Expanded Polystyrene
REDUCES GLOBAL WARMING

A New Perspective on EPS

It is often cited that our greatest source of immediate energy can be provided through conservation. This Environmental Profile illustrates the significant role EPS insulation can play to conserve energy and reduce global warming.

EPS Environmental Scorecard

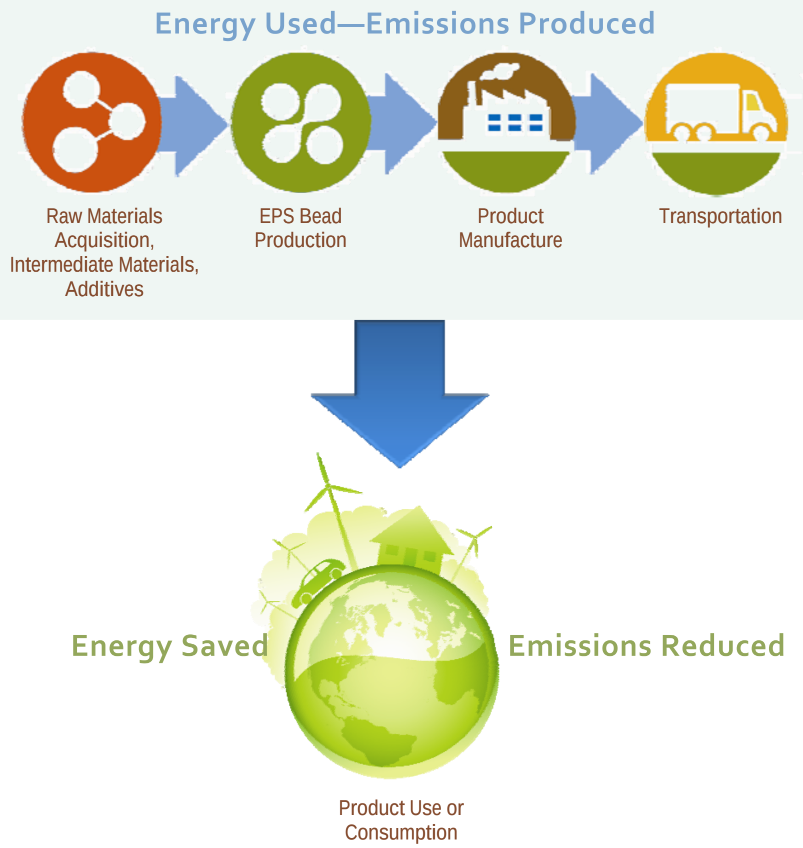
The energy invested in the production and delivery of Expanded Polystyrene (EPS) foam insulation yields an exponential benefit to the environment by providing substantial energy savings and critical reductions in greenhouse gas emissions, when EPS is used to insulate homes in North America. In fact, **EPS insulation can return up to 200 times the amount of energy required to produce it, and reduce emissions by up to 100 times the volume produced during the manufacturing process.** The exceptional performance of EPS as an insulator for the built environment offers the construction industry the tools and technology needed to achieve superior thermal performance while making a significant and restorative contribution to the reduction of global warming. Architects, designers and material specifiers can be more confident than ever that they are providing an environmentally responsible choice when selecting EPS to insulate their buildings.

This Environmental Profile summarizes a life cycle analysis – conducted by Franklin Associates for the EPS Molders Association – to quantify the energy savings and greenhouse gas reductions provided by the use of EPS foam insulation in single-family residential construction, compared to the energy used and emissions generated in the production, processing and transportation of this material. As this life cycle analysis concludes, the savings are not only substantial but also rapid, providing a 100% payback in as little as three months after occupancy. These results present a powerful case for the significant contributions of EPS insulation in making homes more efficient, comfortable and environmentally sustainable.

Performance Model

The base model used to illustrate the properties and performance of EPS insulation was a specific single-family home constructed with wood-framed walls, fiberglass insulation, ½" OSB clad with wood siding on the exterior and finished with ½" gypsum drywall on the interior. The total insulated wall area of the representative home modeled was 1,791 sq. ft.

The study evaluated the net energy and environmental effects of adding EPS insulation board to the exterior of the framed wall installed under the wood siding. The base wall in the U.S. was a 2x4 wood-framed wall with R-13 fiberglass insulation. The base wall in the Canadian house was a 2x6 wood-framed wall with R-19 fiberglass insulation. Accordingly, separate results were calculated for the home as it would be constructed in the U.S. and Canada and occupied for 50 years.



Energy & Emissions Equation

All manufactured products require the use of energy, most of which is currently derived from the combustion of fossil fuels. EPS insulation uses fossil fuels in the production of plastic resin and its blowing agent, as well as for processing, finishing and transportation to make and deliver the product. EPS also uses crude oil and natural gas as raw material inputs. The manufacturing and transportation processes also emit greenhouse gases related to the consumption of energy. We call this **the energy and emissions "investment**." The use of foam insulation on a building significantly increases the R-Value of walls and therefore saves energy, reducing greenhouse gas emissions over the useful life of the building. These savings and emissions reductions represent the "dividend" or **return on investment (ROI)** of the energy used and emissions produced in manufacturing and delivering the product.

