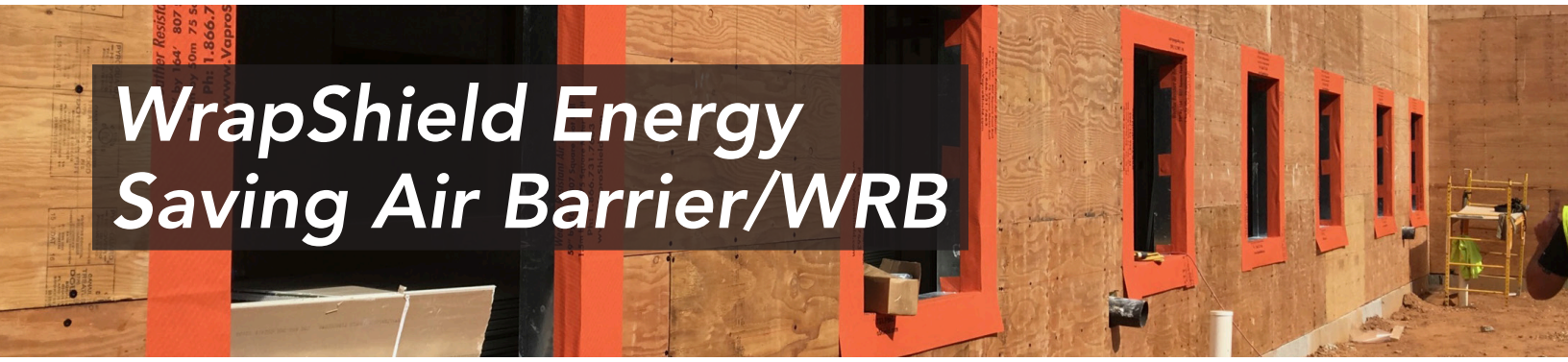
VAPROSHIELD®
Breathable Membrane Systems for Roofs & Walls



WrapShield Energy Saving Air Barrier/WRB

Building Envelope Resilience

The building envelope is a system that meshes multiple elements; structural integrity, moisture control, energy efficiency, and indoor air quality - all rolled up into a single design strategy.
"Moisture has been the number one cause of structural deterioration for as long as there have been structures. Moisture in all its forms—snow and ice, wind-driven rain, water vapor— greatly affect the performance of building materials.[1]"

Since 2001 VaproShield has been committed to keeping the building envelope dry, durable and energy efficient with a highly advanced system of **water resistive air barriers** and accessories that have been tested and proven to perform by independent third-party labs, and 1000's of projects worldwide. VaproShield membranes are the **single source** solution to **manage water** and **air leading to energy conservation** and savings for the life of the building.

"Based on national average heating and cooling energy prices, potential annual heating and cooling energy cost savings ranged from 3-36%," with the most savings occurring in heating dominated climates.[2]"*
**assumed blended*

Lifecycle Costs

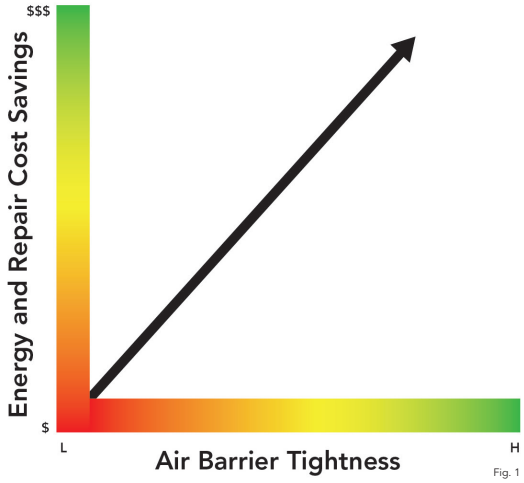
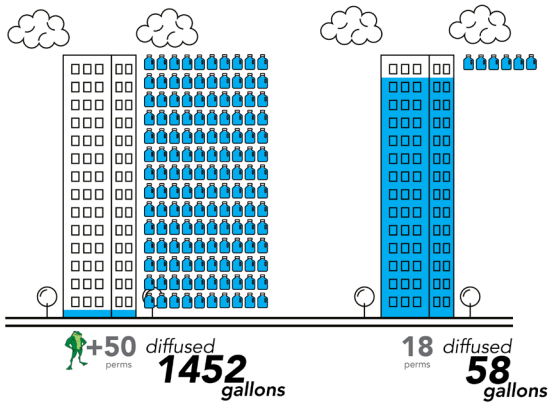


Fig. 1

- Studies show a 10-40% energy savings can be directly attributed to a properly installed continuous air barrier system.
- The US Dept of Energy states "Indoor comfort, and energy management is enhanced by managing air infiltration."

