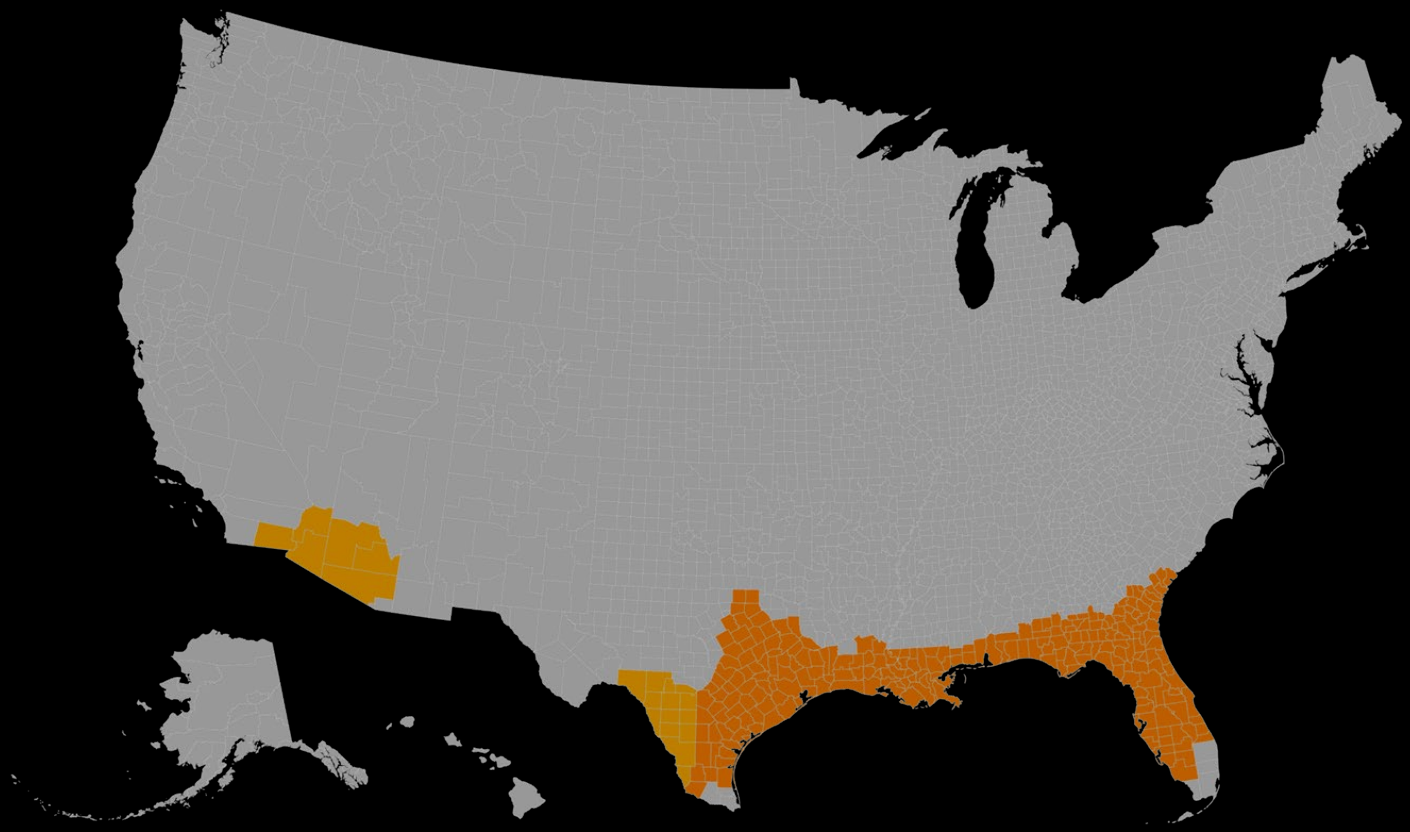
Interior Finish
Out of scope: Identical component in all assemblies

** For Climate Zone 7, the thickness has been increased to 3.2" because 2 boards of 2.6" do not satisfy the minimum R-value requirements of ASHRAE 2019*

Climate Zone

02

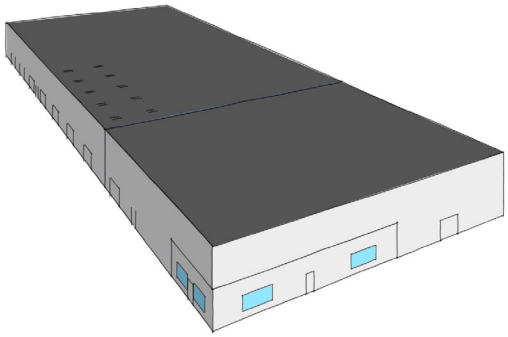
ASHRAE Climate Zone 2 is classified as a **hot-dry climate**, according to the guidelines set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone is characterized by having **fewer than 4500 heating degree days** and **more than 4500 cooling degree days** (based on a base of 10°C). The hot-dry conditions are prevalent with very low annual precipitation and high temperatures that demand extensive cooling measures. Regions typically falling within this climate zone include areas of the **Southwestern United States such as portions of Arizona and Texas**. Buildings in this zone benefit from strategies aimed at reducing cooling loads, such as high thermal mass, adequate insulation, and ventilation that maximizes nighttime cooling.



Houston, Texas

Data Center- Zone 2A (Houston, TX)

Embodied Carbon and EUI



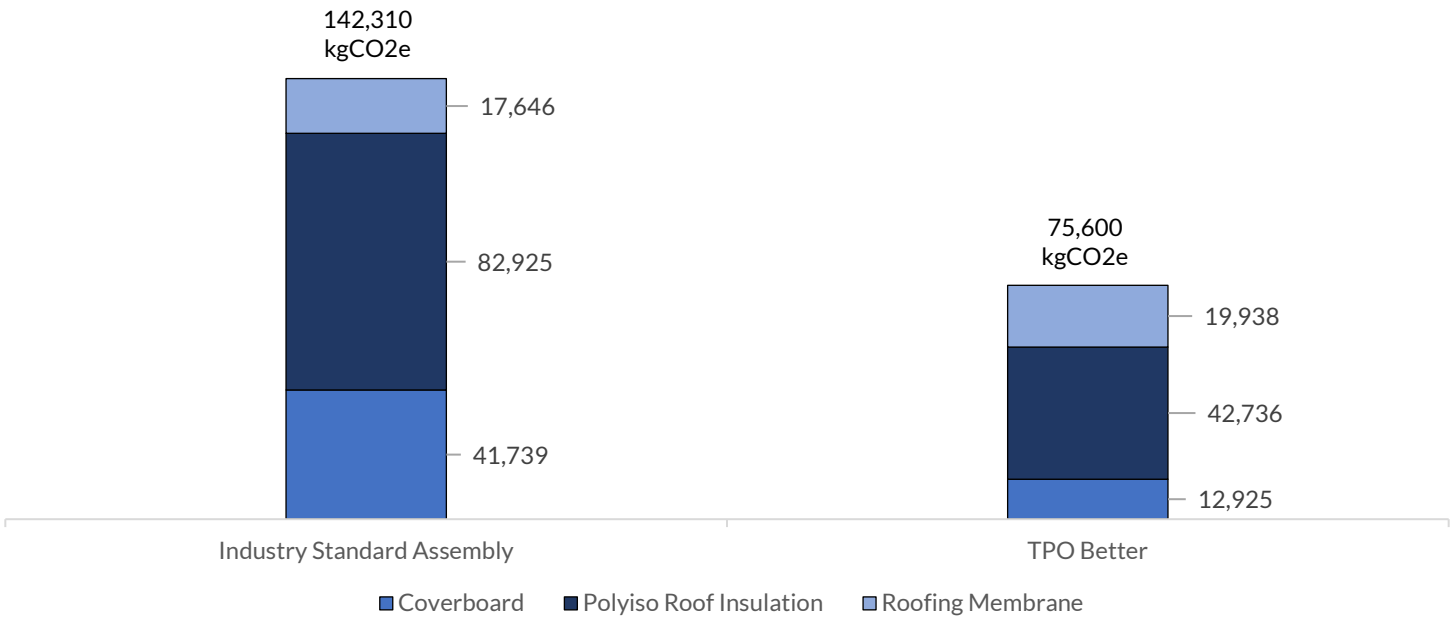
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

-0.01%

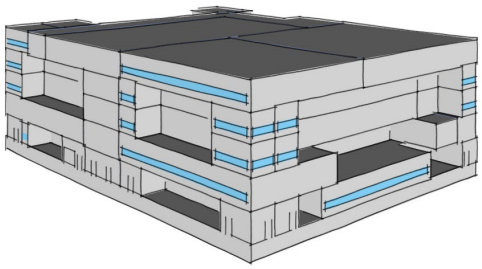
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 2A (Houston, TX)

Embodied Carbon and EUI



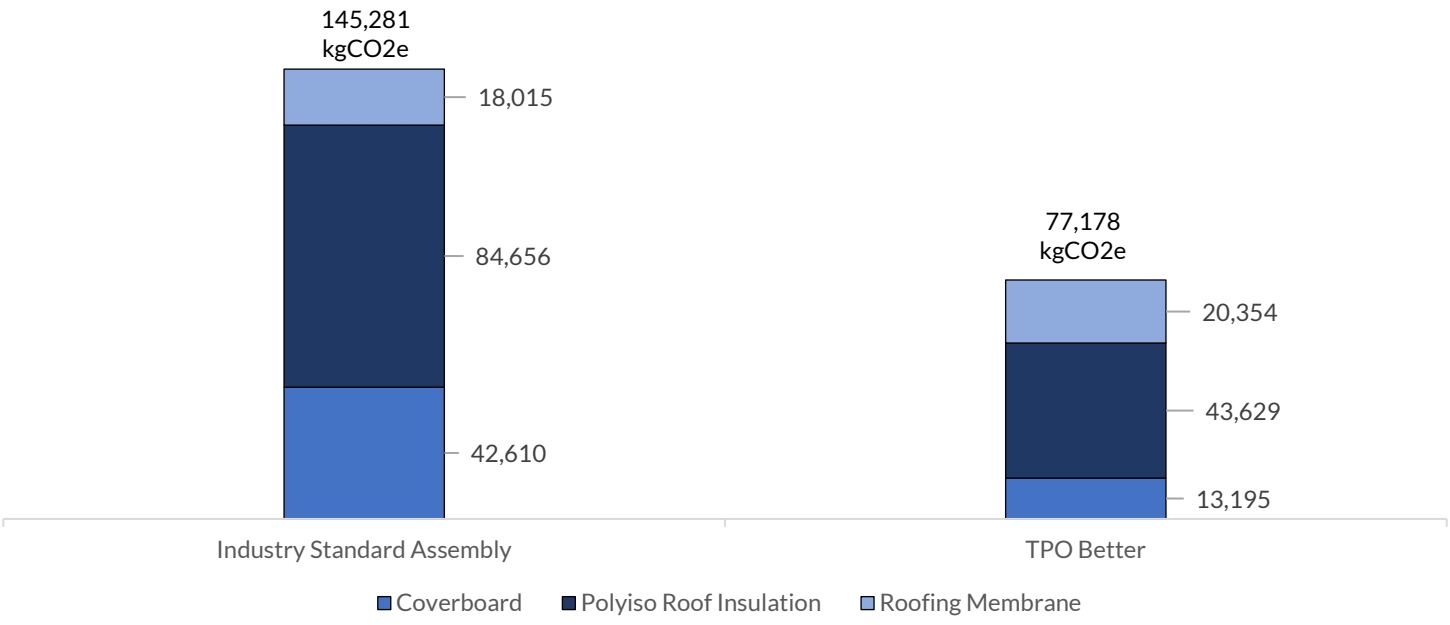
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

-5.05%

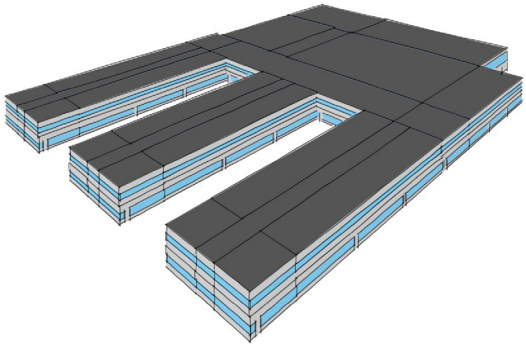
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 2A (Houston, TX)

Embodied Carbon and EUI



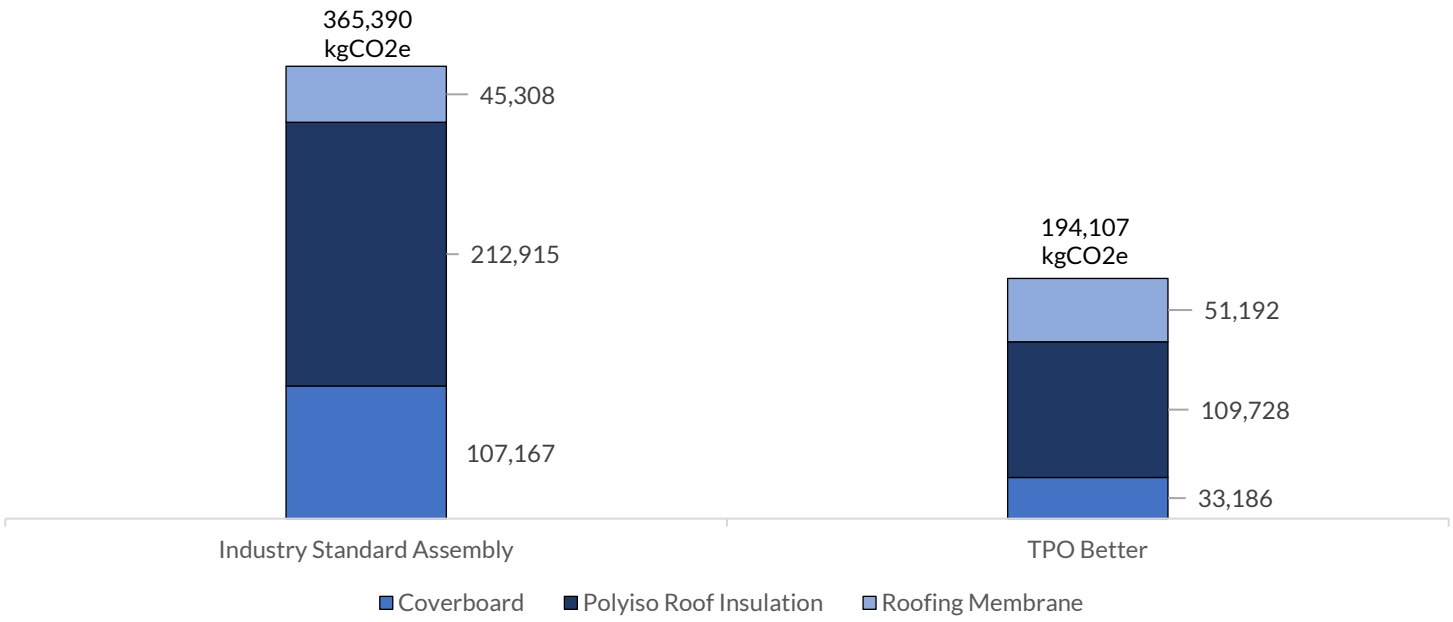
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

-0.30%

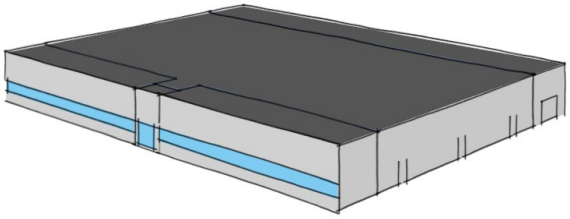
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 2A (Houston, TX)

Embodied Carbon and EUI



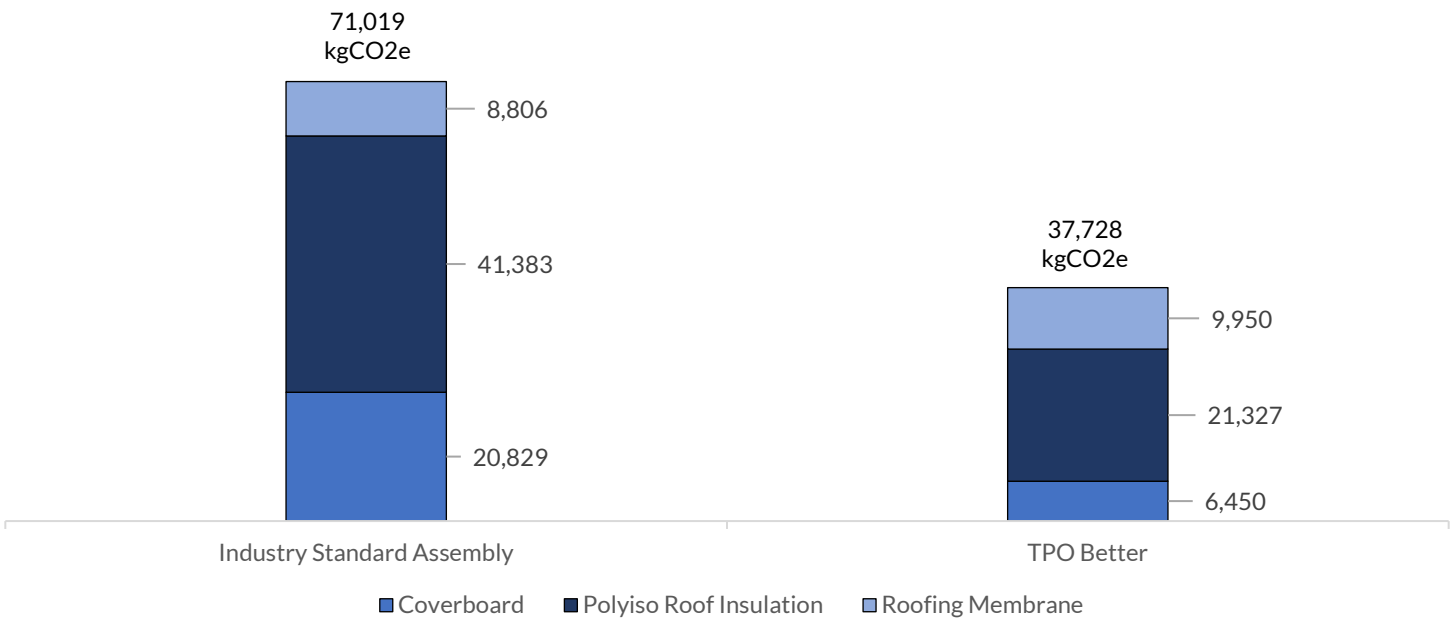
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

0.81%

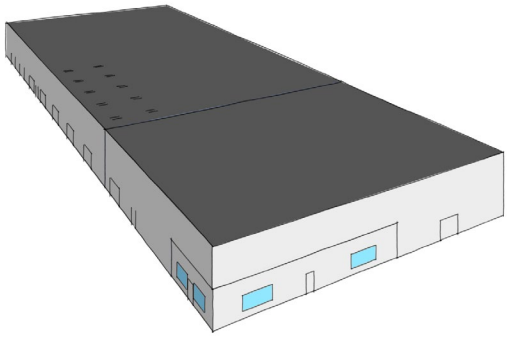
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 2A (Houston, TX)

Embodied Carbon and EUI



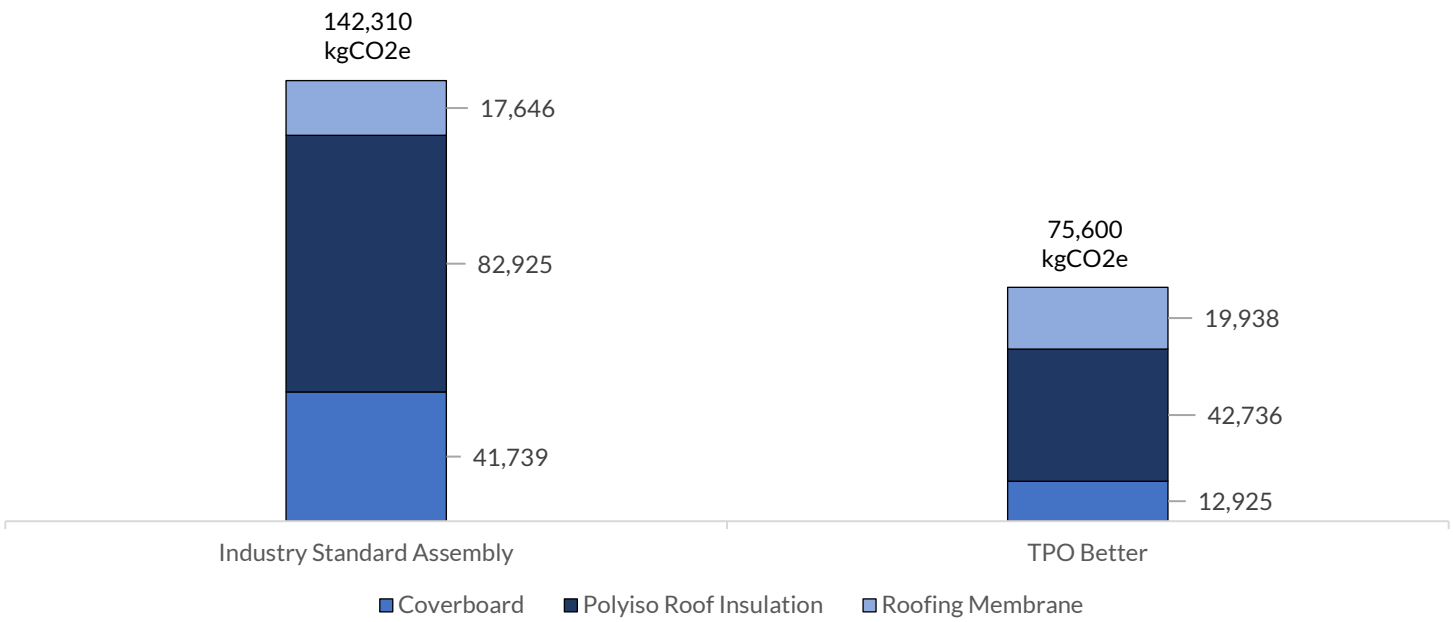
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

2.44%

Savings in Energy Use Intensity

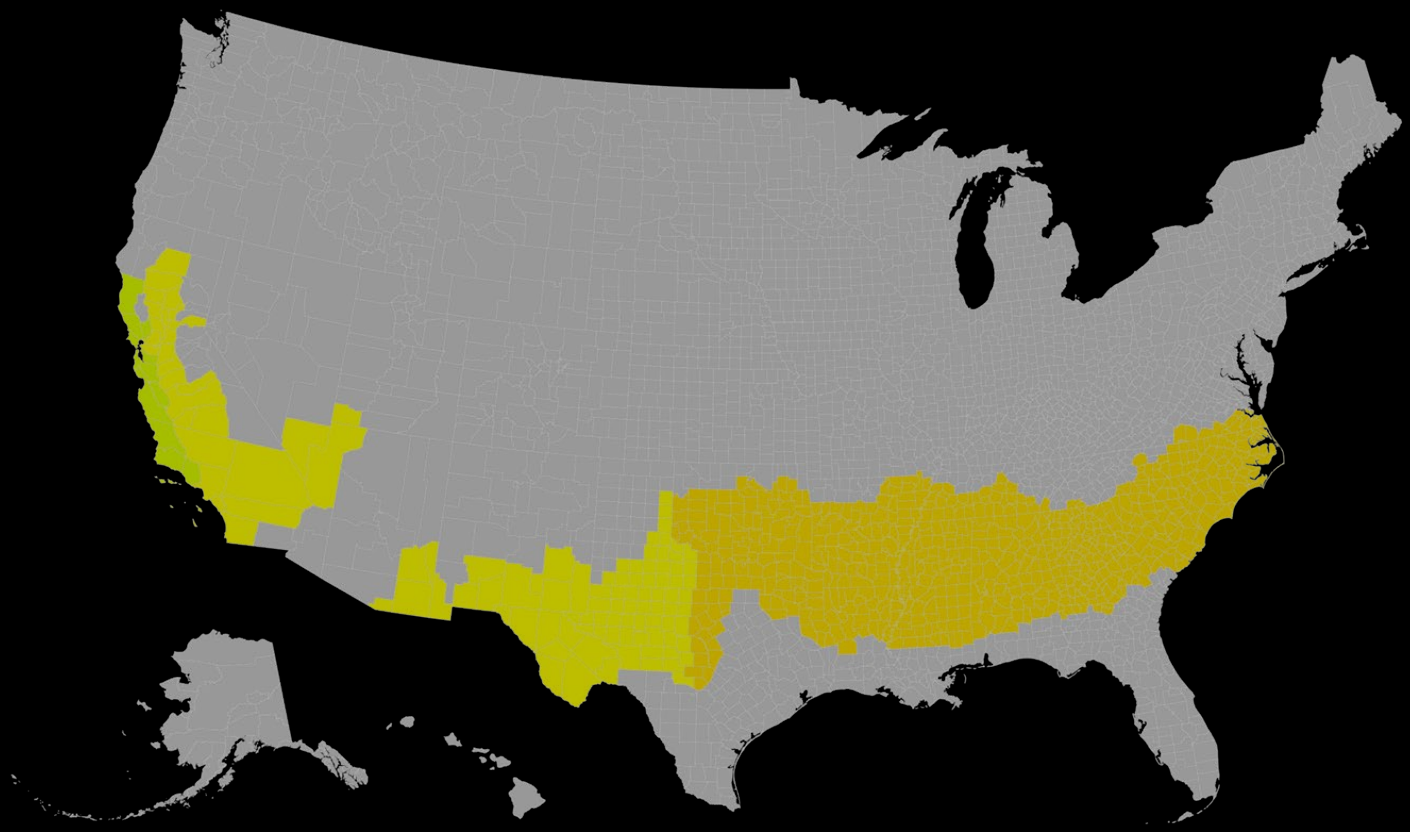


* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

03

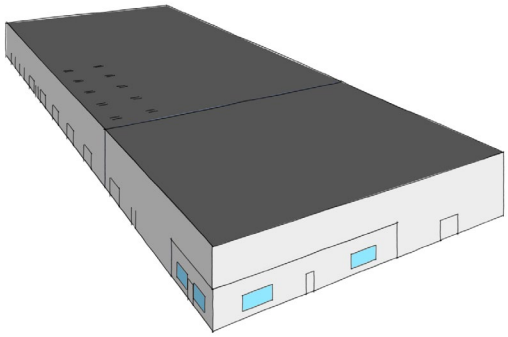
ASHRAE Climate Zone 3 is defined as a **warm-humid climate** according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **fewer than 4500 heating degree days** and **between 4500 to 9000 cooling degree days** (based on a base of 10°C). The warm-humid conditions in this zone necessitate strategies for managing both cooling and humidity control. It covers many **southeastern U.S. states including regions of Texas, Louisiana, Mississippi, Alabama, Georgia, and South Carolina**. Architectural design in this area focuses on optimizing air sealing and insulation to maintain comfortable indoor environments while minimizing the reliance on energy-intensive air conditioning systems. Features such as overhangs, shaded areas, and vapor barriers are commonly utilized to enhance building performance in this climate.



Atlanta, Georgia

Data Center- Zone 3A (Atlanta, GA)

Embodied Carbon and EUI



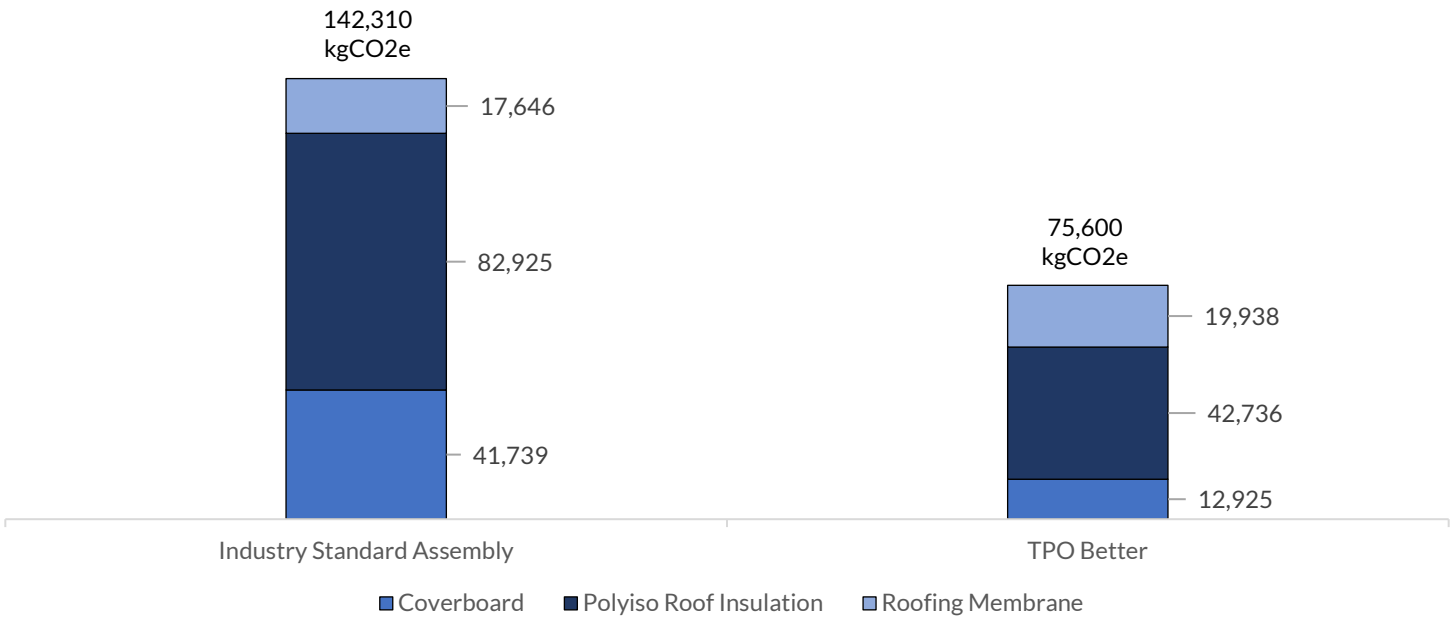
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

-0.01%

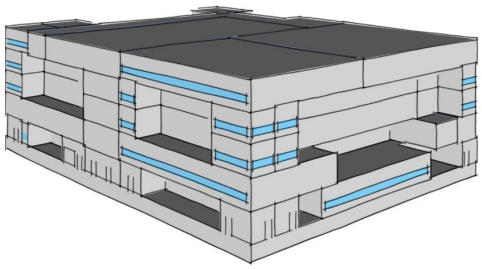
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 3A (Atlanta, GA)

Embodied Carbon and EUI



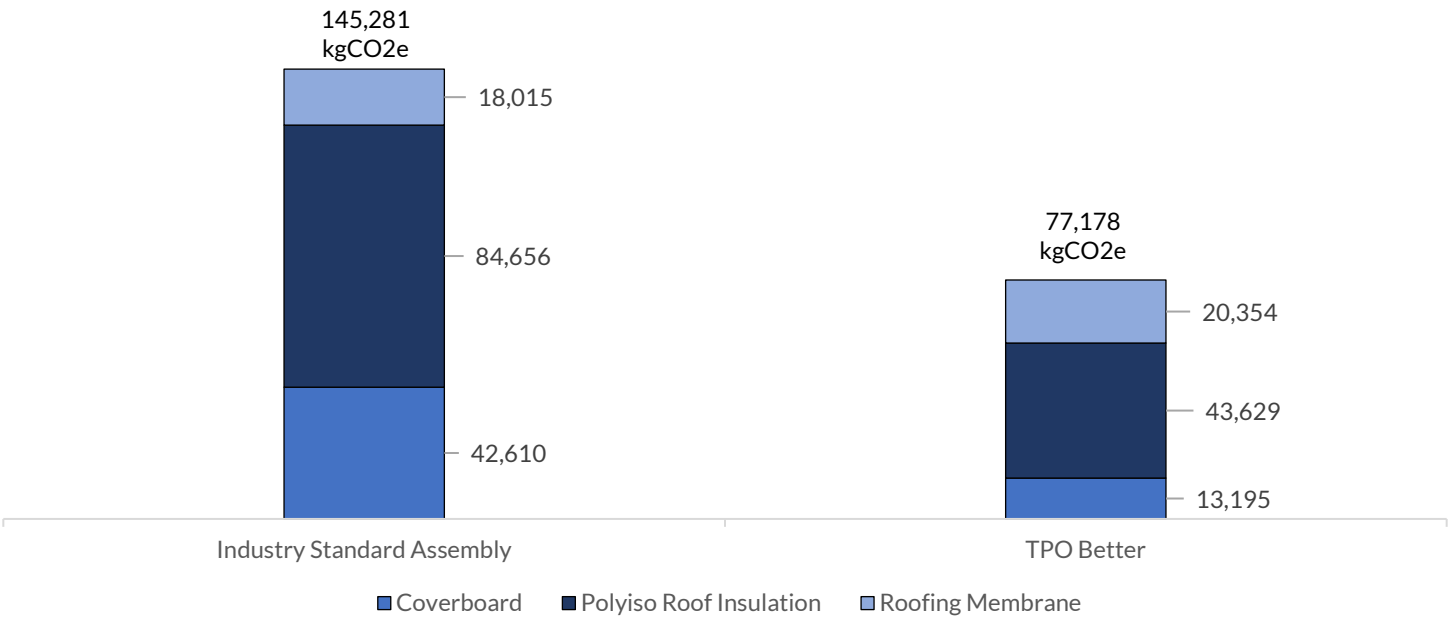
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

0.17%

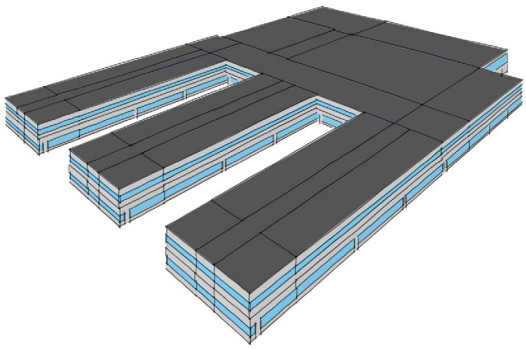
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 3A (Atlanta, GA)

Embodied Carbon and EUI



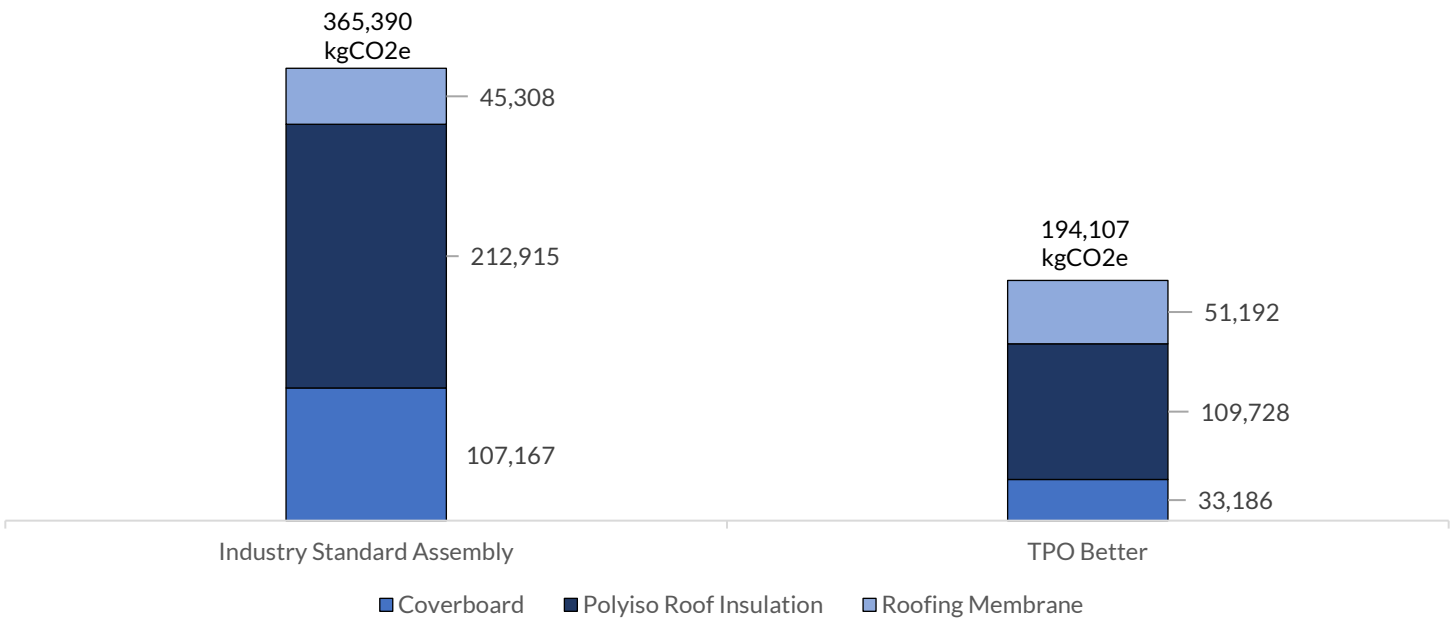
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

-0.11%

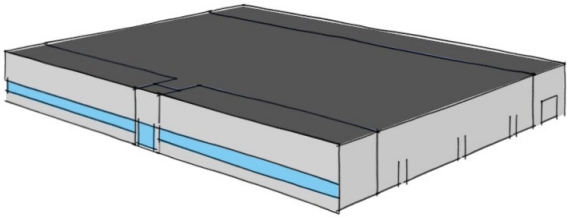
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 3A (Atlanta, GA)