The life cycle stages evaluated in assessing the energy and emissions related to the production and delivery of EPS insulation included all steps in the process, from raw material extraction, to insulation production, manufacturing and transportation to the jobsite. The energy and emissions reduction calculations included all electricity and natural gas consumption for heating and cooling over a 50-year period. The study did not include nominal energy used in the product installation, demolition of the building, or the disposal or recycling of construction waste.

Exceptional Return on Natural Capital

The results of this EPS Insulation Life Cycle Analysis demonstrate an average savings of over 36 times the amount of energy expended when adding EPS insulation to the exterior walls of a home in the U.S, and a reduction in global warming potential by nearly 60 times the CO_2 equivalent of the emissions produced. This represents an energy payback period of less than 17 months and a recapture of greenhouse gas emissions in less than 10 months for adding EPS insulation to America's homes. In Canada, the results were even more pronounced, returning the energy invested in less than 6 months, and the emissions in just less than 1 year. The lower relative global warming reduction in Canada is partially a function of the larger use of hydroelectric energy and lower use of coal, which reduces the base level of CO_2 emissions throughout the production and transportation processes.

It is worth noting that the payback period for energy in all of North America is no greater than 2 years (for R-6 insulation in U.S. Zone 5) and as little as 3 months (for R-4 insulation in the Northwest Territories of Canada). This is an excellent return on investment (ROI) by any measure.

In measuring the ROI on emissions, the payback return ranges from a low of 6 months (Zone 1 in the U.S.) to no greater than 18 months (B.C. Canada). Because the energy components included in the raw material evaluation of EPS are not burned, they do not produce greenhouse gases. This lowers the relative return on emissions compared to the return on energy savings alone.

EPS Insulation Pays Big Dividends

Energy invested in the final product has been calculated in Btu's based on the energy values in the raw material and the energy mix utilized in each country throughout the production and transportation process. Energy saved is also calculated in Btu's and weighted based on both the fuel mix utilized for home heating and cooling and the efficiency of the methods and appliances used. **The Global Warming Potential (GWP) is represented in terms of equivalent units of $C0_2$** and includes contributors from emissions of fossil fuel $C0_2$, methane and nitrous oxide, and is weighted for the relative potency of each contributor.

U.S. Model

Energy Savings Provided by Adding Exterior R-4 EPS Insulation Single Family Home - U.S.

Energy Investment	Millions Btu's
EPS Production	8.90
EPS Transportation	0.13
Total Energy Invested	9.03

Energy Savings (Millions Btu's)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S. Average
Annual Energy Savings	11.37	9.58	7.84	5.58	5.00	6.58
Payback Period In Years	**0.79**	**0.94**	**1.15**	**1.62**	**1.81**	**1.37**
Savings Over 50 Years	**568**	**479**	**392**	**279**	**250**	**329**

The use of foam insulation on a building significantly increases the R-Value of walls to save energy.

Global Warming Potential (GWP) Reductions Provided by Adding Exterior R-4 EPS Insulation Single Family Home - U.S.

GWP Invested	lbs. CO2 Equiv.
EPS Production	7.95
EPS Transportation	24
Total GWP Invested	819

GWP Reductions Compared to Base Wall	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S. Average
Annual Reductions	1,669	1,354	1,155	831	777	982
Payback Period in Years	**0.49**	**0.61**	**0.71**	**0.99**	**1.05**	**0.83**
Savings Over 50 Years	**83,473**	**67,682**	**57,739**	**41,257**	**38,867**	**49,095**

Canadian Model*

Lower residential energy use translates into fewer emissions and reduced Global Warming Potential.

Energy Savings Provided by Adding Exterior R-4 EPS Insulation Single Family Home - CANADA

Energy Investment	Millions Btu's
EPS Production	8.48
EPS Transportation	0.14
Total Energy Invested	8.62

Energy Savings (Millions Btu's)	B.C.	Alberta	Ontario	Quebec	NW Terr.	CDN Average
Annual Energy Savings	13.23	23.03	16.12	20.38	37.17	19.15
Payback Period in Years	**0.65**	**0.37**	**0.53**	**0.42**	**0.23**	**0.45**
Savings Over 50 Years	**661**	**1,152**	**806**	**1,019**	**1,859**	**958**