Vapor Permeance = Dryness = Durability

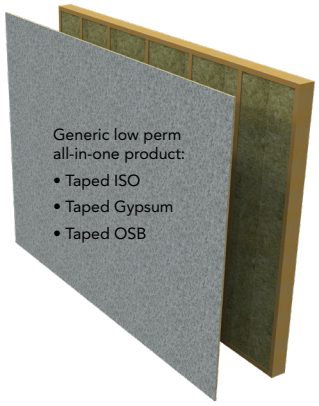


*based on a **50,000** sq. ft. of membrane over **100** hours*
Fig. 2

- VaproShield membranes offer an unimpeded drainage plane (no horizontal tape reverse laps)
- Windows are detailed with monolithic liquid flashing offering the best protection for the #1 leak area
- Resulting in: a DRIER and more DURABLE building with healthier indoor air quality (IAQ)

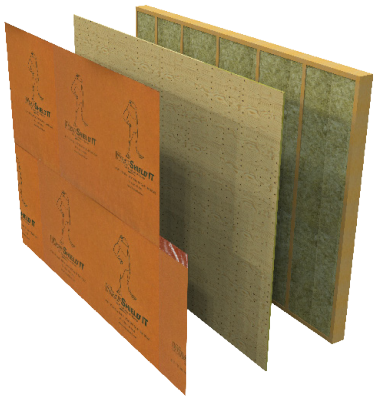
Durable Energy Saving Solutions

Baseline (by others)



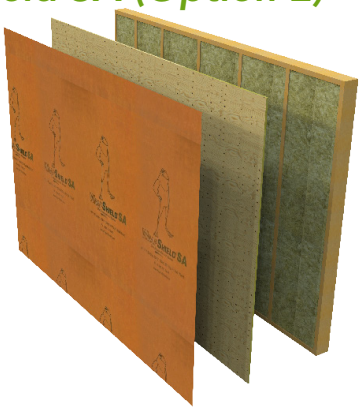
Durability	• Reverse laps are prone to potential leakage and structural deterioration over time • Exposed sheathing nails create vulnerability for air and water infiltration • Minimal drying capacity: below 17 perms
Moisture In	
Moisture Out	
Energy (Air)	Year 1: 0 savings Year 30: 0 savings
Occupant Comfort	Increase airflow increases sound disturbances

WrapShield IT (Option 1)



Durability	• Integrated tape tape and proven details ensure shingled laps (no reverse laps) • Increased drying capacity (Fig. 2) • Protected sheathing and nails by a robust independent layer
Moisture In	
Moisture Out	
Energy (Air)	Year 1: $1,899 savings Year 30: $130,393 savings
Occupant Comfort	Reduced airflow and additional layer reduces sound disturbances

WrapShield SA (Option 2)



Durability	• Continuously adhered air barrier eases detailing and increases efficiency • Maximum air tightness reduces moisture damage and promotes healthy IAQ • Increased drying capacity
Moisture In	
Moisture Out	
Energy (Air)	Year 1: $2,713 savings Year 30: $186,276 savings
Occupant Comfort	Reduced airflow and additional layer reduces sound disturbances

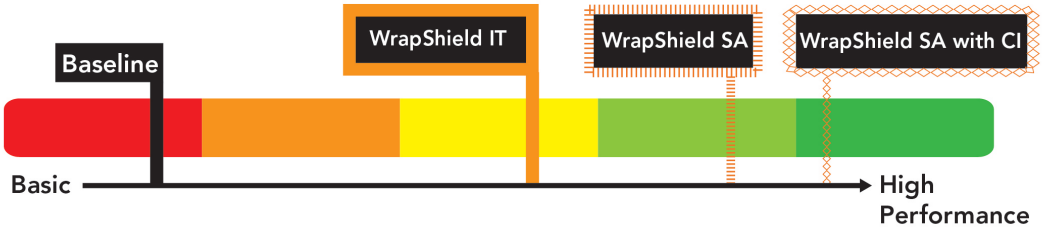
WrapShield SA with CI (Option 3)