Embodied Carbon and EUI



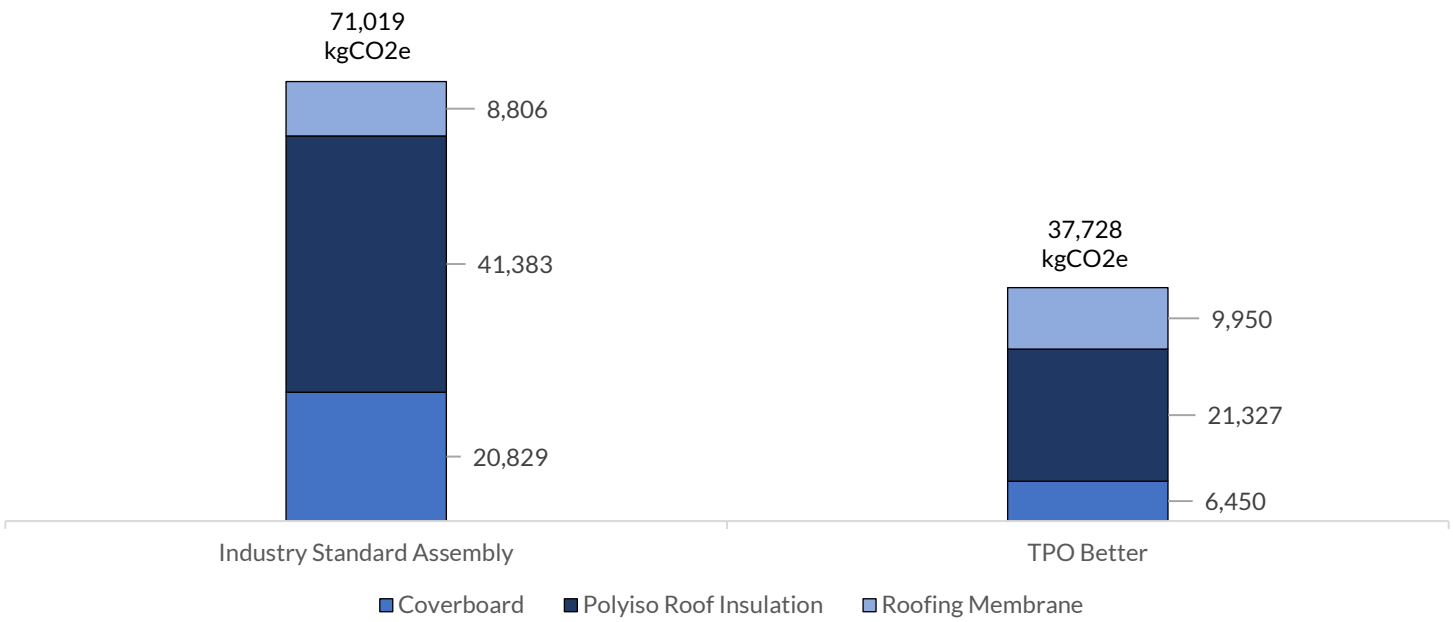
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

1.65%

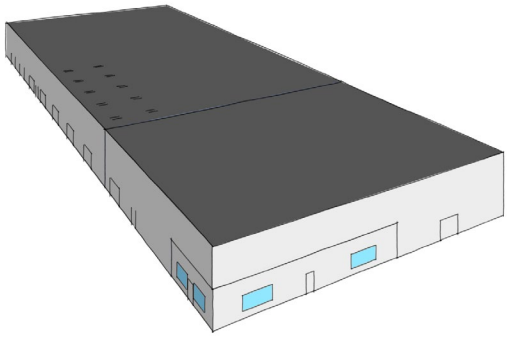
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 3A (Atlanta, GA)

Embodied Carbon and EUI



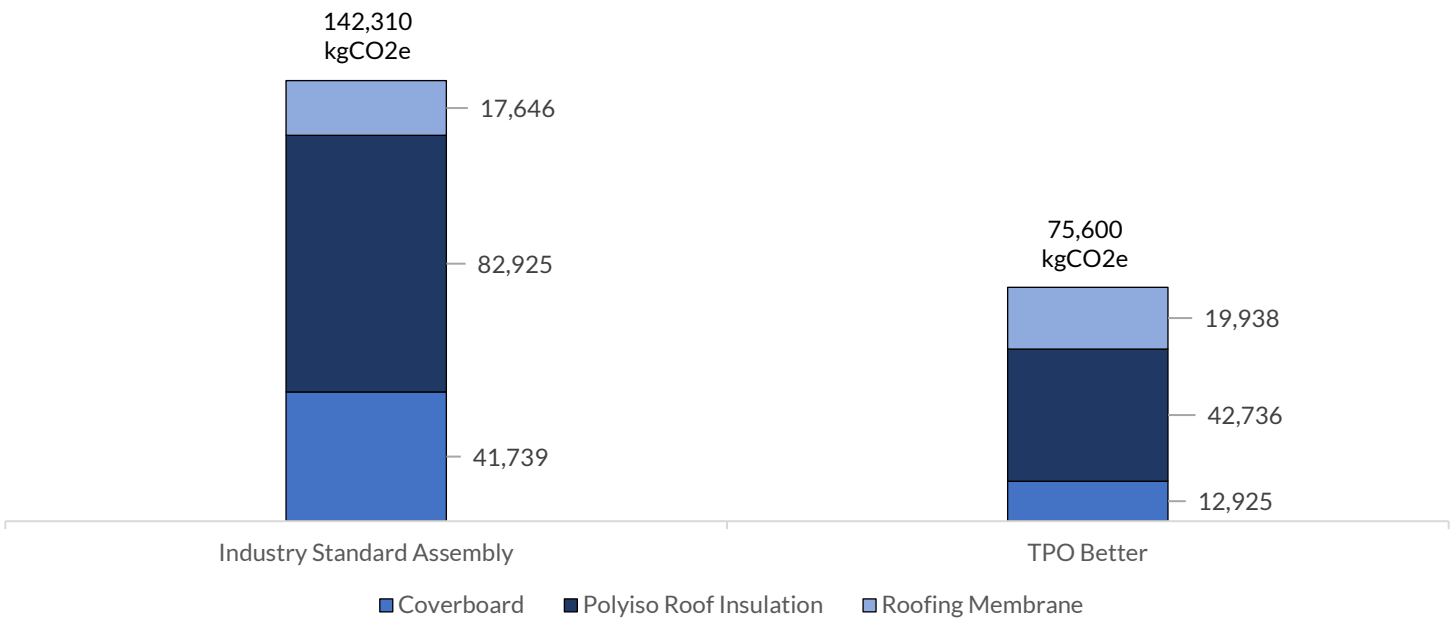
GAF TPO Better vs Industry-standard Assembly

46.88%

Savings in Embodied Carbon

3.89%

Savings in Energy Use Intensity

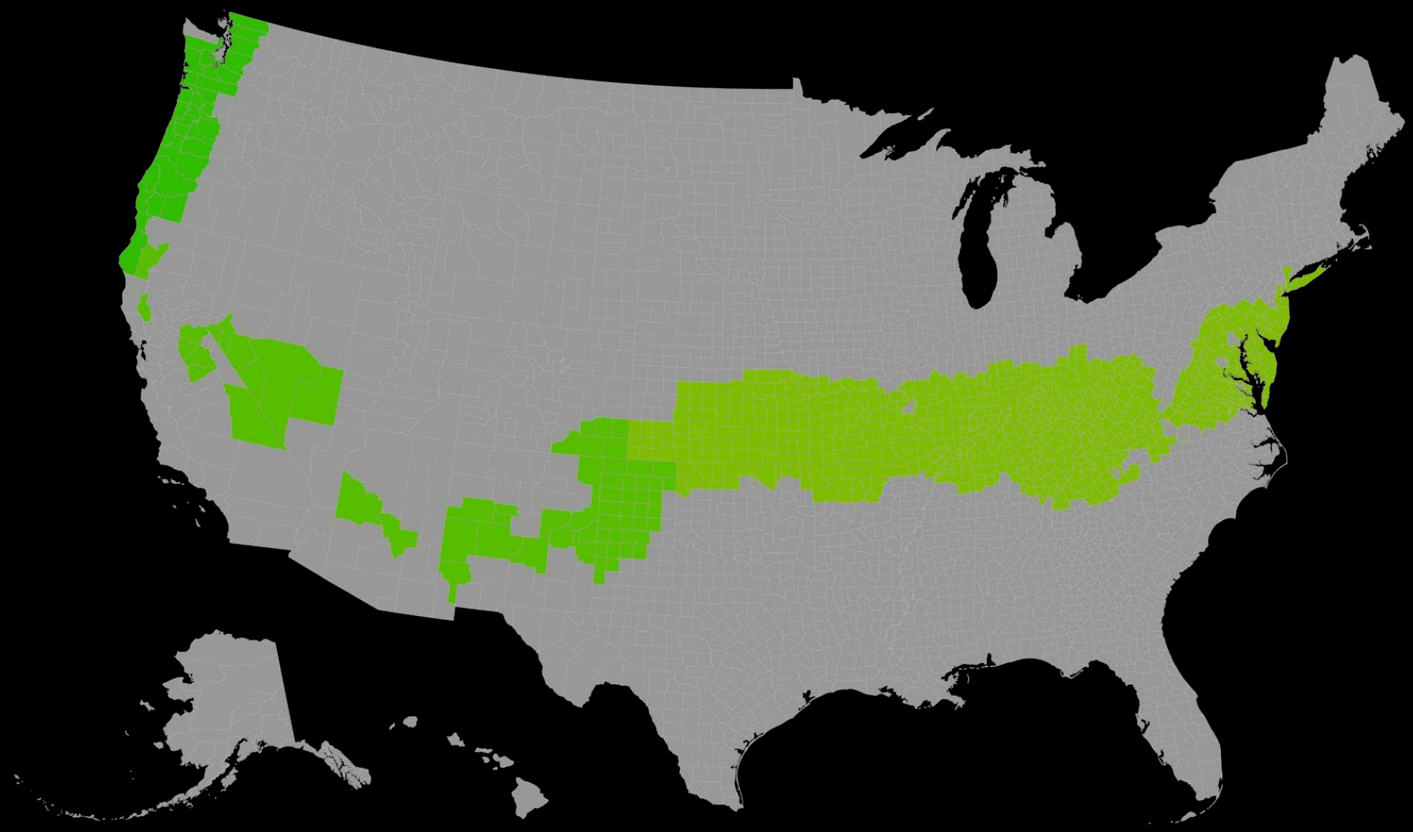


* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

04

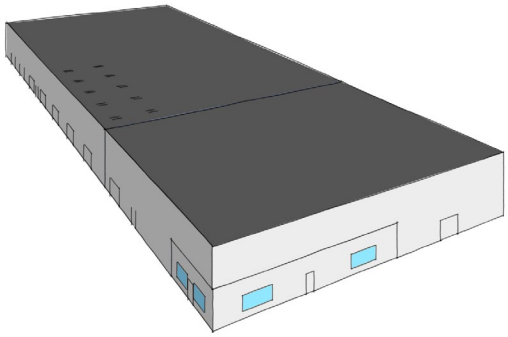
ASHRAE Climate Zone 4 is designated as a **mixed-humid climate**, according to the standards established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **fewer than 4500 heating degree days** and **between 4500 to 9000 cooling degree days** (based on a base of 10°C). The climate here includes distinct seasonal variations with both moderate heating in winter and significant cooling requirements in the summer, necessitating versatile climate control solutions in buildings. Zone 4 covers parts of the **Mid-Atlantic, including some regions of Virginia, North Carolina, Tennessee, and as far west as parts of Kansas and Oklahoma**. Effective strategies in this climate typically involve balanced insulation, energy-efficient windows, and moisture control systems to handle the relatively high humidity and varying temperatures throughout the year.



Baltimore, Maryland

Data Center- Zone 4A (Baltimore, MD)

Embodied Carbon and EUI



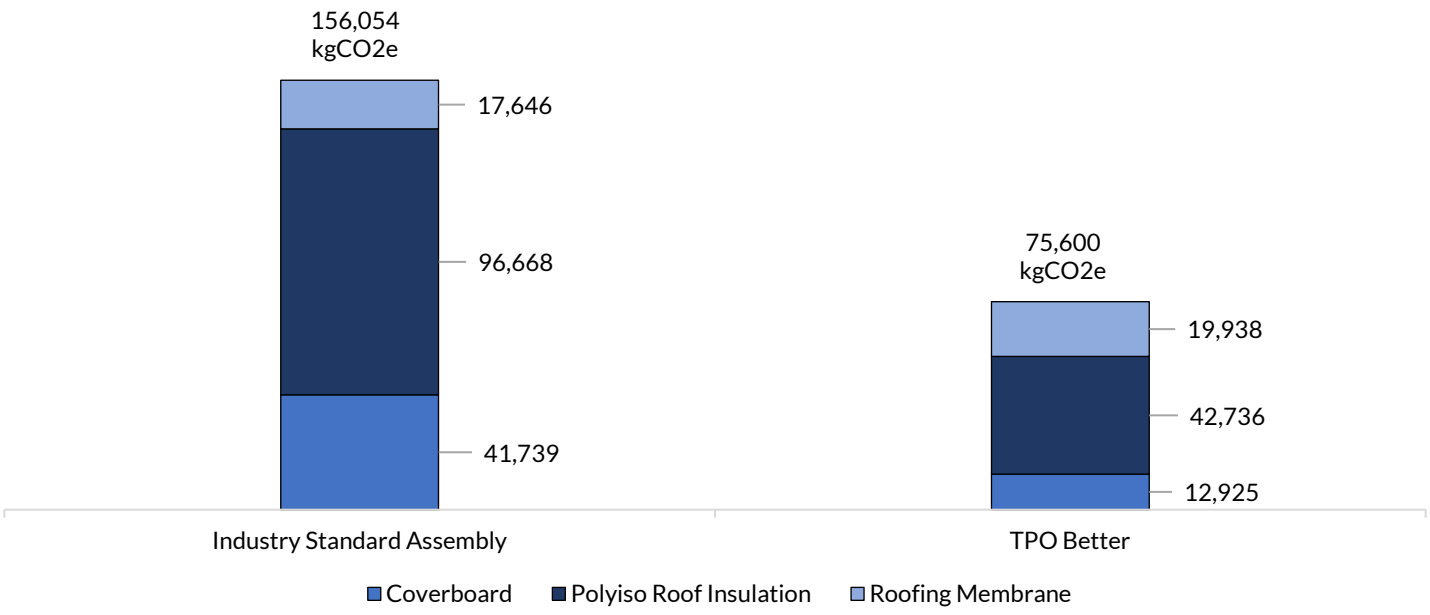
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.00%

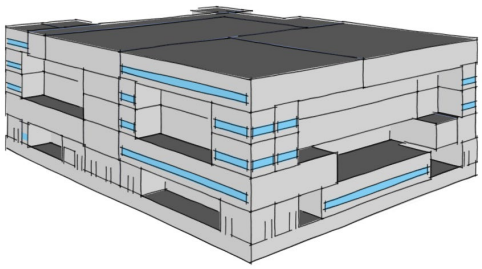
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 4A (Baltimore, MD)

Embodied Carbon and EUI



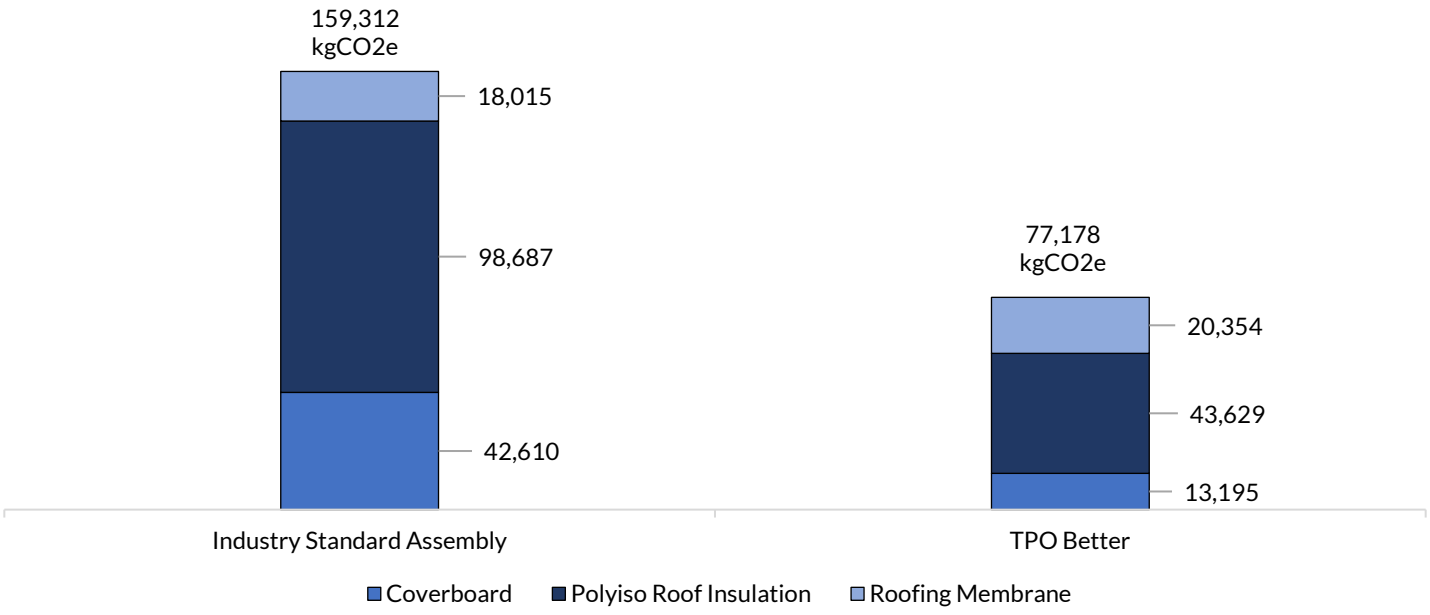
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

-0.03%

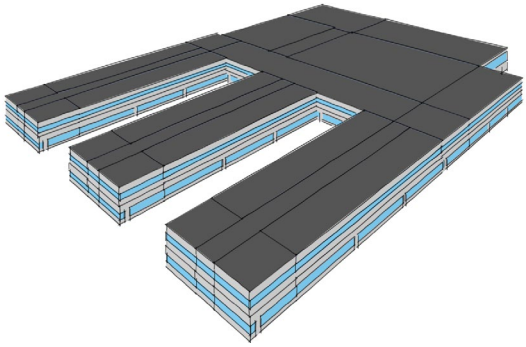
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 4A (Baltimore, MD)

Embodied Carbon and EUI



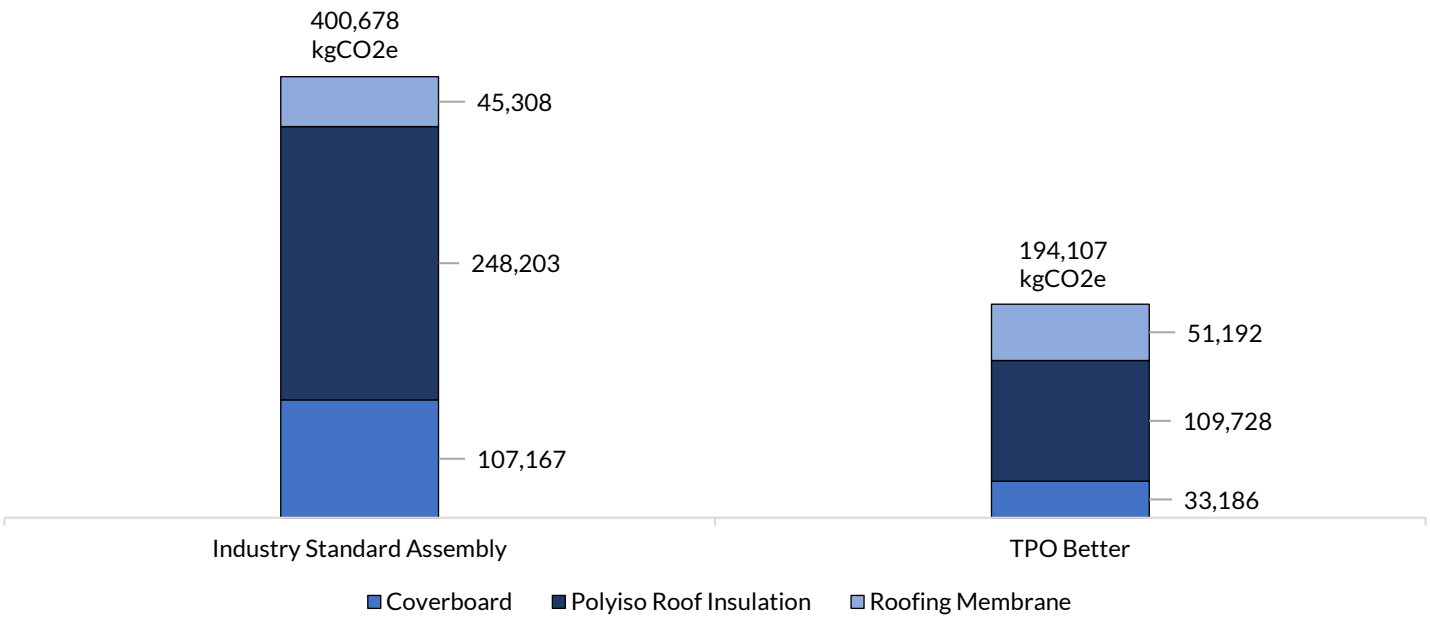
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.07%

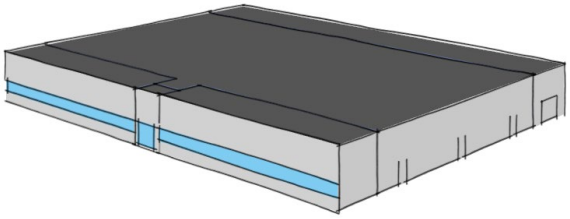
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 4A (Baltimore, MD)

Embodied Carbon and EUI



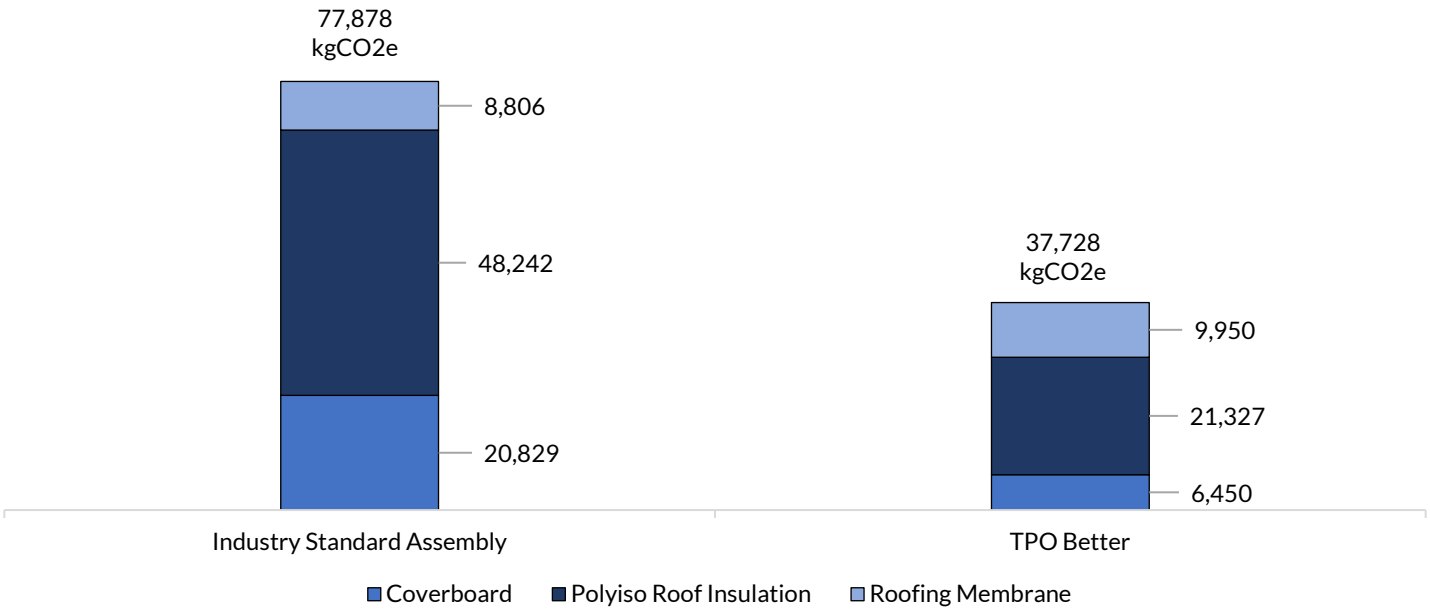
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.24%

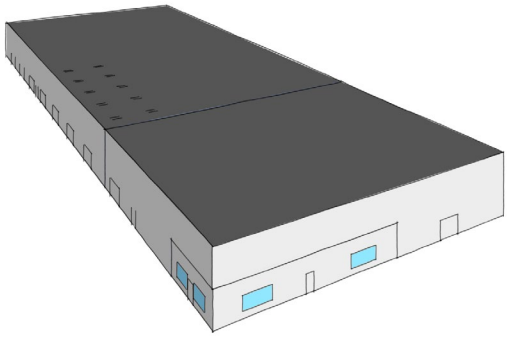
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 4A (Baltimore, MD)

Embodied Carbon and EUI



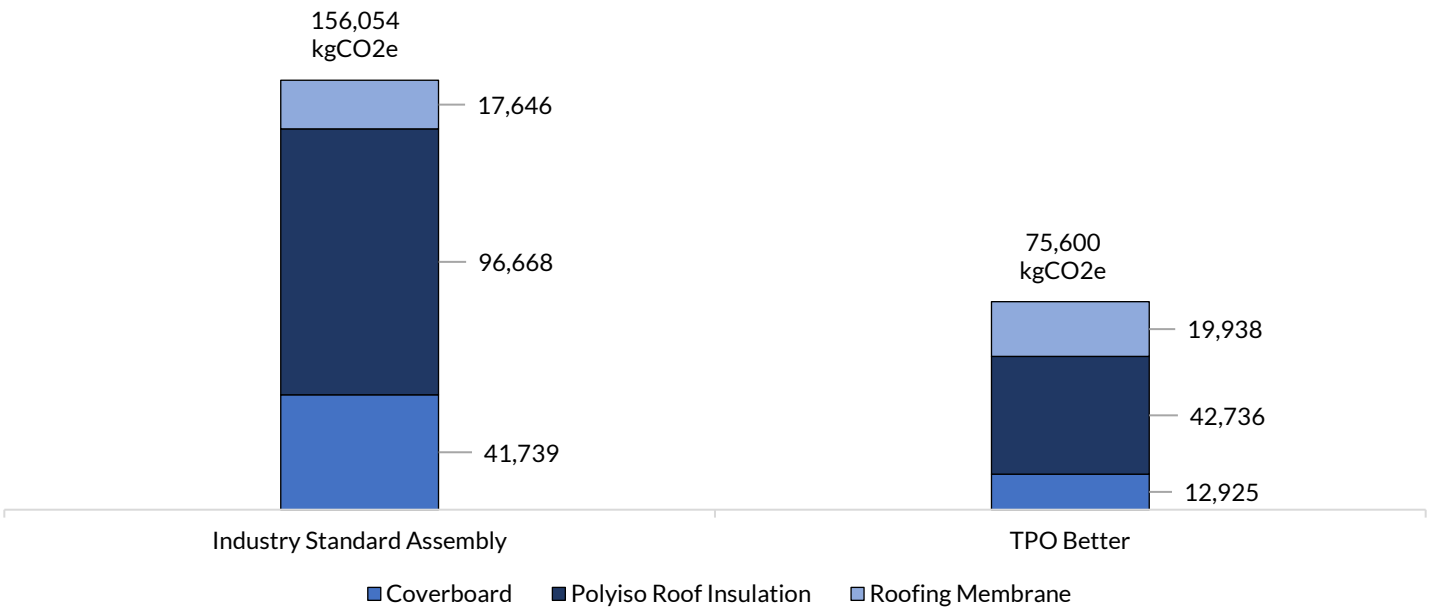
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.39%

Savings in Energy Use Intensity

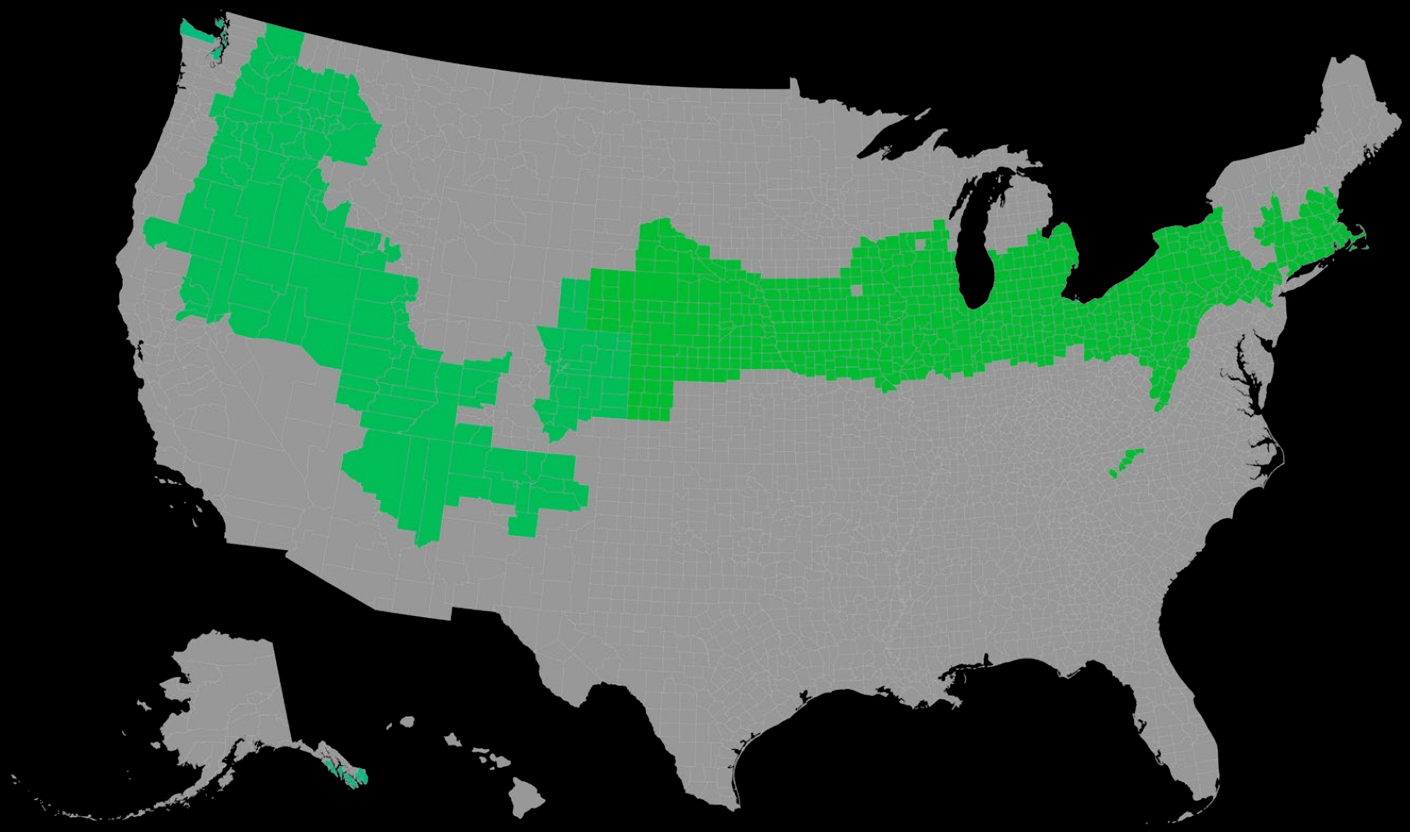


* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

05

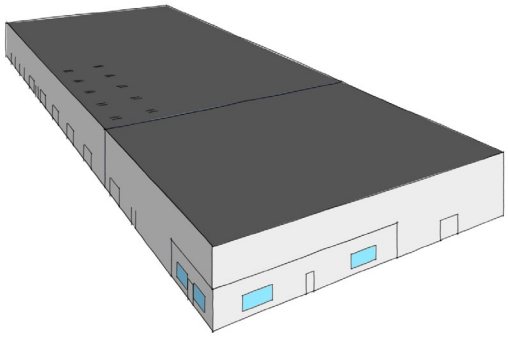
ASHRAE Climate Zone 5 is classified as a **mixed-dry climate**, according to the standards of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **between 4500 and 9000 heating degree days** and **fewer than 4500 cooling degree days** (based on a base of 10°C). The climate in this zone features significant seasonal temperature swings, with cold winters and moderately warm summers, necessitating diverse heating strategies and moderate cooling approaches. Zone 5 encompasses parts of the **interior United States, including regions such as parts of Colorado, Nebraska, and Missouri**. Building strategies in this area often focus on maximizing insulation, utilizing solar heat gain in the winter while minimizing it in the summer, and incorporating efficient heating systems to cope with the colder months while using less extensive cooling systems for the summer.



Chicago, Illinois

Data Center- Zone 5A (Chicago, IL)

Embodied Carbon and EUI



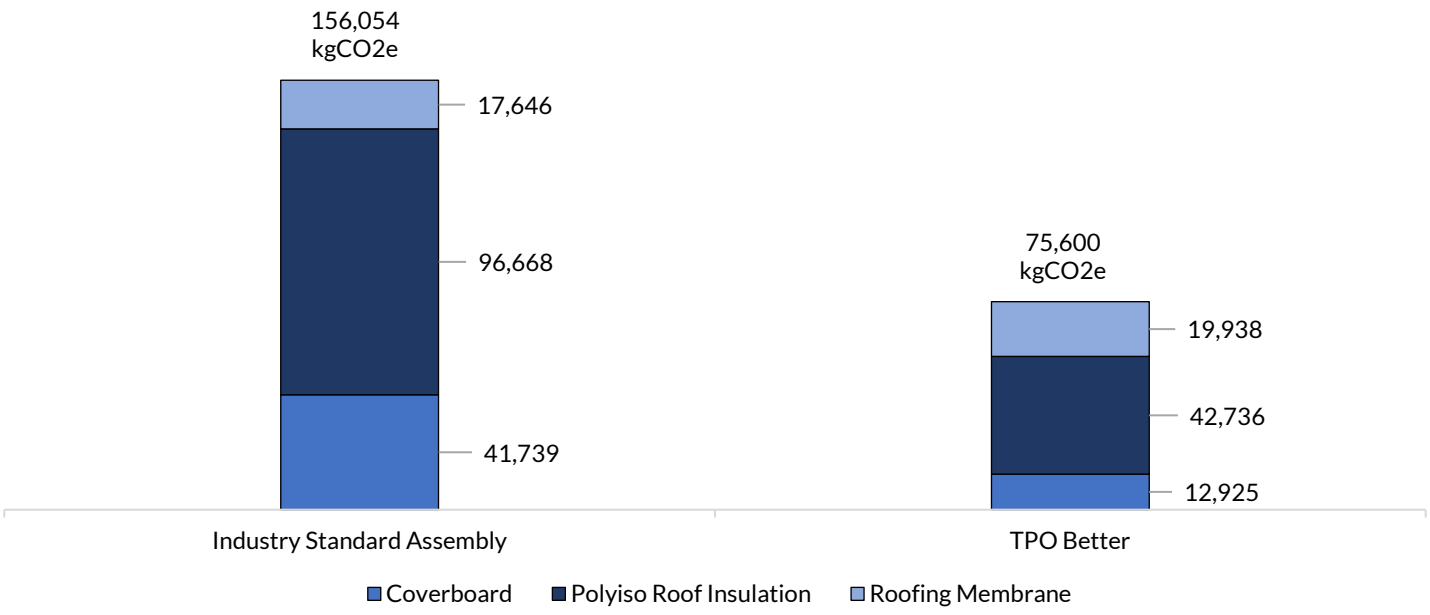
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.00%

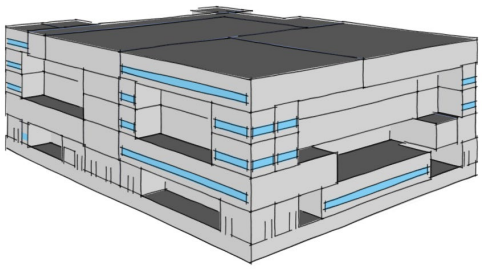
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 5A (Chicago, IL)

Embodied Carbon and EUI



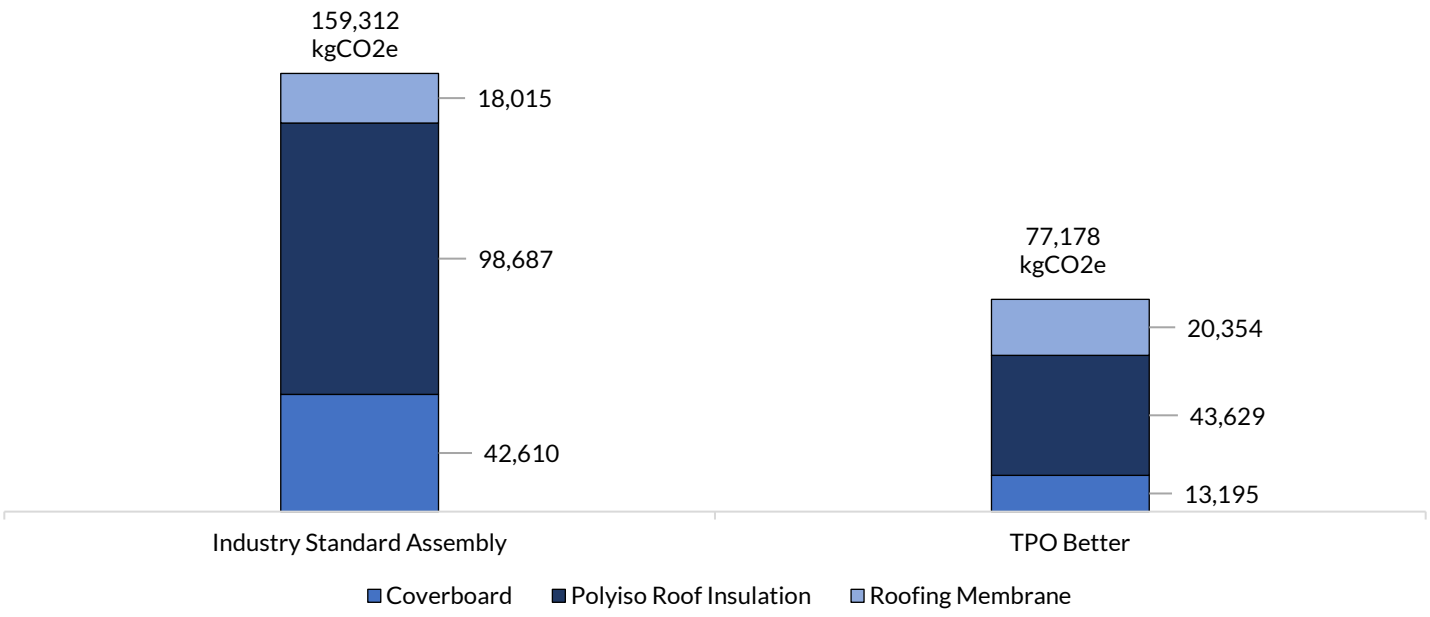
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.03%

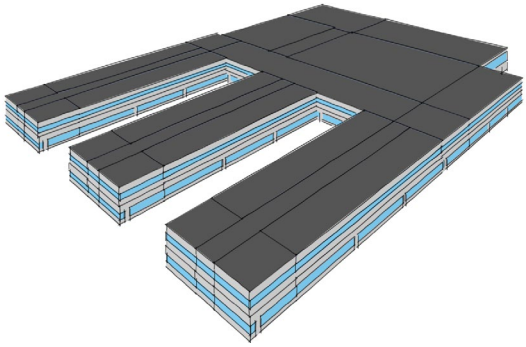
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 5A (Chicago, IL)