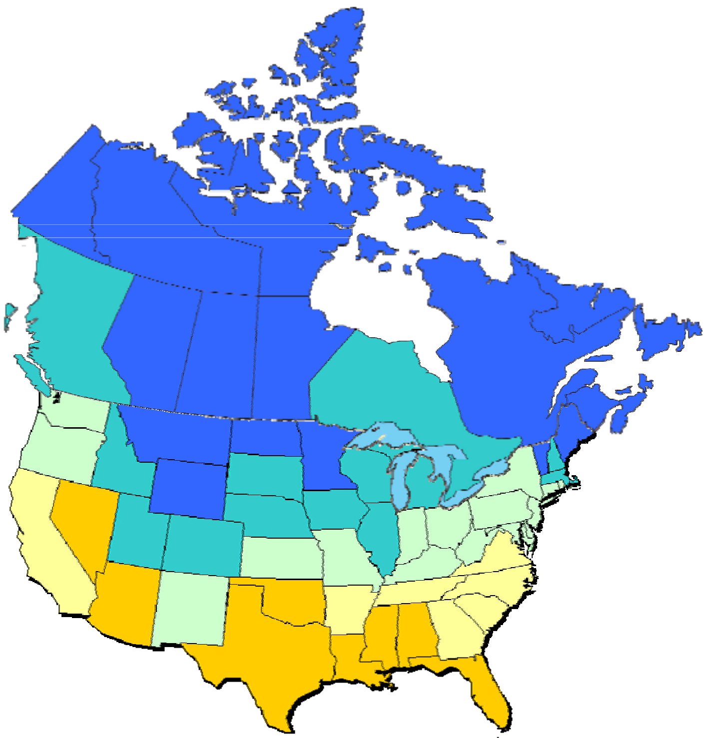
Global Warming Potential (GWP) Reductions Provided by Adding Exterior R-4 EPS Insulation Single Family Home - CANADA

GWP Invested	lbs. CO2 Equiv.
EPS Production	683
EPS Transportation	24
Total GWP Invested	707

GWP Reductions Compared to Base Wall	B.C.	Alberta	Ontario	Quebec	NW Terr.	CDN Average
Annual Reductions	513	893	625	790	1,441	742
Payback Period in Years	**1.38**	**0.79**	**1.13**	**0.89**	**0.49**	**0.95**
Savings Over 50 Years	**25,639**	**44,640**	**31,240**	**39,505**	**72,050**	**37,124**

* The Canadian (CDN) tables reflect a sample range of the Provinces and Territories evaluated. The CDN Average is the weighted average of all Provinces and Territories.

Climate Matters



Zone 1	Greater than 7,000 HDD
Zone 2	5,500—7,000 HDD—Less than 2,000 CDD
Zone 3	4,000—5,499 HDD—Less than 2,000 CDD
Zone 4	Less than 4,000 HDD—Less than 2,000 CDD
Zone 5	Less than 4,000 HDD—Greater than 2,000 CDD

The benefits of insulation vary with the climate and are generally more pronounced in colder regions where significant energy is used to heat a home. A common method used to distinguish climate zones in North America is by measuring a region's Heating Degree Days (HDD) and Cooling Degree Days (CDD) using a base temperature of 65°F. The annual HDD for a region is the sum of the daily differences between 65° and the average daily temperature (ADT) when it falls below that target.

For example, if the ADT on March 14 is 58° it would be assigned a value of 7 HDD. This calculation would be made for each day that falls below 65° and the sum would be the HDD for that region. The same calculation is made for CDD for those days when the ADT is over 65°. The average performance for a **U.S.** home was determined by weighting each climate zone by the number of building permits issued in 2006 for single-family homes in that region. This method provides an average weather condition based on where homes were actually constructed.

For the calculations in CANADA, each of the Provinces and Territories was identified as a separate region and no calculation was done for CDD as the energy used for cooling is less than 1% of total energy use to heat homes in Canada. The average performance for a Canadian home was weighted by building activity in the same manner and method used in the U.S.

Life cycle assumptions & methodology

Product. The EPS insulation modeled has a density of 1.0 lb/ft^3 and an R-Value of R-3.85 per inch. The study evaluated EPS board stock insulation with a value of R-4 and R-6. The results for R-6 provided a greater nominal return on investment than those for R-4 and a lesser percentage return.

Raw Material Production. The production of EPS resin is modeled using the U.S. Life Cycle Index (LCI) Database and from Franklin Associates private LCI database for blowing agent and resin production. The brominated fire retardant commonly used represents about 0.7% by weight. As life cycle data for the fire retardant was not available, the entire weight was modeled as EPS.

EPS Processing. Process data for block molding was collected from ten manufacturers in the U.S. and Canada. The data were compiled to produce a North American industry average data set.

Transportation. The fuel use and emissions calculated for transportation were based on a full truckload of insulation (3,072 cu. ft.) traveling an average of 300 miles to the jobsite at a fuel efficiency rating of 6.5 miles per gallon. A 10% scrap rate was factored in during installation.

Energy Savings for Heating & Cooling. The thermal performance of the base walls was modeled using Oak Ridge National Laboratory's Whole-Wall R-Value Calculator. It was assumed windows represented 15% of the total wall area. Only radiant heat was considered (heat flow) in calculating the R-Value of the wall with the addition of EPS insulation. The performance benefits EPS provides from reducing thermal bridging and air flow through the wall were not factored in. There was also no consideration for the savings that would be associated with the downsizing of HVAC equipment that would occur from the increased use of EPS insulation. Accordingly, the results of this analysis were considered conservative.

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