Durability	• Continuously adhered air barrier eases detailing and increases efficiency • Maximum air tightness reduces moisture damage and promotes healthy IAQ • Increased drying capacity • Continuous exterior insulation increases performance
Moisture In	
Moisture Out	
Energy (Air)	Year 1: $2,984 savings Year 30: $204,904 savings
Occupant Comfort	Maximum comfort with exterior insulation

Durable Energy Saving Solutions Summary

Durability

Building longevity, resilience, and reduced maintenance/repair costs.



Energy Savings

Increased building air tightness and insulation lowers lifetime energy costs.

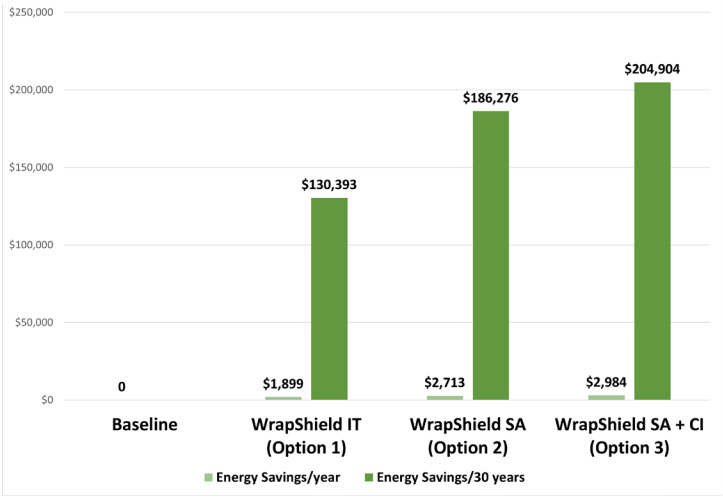
Occupant Comfort

Well detailed air barrier systems and additional material buffers help with sound and interior climate performance.

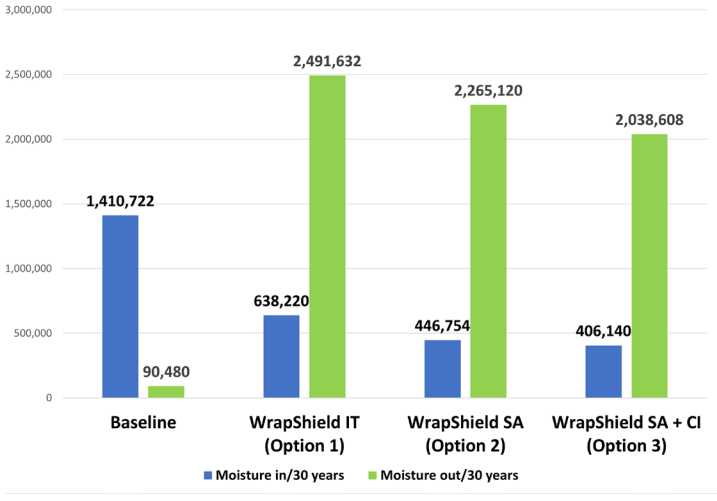
Lifecycle Cost

Estimated relative cost of installation, operational energy savings, maintenance and remediation based on modeled moisture loading vulnerabilities.

Energy Savings



Moisture In/Out



References, Notes and Modeling Assumptions:

1. CRH Building Soltutions.com, July 4, 2018 https://www.buildingsolutions.com/industry-insights/masonry-and-moisture-what-is-the-worst-that-could-happen

2. James C. Freeling Principal Engineer, Building Envelope Engineering (BEE)

3. Plywood, where applicable, has been shown to have better moisture cycling and drying (permeability) performance than OSB, leading to increased long-term structural resilience. See references: https://www.energyvanguard.com/blog/moisture-and-the-quirkiness-of-osb/ and https://www.buildingscience.com/sites/default/files/01.05b_Timusk%20Thesis.pdf and http://support.sbcindustry.com/Archive/2006/aug/Paper_266.pdf and https://www.appliedbuildingtech.com/system/files/modules/node/119/tolerablemoisturecontentofmaterials-ashrae160.pdf