Embodied Carbon and EUI



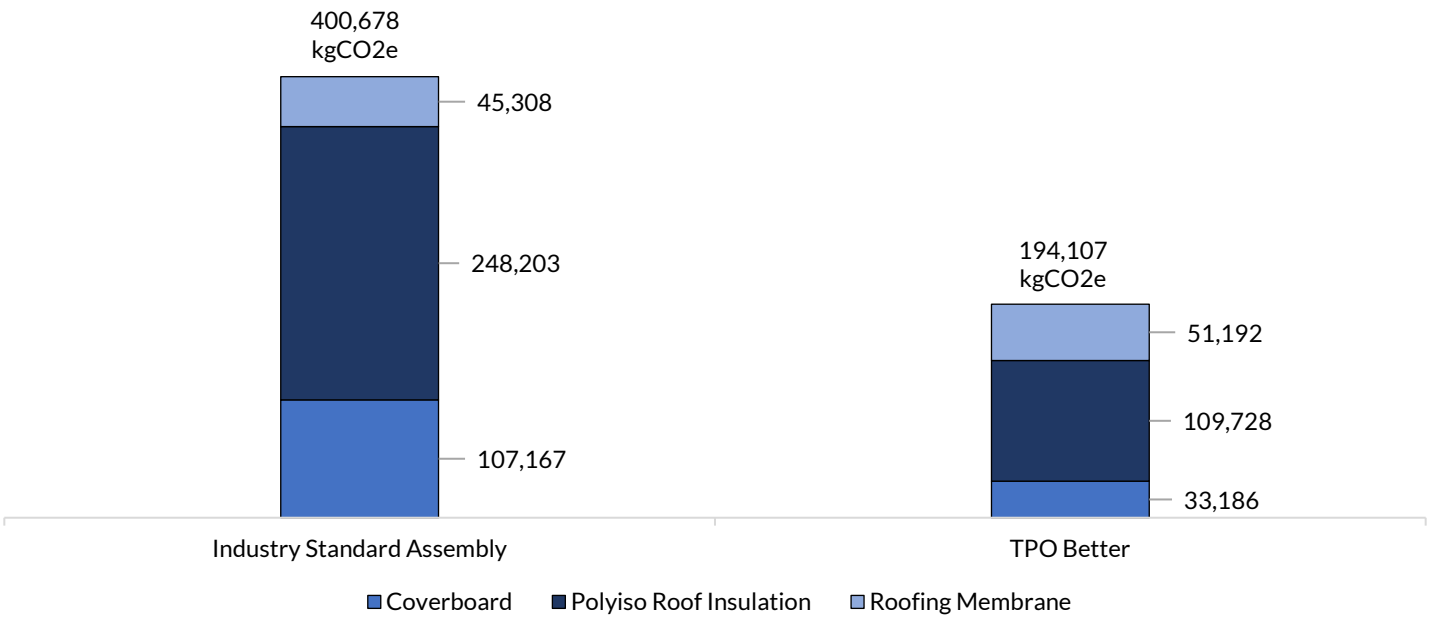
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.13%

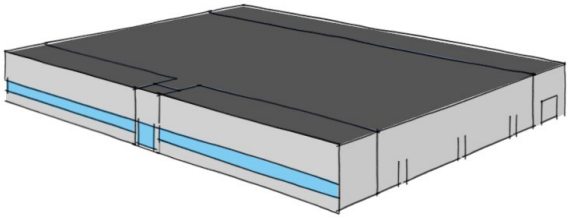
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 5A (Chicago, IL)

Embodied Carbon and EUI



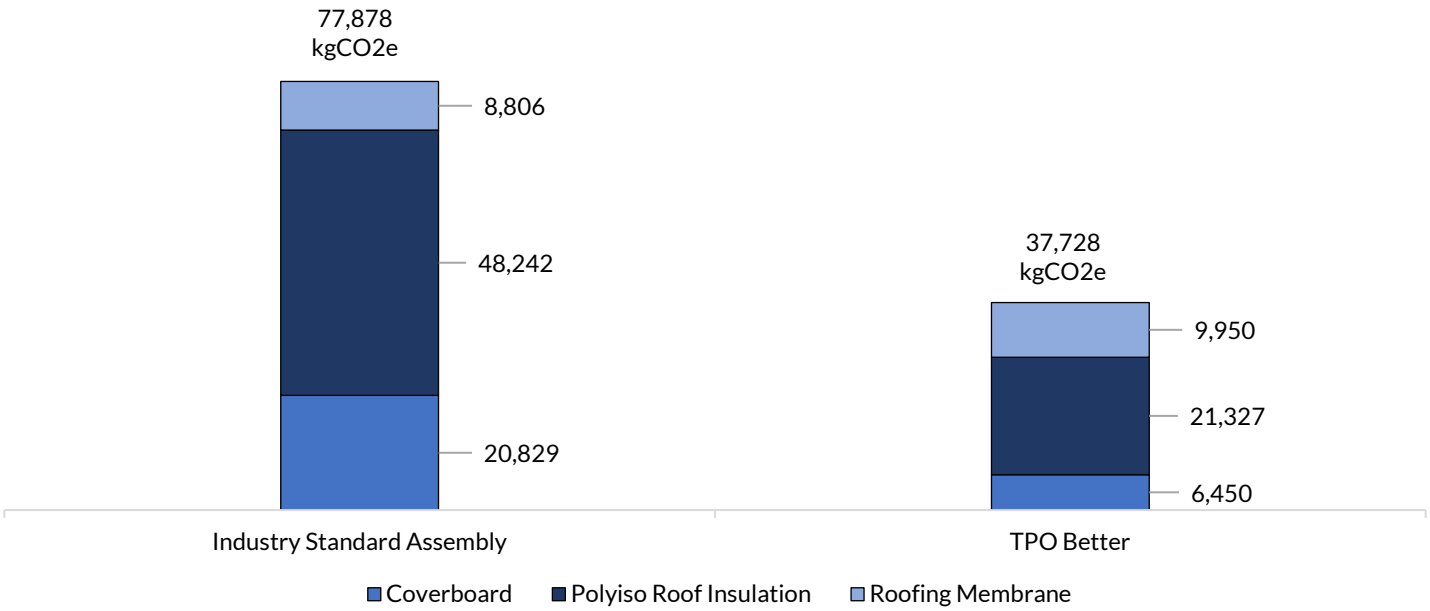
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.25%

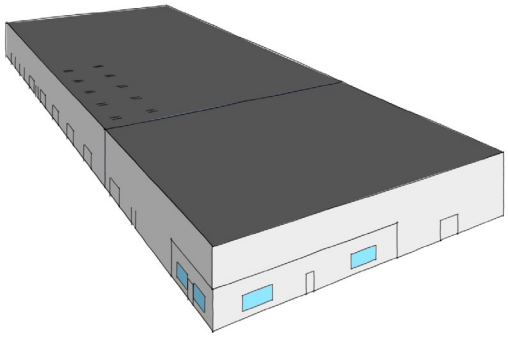
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 5A (Chicago, IL)

Embodied Carbon and EUI



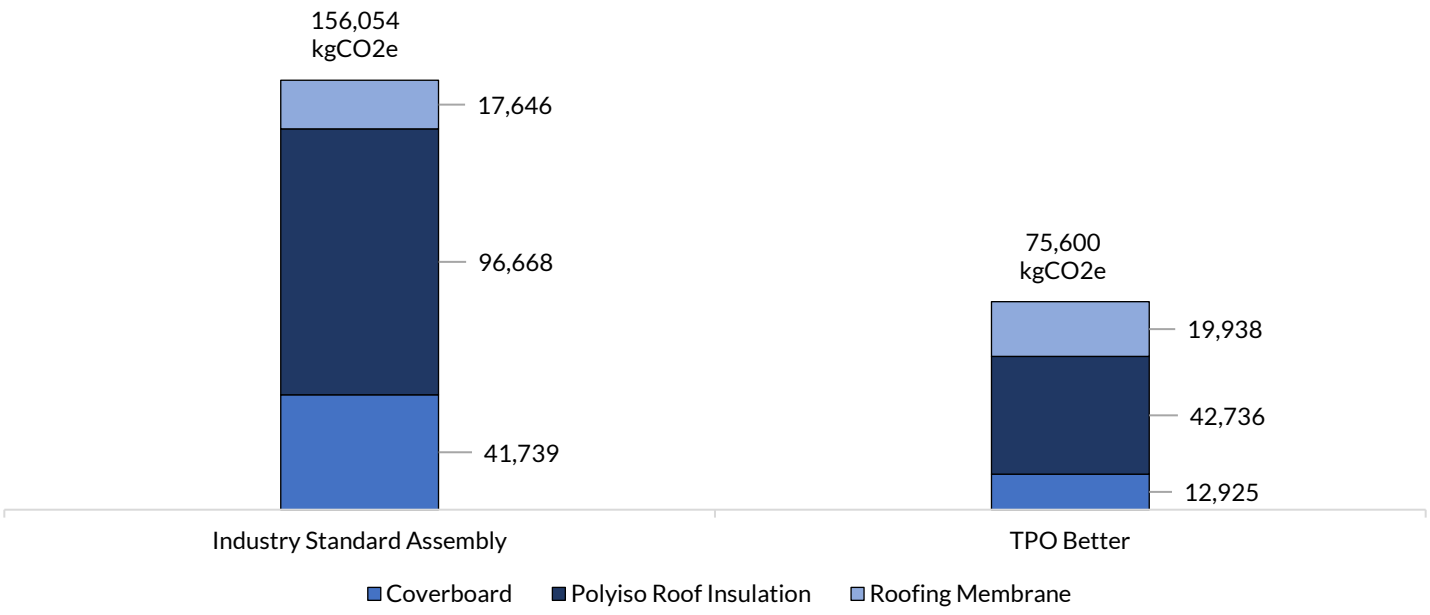
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.40%

Savings in Energy Use Intensity

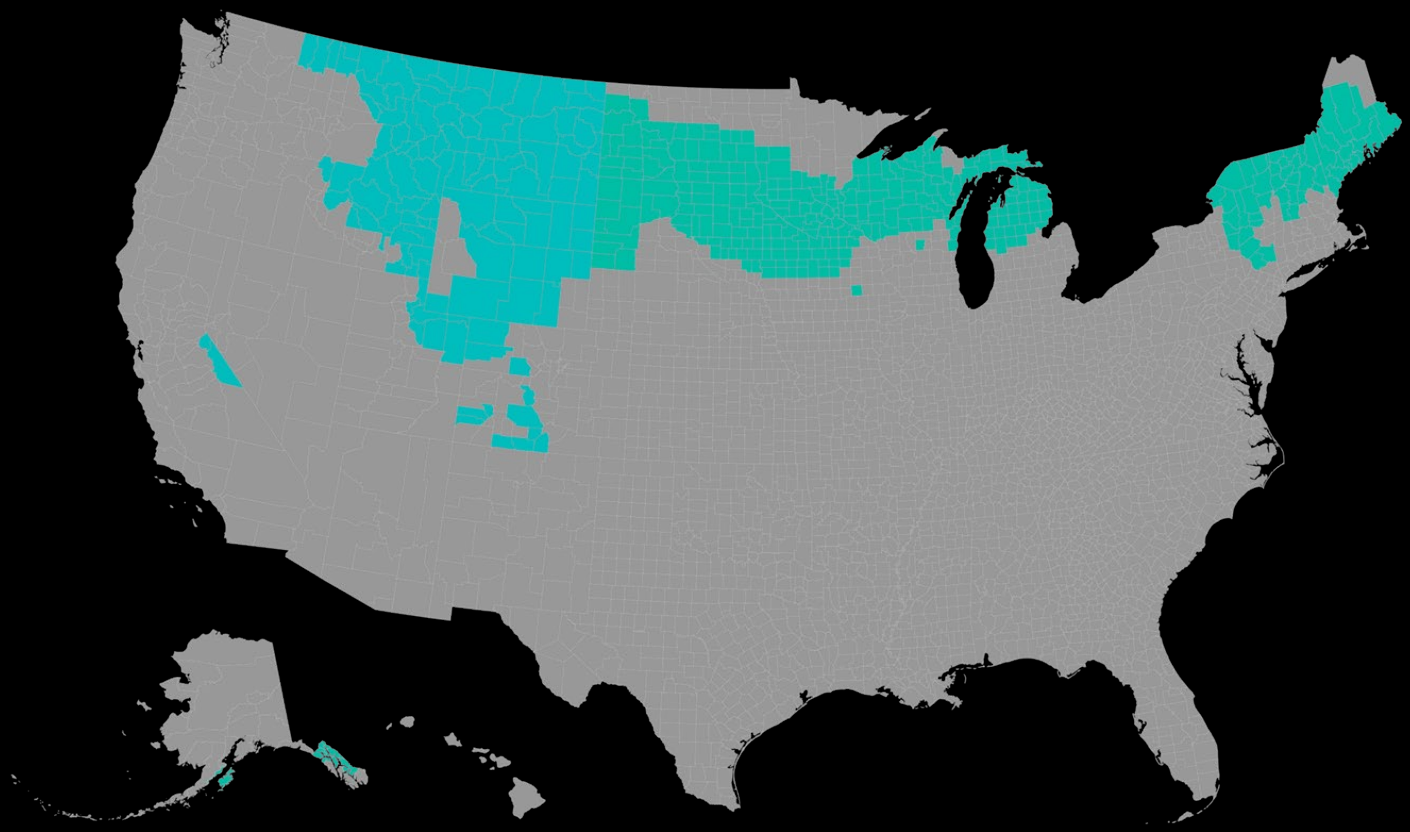


* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

06

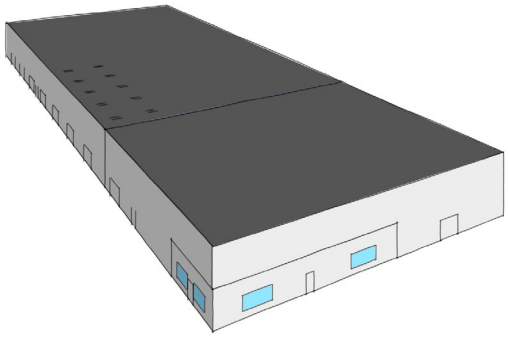
ASHRAE Climate Zone 6 is categorized as a **cold climate**, according to the specifications set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone is defined by having **9000 to 12,000 heating degree days** (based on a base of 10°C) and **fewer than 4500 cooling degree days**, indicating significant heating needs due to the cold winters and only moderate cooling requirements during the short summers. Zone 6 includes much of the **northern United States, covering areas such as parts of Massachusetts, Michigan, and as far west as Idaho**. In this climate, building designs typically emphasize robust insulation, high-performance windows, and controlled ventilation to prevent heat loss during the long, cold winter months, while cooling strategies remain relatively simple due to the mild summer conditions.



Minneapolis, Minnesota

Data Center- Zone 6A (Minneapolis, MN)

Embodied Carbon and EUI



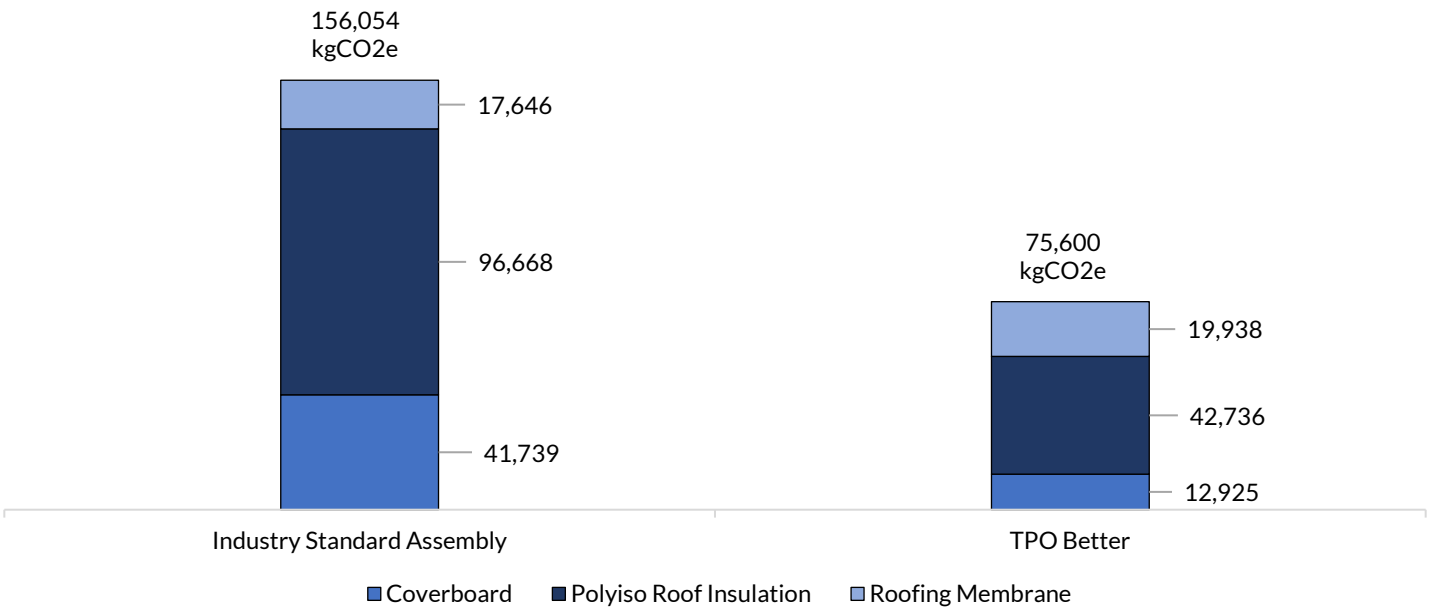
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.00%

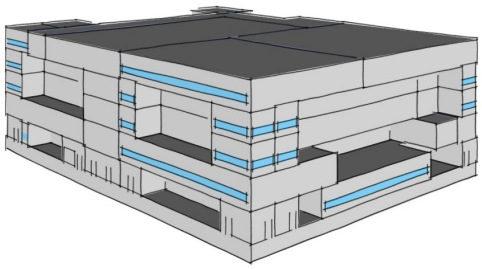
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 6A (Minneapolis, MN)

Embodied Carbon and EUI



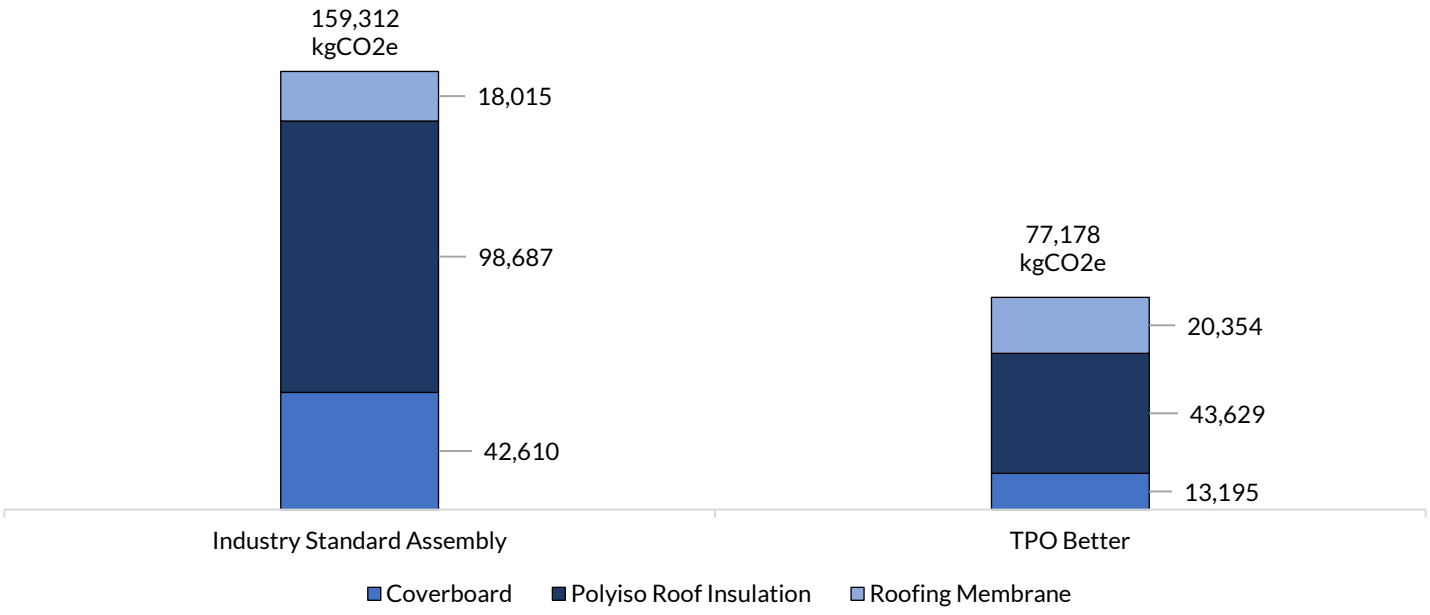
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.04%

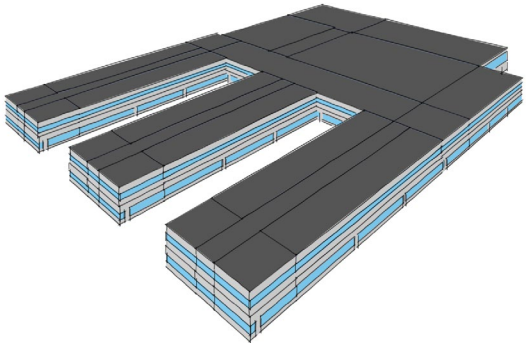
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 6A (Minneapolis, MN)

Embodied Carbon and EUI



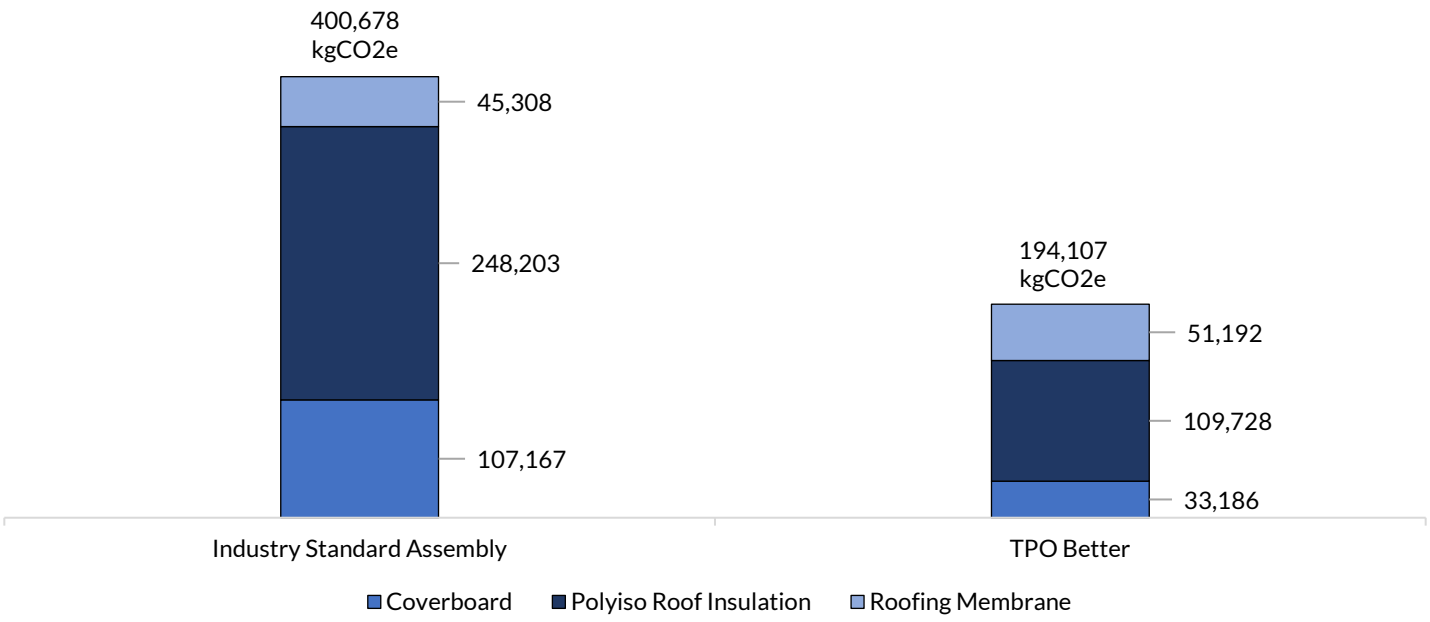
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.39%

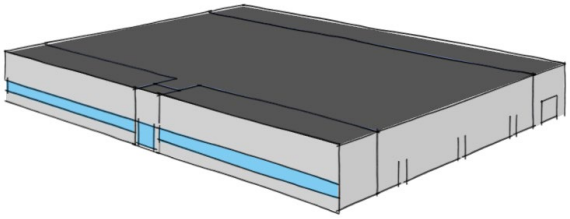
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 6A (Minneapolis, MN)

Embodied Carbon and EUI



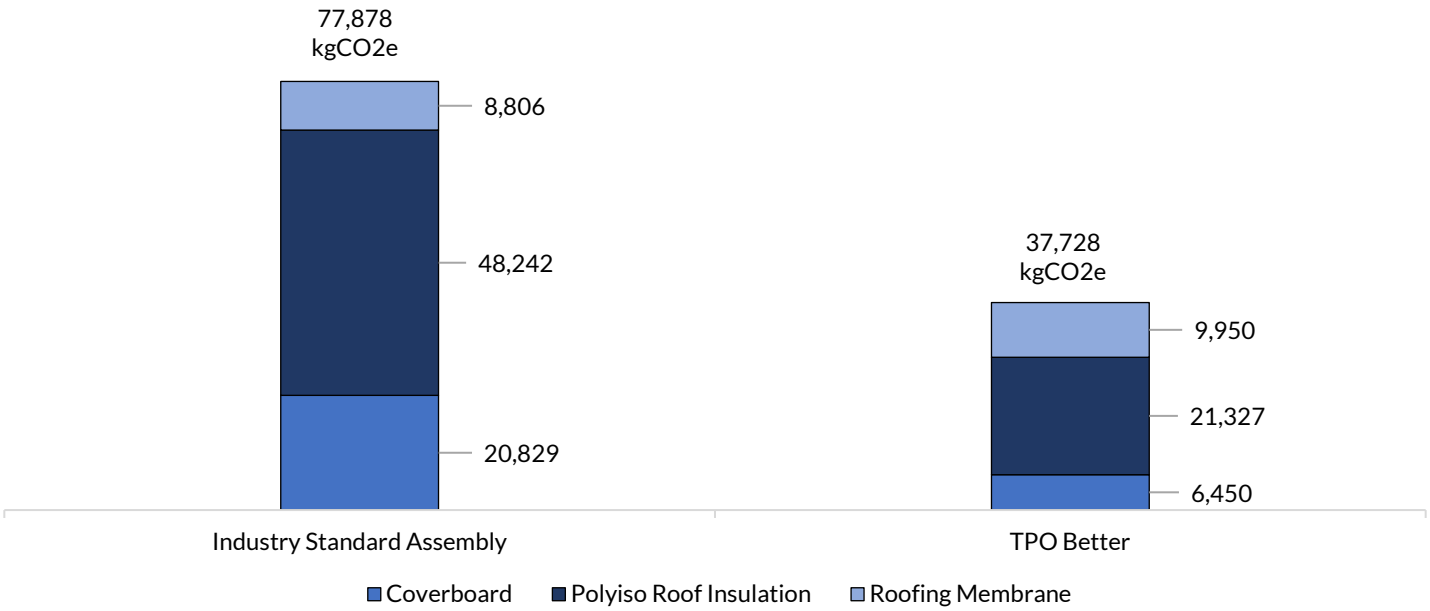
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.51%

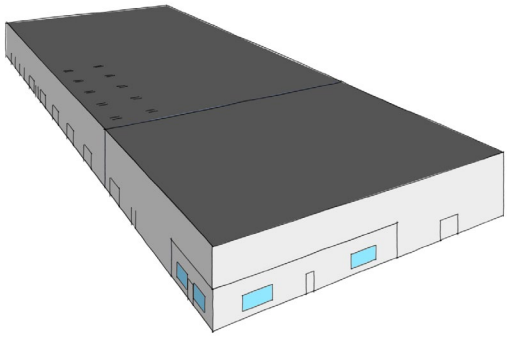
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 6A (Minneapolis, MN)

Embodied Carbon and EUI



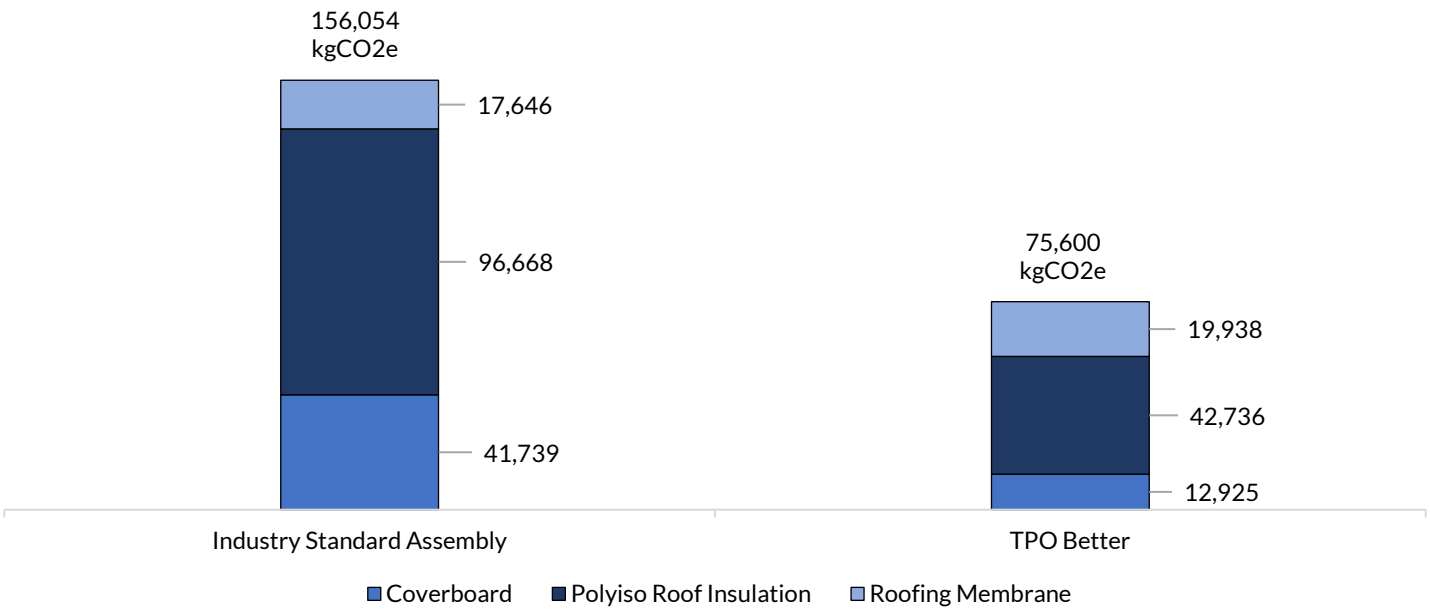
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.39%

Savings in Energy Use Intensity

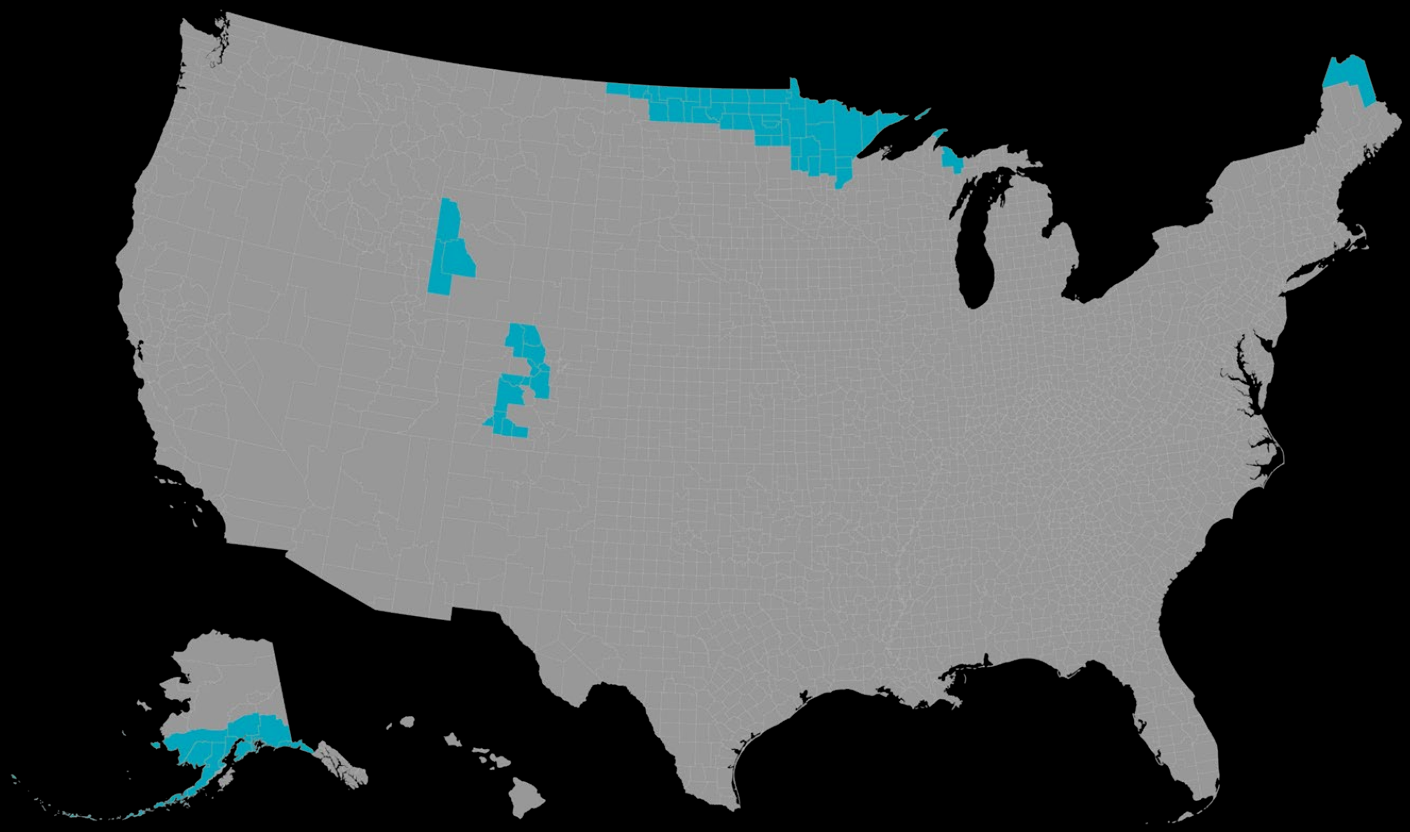


* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

07

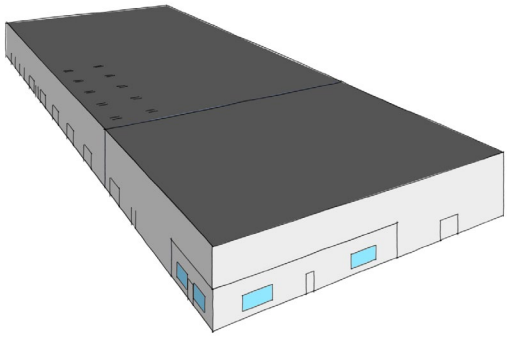
ASHRAE Climate Zone 7 is classified as a **very cold climate**, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **more than 12,000 heating degree days** (based on a base of 10°C) and **fewer than 4500 cooling degree days**, highlighting an intense need for heating solutions due to the harsh winter conditions and minimal cooling requirements during the brief, mild summers. Zone 7 is found in the **northernmost parts of the United States, including regions like northern Minnesota, parts of North Dakota, and areas in Montana**. Building strategies in this zone focus on maximizing thermal resistance with extensive insulation, triple-glazed windows, and advanced heating systems designed to operate efficiently under extreme cold. Additionally, air sealing to minimize heat leakage and incorporating energy recovery ventilation systems are crucial to maintaining indoor air quality and warmth throughout the severe winter months.



