



Building America Case Study

Cost Analysis of Roof-Only Air Sealing and Insulation Strategies on 1 ½-Story Homes in Cold Climates

Minneapolis, Minnesota

PROJECT INFORMATION

Project Name: Project Overcoat: A Focus on Cost-Effective Options for Roof Applications

Location: Minneapolis, MN

Partners:

Cocoon, cocoon-solutions.com

Byggmeister, Inc., byggmeister.com

NorthernSTAR Building America Partnership

Building Component: Roof/attic air sealing and insulation

Application: Retrofit; single-family

Year Tested: 2013

Climate Zones: Cold, very cold

PERFORMANCE DATA

Cost of the core ETMMS measures installed on the roof planes ranged from \$10.25–\$11.30/ft² of roof surface area. Full measure costs to complete a project will be higher.

Moisture damage to roofs in cold climates is common and often caused by ice dams and frost on the underside of the roof deck. These situations are created by heat loss through the roof and are a key durability concern for existing homes. Especially vulnerable is the 1-½-story Cape Cod. This house type presents many challenges—finished interior walls, shallow rafter depths, lack of raised heel energy truss, thermal bridging, and lack of air barrier continuity, among others—that prevent thorough insulation, air sealing, and ventilation from the interior.

The U.S. Department of Energy Building America team, NorthernSTAR, created the External Thermal Moisture Management System (ETMMS) as a means to mitigate ice dam formation on the roofs of 1-½-story homes to improve airtightness. Two previous studies discussed maximizing opportunities for insulation, air sealing, and roof deck ventilation and investigated the airtightness impact of the roof-only ETMMS technique on 1-½-story homes. The current study sought to understand the costs for using the roof-only ETMMS protocol on 1-½-story homes in cold and very cold climates.

Finding very few roof-only ETMMS projects to review, the team also considered the whole-house ETMMS application seen in deep energy retrofits. The team analyzed cost data provided by independent contractors, Cocoon and Byggmeister, Inc. as well as ancillary cost data from market rate utility and weatherization programs for roof-only, interior-applied retrofits to help inform the costs discussion in terms of what is generally done in the market.

When estimating costs for ETMMS, consider the following basic points:

- Roof deck components: air/water/vapor control membrane, exterior insulation, sleepers and fasteners, and roof decking
- Removal/rebuild of the soffit frame work and removal of part of roof deck to access the roof/gable wall connection for air sealing
- Air sealing and insulation at the roof/wall and roof/gable wall/floor connections

Description

The following images illustrate the roof-only ETMMS process. Here short 2×4 sleepers are placed over the insulation to create cross ventilation in valleys.



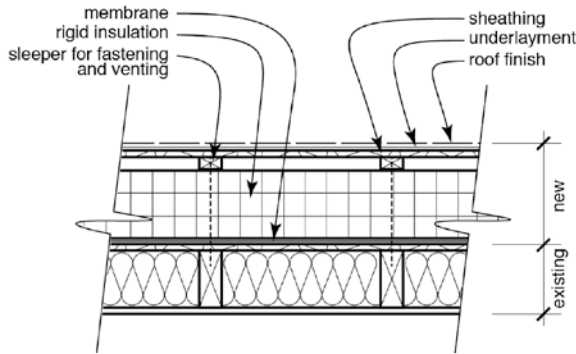
The photo below shows the beginning stages of creating the rake details before the air/water membrane and insulation are added on the gable end. When wall cladding cannot be removed, interior insulation and air sealing can be done.



For more information, see the Building America report, *Cost Analysis of Roof-Only Air Sealing and Insulation Strategies on 1½-Story Homes in Cold Climates* at: buildingamerica.gov

Image credit: All images were created by the NorthernSTAR team.

- Gable end wall treatment: air/water/vapor control membrane, insulation, and furring strips/fasteners applied to the exterior of the gable walls or air sealing/insulation on interior of gable walls
- All components assigned as a cost to the energy retrofit
- Method to communicate final cost in consistent manner, such as project total divided by roof surface area, as used by Cocoon.



In the ETMMS process, a continuous air/water/vapor control barrier is applied to the existing roof decking. Insulation is then added over the air barrier with seams staggered to control convective looping. Sleepers are placed between the insulation and new roof decking to create an air space for venting. The gable ends are addressed in a similar manner.

Lessons Learned

- The average cost to install the core ETMMS measures on the roof planes ranged from \$10.25–\$11.30/ft². Full measure costs will be higher and depend on variables related to the other five parts of cost equation. The full measure costs of the Cocoon projects ranged from \$20–\$30/ft² of roof surface area.
- Each home is unique and each set of homeowners is pursuing specific solutions. Therefore, variables from home to home make it difficult to truly compare full measure costs.
- A literature review found interior-applied ice dam mitigation retrofits ranging from \$16–\$21.64/ft² of roof surface area.
- Fluid-applied membranes used for foundation waterproofing and vertical wall air/water barriers may lower ETMMS costs.
- Homeowners who experience ice dams and the consequent structural damage may find the cost to be worthwhile; they will almost certainly find the process more cost effective when their homes need major upgrades such as roofing and wall cladding.

Looking Ahead

The two homes that underwent the roof-only ETMMS retrofit provided great insight into cost; however, more research is needed to determine whether the costs are consistent across more homes and geographic areas. Costs may also be reduced as contractors become more skilled with the procedure; however, this is yet to be determined.