4. Self-adhered membrane systems contribute to maximum durability and air tightness through ease of installation and interfacing; weighted factor 1. See: https://vaproshield.com/home/about-us and https://vaproshield.com/viewall?sort=-link_created&keyword=&cf81%5B%5D=WrapShield+SA and https://vaproshield.com/installation/videos

5. Mechanically attached membrane system with integrated tape and liquid flashing easily achieves ASTM E 2357 compliant air-tightness; weighted constructability factor 0.8

6. Baseline air leakage rate of 0.79 CFM/ft² at 75 Pa, per ORNL Energy Savings and Moisture Transport Calculator v1.0-BETA. reference: https://airleakage-calc.ornl.gov/#/infiltrationcalculation

7. Option 2 air leakage rate of 0.25 CFM/ft² at 75 Pa is based on actual projects exceeding this U.S. Army Corps of Engineers requirement.

8. These calculations are based on modeling a generically dimensioned 81,243 square foot mid-rise apartment building with. Actual figures may vary considerably based on amount of corners and framing efficiencies, among other factors.

9. We expect that the initial installed costs of these systems will be roughly inverse along the same spectrum, but much closer together, especially compared to overall construction costs, but the cost savings over the life of the building are much more significant.

10. All VaproShield air barrier WRB membrane systems enhance durability by providing a high degree of drying potential, adding considerable protection against incidental, occupational, and even construction phase moisture ingress. See the following published industry white papers: https://vaproshield.com/images/pdf/2018-cts-wood.pdf and https://vaproshield.com/images/pdf/20140902_Drying_Study_Final_Report.pdf and https://vaproshield.com/images/pdf/Self-Drying_Roofs_IIBEC_Interface_July_2020_Vol.XXXVIII__No.7_CRM.pdf

11. Option 3 energy efficiency factor assumed 1.1 (10% greater than Option 2); drying factor of 0.9 (10% less than Option 2). Actual figures could vary considerably, depending on continuous exterior insulation (Ci) type and depth, among other variables.

12. Option 1 energy efficiency factor assumed 0.7 (30% less than Option 2, based on adhesive-backed membrane system easing some detailing); drying factor 1.1, based on absence of adhesive. Actual figures will vary depending on, among other variables, quality of installation. All VaproShield membrane systems include access to free technical assistance and training which can greatly increase long term effectiveness of the energy efficiency and resilience of the building envelope. All durability and air-tightness based figures assume all relevant project team members availing themselves of this service.

13. Additional resources on air barriers and/or moisture protection and damage: https://www.wbdg.org/resources/air-barrier-systems-buildings, https://www1.appa.org/files/FMArticles/36-44%20REVISED.pdf , https://www.hq.nasa.gov/office/codej/codejx/Assets/Docs/DMParametricEstimatingGuideApr03.pdf , https://www.huduser.gov/Publications/pdf/BuildingMoistureandDurability.pdf, https://www.dupont.com/knowledge/how-moisture-impacts-building-envelope.html , https://amienvironmental.com/introduction-to-moisture-problems-design-construction/ , https://cdn.intechopen.com/pdfs/23535/InTech-Moisture_and_bio_deterioration_risk_of_building_materials_and_structures.pdf , https://www.uamd.edu.al/new/wp-content/uploads/2017/02/20.-Mimoza-Demo.pdf

14. Annual "moisture in" calculations provided by ORNL Energy Savings and Moisture Transport Calculator v1.0-BETA. reference: https:// airleakage-calc.ornl.gov/#/infiltrationcalculation. 30 year extrapolation based on Congressional Budget Office (https://www.cbo.gov/system/files/2020-07/56442-CBO-update-economic-outlook.pdf) referenced "Federal Reserve's long-run objective for inflation" of 2.0%, along with long term electricity rate outlook based on figures from: https://www.eia.gov/analysis/ of approximately 2.5% annually (Rocky Mountain Region). Several factors could render these estimates low or high, for example, increase of renewable energy implementation and decrease in fossil fuel extraction.

15. LCCA and/or LCA? For a helpful discussion on the relationship of sustainability to economic sustainability in terms of building ownership and operation costs, see the following article: https://sustainable.stanford.edu/sites/default/files/Guidelines_for_Life_Cycle_Cost_Analysis.pdf

16. For a discussion on whole building air tightness strategies, see: https://www.rdh.com/blog/early-airtightness-testing/