Duluth, Minnesota

Data Center- Zone 7A (Duluth, MN)

Embodied Carbon and EUI



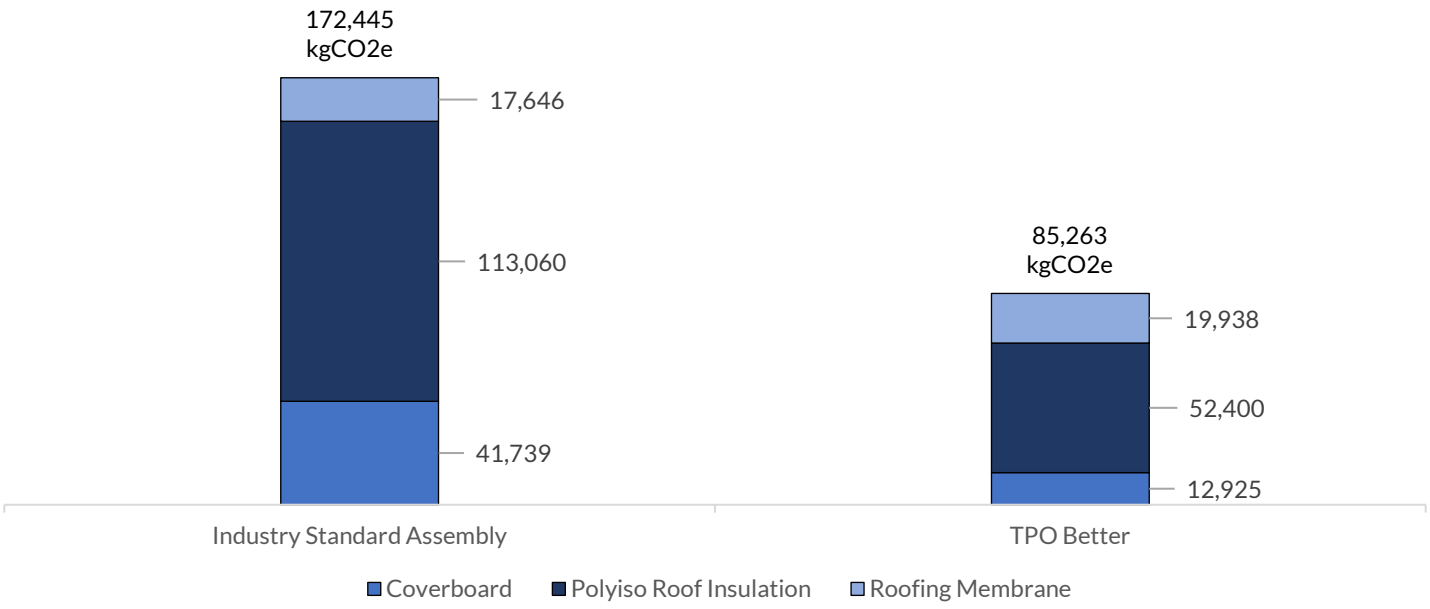
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.00%

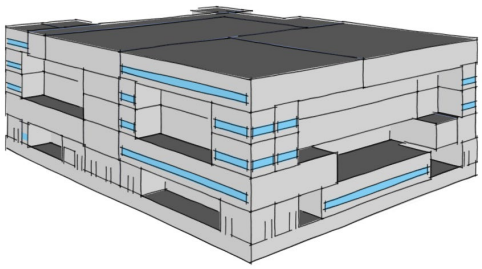
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 7A (Duluth, MN)

Embodied Carbon and EUI



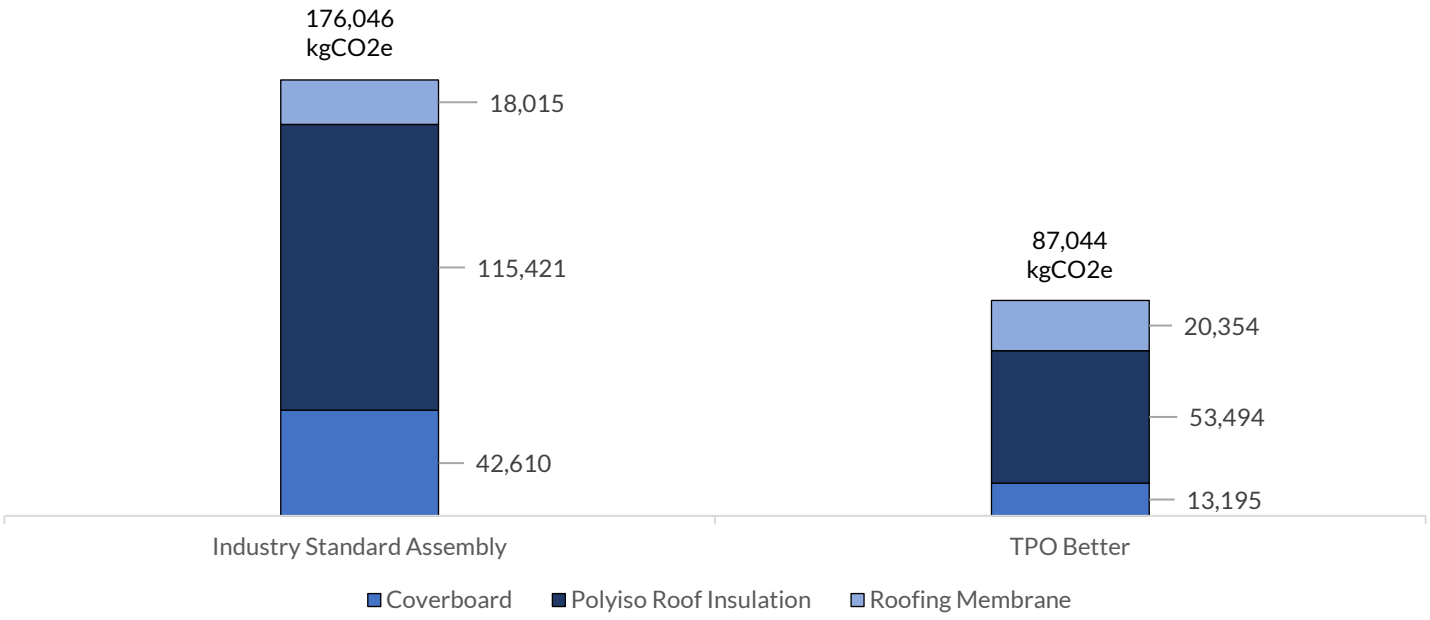
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.12%

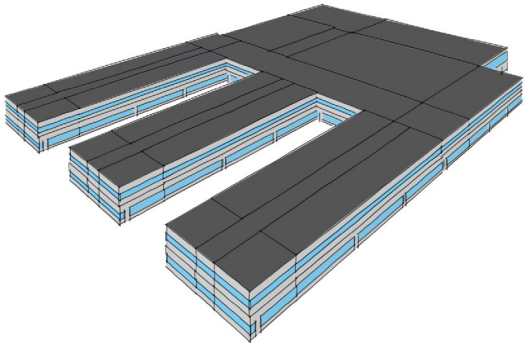
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 7A (Duluth, MN)

Embodied Carbon and EUI



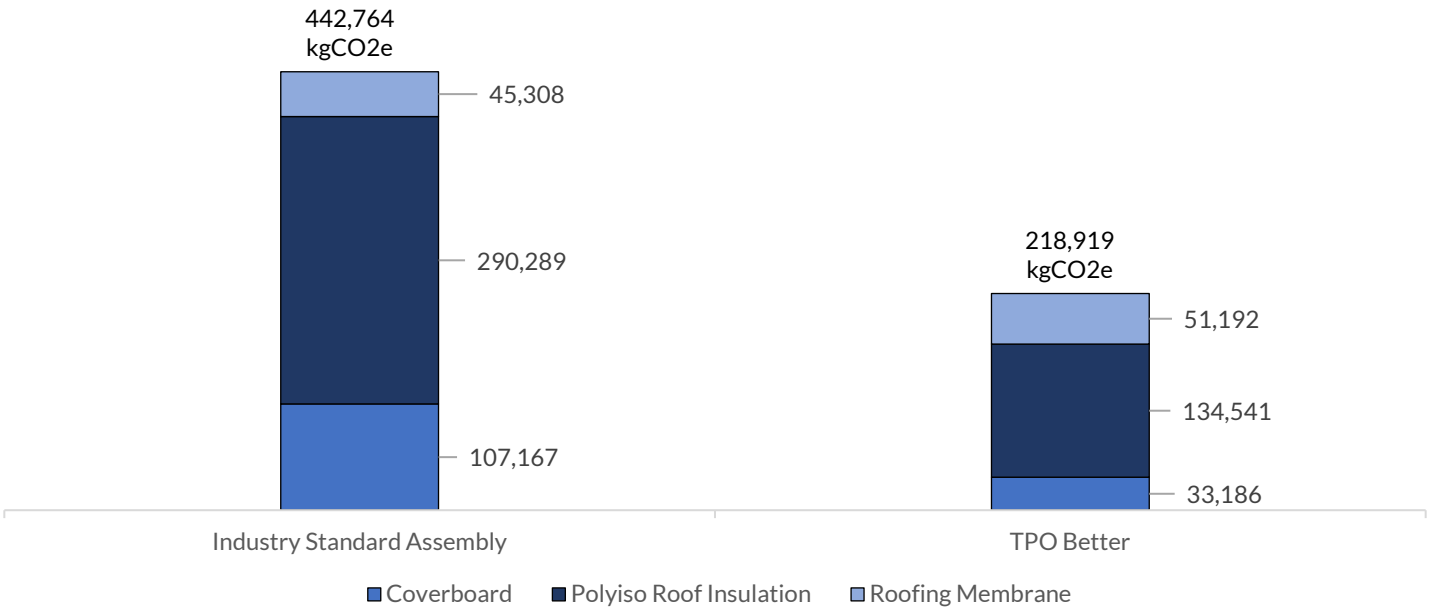
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.57%

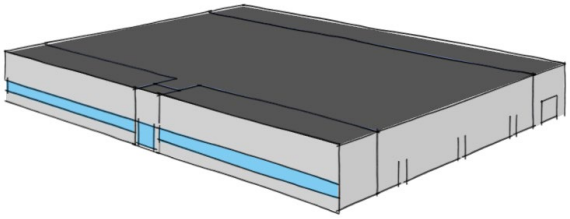
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 7A (Duluth, MN)

Embodied Carbon and EUI



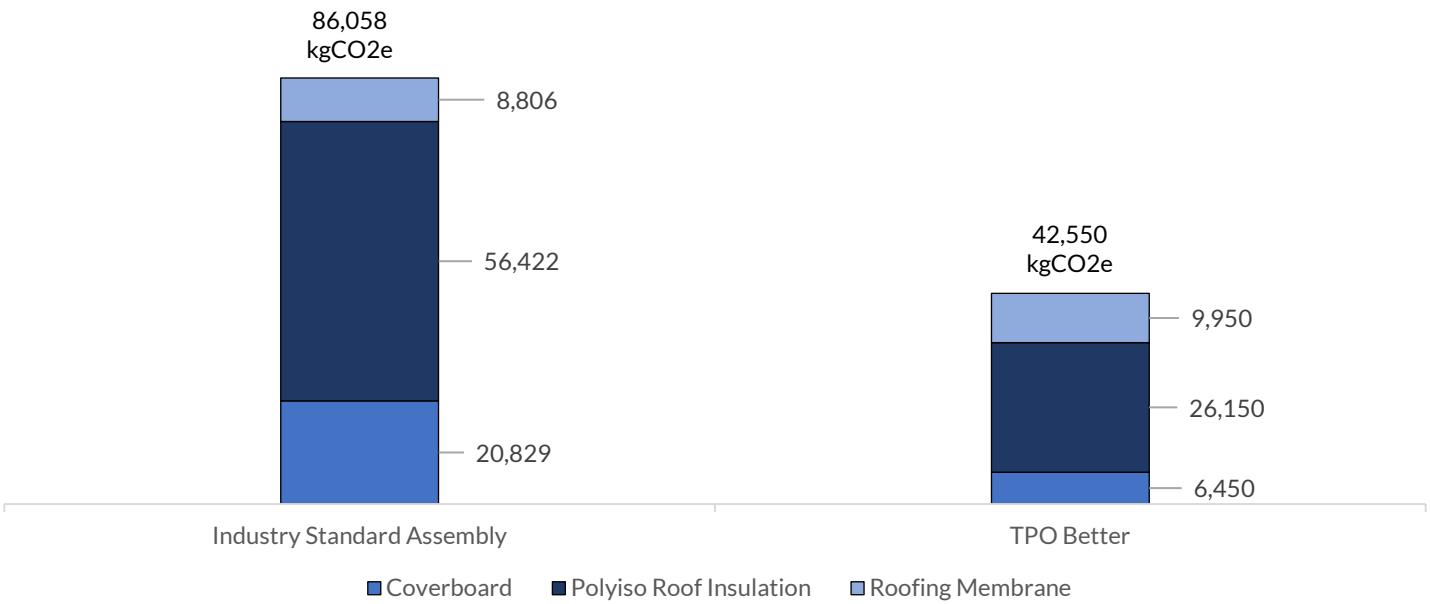
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

0.93%

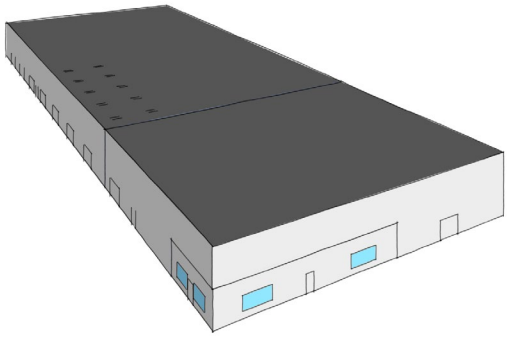
Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Warehouse - Zone 7A (Duluth, MN)

Embodied Carbon and EUI



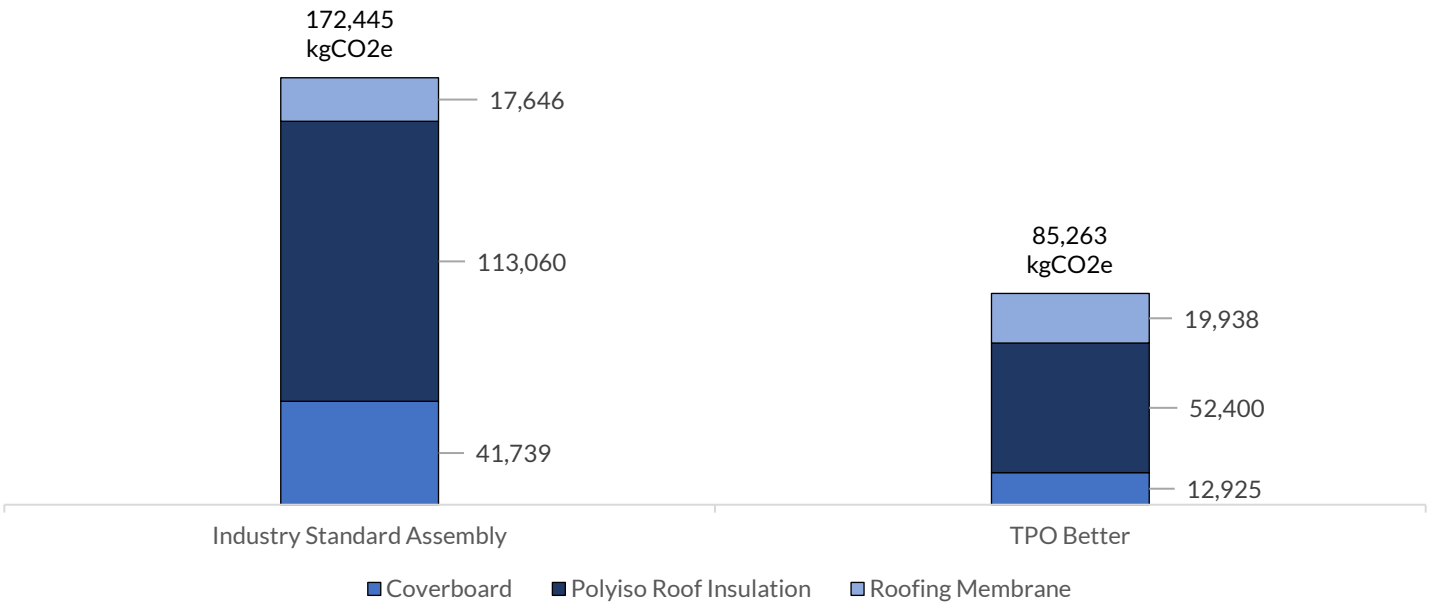
GAF TPO Better vs Industry-standard Assembly

51.56%

Savings in Embodied Carbon

1.38%

Savings in Energy Use Intensity



* A negative value indicates that the GAF assembly is outperformed by that percentage

Comparison

03

Polyiso Insulation + Polyiso Coverboard + Thermal Barrier + Roofing Membrane

38.50%
Average Savings in Embodied Carbon

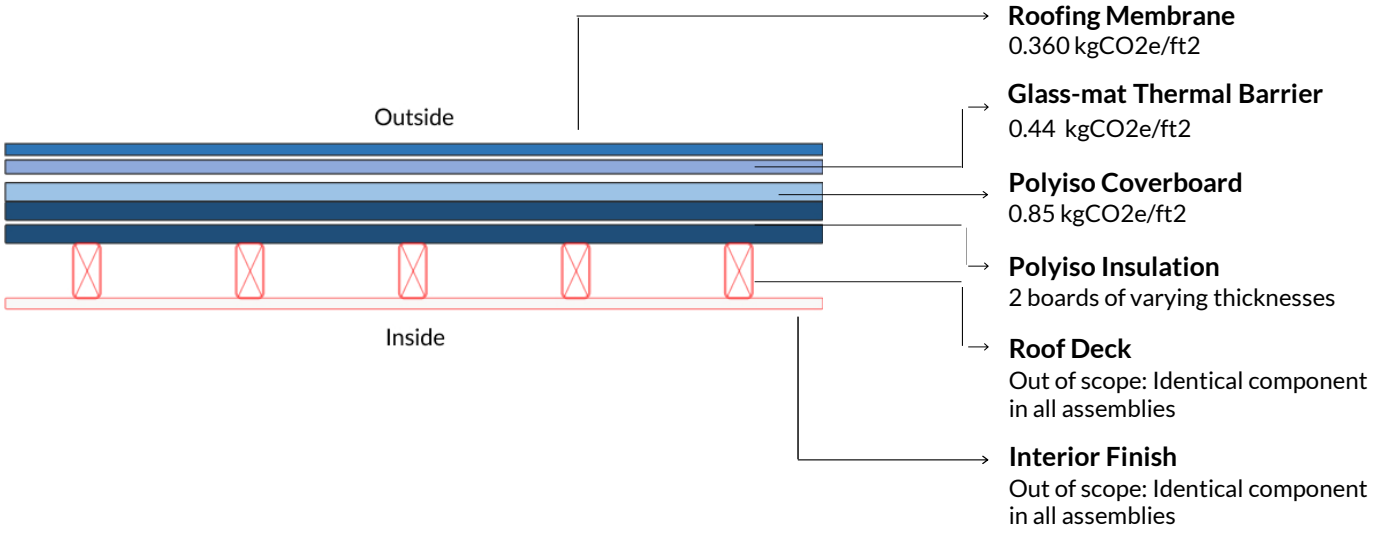
<5%
Average Savings in Energy Use Intensity (EUI)

This section of the report outlines the comparison of a wall assembly that includes

1. Two layers of polyiso insulation,
2. A Polysio coverboard,
3. A Thermal Barrier and
4. A roofing membrane.

The chapter provides a detailed comparison of such an industry standard assembly against 2 similar GAF Assemblies across five distinct building types and six different climate zones, examining their performance and efficiency in various environmental conditions.

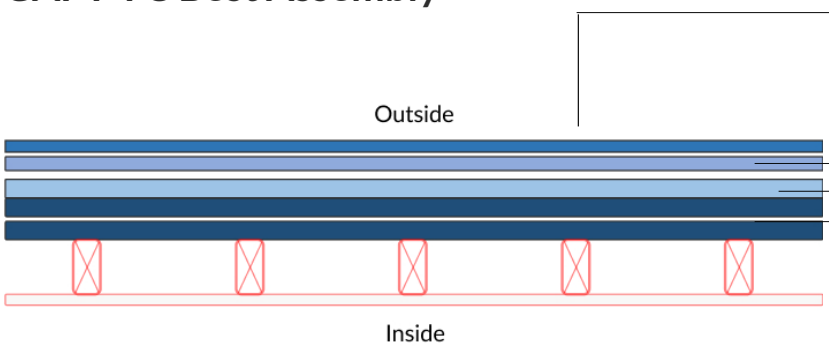
Industry-Standard Assembly being compared



GAF Assemblies

Rigid Insulation thicknesses are adjusted based on climate zone and Roof (Insulation Entirely Above Deck) U-factor requirements to comply with ASHRAE 2019 standards. The manufacturer offers specific thicknesses, and the one that best aligns with ASHRAE specifications is selected.

GAF PVC Best Assembly



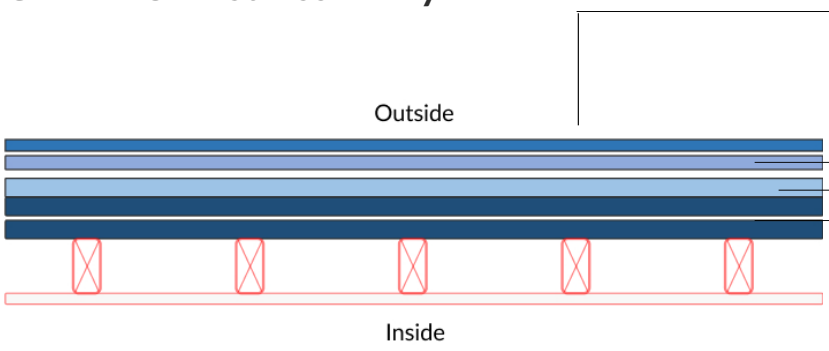
EverGuard PVC KEE FB 80 mil
0.63 kgCO2e/ft2

DensDeck
0.46 kgCO2e/ft2

EnergyGuard NH HD Polyiso
0.26 kgCO2e/ft2

EnergyGuard NH Ultra Polyiso (CGF)
1.12 kgCO2e/ft2
(2 x 2.4" except for Climate Zone 7)

GAF TPO Best Assembly



EverGuard TPO 60mil Fleeceback
0.48 kgCO2e/ft2

DensDeck
0.46 kgCO2e/ft2

EnergyGuard NH HD Polyiso
0.26 kgCO2e/ft2

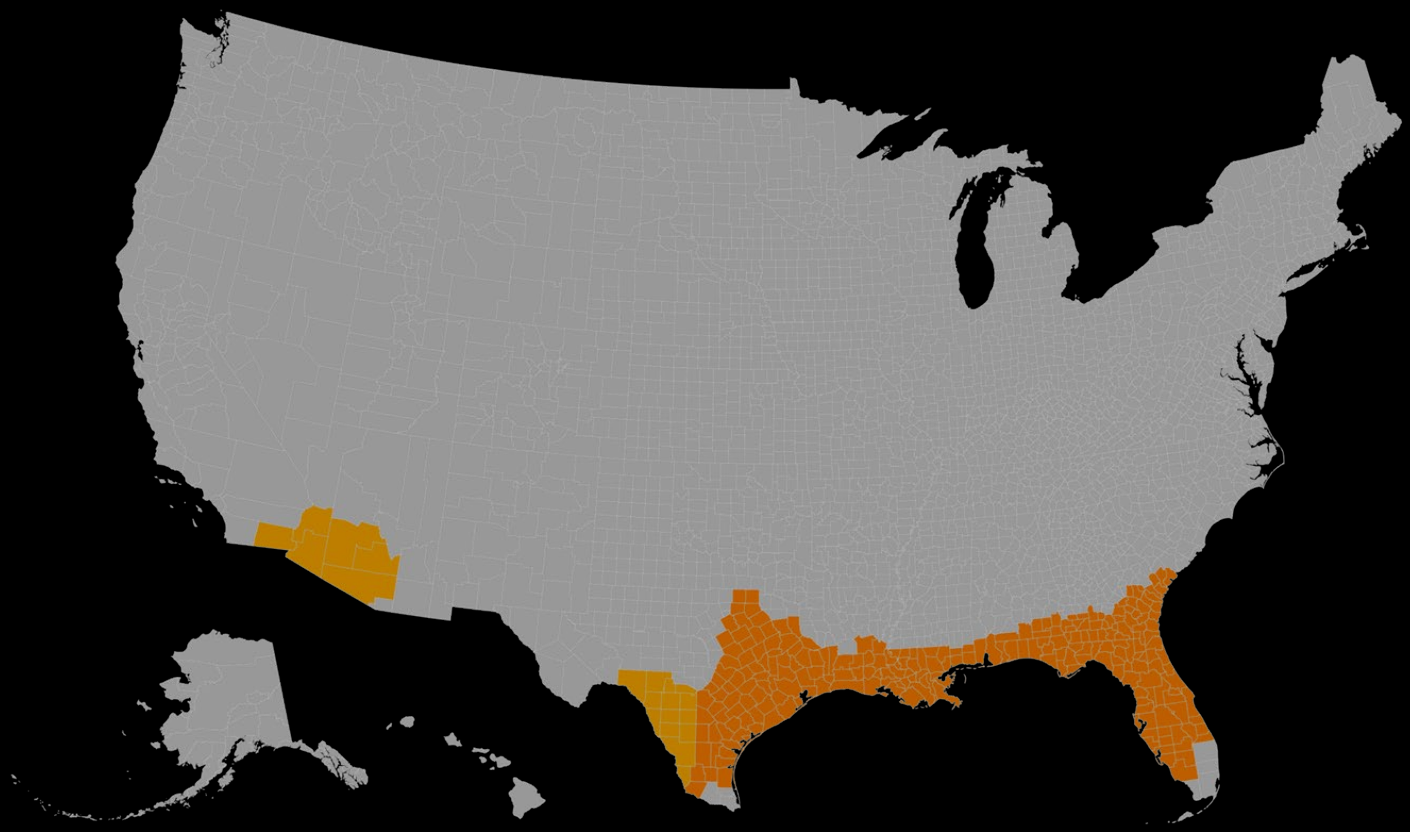
EnergyGuard NH Ultra Polyiso (CGF)
1.12 kgCO2e/ft2
(2 x 2.4" except for Climate Zone 7)

** For Climate Zone 7, the thickness has been increased to 3" because 2 boards of 2.4" do not satisfy the minimum R-value requirements of ASHRAE 2019*

Climate Zone

02

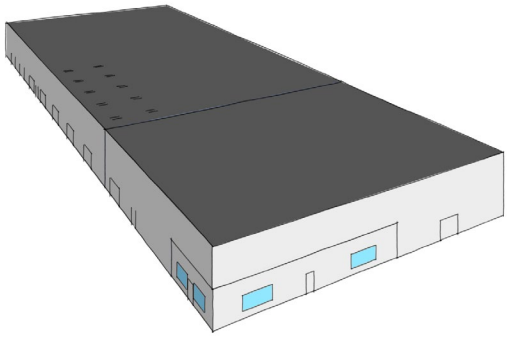
ASHRAE Climate Zone 2 is classified as a **hot-dry climate**, according to the guidelines set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone is characterized by having **fewer than 4500 heating degree days** and **more than 4500 cooling degree days** (based on a base of 10°C). The hot-dry conditions are prevalent with very low annual precipitation and high temperatures that demand extensive cooling measures. Regions typically falling within this climate zone include areas of the **Southwestern United States such as portions of Arizona and Texas**. Buildings in this zone benefit from strategies aimed at reducing cooling loads, such as high thermal mass, adequate insulation, and ventilation that maximizes nighttime cooling.



Houston, Texas

Data Center- Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

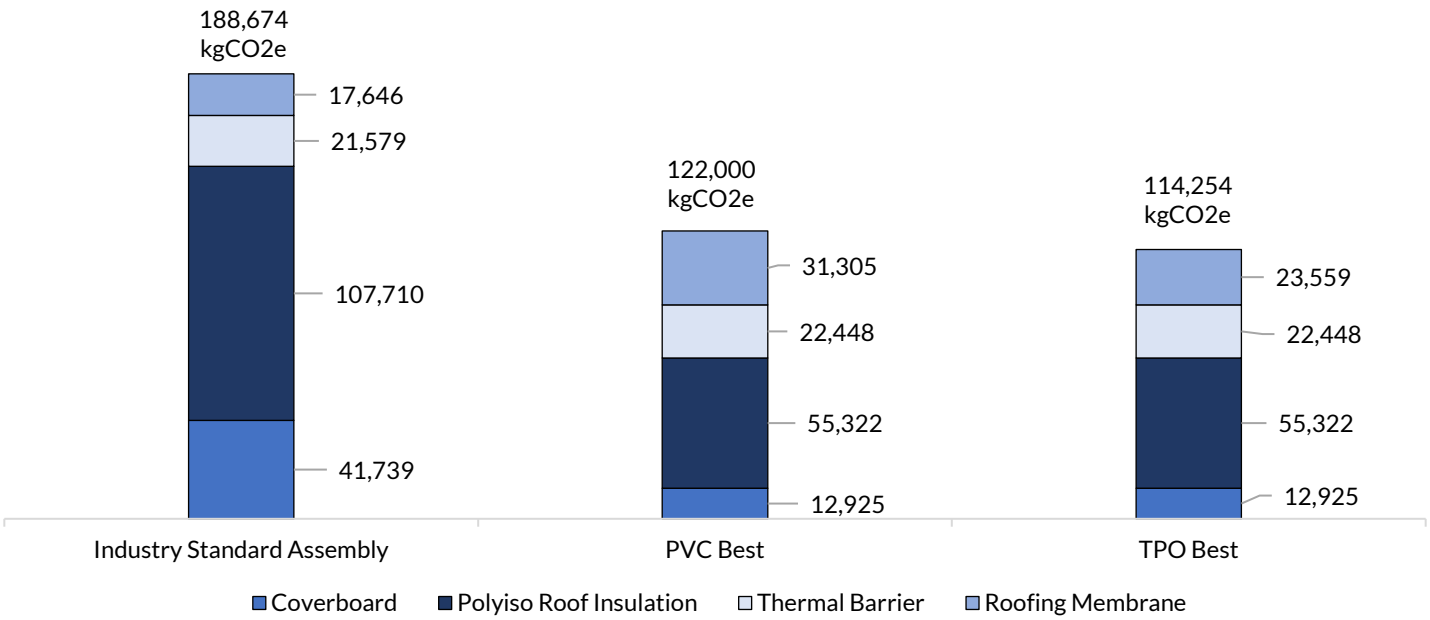
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

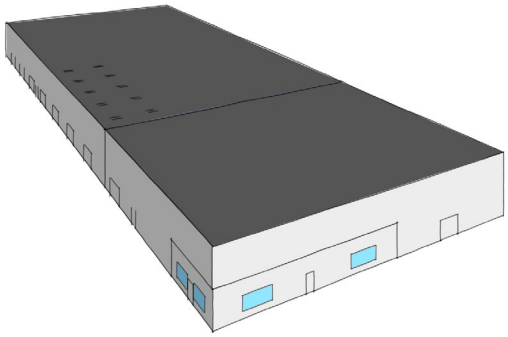
39.44 %

Savings in Embodied Carbon



Data Center- Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

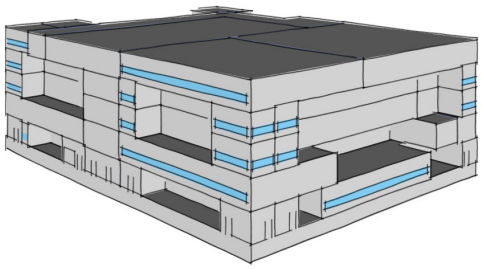
-0.01%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

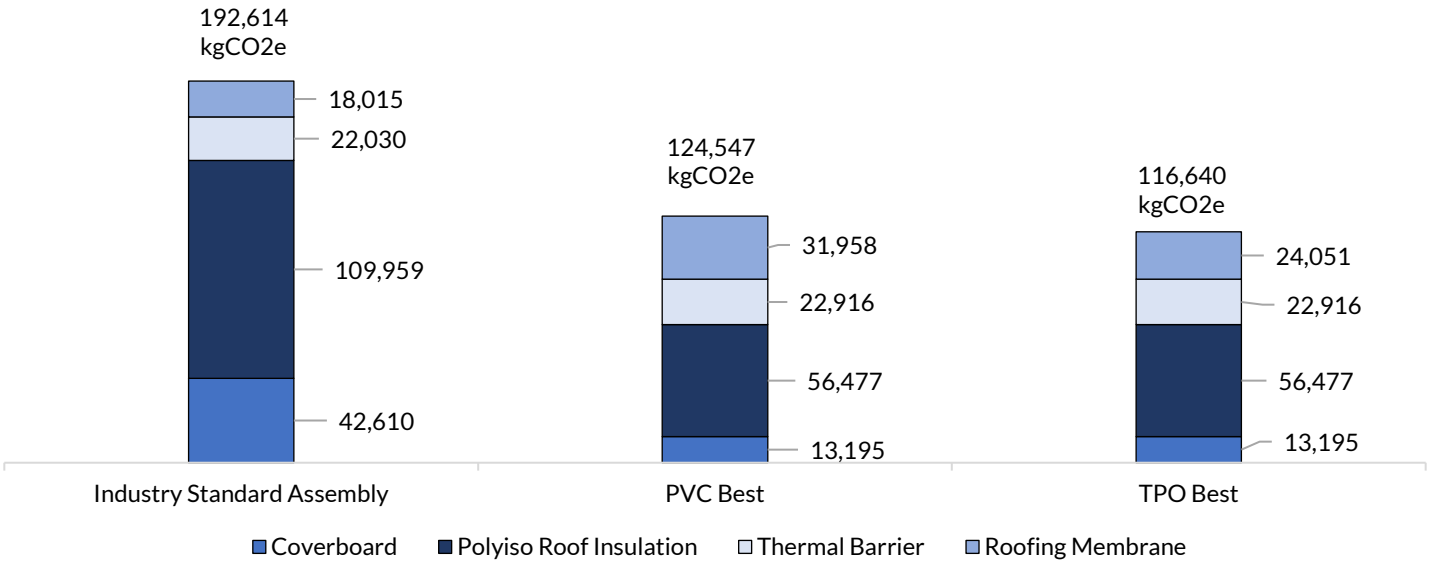
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

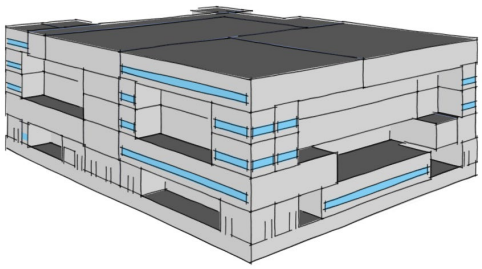
39.44 %

Savings in Embodied Carbon



Hospital - Zone 2A (Houston. TX)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-4.89%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

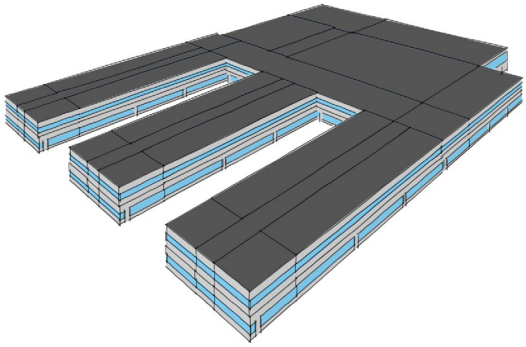
-4.89%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

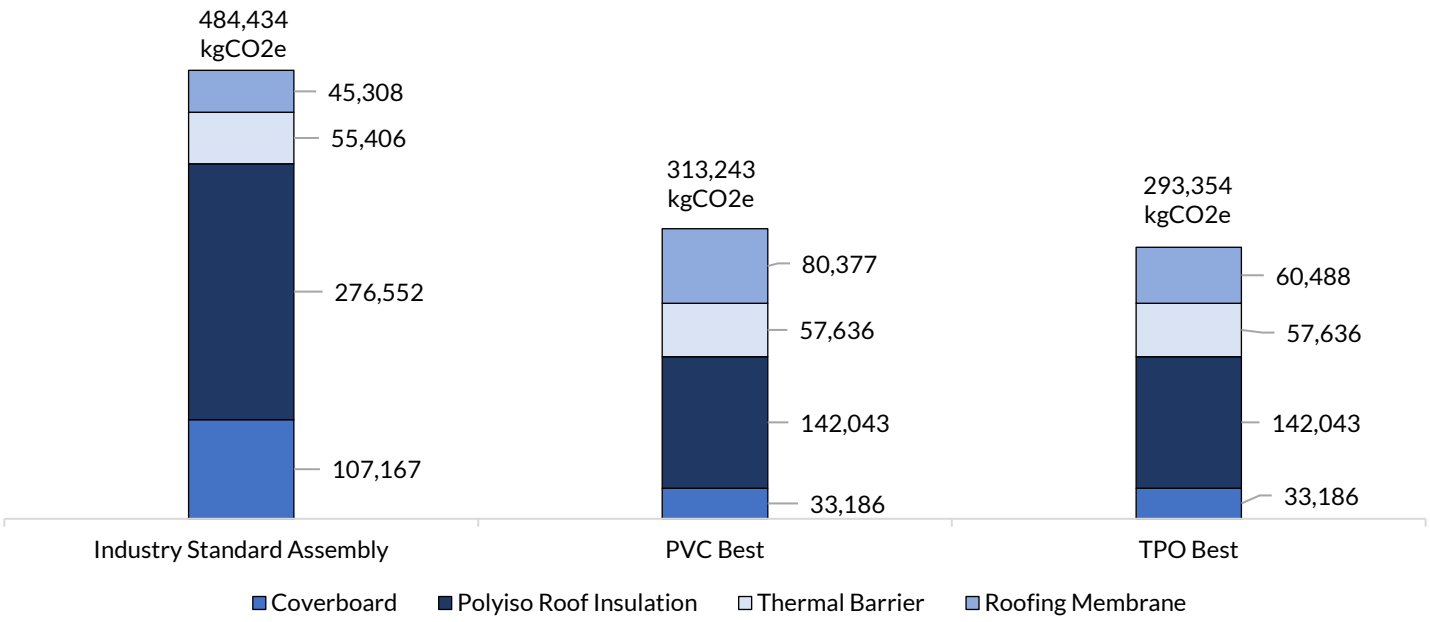
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

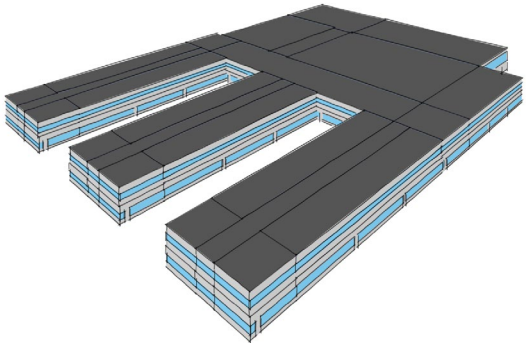
39.44 %

Savings in Embodied Carbon



Secondary School - Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-0.30%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

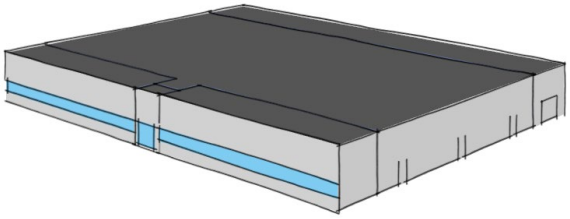
-0.30%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

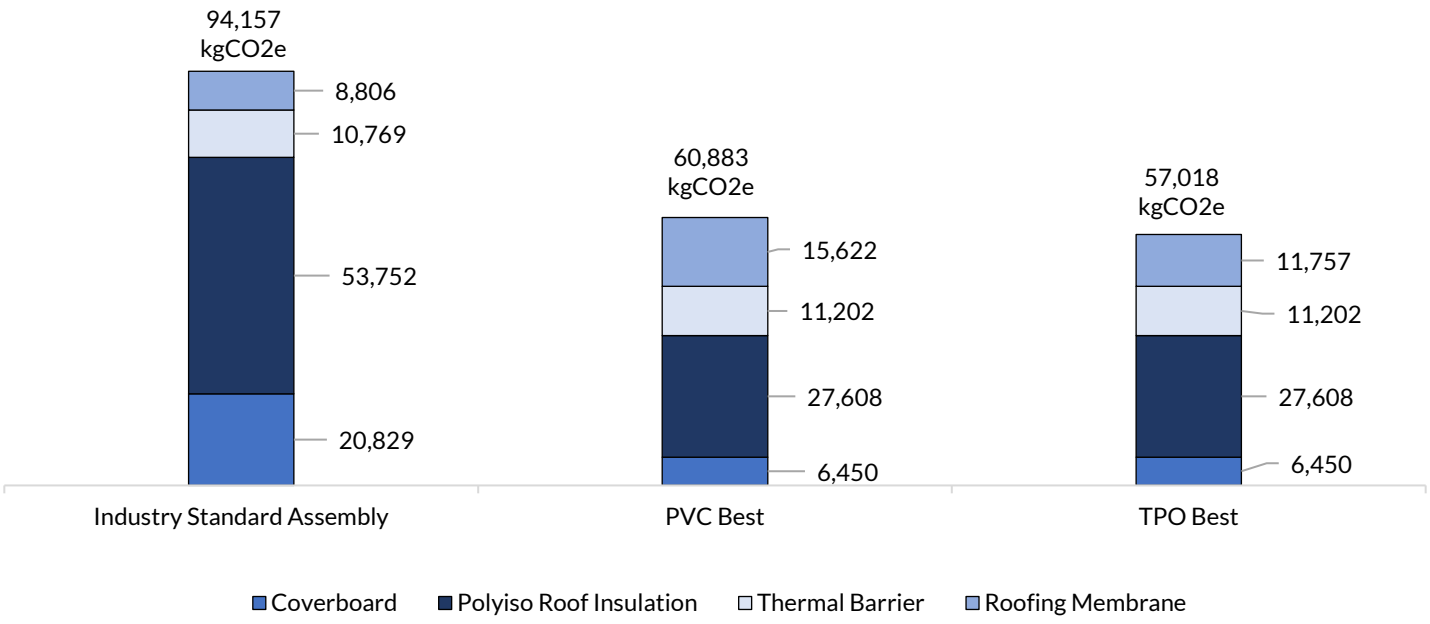
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

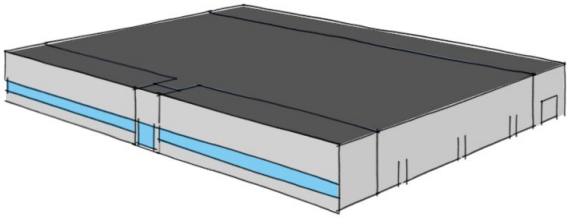
39.44 %

Savings in Embodied Carbon



Retail - Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

1.03%

Savings in Energy Use Intensity

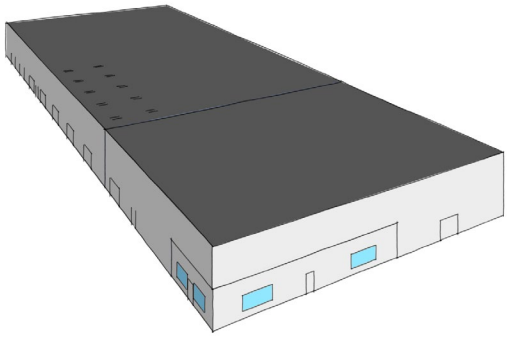
GAF TPO Best vs Industry-standard Assembly

1.03%

Savings in Energy Use Intensity

Warehouse - Zone 2A (Houston, TX)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

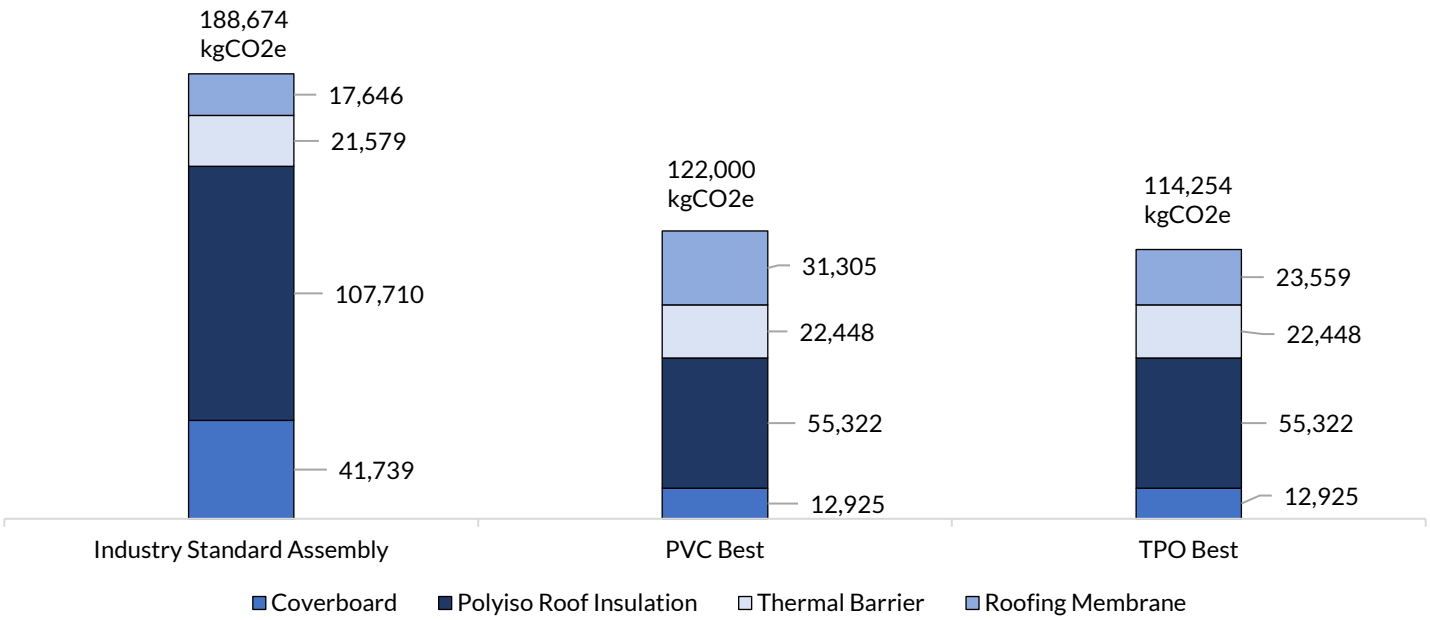
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

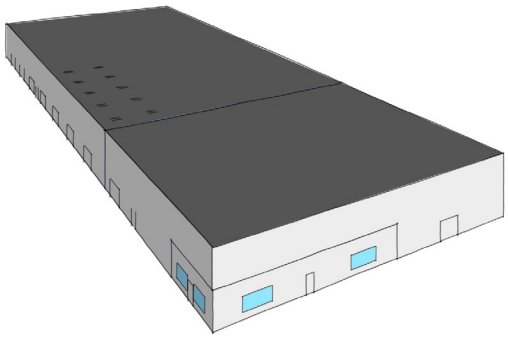
39.44 %

Savings in Embodied Carbon



Warehouse - Zone 2A (Houston, TX)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

2.96%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

2.96%

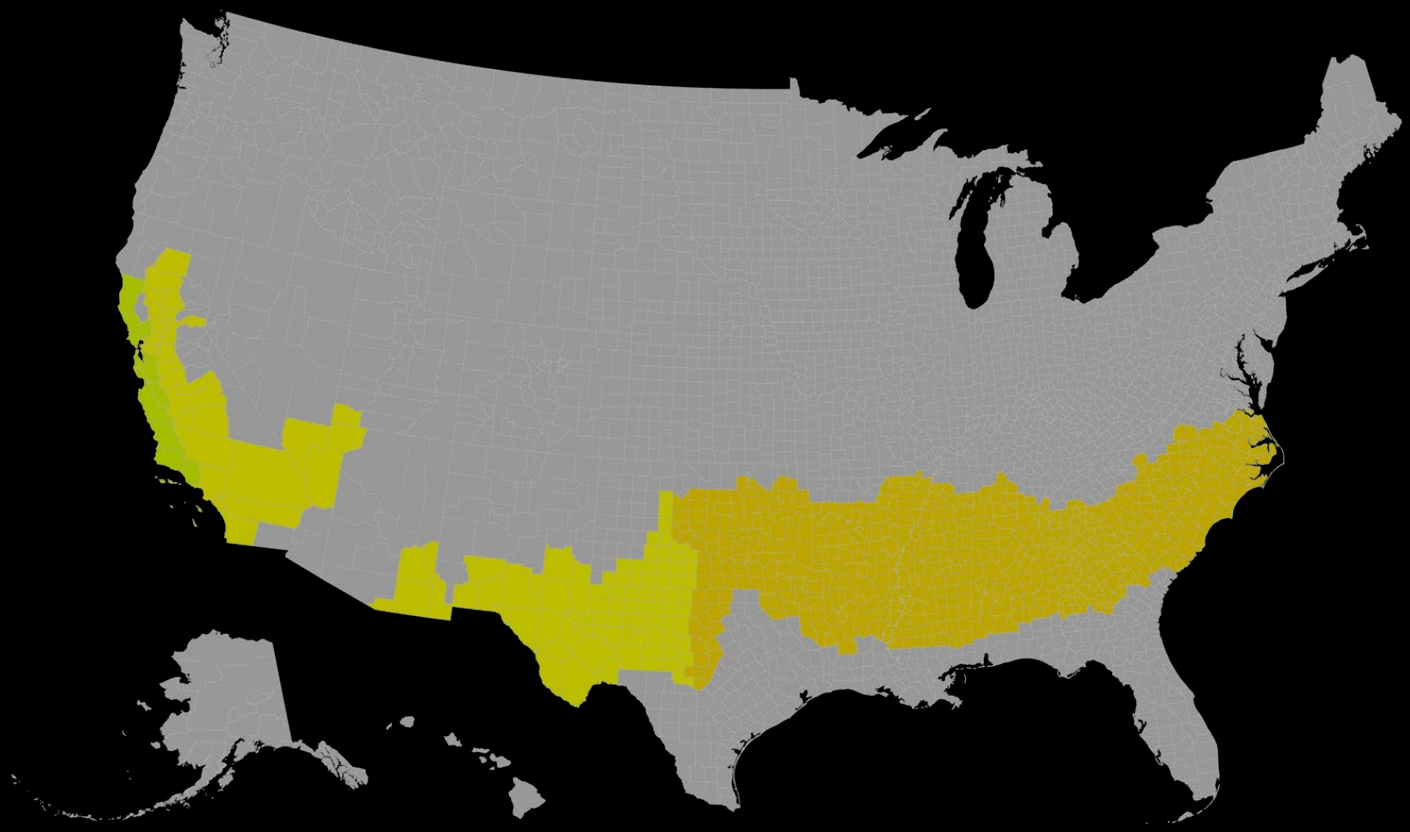
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

03

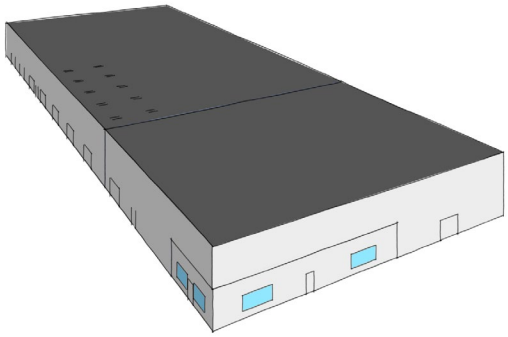
ASHRAE Climate Zone 3 is defined as a **warm-humid climate** according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **fewer than 4500 heating degree days** and **between 4500 to 9000 cooling degree days** (based on a base of 10°C). The warm-humid conditions in this zone necessitate strategies for managing both cooling and humidity control. It covers many **southeastern U.S. states including regions of Texas, Louisiana, Mississippi, Alabama, Georgia, and South Carolina**. Architectural design in this area focuses on optimizing air sealing and insulation to maintain comfortable indoor environments while minimizing the reliance on energy-intensive air conditioning systems. Features such as overhangs, shaded areas, and vapor barriers are commonly utilized to enhance building performance in this climate.



Atlanta, Georgia

Data Center- Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

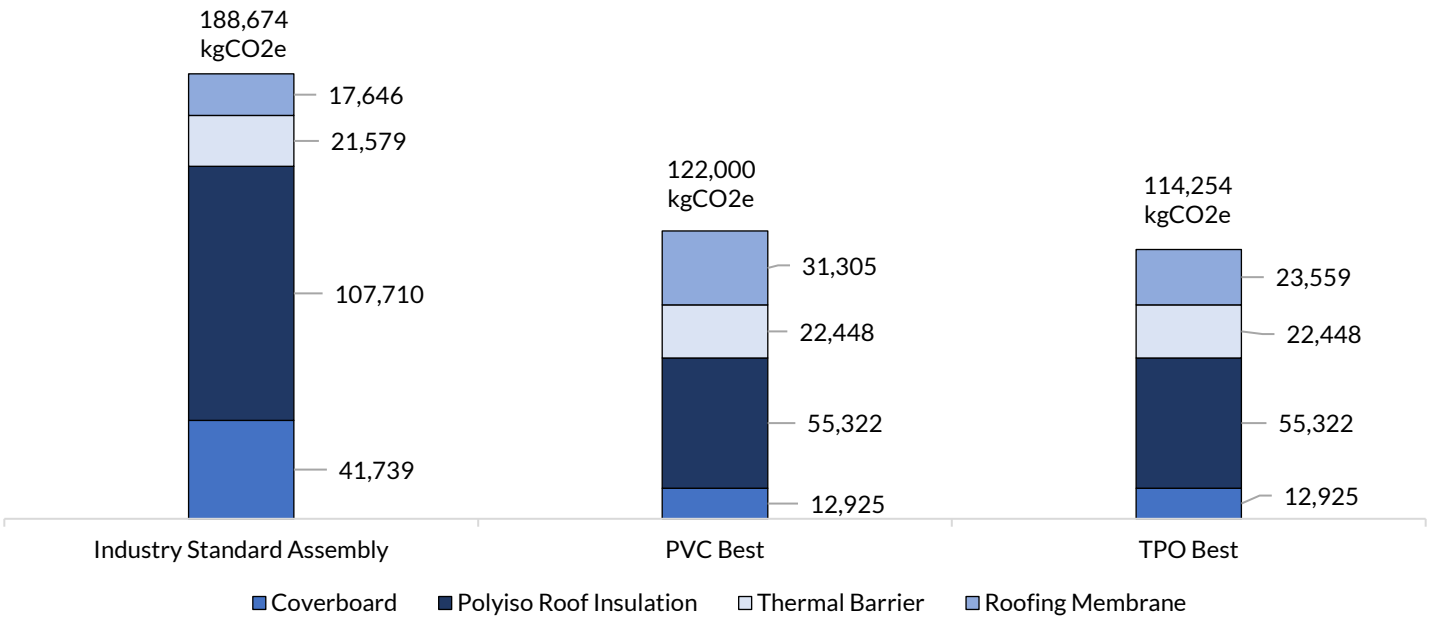
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

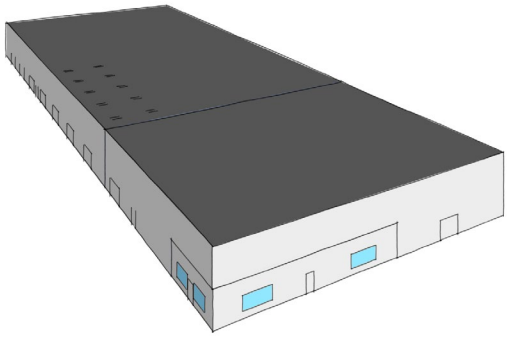
39.44 %

Savings in Embodied Carbon



Data Center- Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

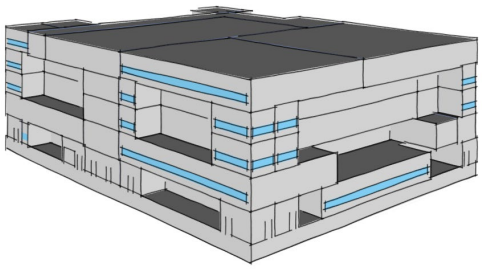
-0.01%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

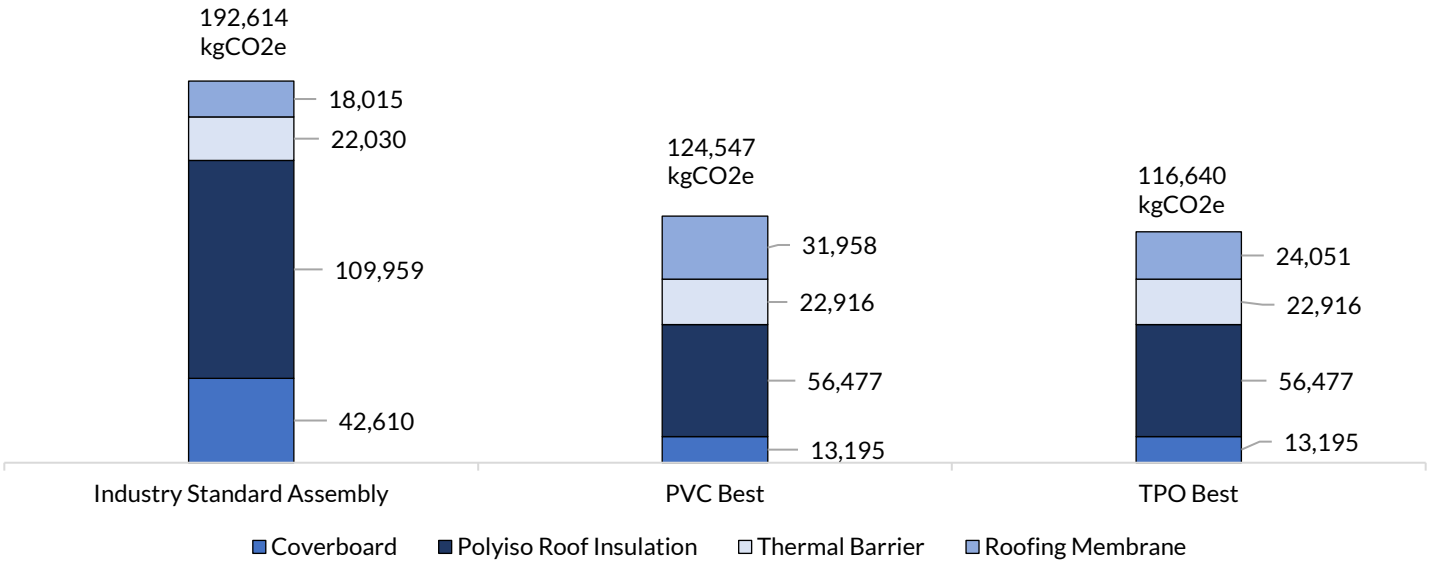
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

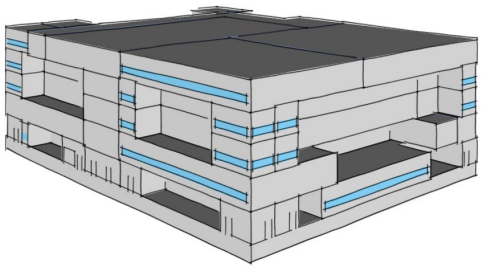
39.44 %

Savings in Embodied Carbon



Hospital - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.21%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

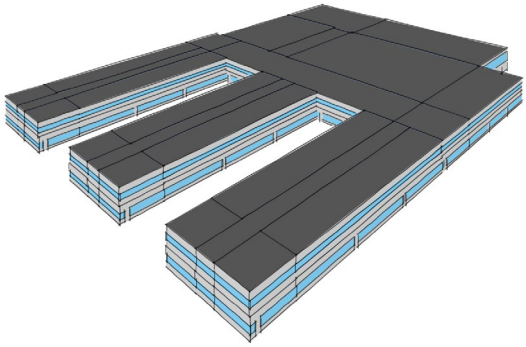
0.21%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

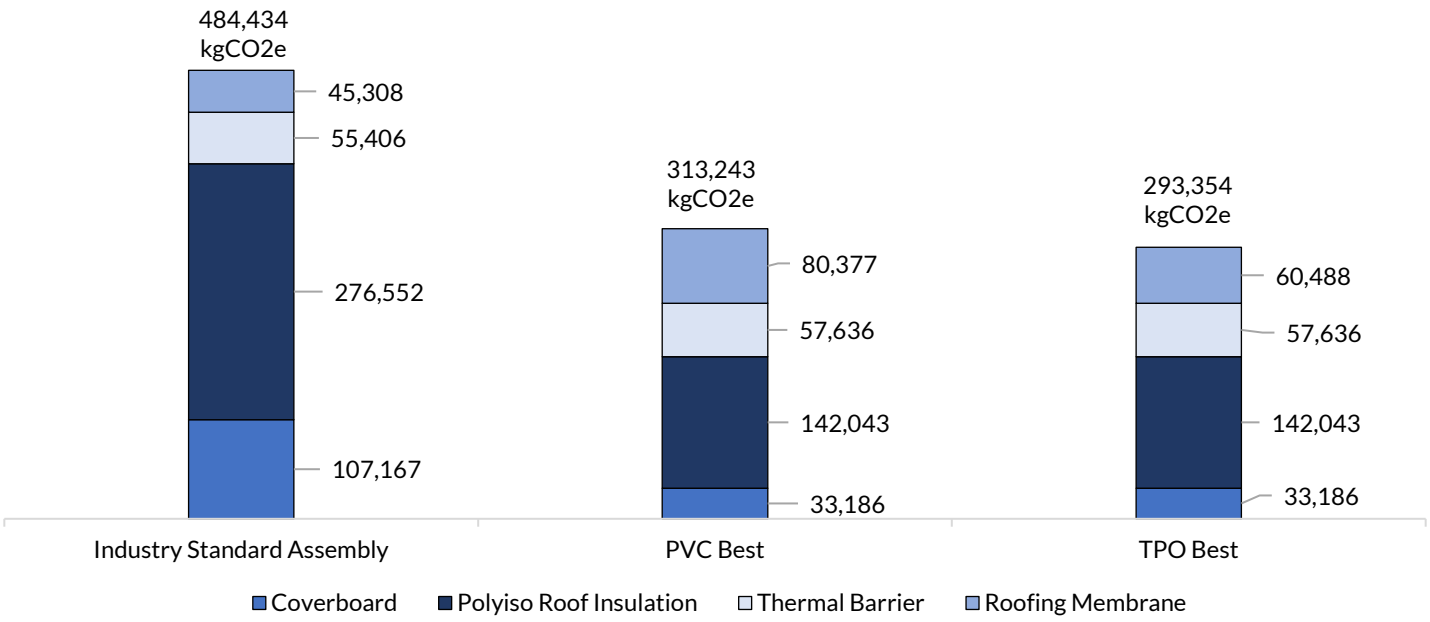
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

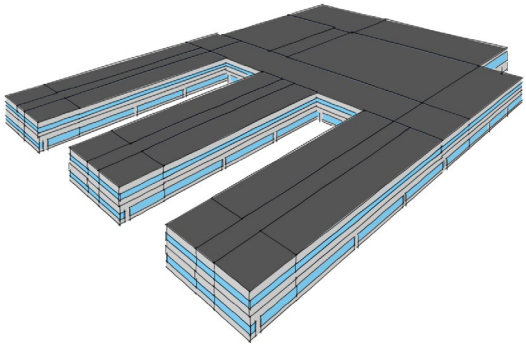
39.44 %

Savings in Embodied Carbon



Secondary School - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-0.15%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

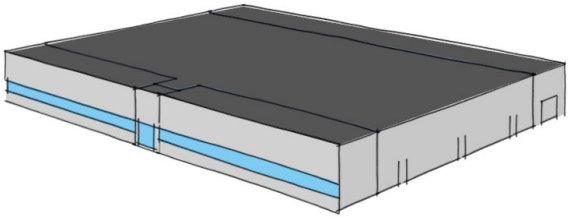
-0.15%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

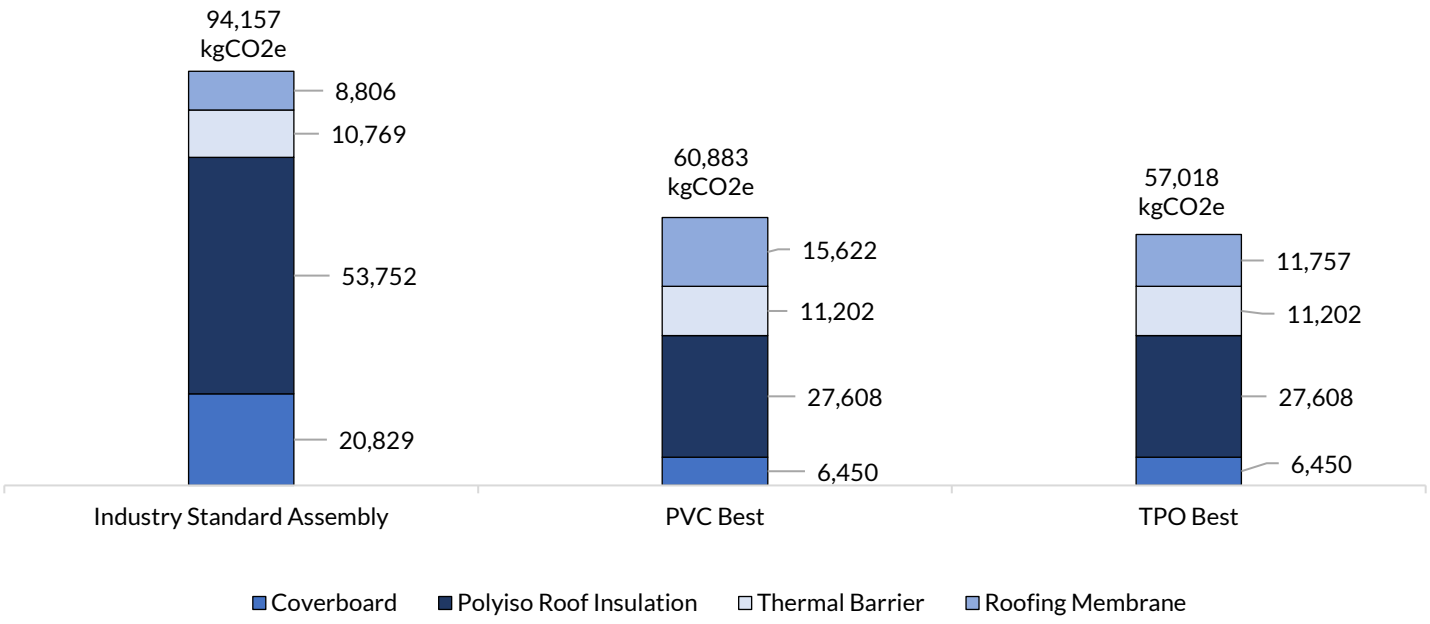
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

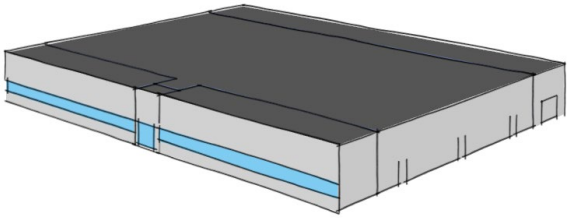
39.44 %

Savings in Embodied Carbon



Retail - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

2.05%

Savings in Energy Use Intensity

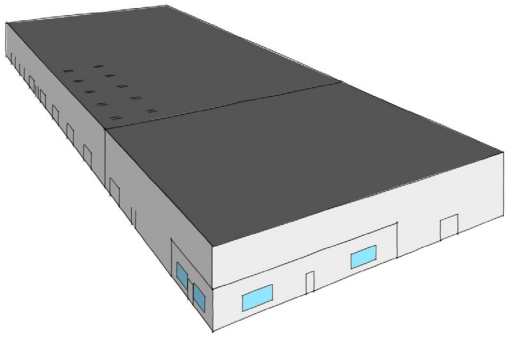
GAF TPO Best vs Industry-standard Assembly

2.05%

Savings in Energy Use Intensity

Warehouse - Zone 3A (Atlanta, GA)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

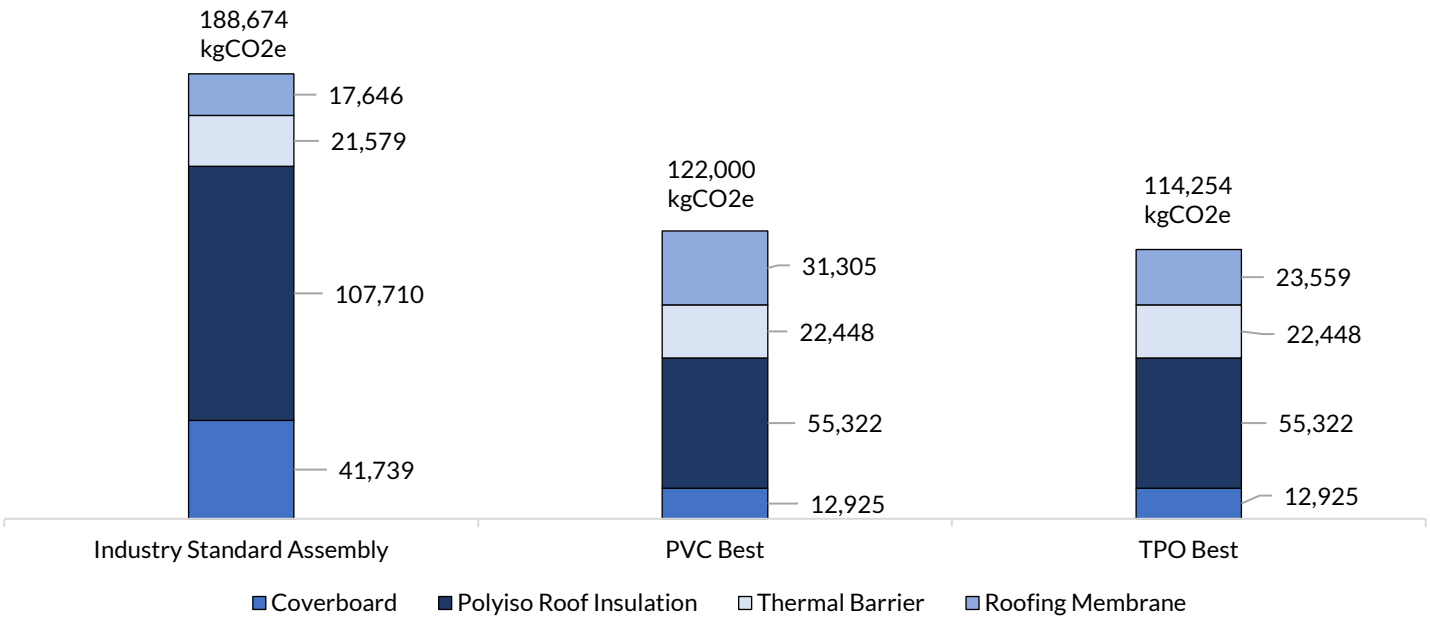
35.34%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

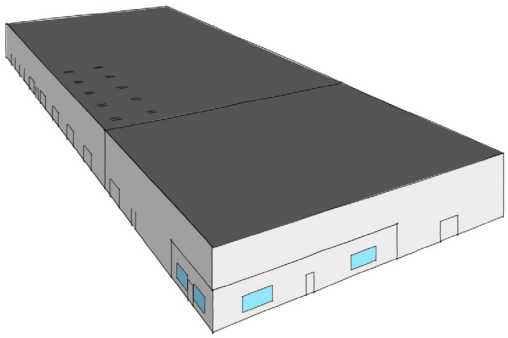
39.44 %

Savings in Embodied Carbon



Warehouse - Zone 3A (Atlanta, GA)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

4.73%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

4.73%

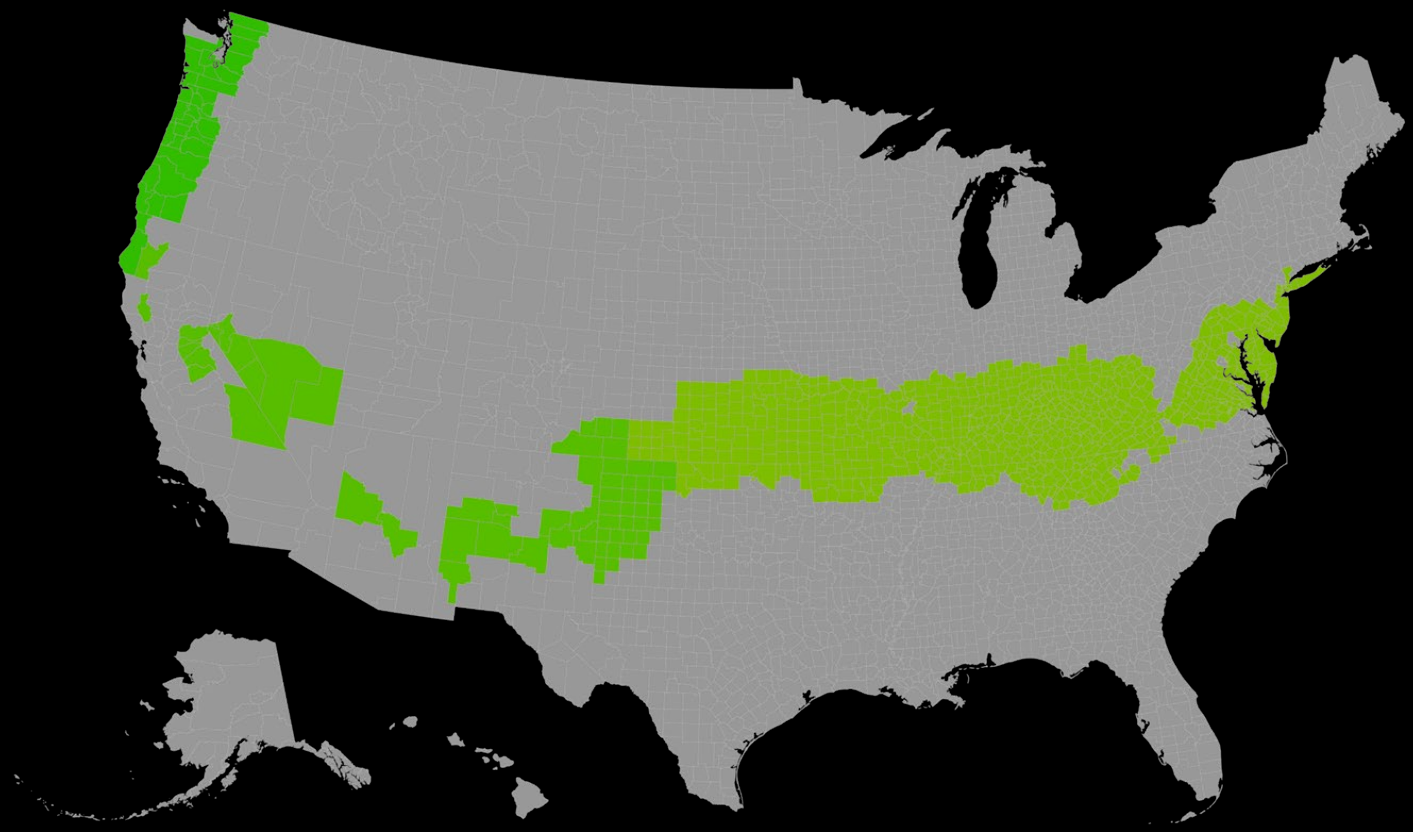
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

04

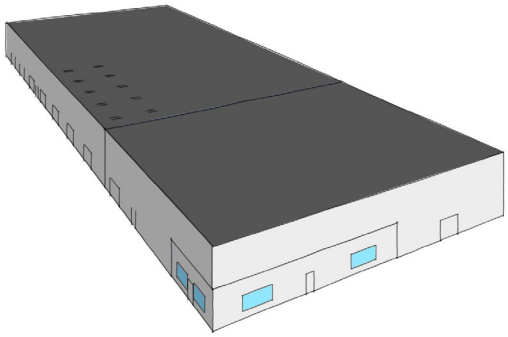
ASHRAE Climate Zone 4 is designated as a **mixed-humid climate**, according to the standards established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **fewer than 4500 heating degree days** and **between 4500 to 9000 cooling degree days** (based on a base of 10°C). The climate here includes distinct seasonal variations with both moderate heating in winter and significant cooling requirements in the summer, necessitating versatile climate control solutions in buildings. Zone 4 covers parts of the **Mid-Atlantic, including some regions of Virginia, North Carolina, Tennessee, and as far west as parts of Kansas and Oklahoma**. Effective strategies in this climate typically involve balanced insulation, energy-efficient windows, and moisture control systems to handle the relatively high humidity and varying temperatures throughout the year.



Baltimore, Maryland

Data Center- Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

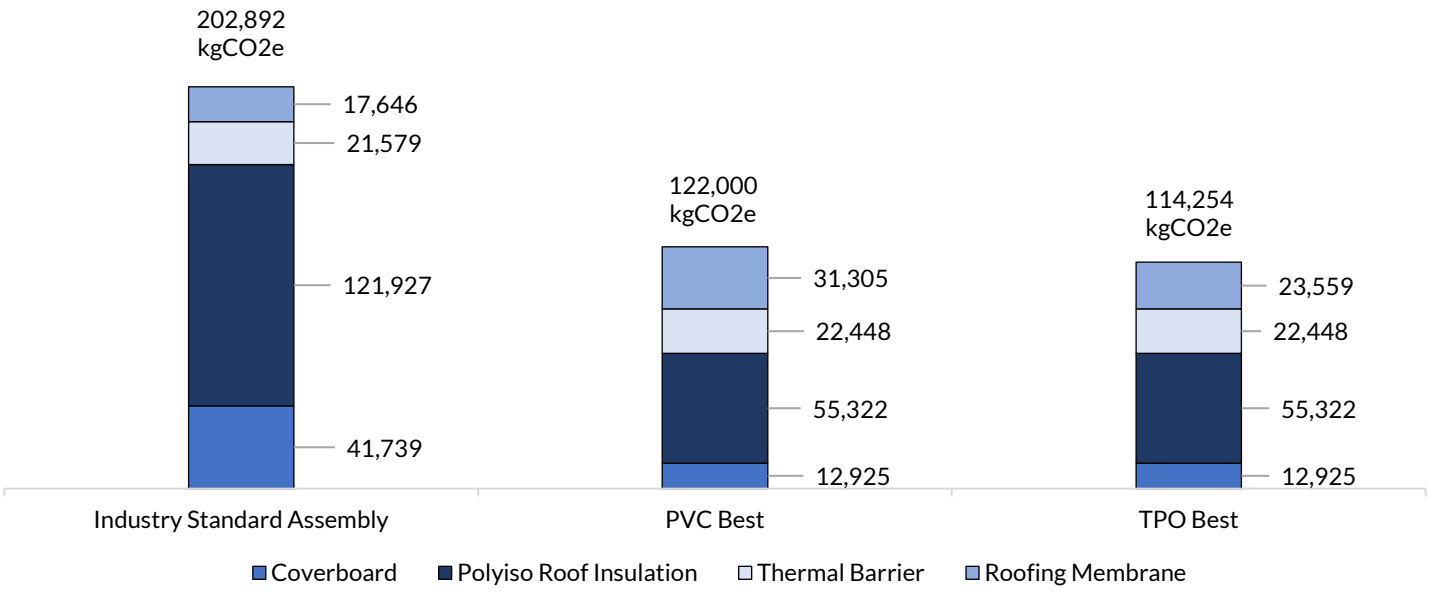
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

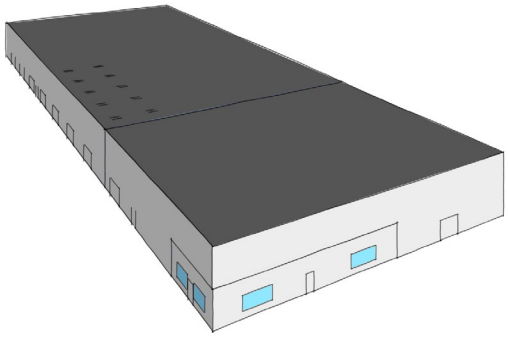
43.69 %

Savings in Embodied Carbon



Data Center- Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

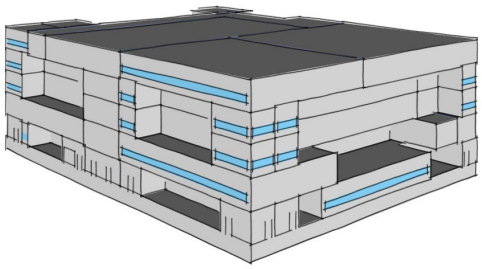
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

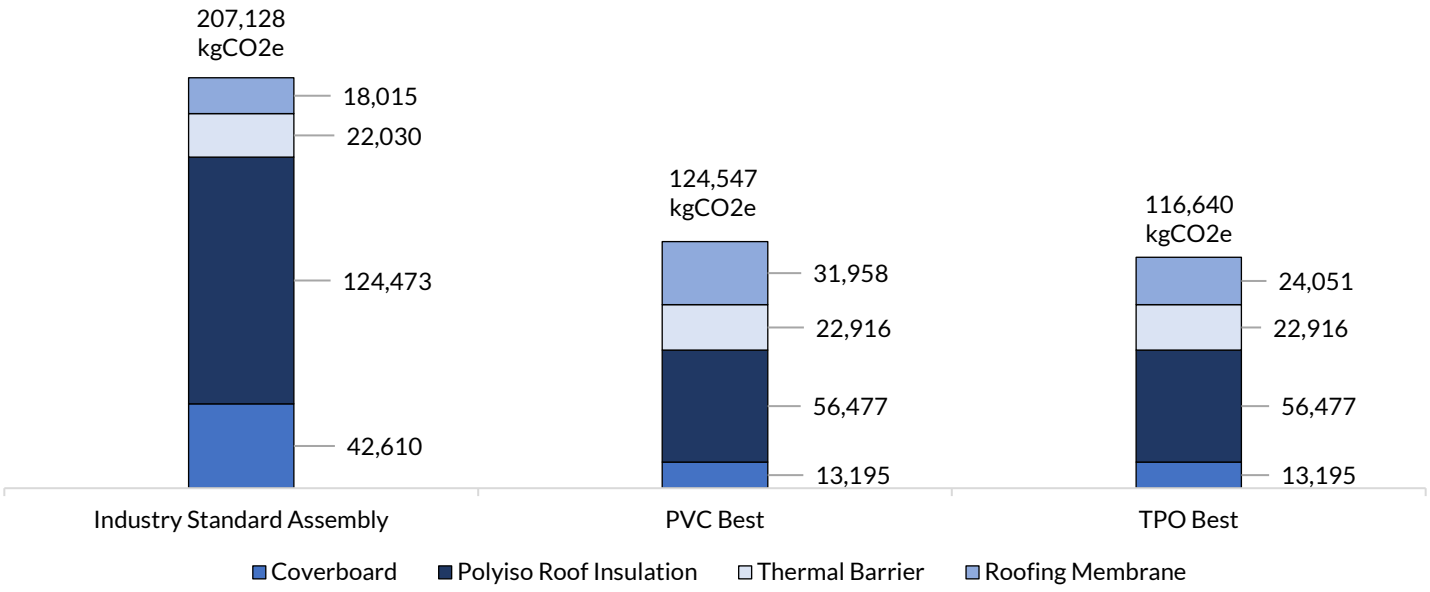
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

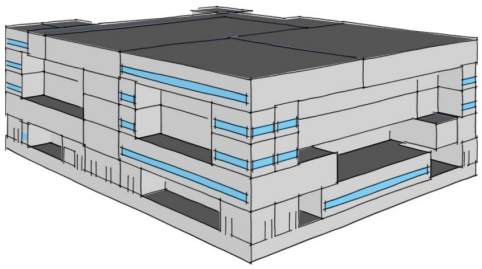
43.69 %

Savings in Embodied Carbon



Hospital - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.05%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

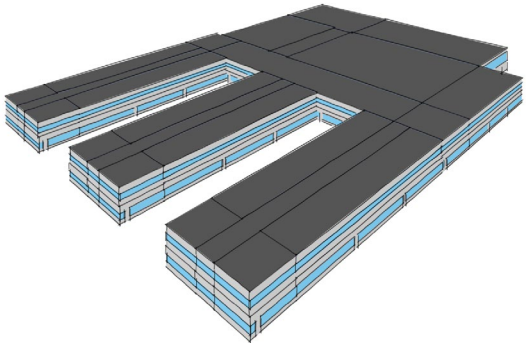
0.05%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

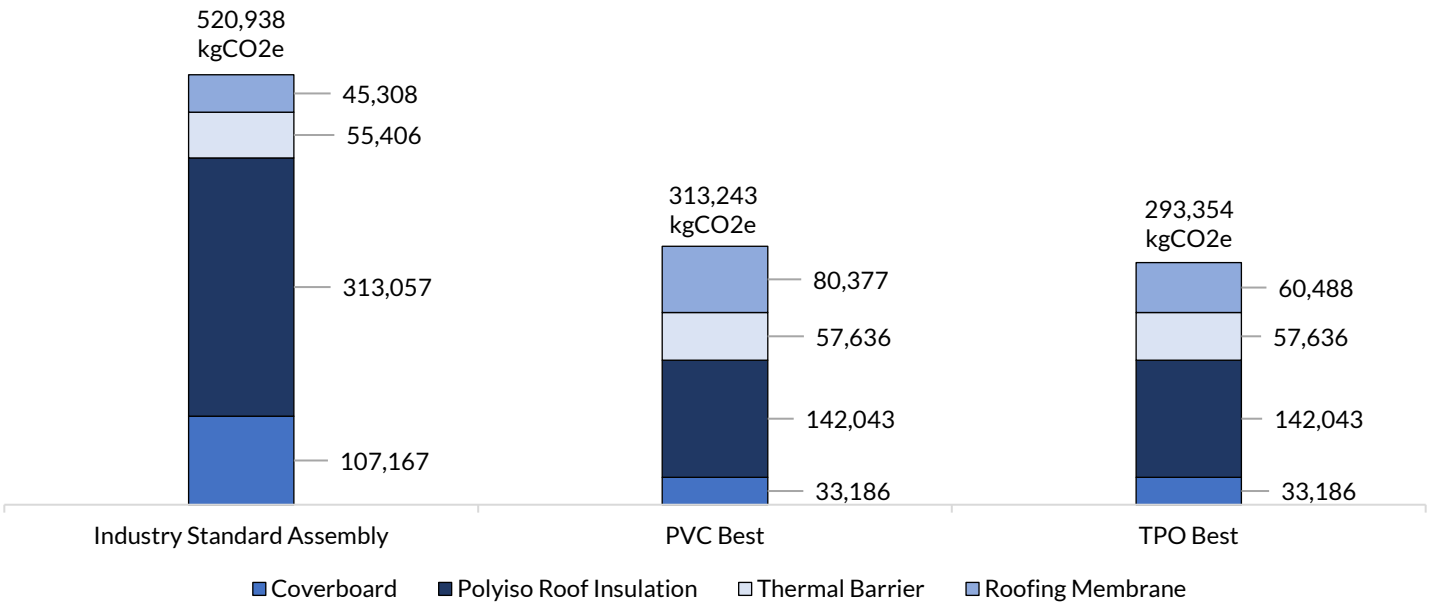
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

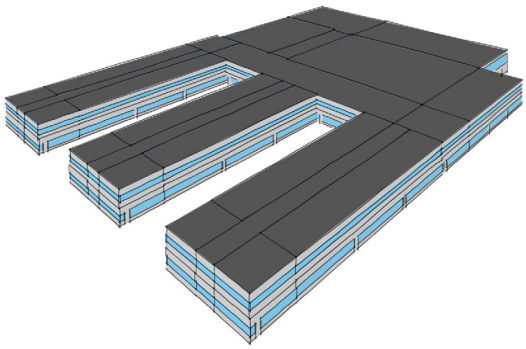
43.69 %

Savings in Embodied Carbon



Secondary School - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.15%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

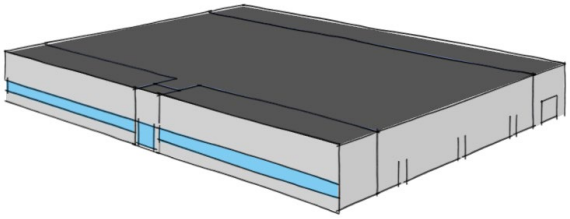
0.15%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

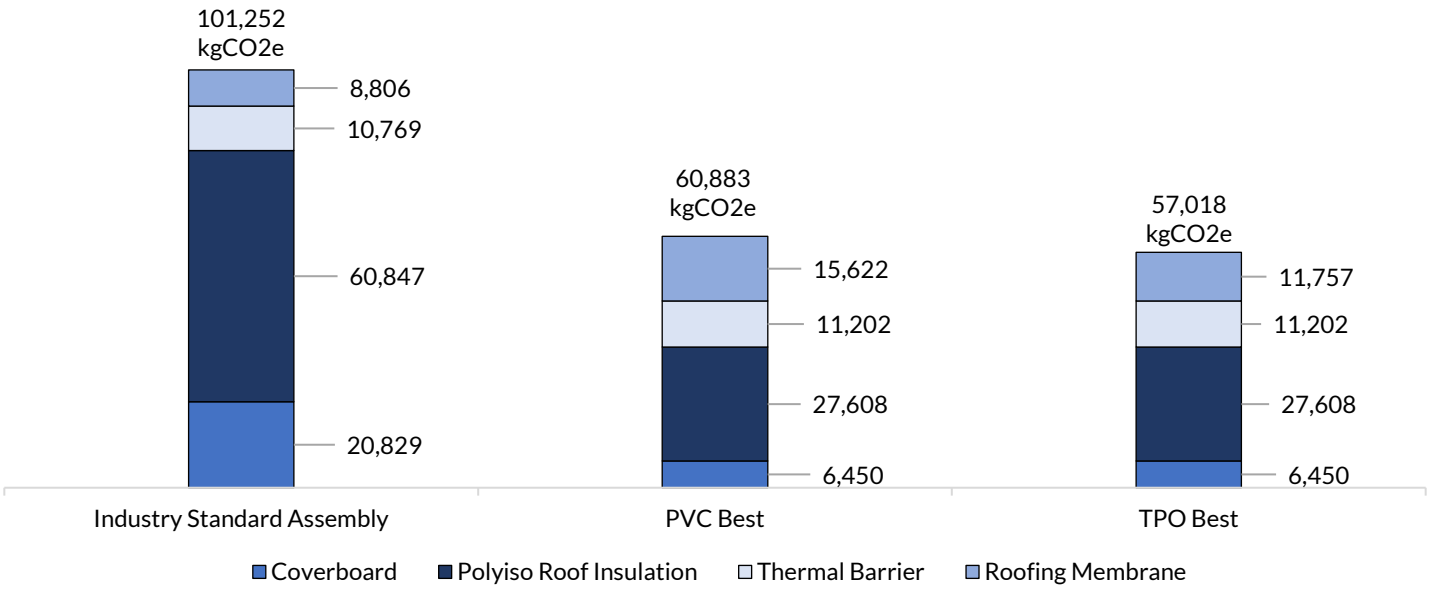
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

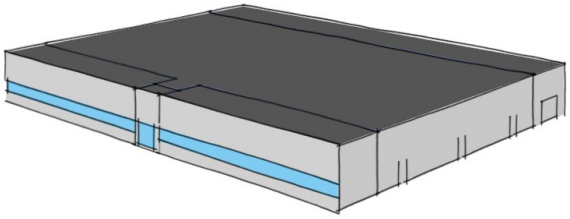
43.69 %

Savings in Embodied Carbon



Retail - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-2.90%

Savings in Energy Use Intensity

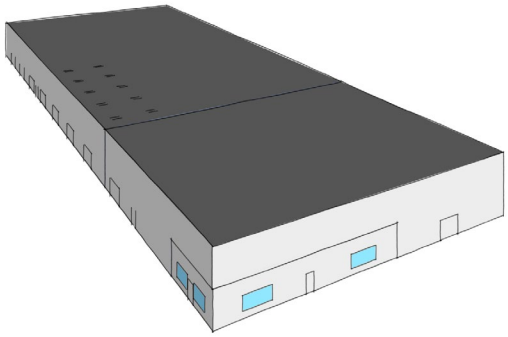
GAF TPO Best vs Industry-standard Assembly

-2.90%

Savings in Energy Use Intensity

Warehouse - Zone 4A (Baltimore, MD)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

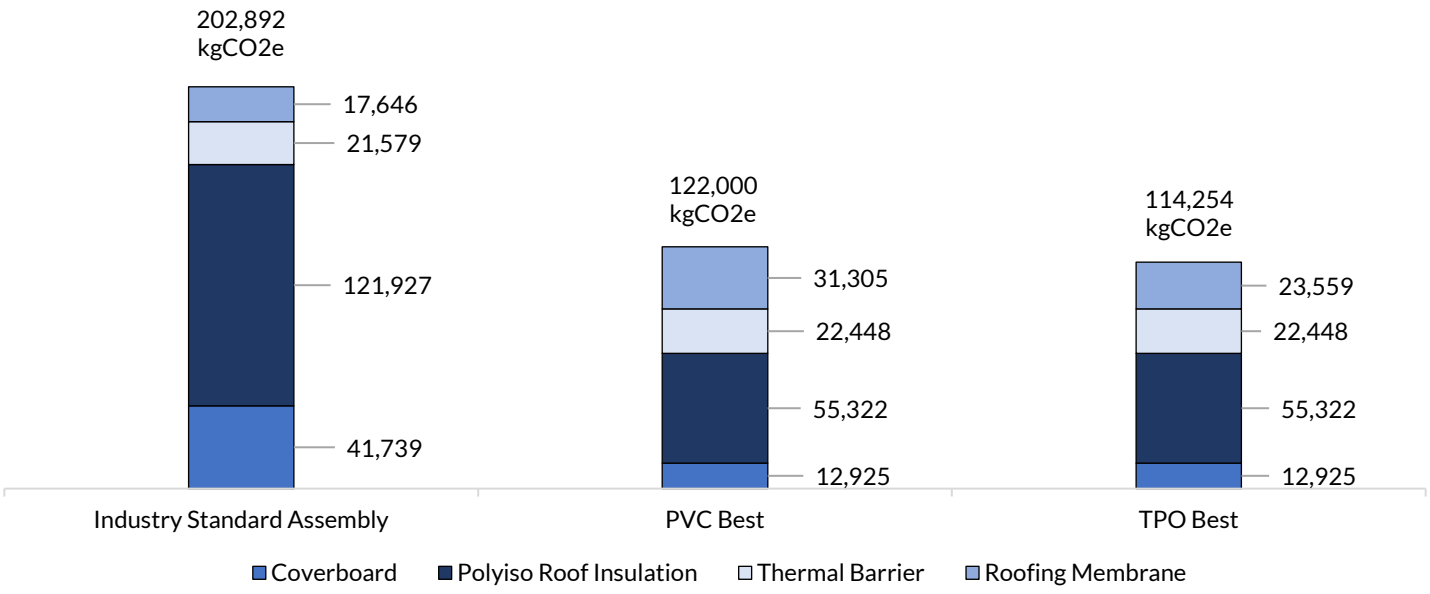
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

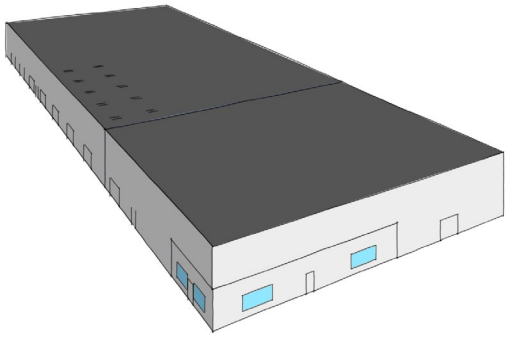
43.69 %

Savings in Embodied Carbon



Warehouse - Zone 4A (Baltimore, MD)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.72%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

0.72%

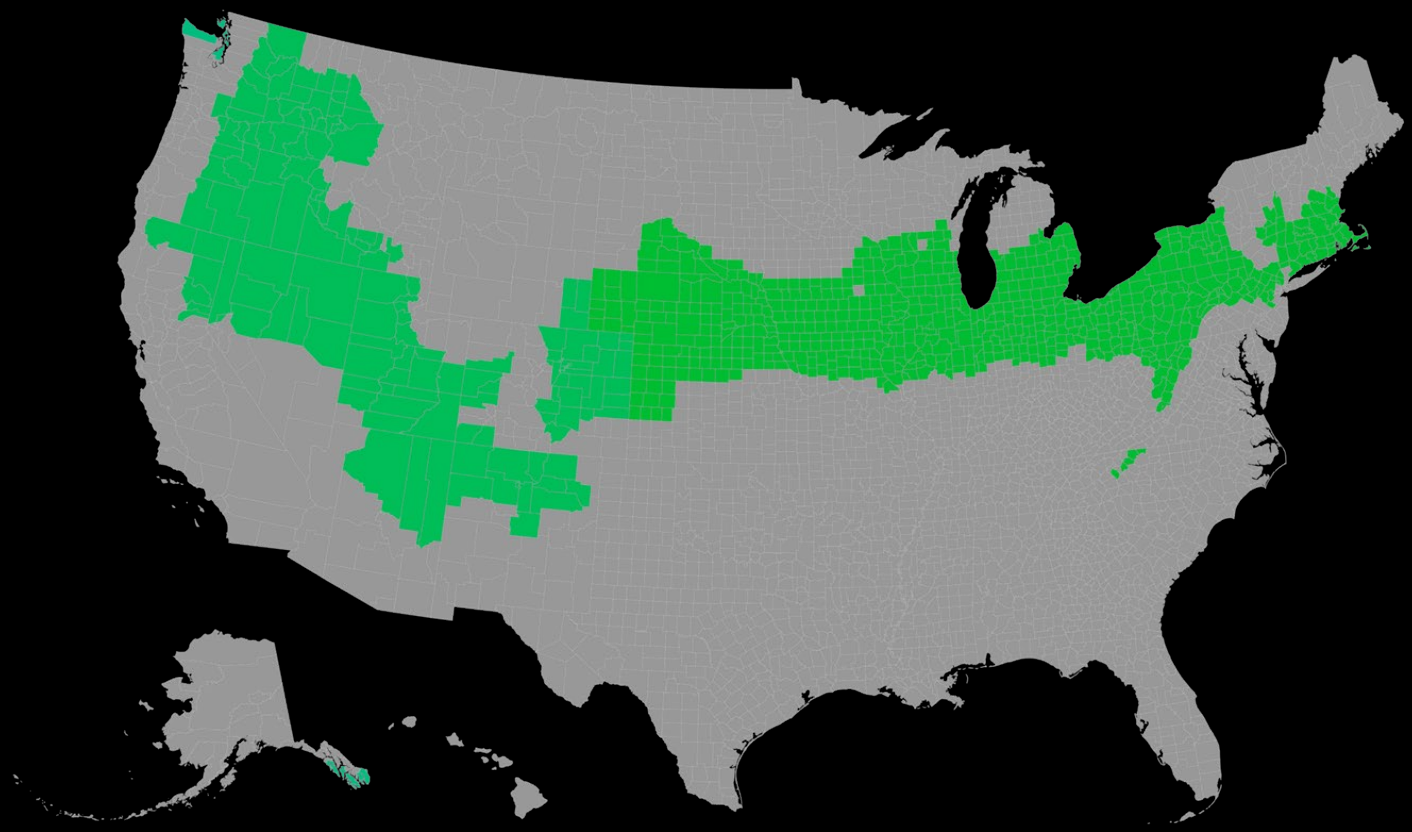
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

05

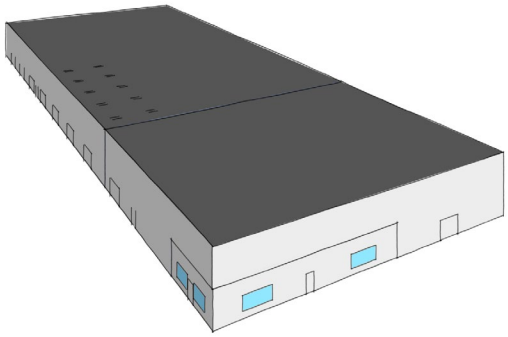
ASHRAE Climate Zone 5 is classified as a **mixed-dry climate**, according to the standards of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **between 4500 and 9000 heating degree days** and **fewer than 4500 cooling degree days** (based on a base of 10°C). The climate in this zone features significant seasonal temperature swings, with cold winters and moderately warm summers, necessitating diverse heating strategies and moderate cooling approaches. Zone 5 encompasses parts of the **interior United States, including regions such as parts of Colorado, Nebraska, and Missouri**. Building strategies in this area often focus on maximizing insulation, utilizing solar heat gain in the winter while minimizing it in the summer, and incorporating efficient heating systems to cope with the colder months while using less extensive cooling systems for the summer.



Chicago, Illinois

Data Center- Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

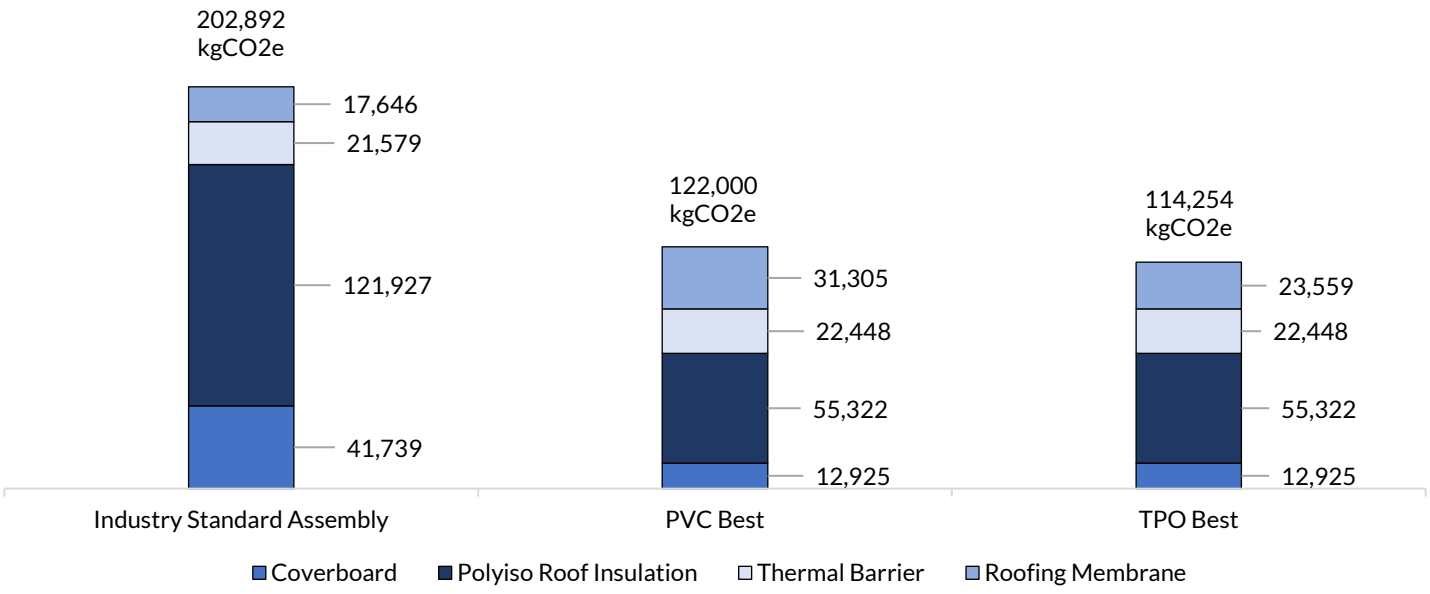
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

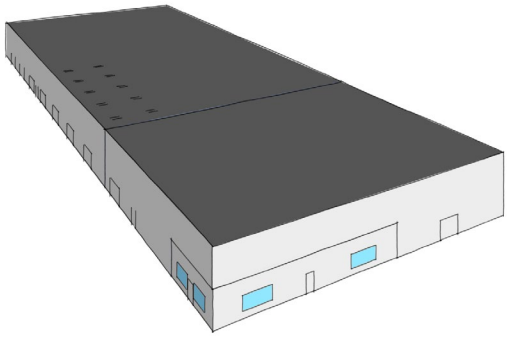
43.69 %

Savings in Embodied Carbon



Data Center- Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

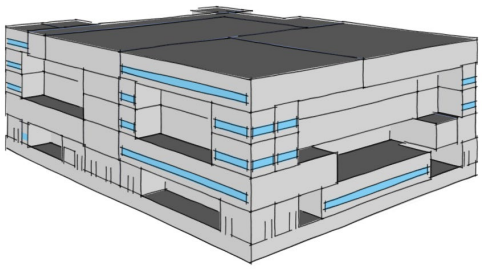
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

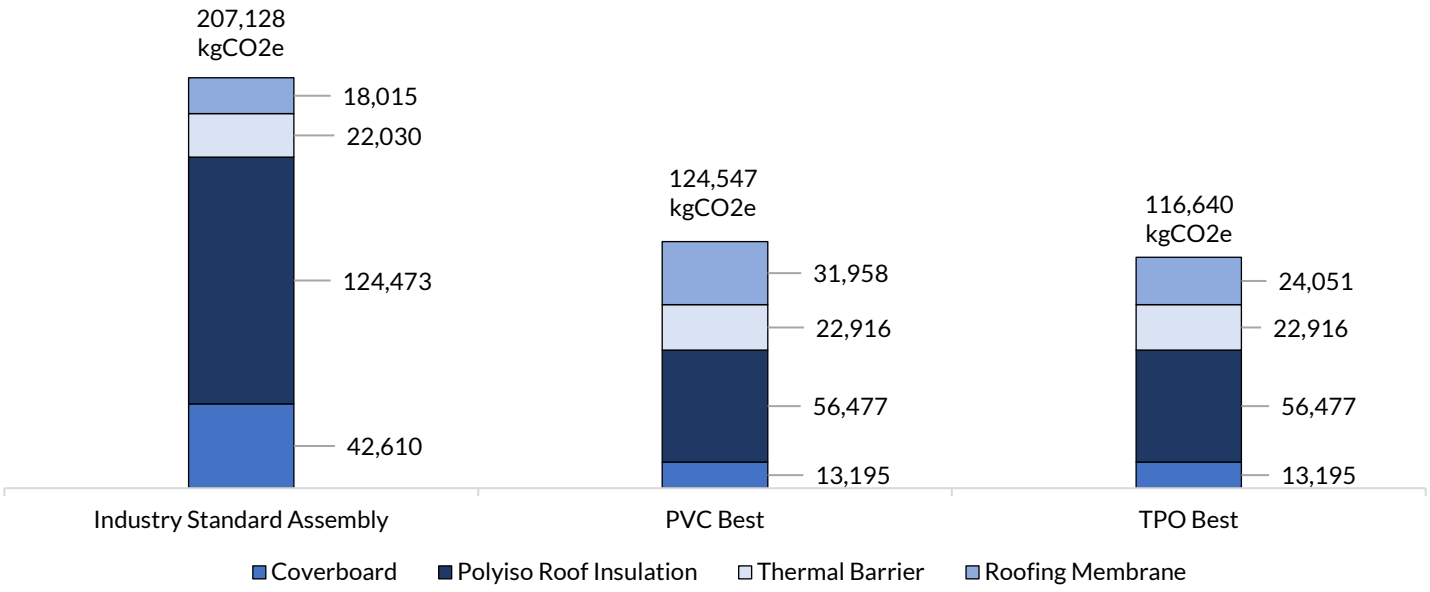
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

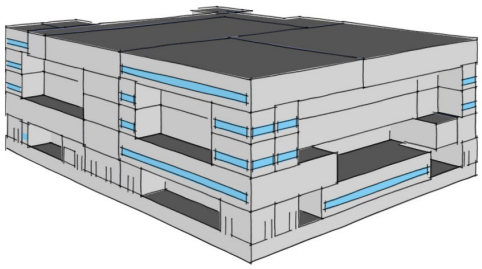
43.69 %

Savings in Embodied Carbon



Hospital - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.01%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

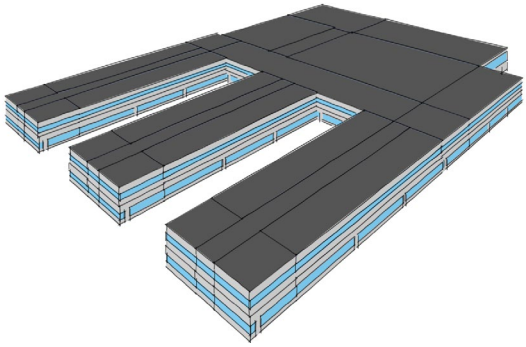
0.01%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

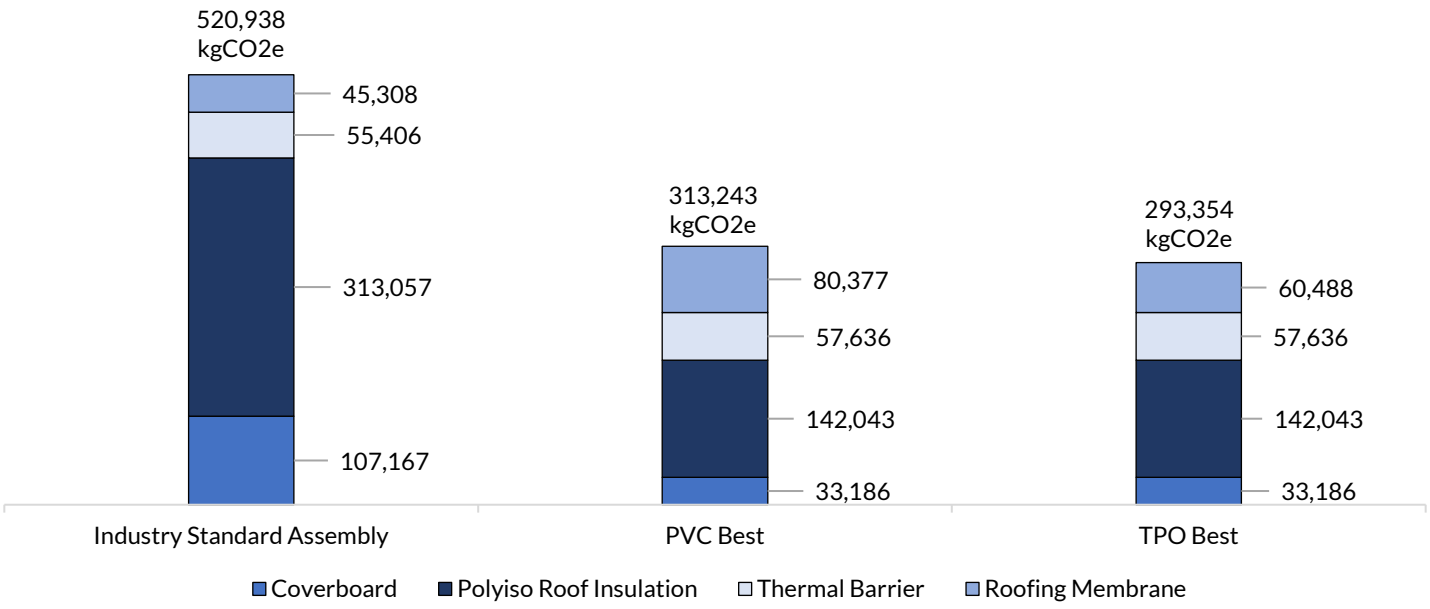
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

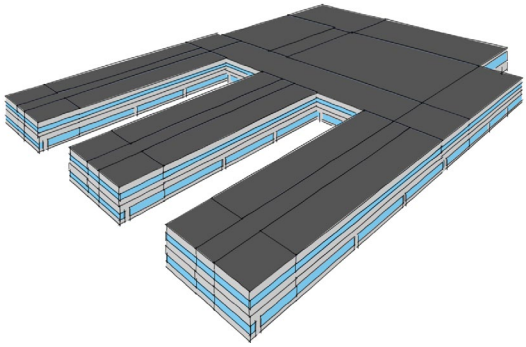
43.69 %

Savings in Embodied Carbon



Secondary School - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.26%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

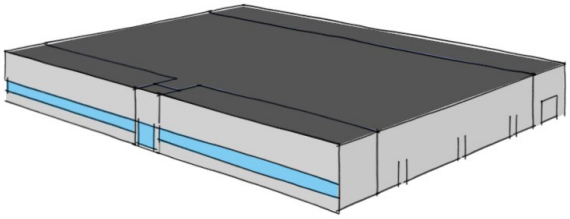
0.26 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

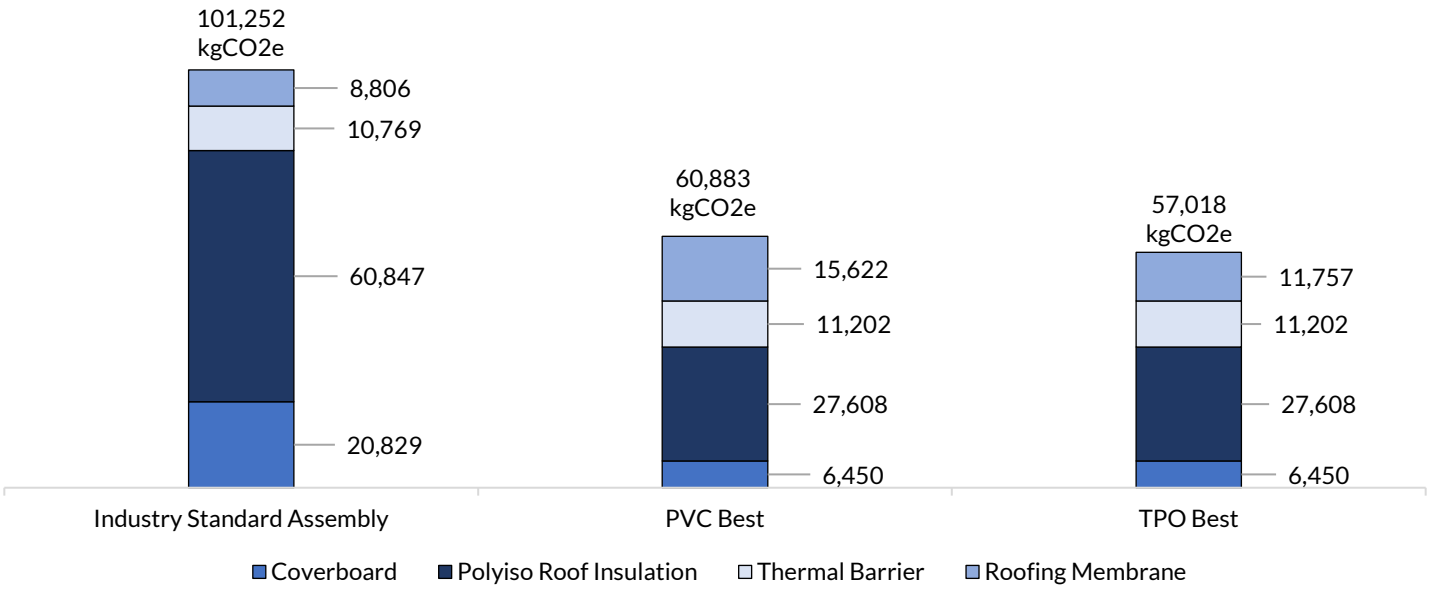
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

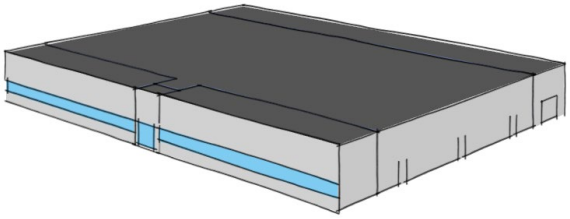
43.69 %

Savings in Embodied Carbon



Retail - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.93%

Savings in Energy Use Intensity

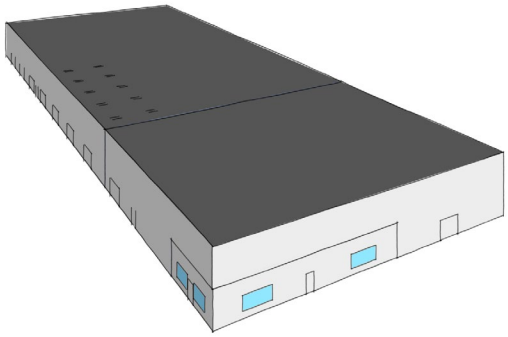
GAF TPO Best vs Industry-standard Assembly

0.93 %

Savings in Energy Use Intensity

Warehouse - Zone 5A (Chicago, IL)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

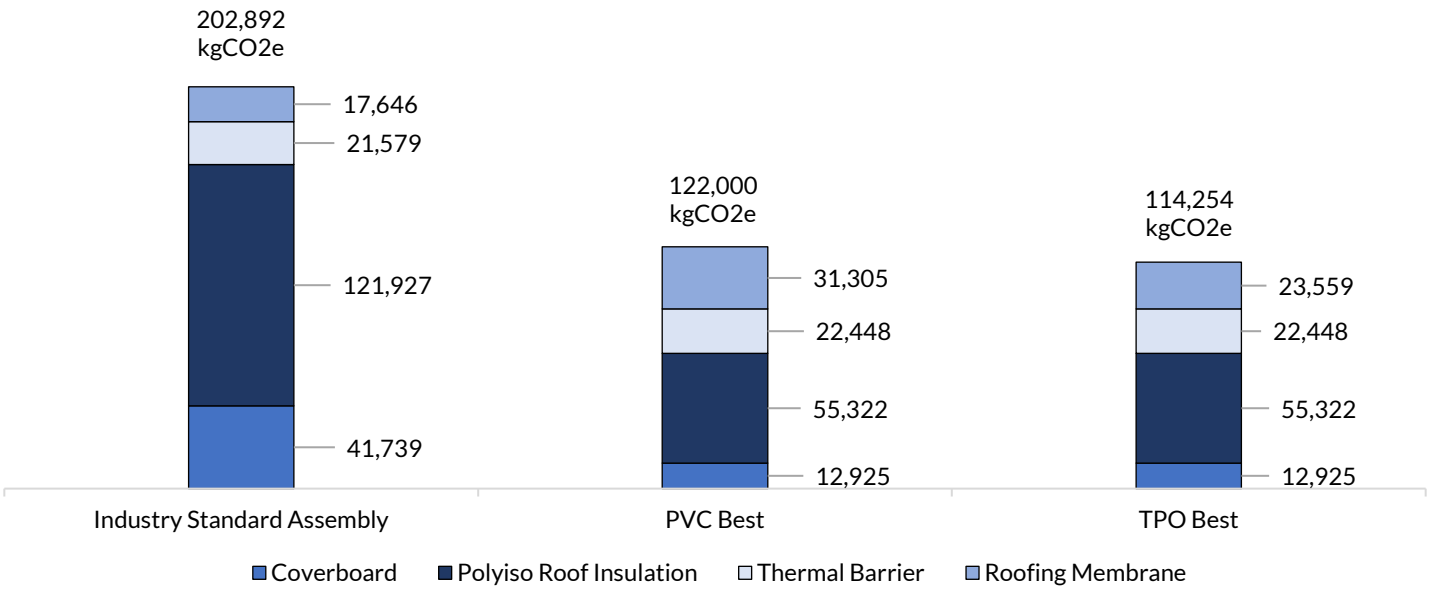
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

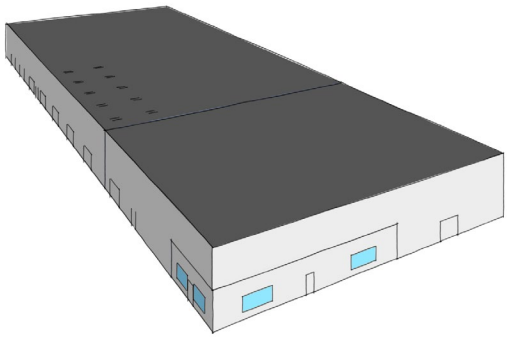
43.69 %

Savings in Embodied Carbon



Warehouse - Zone 5A (Chicago, IL)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.75%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

0.75%

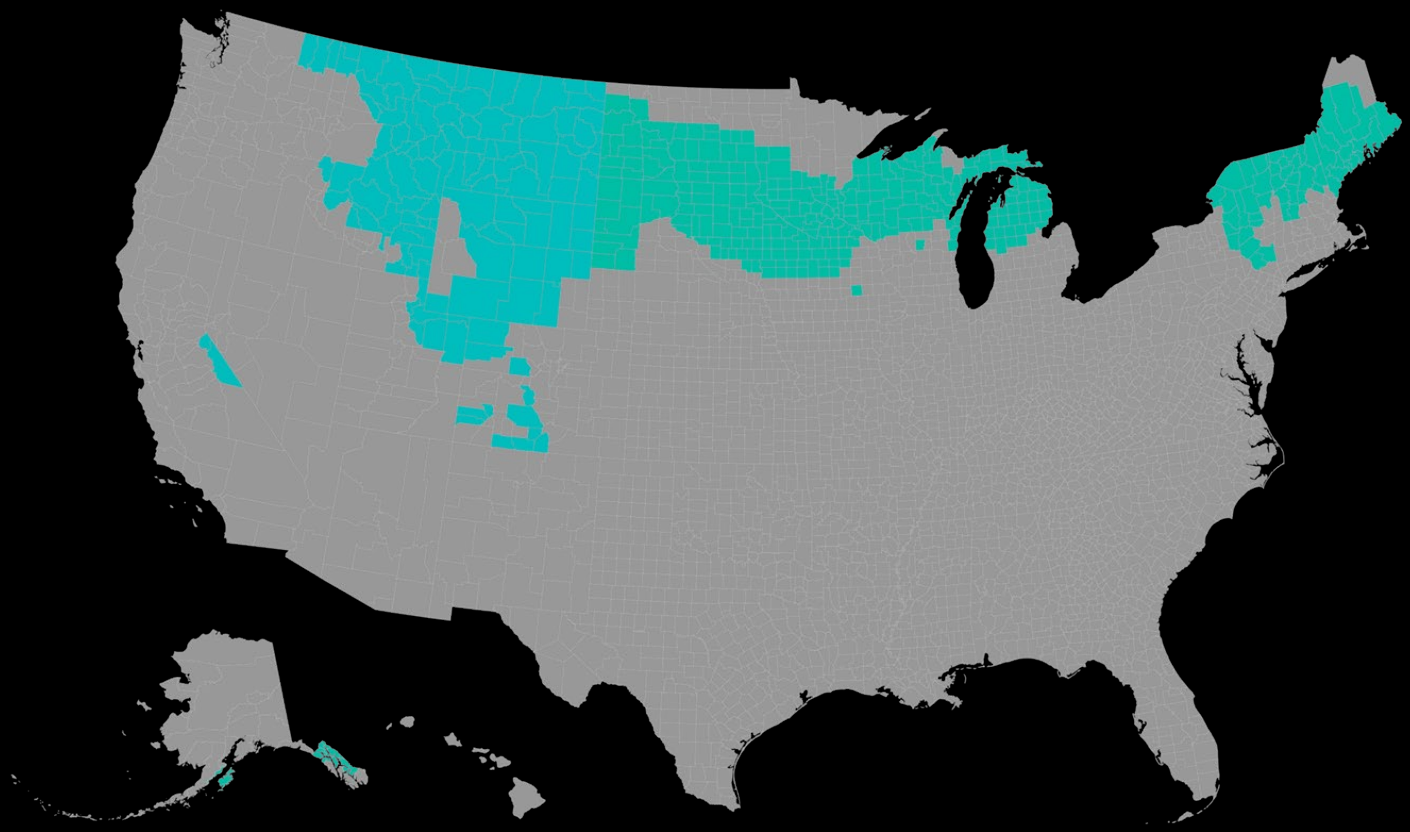
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

06

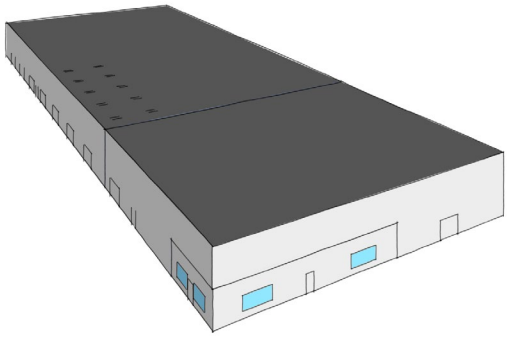
ASHRAE Climate Zone 6 is categorized as a **cold climate**, according to the specifications set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone is defined by having **9000 to 12,000 heating degree days** (based on a base of 10°C) and **fewer than 4500 cooling degree days**, indicating significant heating needs due to the cold winters and only moderate cooling requirements during the short summers. Zone 6 includes much of the **northern United States, covering areas such as parts of Massachusetts, Michigan, and as far west as Idaho**. In this climate, building designs typically emphasize robust insulation, high-performance windows, and controlled ventilation to prevent heat loss during the long, cold winter months, while cooling strategies remain relatively simple due to the mild summer conditions.



Minneapolis, Minnesota

Data Center- Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

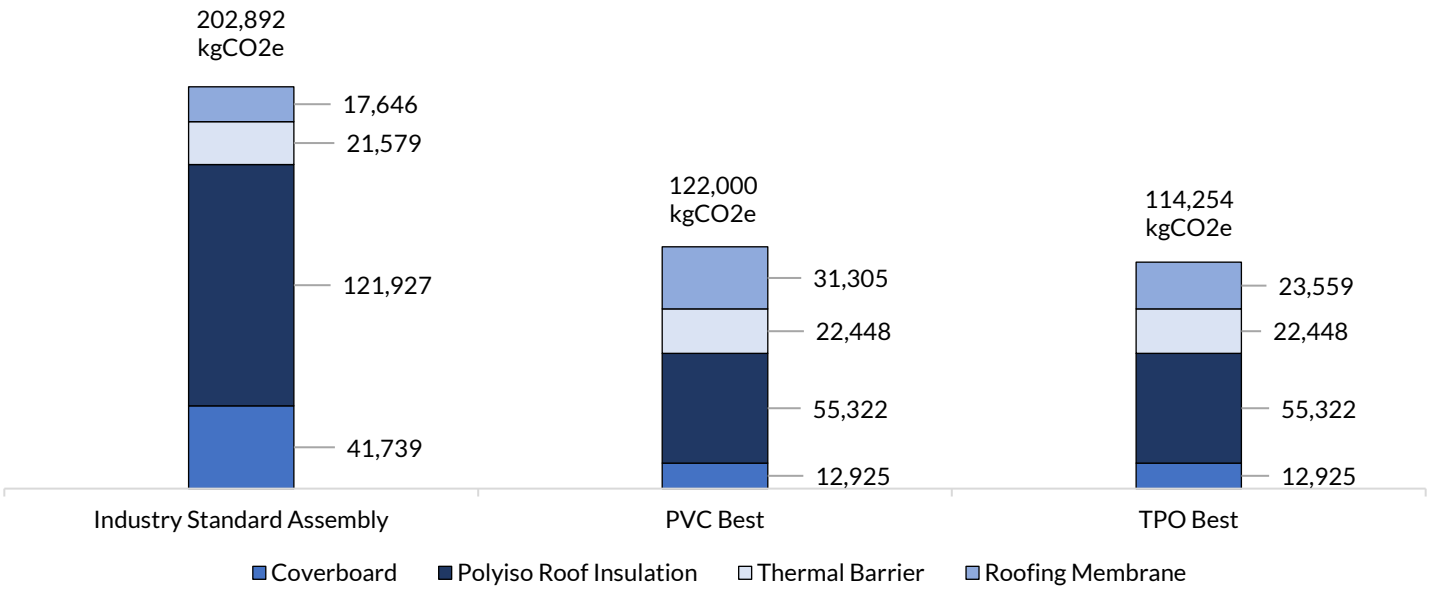
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

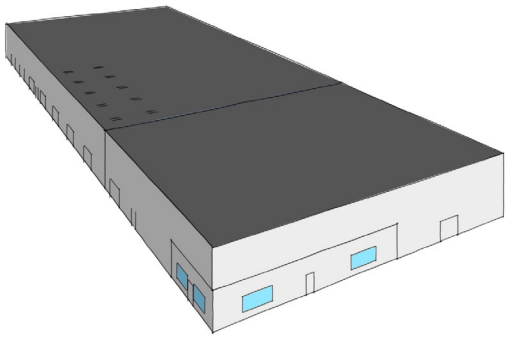
43.69 %

Savings in Embodied Carbon



Data Center- Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.00%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

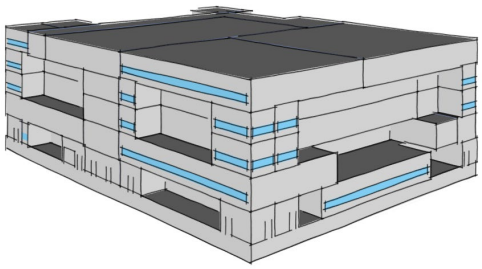
0.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

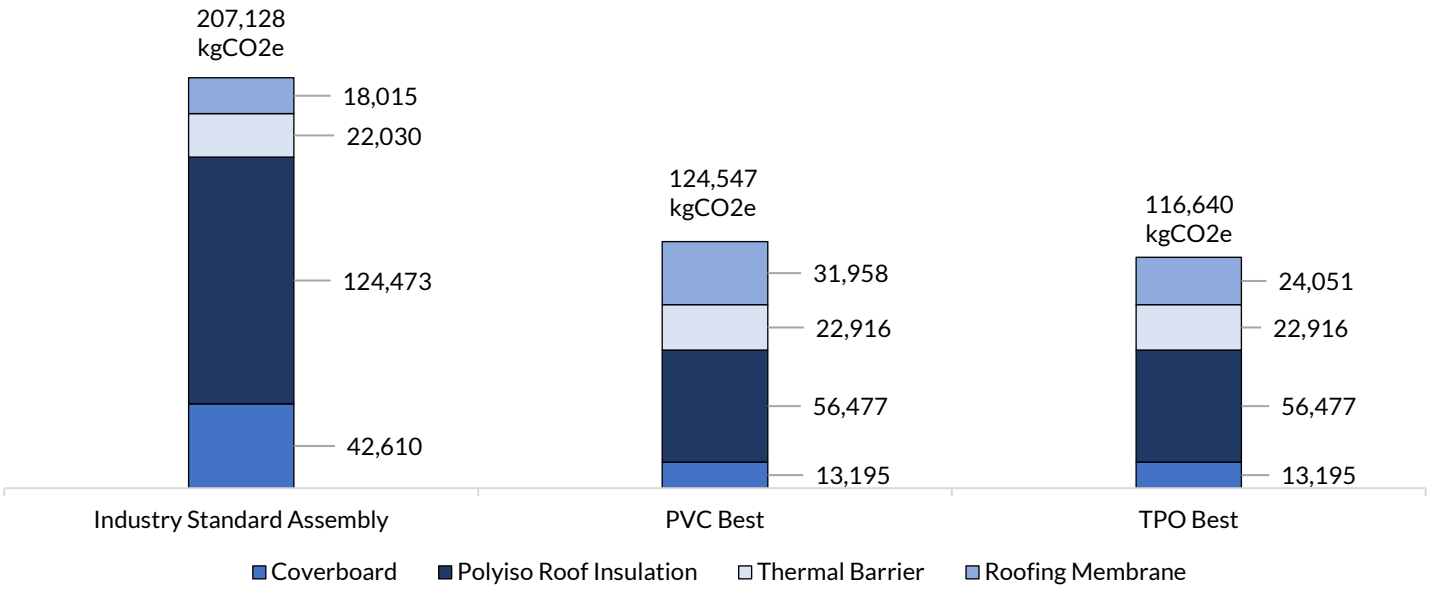
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

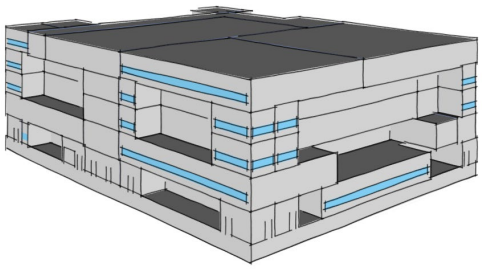
43.69 %

Savings in Embodied Carbon



Hospital - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.07%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

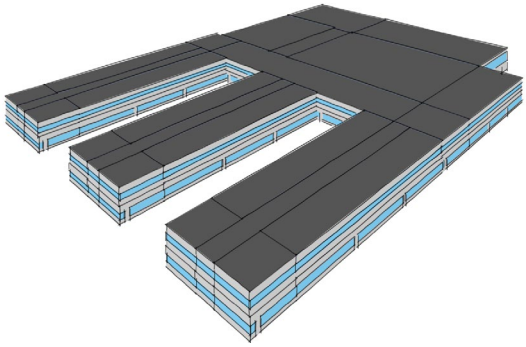
0.07 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

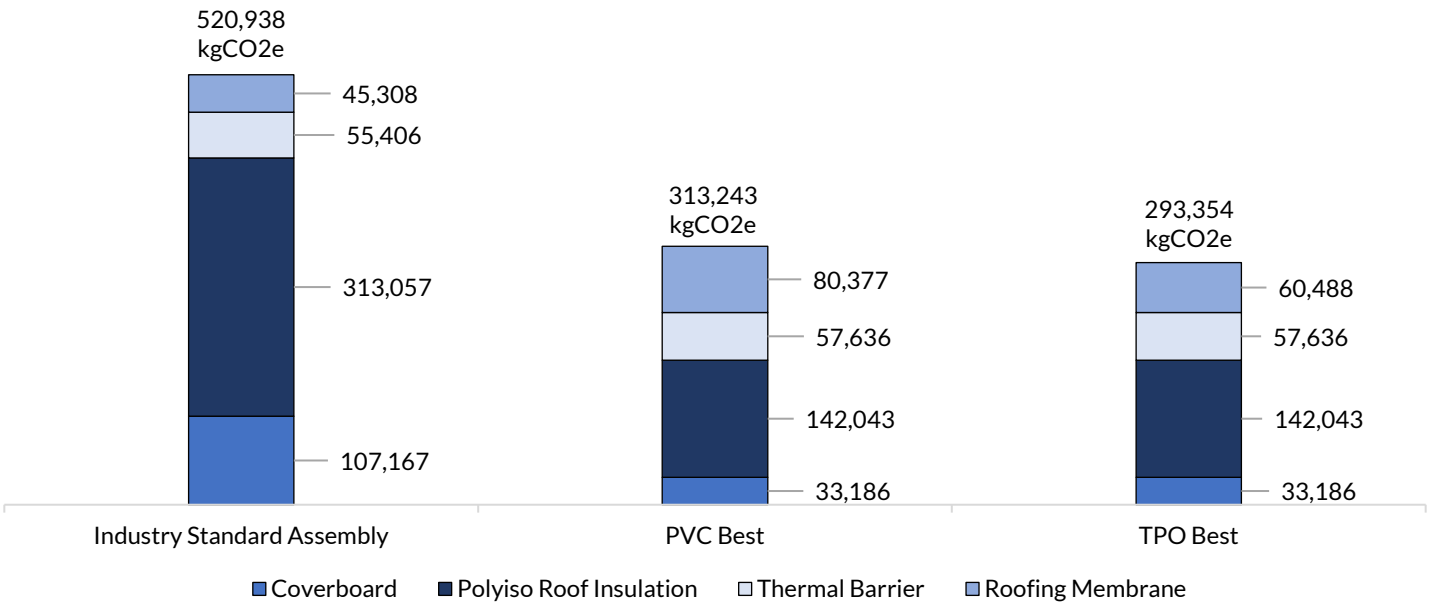
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

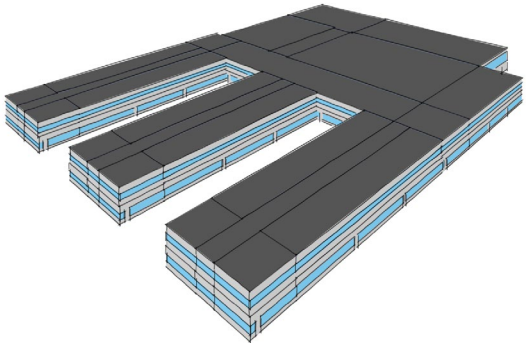
43.69 %

Savings in Embodied Carbon



Secondary School - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.32%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

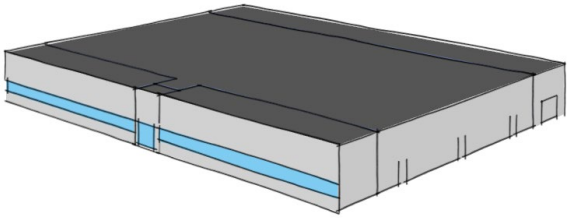
0.32 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

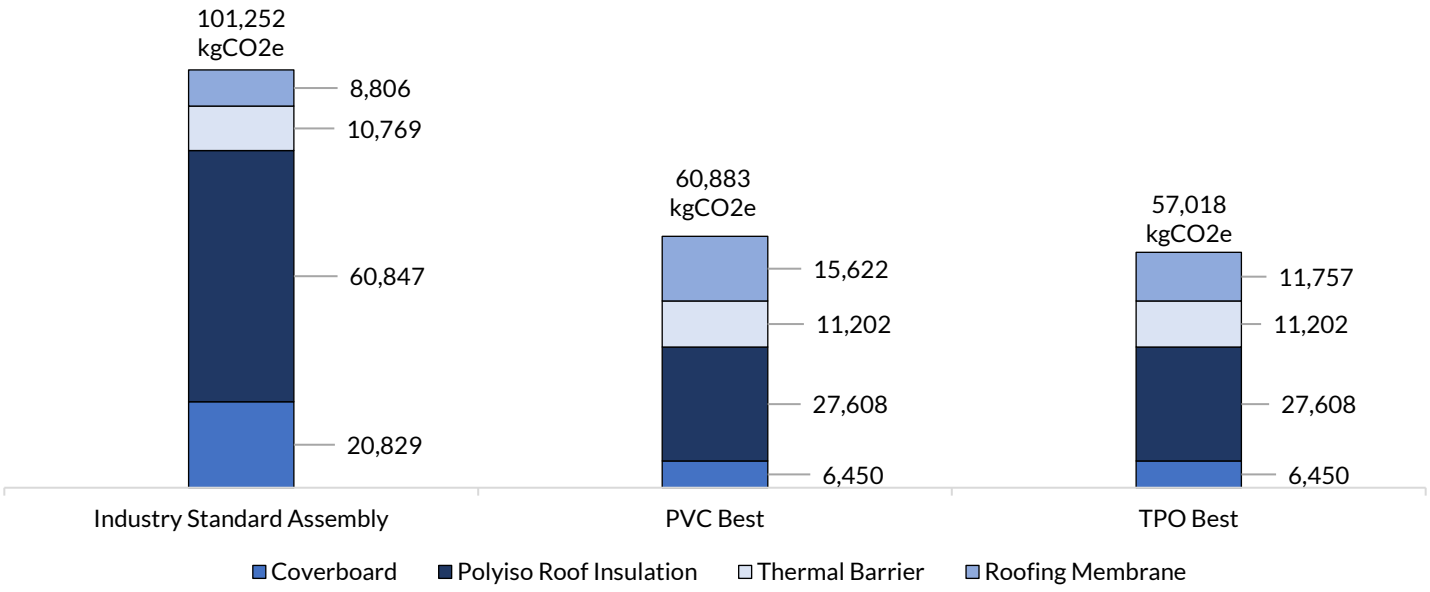
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

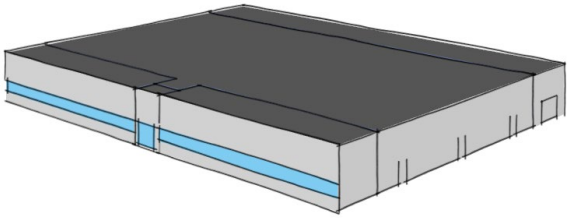
43.69 %

Savings in Embodied Carbon



Retail - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.75%

Savings in Energy Use Intensity

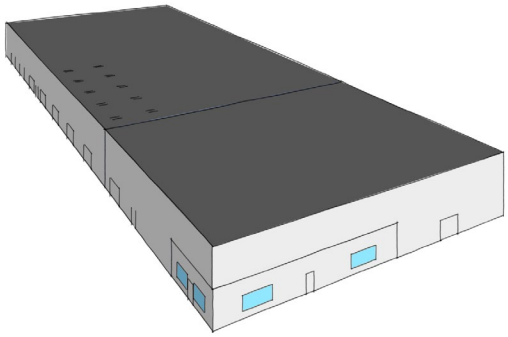
GAF TPO Best vs Industry-standard Assembly

0.75 %

Savings in Energy Use Intensity

Warehouse - Zone 6A (Minneapolis, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

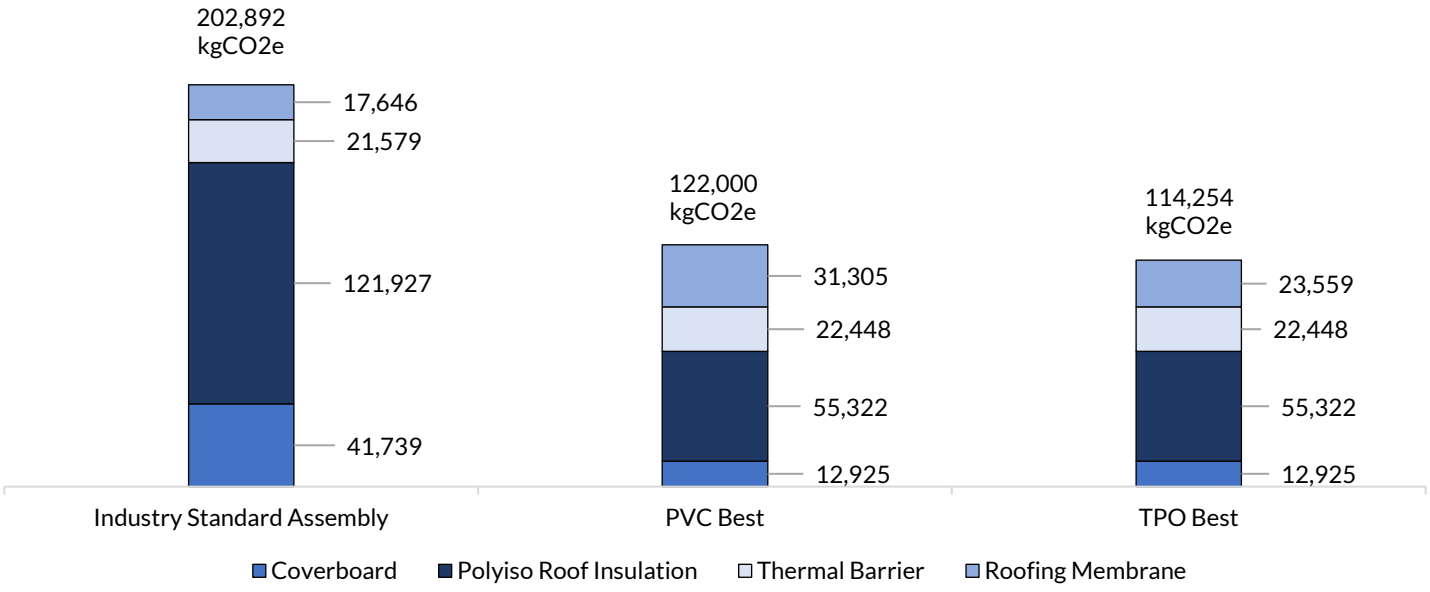
39.87%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

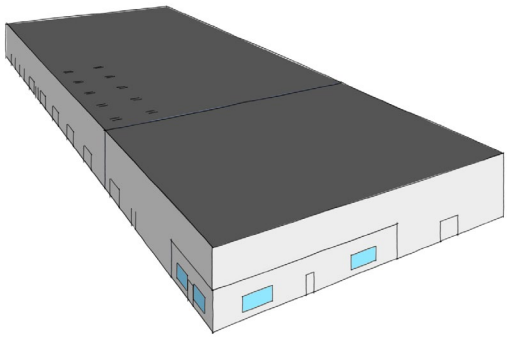
43.69 %

Savings in Embodied Carbon



Warehouse - Zone 6A (Minneapolis, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.77%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

0.77%

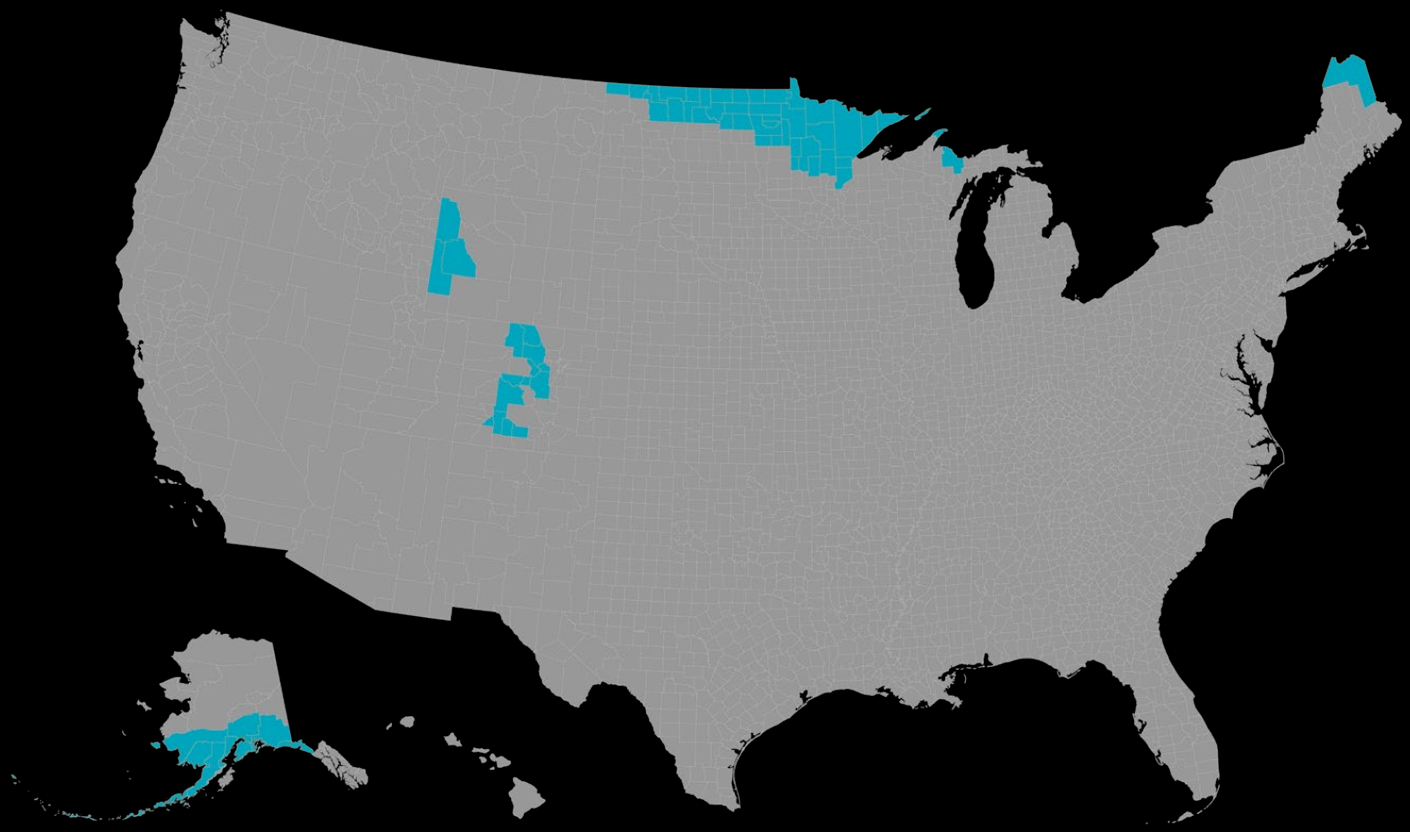
Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Climate Zone

07

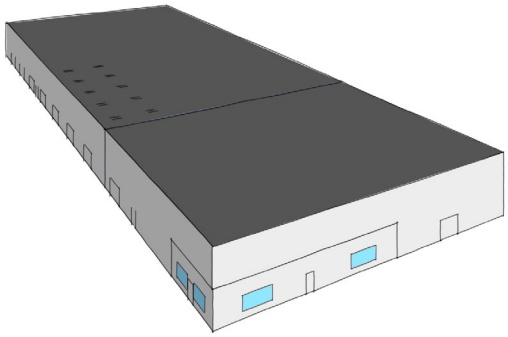
ASHRAE Climate Zone 7 is classified as a **very cold climate**, according to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This zone experiences **more than 12,000 heating degree days** (based on a base of 10°C) and **fewer than 4500 cooling degree days**, highlighting an intense need for heating solutions due to the harsh winter conditions and minimal cooling requirements during the brief, mild summers. Zone 7 is found in the **northernmost parts of the United States, including regions like northern Minnesota, parts of North Dakota, and areas in Montana**. Building strategies in this zone focus on maximizing thermal resistance with extensive insulation, triple-glazed windows, and advanced heating systems designed to operate efficiently under extreme cold. Additionally, air sealing to minimize heat leakage and incorporating energy recovery ventilation systems are crucial to maintaining indoor air quality and warmth throughout the severe winter months.



Duluth, Minnesota

Data Center- Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

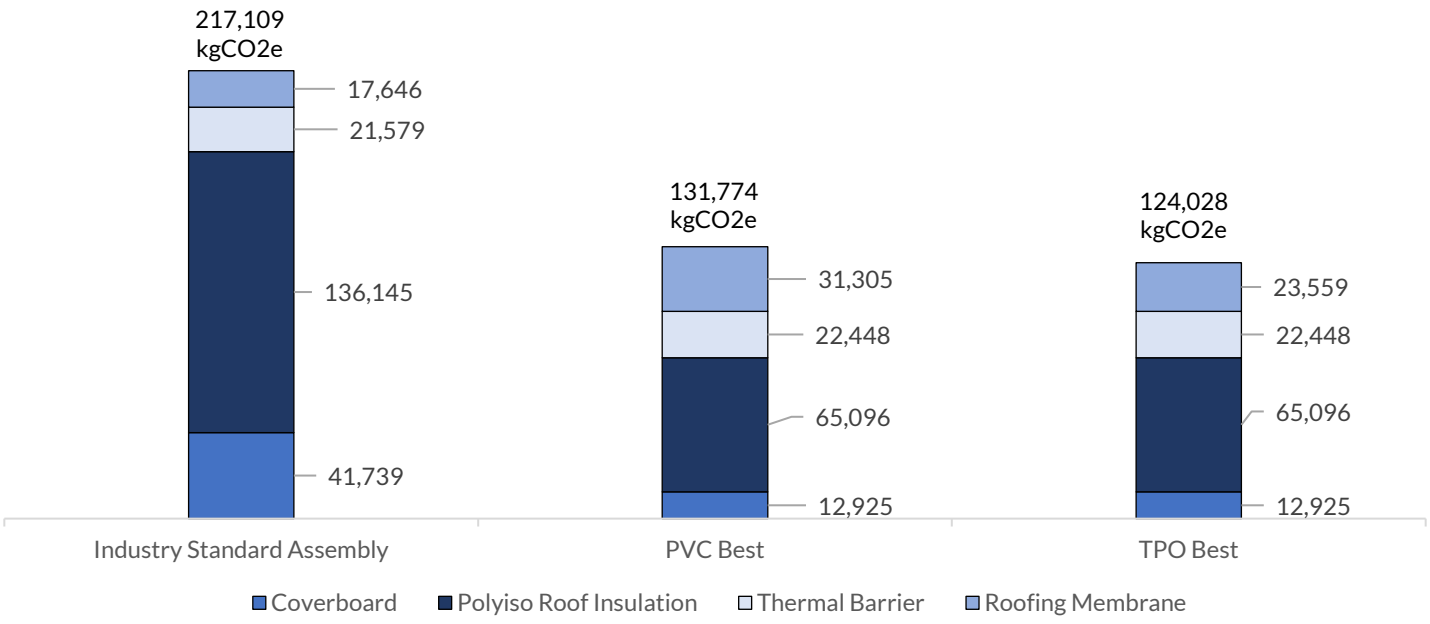
39.31%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

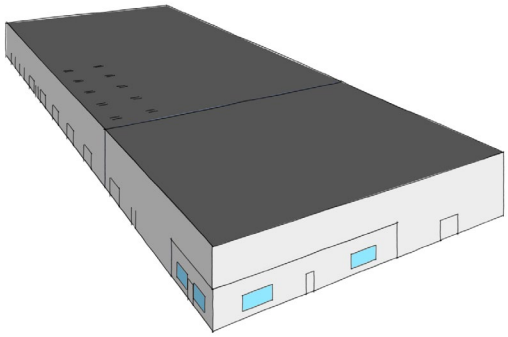
42.87 %

Savings in Embodied Carbon



Data Center- Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

-0.01%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

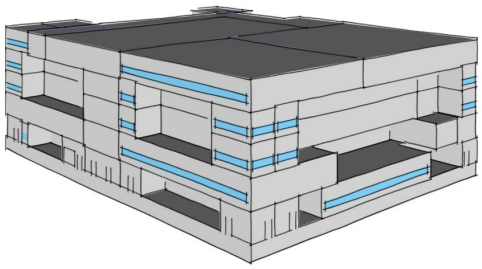
-0.01 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Hospital - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

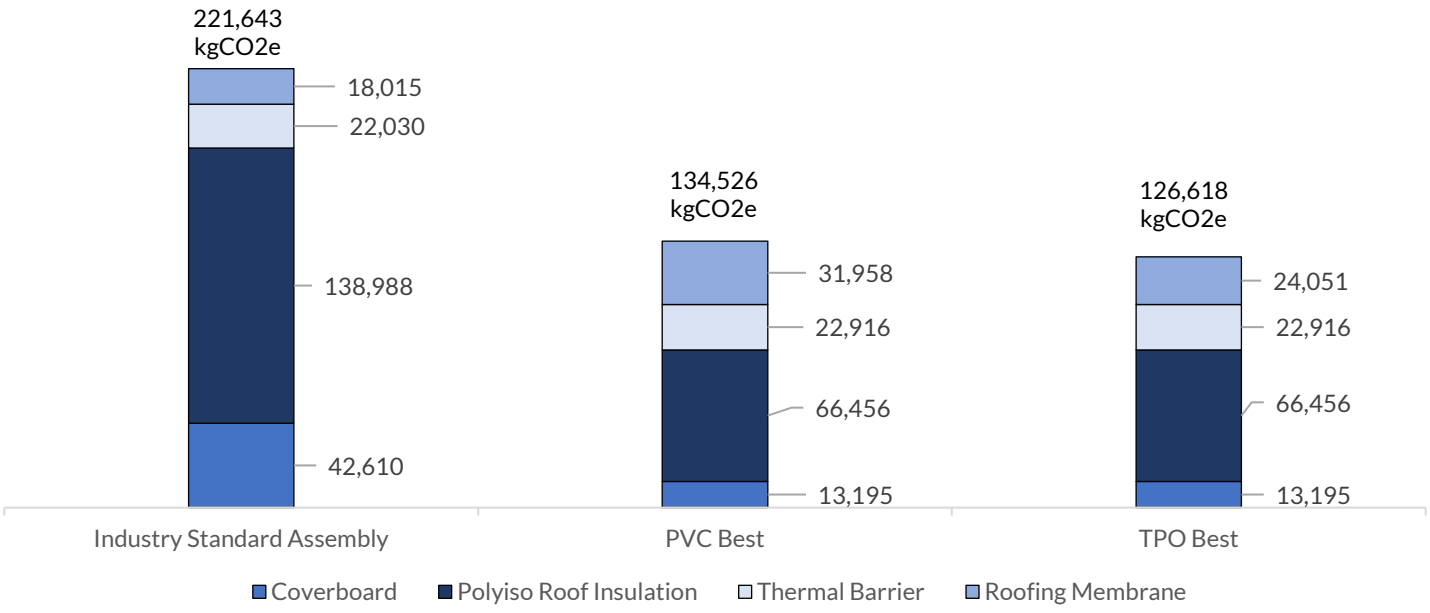
39.31%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

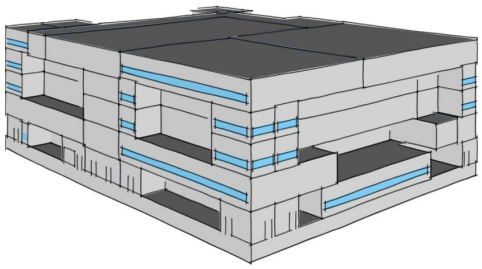
42.87 %

Savings in Embodied Carbon



Hospital - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

0.21%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

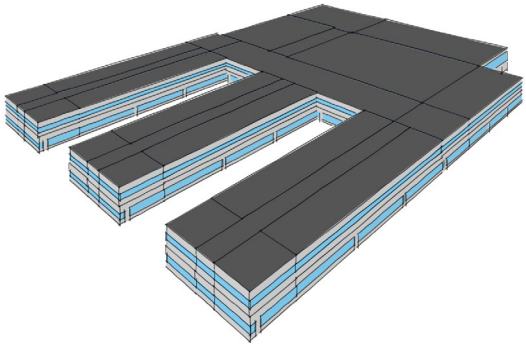
0.21 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Secondary School - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

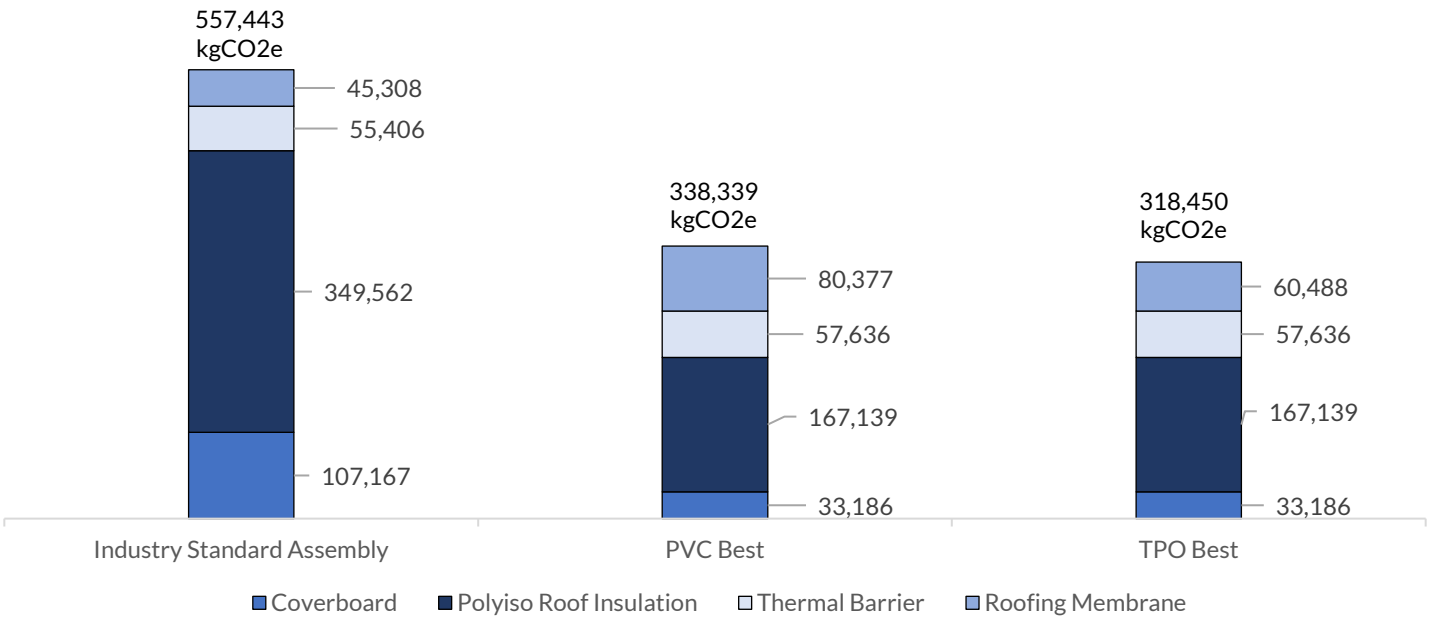
39.31%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

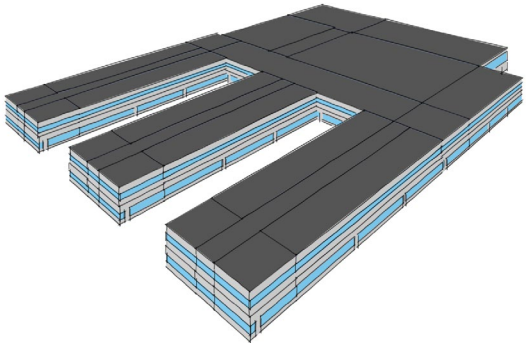
42.87 %

Savings in Embodied Carbon



Secondary School - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

1.00%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

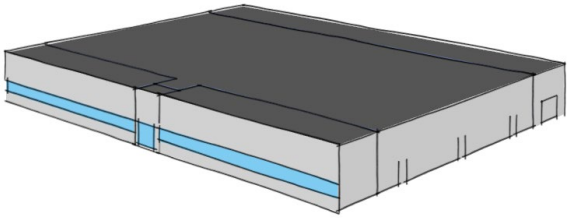
1.00 %

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

Retail - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

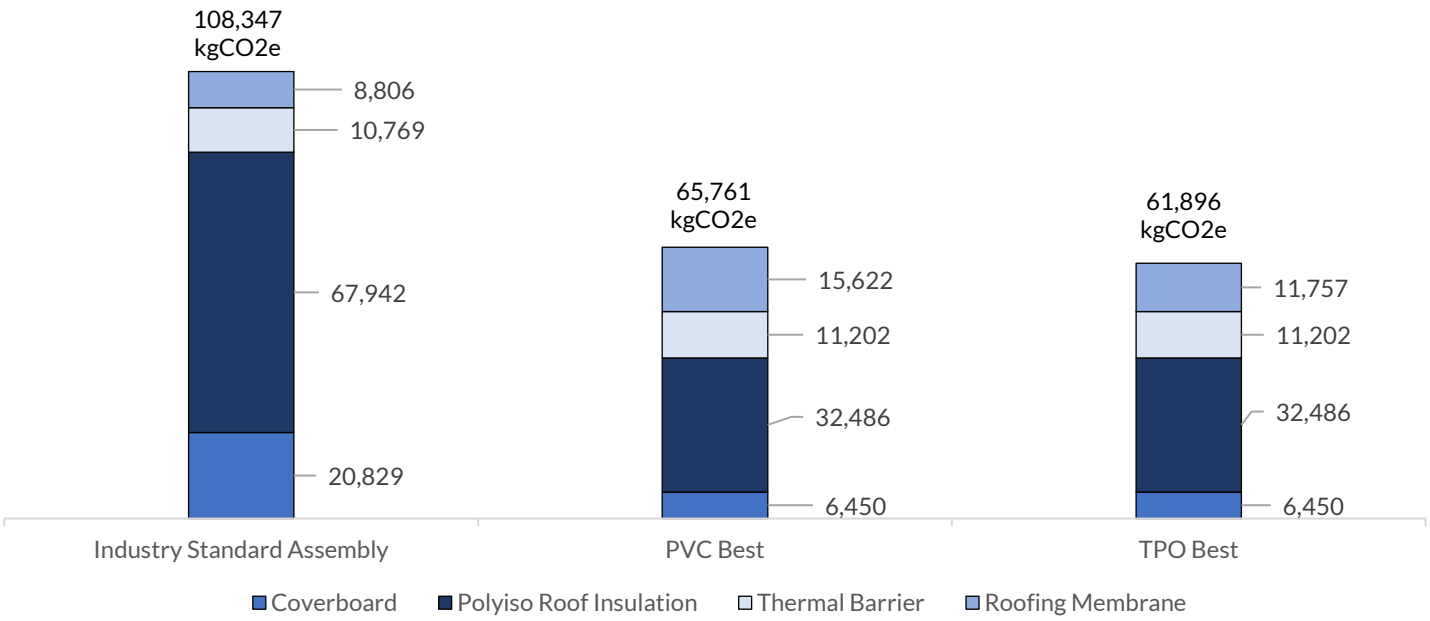
39.31%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

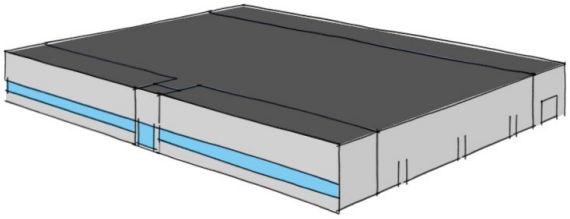
42.87 %

Savings in Embodied Carbon



Retail - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

1.68%

Savings in Energy Use Intensity

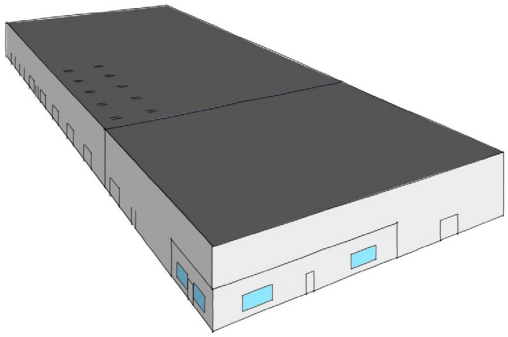
GAF TPO Best vs Industry-standard Assembly

1.68%

Savings in Energy Use Intensity

Warehouse - Zone 7A (Duluth, MN)

Embodied Carbon



GAF PVC Best vs Industry-standard Assembly

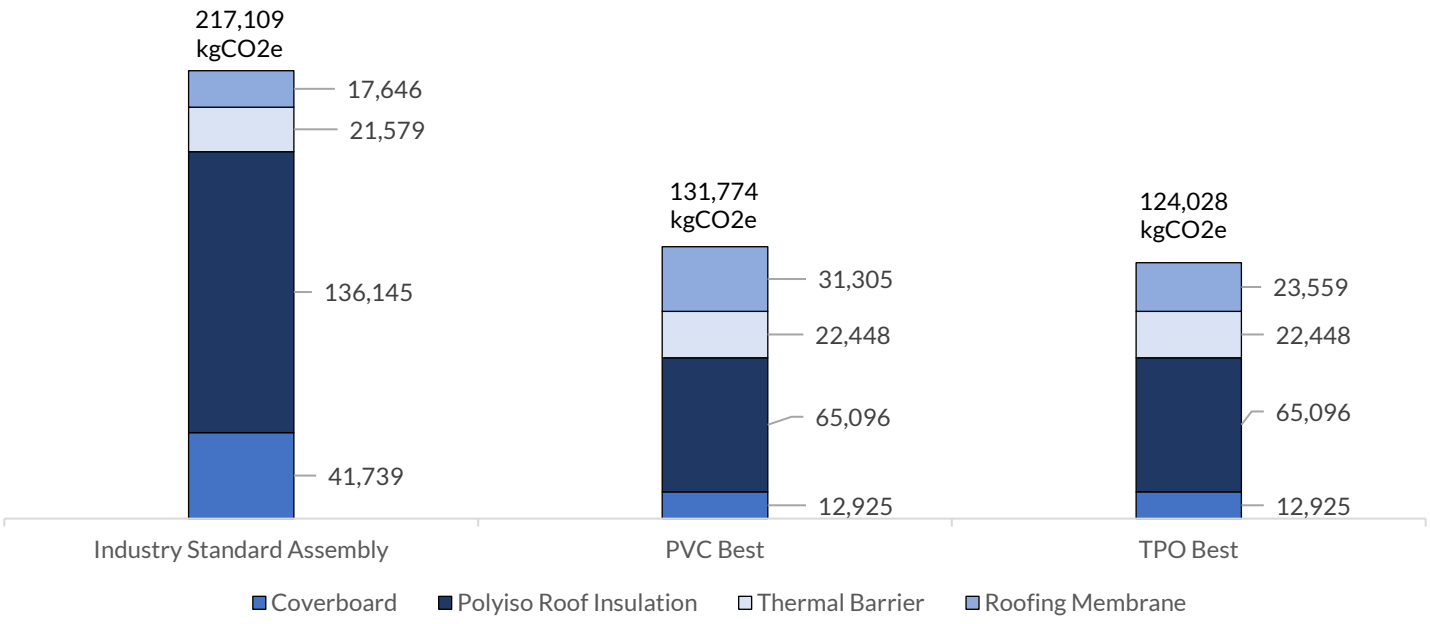
39.31%

Savings in Embodied Carbon

GAF TPO Best vs Industry-standard Assembly

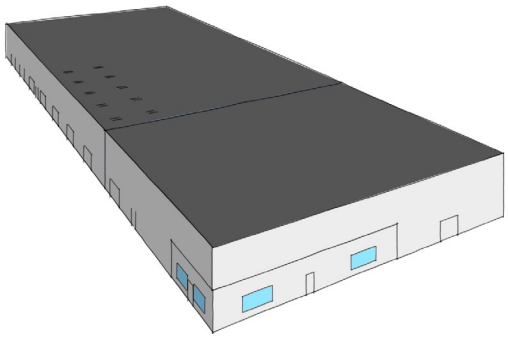
42.87 %

Savings in Embodied Carbon



Warehouse - Zone 7A (Duluth, MN)

Energy Use Intensity



GAF PVC Best vs Industry-standard Assembly

2.31%

Savings in Energy Use Intensity

GAF TPO Best vs Industry-standard Assembly

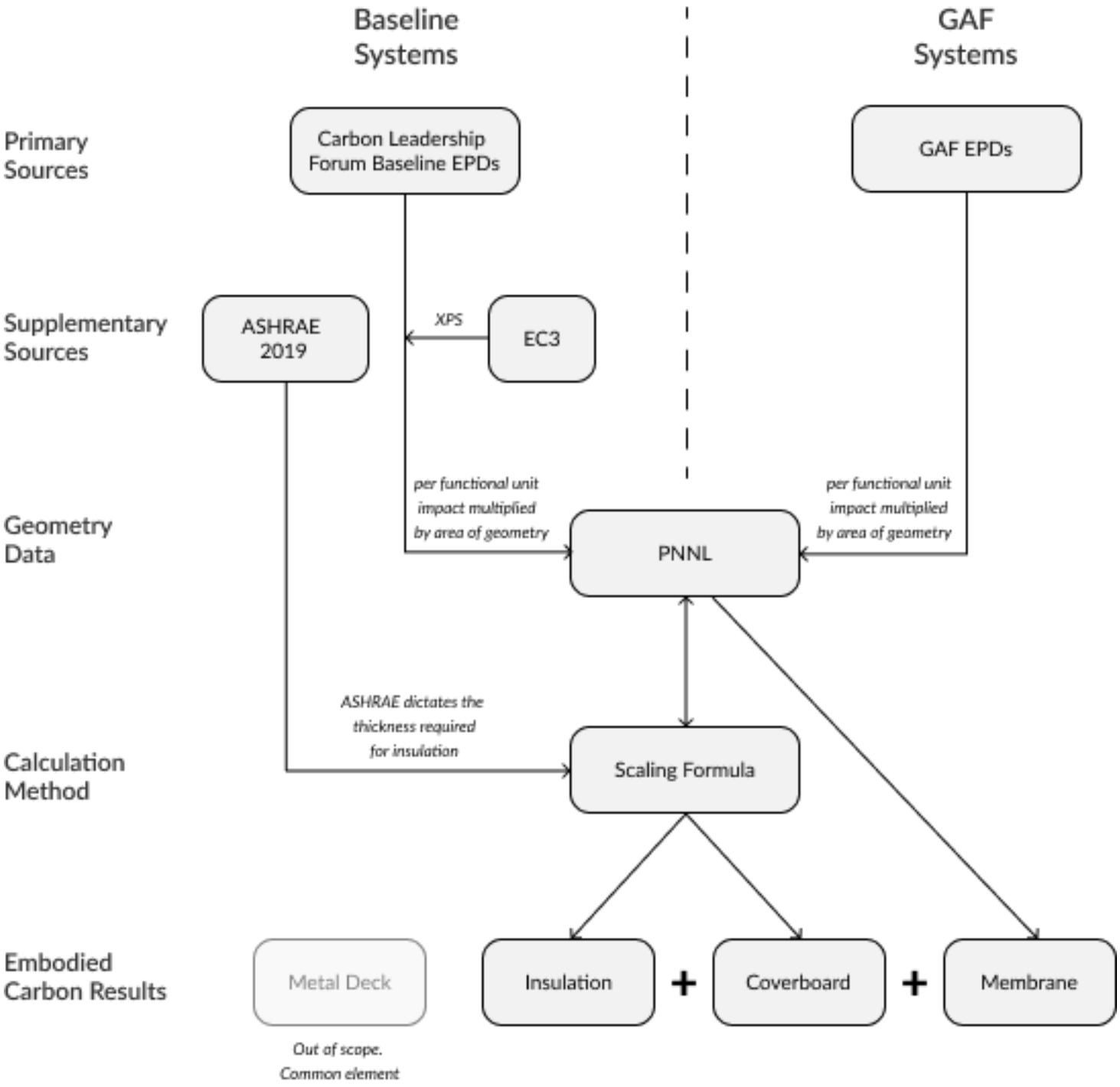
2.31%

Savings in Energy Use Intensity

* A negative value indicates that the GAF assembly is outperformed by that percentage

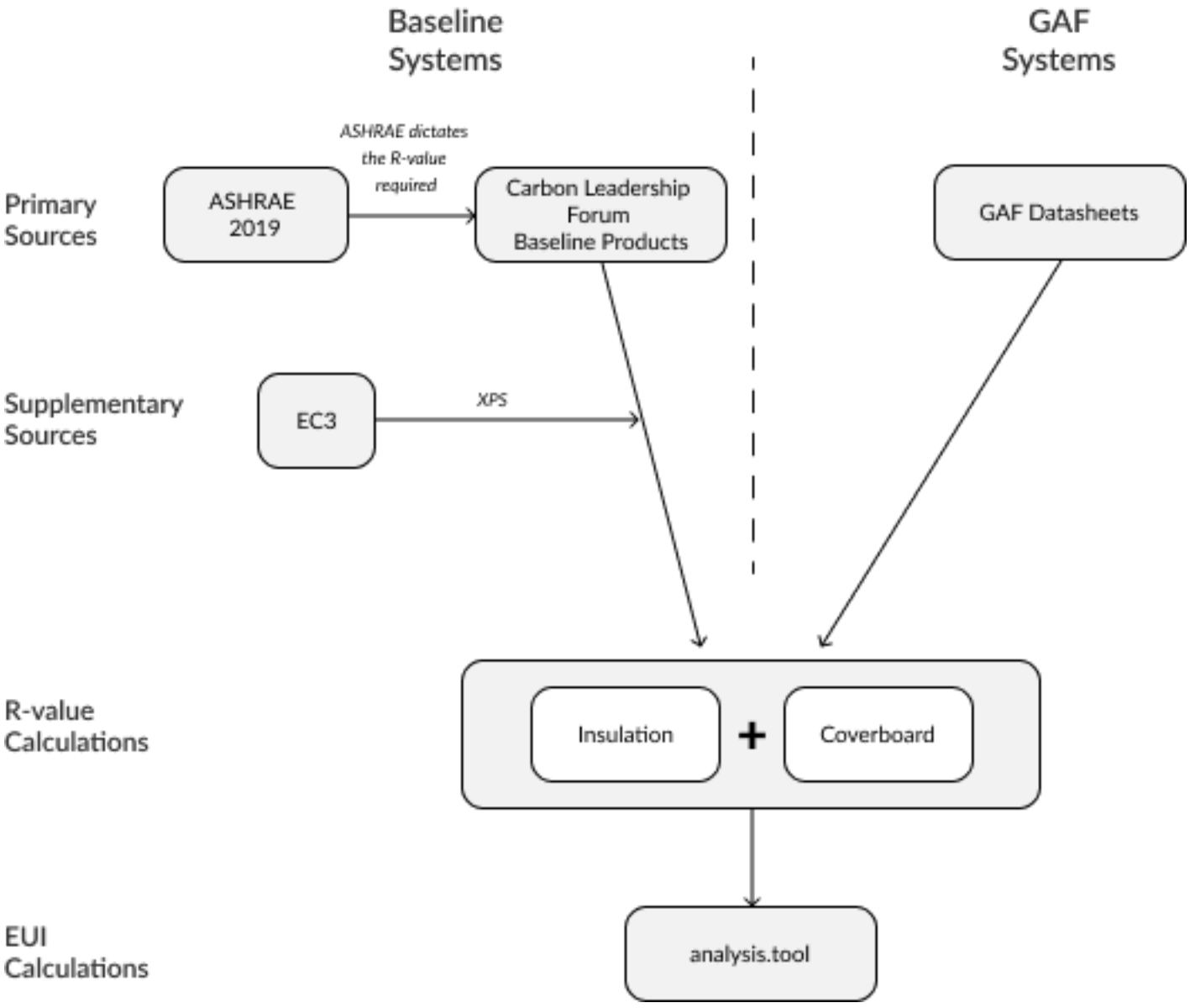
Appendix

Embodied Carbon Methodology



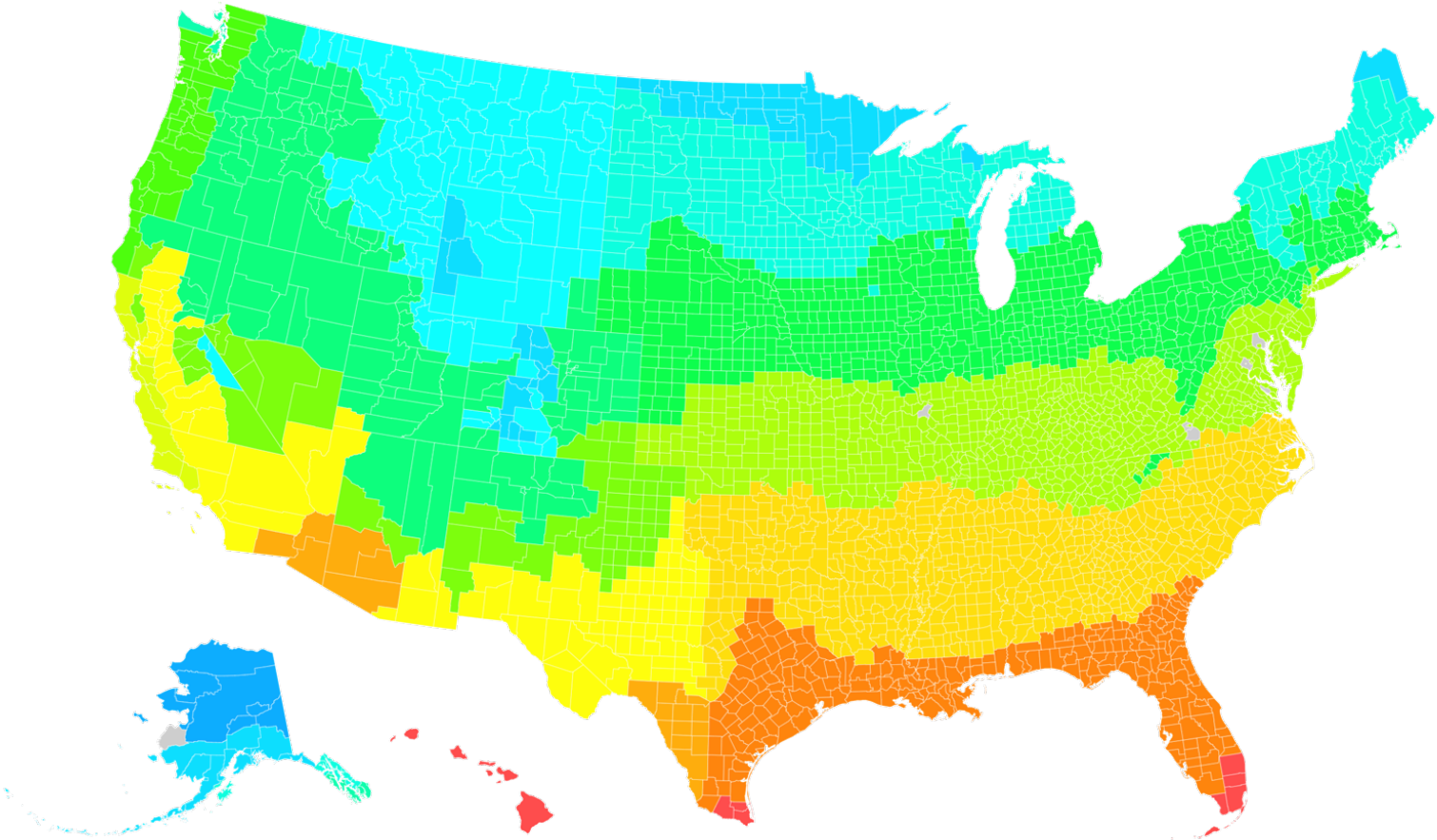
Appendix

EUI Simulation Methodology



Appendix

ASHRAE 2021 Climate Zone Map



- Climate Zone 1
- Climate Zone 2
- Climate Zone 3
- Climate Zone 4
- Climate Zone 5
- Climate Zone 6
- Climate Zone 7
- Climate Zone 8

Appendix

PNNL Geometry Data

Table 01: PNNL Geometry Data

Building Type	Number of Floors	Floor Area (ft2)	Roof Area (ft2)
Data Center	2	52823.11	49096.15
Hospital	6	214094.98	50365.33
Secondary School	2	210886.53	126671.59
Stand-alone Retail	1	24692.33	24620.33
Warehouse	2	52823.11	49096.15

Appendix

Assembly Carbon Data

Table 02: Industry-standard Assembly 01

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for Roofing Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	1.8	1	0.70	0.36	2.04
	2.6	1	0.98		
3	1.8	1	0.70	0.36	2.04
	2.6	1	0.98		
4	2.6	2	1.96	0.36	2.32
5	2.6	2	1.96	0.36	2.32
6	2.6	2	1.96	0.36	2.32
7	2.6	1	0.98	0.36	2.65
	3.5	1	1.31		

Table 03: Industry-standard Assembly 02

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for Polyiso Coverboard (kg/CO2e/ft2)	Embodied Carbon for Roofing Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	1.8	1	0.70	0.85	0.36	2.88
	2.6	1	0.98			
3	1.8	1	0.70	0.85	0.36	2.88
	2.6	1	0.98			
4	2.6	2	1.96	0.85	0.36	3.16
5	2.6	2	1.96	0.85	0.36	3.16
6	2.6	2	1.96	0.85	0.36	3.16
7	2.6	1	0.98	0.85	0.36	3.50
	3.5	1	1.31			

Appendix

Assembly Carbon Data

Table 04: Industry-standard Assembly 03

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for Polyiso Coverboard (kg/CO2e/ft2)	Embodied Carbon for Thermal Barrier (kg/CO2e/ft2)	Embodied Carbon for Roofing Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	1.8	2	2.18	0.85	0.44	0.36	3.82
3	1.8	2	2.18	0.85	0.44	0.36	3.82
4	1.8	1	1.09	0.85	0.44	0.36	4.11
	2.6	1	1.38				
5	1.8	1	1.09	0.85	0.44	0.36	4.11
	2.6	1	1.38				
6	1.8	1	1.09	0.85	0.44	0.36	4.11
	2.6	1	1.38				
7	2.6	2	2.76	0.85	0.44	0.36	4.40

Table 05: GAF PVC Good Assembly

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for PVC Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	2.6	2	0.871	0.38	1.25
3	2.6	2	0.871	0.38	1.25
4	2.6	2	0.871	0.38	1.25
5	2.6	2	0.871	0.38	1.25
6	2.6	2	0.871	0.38	1.25
7	3.2	2	1.068	0.38	1.44

Appendix

Assembly Carbon Data

Table 06: GAF PVC Better Assembly

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for PVC Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	2.6	2	0.871	0.45	1.31
3	2.6	2	0.871	0.45	1.31
4	2.6	2	0.871	0.45	1.31
5	2.6	2	0.871	0.45	1.31
6	2.6	2	0.871	0.45	1.31
7	3.2	2	1.068	0.45	1.51

Table 07: GAF PVC Best Assembly

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for Polyiso Coverboard (kg/CO2e/ft2)	Embodied Carbon for Thermal Barrier (kg/CO2e/ft2)	Embodied Carbon for PVC Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	2.4	2	1.12	0.26	0.46	0.63	2.47
3	2.4	2	1.12	0.26	0.46	0.63	2.47
4	2.4	2	1.12	0.26	0.46	0.63	2.47
5	2.4	2	1.12	0.26	0.46	0.63	2.47
6	2.4	2	1.12	0.26	0.46	0.63	2.47
7	3.0	2	1.32	0.26	0.46	0.63	2.67

Appendix

Assembly Carbon Data

Table 08: GAF TPO Good Assembly

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for TPO Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	2.6	2	0.871	0.404	1.275
3	2.6	2	0.871	0.404	1.275
4	2.6	2	0.871	0.404	1.275
5	2.6	2	0.871	0.404	1.275
6	2.6	2	0.871	0.404	1.275
7	3.2	2	1.068	0.404	1.472

Table 09: GAF TPO Better Assembly

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for Polyiso Coverboard (kg/CO2e/ft2)	Embodied Carbon for TPO Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	2.6	2	0.871	0.26	0.404	1.53
3	2.6	2	0.871	0.26	0.404	1.53
4	2.6	2	0.871	0.26	0.404	1.53
5	2.6	2	0.871	0.26	0.404	1.53
6	2.6	2	0.871	0.26	0.404	1.53
7	3.2	2	1.068	0.26	0.404	1.73

Appendix

Assembly Carbon Data

Table 10: GAF TPO Best Assembly

Climate Zone	Polyiso Thickness (inch)	Number of Boards	Embodied Carbon for Polyiso (kgCO2e/ft2)	Embodied Carbon for Polyiso Coverboard (kg/CO2e/ft2)	Embodied Carbon for Thermal Barrier (kg/CO2e/ft2)	Embodied Carbon for TPO Membrane (kg/CO2e/ft2)	Assembly Carbon (kgCO2e/ft2)
2	2.4	2	1.12	0.26	0.46	0.48	2.32
3	2.4	2	1.12	0.26	0.46	0.48	2.32
4	2.4	2	1.12	0.26	0.46	0.48	2.32
5	2.4	2	1.12	0.26	0.46	0.48	2.32
6	2.4	2	1.12	0.26	0.46	0.48	2.32
7	3.0	2	1.32	0.26	0.46	0.48	2.51

Appendix

Data Center

Table 11: Embodied Carbon Comparison (Data Center)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kgCO2e)	Baseline for TPO Better (kgCO2e)	Baseline for PVC and TPO Best (kgCO2e)	PVC Good (kgCO2e)	PVC Better (kgCO2e)	PVC Best (kgCO2e)	TPO Good (kgCO2e)	TPO Better (kgCO2e)	TPO Best (kgCO2e)
2	100,570.66	142,309.32	188,673.62	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
3	100,570.66	142,309.32	188,673.62	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
4	114,314.37	156,053.03	202,891.30	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
5	114,314.37	156,053.03	202,891.30	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
6	114,314.37	156,053.03	202,891.30	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
7	130,705.96	172,444.61	217,108.99	71,211.41	74,354.44	131,773.54	72,632.26	85,262.91	124,027.61

Table 12: Energy Use Intensity Comparison (Data Center)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kBTU / sqft)	Baseline for TPO Better (kBTU / sqft)	Baseline for PVC and TPO Best (kBTU / sqft)	PVC Good (kBTU / sqft)	PVC Better (kBTU / sqft)	PVC Best (kBTU / sqft)	TPO Good (kBTU / sqft)	TPO Better (kBTU / sqft)	TPO Best (kBTU / sqft)
2	4,437.49	4,437.60	4,437.47	4,437.73	4,437.73	4,437.76	4,437.73	4,437.83	4,437.76
3	4,435.00	4,435.19	4,434.98	4,435.40	4,435.40	4,435.45	4,435.40	4,435.57	4,435.45
4	4,431.22	4,431.41	4,431.20	4,431.22	4,431.22	4,431.29	4,431.22	4,431.45	4,431.29
5	4,428.92	4,429.14	4,428.90	4,428.92	4,428.92	4,429.00	4,428.92	4,429.20	4,429.00
6	4,427.17	4,427.43	4,427.14	4,427.17	4,427.17	4,427.26	4,427.17	4,427.48	4,427.26
7	4,281.66	4,281.86	4,281.55	4,281.83	4,281.83	4,281.90	4,281.83	4,282.07	4,281.90

Appendix

Hospital

Table 13: Embodied Carbon Comparison (Hospital)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kgCO2e)	Baseline for TPO Better (kgCO2e)	Baseline for PVC and TPO Best (kgCO2e)	PVC Good (kgCO2e)	PVC Better (kgCO2e)	PVC Best (kgCO2e)	TPO Good (kgCO2e)	TPO Better (kgCO2e)	TPO Best (kgCO2e)
2	102,670.66	145,280.86	192,613.29	62,776.42	66,041.46	124,546.77	64,226.94	77,177.71	116,639.10
3	102,670.66	145,280.86	192,613.29	62,776.42	66,041.46	124,546.77	64,226.94	77,177.71	116,639.10
4	116,701.35	159,311.55	207,127.85	62,776.42	66,041.46	124,546.77	64,226.94	77,177.71	116,639.10
5	116,701.35	159,311.55	207,127.85	62,776.42	66,041.46	124,546.77	64,226.94	77,177.71	116,639.10
6	116,701.35	159,311.55	207,127.85	62,776.42	66,041.46	124,546.77	64,226.94	77,177.71	116,639.10
7	133,435.21	176,045.40	221,642.40	72,698.36	75,907.02	134,525.09	74,148.88	87,043.27	126,617.41

Table 14: Energy Use Intensity Comparison (Hospital)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kBTU / sqft)	Baseline for TPO Better (kBTU / sqft)	Baseline for PVC and TPO Best (kBTU / sqft)	PVC Good (kBTU / sqft)	PVC Better (kBTU / sqft)	PVC Best (kBTU / sqft)	TPO Good (kBTU / sqft)	TPO Better (kBTU / sqft)	TPO Best (kBTU / sqft)
2	51.44	49.07	49.06	51.46	51.46	51.46	51.46	51.55	51.46
3	51.69	51.64	51.69	51.59	51.59	51.58	51.59	51.55	51.58
4	62.88	62.80	62.88	62.88	62.88	62.85	62.88	62.82	62.85
5	75.67	75.56	75.68	75.71	75.71	75.67	75.71	75.54	75.67
6	91.37	91.23	91.38	91.37	91.37	91.32	91.37	91.19	91.32
7	110.91	110.77	110.98	110.79	110.79	110.75	110.79	110.64	110.75

Appendix

School

Table 15: Embodied Carbon Comparison (School)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kgCO2e)	Baseline for TPO Better (kgCO2e)	Baseline for PVC and TPO Best (kgCO2e)	PVC Good (kgCO2e)	PVC Better (kgCO2e)	PVC Best (kgCO2e)	TPO Good (kgCO2e)	TPO Better (kgCO2e)	TPO Best (kgCO2e)
2	258,222.39	365,389.38	484,433.07	157,886.18	166,097.91	313,242.02	161,534.32	194,106.20	293,353.78
3	258,222.39	365,389.38	484,433.07	157,886.18	166,097.91	313,242.02	161,534.32	194,106.20	293,353.78
4	293,510.36	400,677.35	520,937.99	157,886.18	166,097.91	313,242.02	161,534.32	194,106.20	293,353.78
5	293,510.36	400,677.35	520,937.99	157,886.18	166,097.91	313,242.02	161,534.32	194,106.20	293,353.78
6	293,510.36	400,677.35	520,937.99	157,886.18	166,097.91	313,242.02	161,534.32	194,106.20	293,353.78
7	335,596.92	442,763.92	557,442.90	182,840.41	190,910.36	338,338.03	186,488.54	218,918.64	318,449.79

Table 16: Energy Use Intensity Comparison (School)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kBTU / sqft)	Baseline for TPO Better (kBTU / sqft)	Baseline for PVC and TPO Best (kBTU / sqft)	PVC Good (kBTU / sqft)	PVC Better (kBTU / sqft)	PVC Best (kBTU / sqft)	TPO Good (kBTU / sqft)	TPO Better (kBTU / sqft)	TPO Best (kBTU / sqft)
2	27.07	27.10	27.07	27.15	27.15	27.15	27.15	27.18	27.15
3	26.24	26.25	26.23	26.27	26.27	26.27	26.27	26.28	26.27
4	27.53	27.43	27.54	27.53	27.53	27.50	27.53	27.41	27.50
5	31.20	31.02	31.22	31.20	31.20	31.14	31.20	30.98	31.14
6	33.89	33.66	33.92	33.89	33.89	33.81	33.89	33.53	33.81
7	38.82	38.60	38.95	38.63	38.63	38.56	38.63	38.38	38.56

Appendix

Retail

Table 17: Embodied Carbon Comparison (Retail)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kgCO2e)	Baseline for TPO Better (kgCO2e)	Baseline for PVC and TPO Best (kgCO2e)	PVC Good (kgCO2e)	PVC Better (kgCO2e)	PVC Best (kgCO2e)	TPO Good (kgCO2e)	TPO Better (kgCO2e)	TPO Best (kgCO2e)
2	50,189.00	71,018.35	94,156.09	30,687.31	32,283.37	60,882.81	31,396.37	37,727.15	57,017.26
3	50,189.00	71,018.35	94,156.09	30,687.31	32,283.37	60,882.81	31,396.37	37,727.15	57,017.26
4	57,047.69	77,877.04	101,251.32	30,687.31	32,283.37	60,882.81	31,396.37	37,727.15	57,017.26
5	57,047.69	77,877.04	101,251.32	30,687.31	32,283.37	60,882.81	31,396.37	37,727.15	57,017.26
6	57,047.69	77,877.04	101,251.32	30,687.31	32,283.37	60,882.81	31,396.37	37,727.15	57,017.26
7	65,227.78	86,057.13	108,346.54	35,537.50	37,106.00	65,760.55	36,246.56	42,549.79	61,895.01

Table 18: Energy Use Intensity Comparison (Retail)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kBTU / sqft)	Baseline for TPO Better (kBTU / sqft)	Baseline for PVC and TPO Best (kBTU / sqft)	PVC Good (kBTU / sqft)	PVC Better (kBTU / sqft)	PVC Best (kBTU / sqft)	TPO Good (kBTU / sqft)	TPO Better (kBTU / sqft)	TPO Best (kBTU / sqft)
2	26.09	25.98	26.10	25.86	25.86	25.83	25.86	25.77	25.83
3	26.30	26.09	26.33	25.84	25.84	25.79	25.84	25.66	25.79
4	34.05	33.72	34.08	35.18	35.18	35.07	35.18	33.64	35.07
5	40.71	40.43	40.93	40.71	40.71	40.55	40.71	40.33	40.55
6	45.17	44.75	45.33	45.17	45.17	44.99	45.17	44.52	44.99
7	53.27	52.81	53.58	52.84	52.84	52.68	52.84	52.32	52.68

Appendix

Warehouse

Table 19: Embodied Carbon Comparison (Warehouse)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kgCO2e)	Baseline for TPO Better (kgCO2e)	Baseline for PVC and TPO Best (kgCO2e)	PVC Good (kgCO2e)	PVC Better (kgCO2e)	PVC Best (kgCO2e)	TPO Good (kgCO2e)	TPO Better (kgCO2e)	TPO Best (kgCO2e)
2	100,570.66	142,309.32	188,673.62	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
3	100,570.66	142,309.32	188,673.62	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
4	114,314.37	156,053.03	202,891.30	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
5	114,314.37	156,053.03	202,891.30	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
6	114,314.37	156,053.03	202,891.30	61,492.41	64,690.66	121,999.32	62,913.26	75,599.13	114,253.39
7	130,705.96	172,444.61	217,108.99	71,211.41	74,354.44	131,773.54	72,632.26	85,262.91	124,027.61

Table 20: Energy Use Intensity Comparison (Warehouse)

Climate Zone	Baseline for PVC Good, Better and TPO Good (kBTU / sqft)	Baseline for TPO Better (kBTU / sqft)	Baseline for PVC and TPO Best (kBTU / sqft)	PVC Good (kBTU / sqft)	PVC Better (kBTU / sqft)	PVC Best (kBTU / sqft)	TPO Good (kBTU / sqft)	TPO Better (kBTU / sqft)	TPO Best (kBTU / sqft)
2	12.47	12.32	12.48	12.15	12.15	12.11	12.15	12.02	12.11
3	15.20	14.91	15.23	14.58	14.58	14.51	14.58	14.33	14.51
4	20.71	20.38	20.75	20.71	20.71	20.60	20.71	20.30	20.60
5	25.19	24.79	25.24	25.19	25.19	25.05	25.19	24.69	25.05
6	28.67	28.19	28.72	28.67	28.67	28.50	28.67	28.08	28.50
7	34.41	33.95	34.67	34.01	34.01	33.87	34.01	33.48	33.87

cove.tool

contact us

cove.tool, Inc.

100 Peachtree St NW, FLR 5
Atlanta, GA, GA 30303
United States

+ 1 404 998 5846

Email: hello@covetool.com

Website: www.cove.tools