EPS Recycling Advancements & Technology Innovations

TECHNICAL BRIEFING

EPS Industry Alliance

Structual Insulated Panels Reduce Global Warming: Life Cycle Benefits of SIPs

SIPS Environmental Advantage

By providing substantial energy savings and critical reductions in greenhouse gas emissions, the energy invested in the production and delivery of SIPs yields an exponential benefit to the environment, when compared to traditional stick framing.

The exceptional performance of SIPs as an insulator coupled with low air leakage 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.

This Environmental Profile summarizes a life cycle analysis conducted by Franklin Associates for the EPS Industry Alliance SIPs Work Group. The study was to quantify the energy savings and greenhouse gas reductions provided by the use of SIPs walls as an alternative to traditional stick construction.

Study results present a powerful case for the significant contributions SIPs provide in making homes more efficient, comfortable and environmentally sustainable.

Performance Model

A representative single-family home was the model used to illustrate the properties and performance of SIPs with EPS insulation compared to stick-framed construction. The total insulated wall area of the home modeled was 1,791 sq. ft.

The stick-framed home was constructed with 2x6 dimensional lumber 24 in. on center, R-19 fiberglass insulation, vapor barrier, and 7/16" OSB sheathing. The SIP home was constructed with 6-1/2" SIPs with an EPS core and dimensional lumber plating.

Both homes were clad with wood siding on the exterior and finished with 1/2" gypsum drywall on the interior. The study evaluated the environmental effects of using SIPs as an alternative to the stick-framed wall.

Energy & Emissions Equation

All manufactured products require the use of energy, most of which is currently derived from the combustion of fossil fuels. SIPs are comprised of EPS insulation, oriented strand board wood facings and a small amount of structural adhesive. The manufacture of SIPs uses fossil fuels in the production of components as well as for processing, finishing and transportation. 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 SIPs on a building significantly increases the R-value of walls and reduces air leakage 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 SIPs included all steps in the process, from raw material extraction, to component production, wall production 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.

SIPS Innovation Delivers

The results of this SIP Life Cycle Analysis demonstrate the average The results of this SIP Life Cycle Analysis demonstrate the average energy savings over 50 years were 9.9 times the energy invested when using SIPs compared to traditional stick framing for a home in the U.S. and would provide a reduction in global warming potential 13.2 times the CO2 equivalent of the emissions produced. This represents an energy payback period of 5.1 years and a recapture of greenhouse gas emissions in 3.8 years for using SIPs for America's homes.

In Canada, the analysis demonstrates the average energy savings over 50 years were 18.6 times the energy invested when using SIPs compared to traditional stick framing for a home, and would provide a reduction in global warming potential 18.2 times the CO2 equivalent of the emissions produced. This represents a return on energy invested in 2.7 years and greenhouse gas emissions in 2.7 years.

It is worth noting that the payback period for energy is as low as 2.7 years for U.S. Zone 1 and 1.4 years for the Northwest Territories of Canada. This is an excellent return on investment (ROI) by any measure.

Energy Payback in Short Order

Energy invested 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 CO2 and includes contributors from emissions of fossil fuel CO2, methane and nitrous oxide, and is weighted for the relative potency of each contributor.

Life Cycle Assumptions & Methodology

Products. The 6-1/2" SIP was modeled as a combination of 5-5/8" EPS insulation, two layers of 7/16" oriented strand board and laminating adhesive. The SIP wall also included dimensional lumber plating. The stick framed wall was modeled as a combination of 2X6 dimensional lumber, R-19 fiberglass insulation, vapor barrier and one layer of 7/16" oriented strand board.

Raw Material Production. The EPS insulation production was based upon a Life Cycle Analysis conducted by Franklin Associates, Inc. for the EPS Industry Alliance. Other components for the SIP and stick walls were modeled using the U.S. Life Cycle Index (LCI) Database and the Franklin Associates private LCI database.

Transportation. The fuel use and emissions calculated for transportation were based upon a full truckload of SIPs traveling an average of 300 miles to the jobsite at a fuel efficiency rating of 6.5 miles per gallon.

Energy Savings for Heating and Cooling. The thermal performance of the walls were modeled using Oak Ridge National Laboratory's Whole Wall R-Value Calculator. Radiant heat was considered in calculating the heating and cooling loads for the walls. In addition, heating and cooling loads that result from air infiltration were calculated. The walls were modeled with air exchange rates from Manual J: Residential Load Calculation, Eighth Edition, from the Air Conditioning Contractors of America. The stick wall was modeled as "average" air tightness and the SIP wall was modeled as "tight".

Energy Savings Provided by using SIPS Single Family Homes - U.S.				Energy Investment		Millions Btu's
				SIP		177.1
				Stud Wall		110.4
				Add'l Energy Invested		66.7
Energy Savings (compared to Stud Walls)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S. Average
Conductive Energy Loss	4.2	3.6	3.0	2.3	2.4	2.7
Air Leakage Energy Loss	14.6	12.4	10.0	6.9	5.7	8.0
Total (including energy production & delivery)	24.8	20.7	16.8	11.2	8.6	13.2
Payback Period in Years	2.7	3.2	4.0	6.0	7.8	5.1
Savings Over 50 Years	1242	1037	839	562	431	660

Global Warming Potential (GWP) Reductions Provided by using SIPs Single Family Home - U.S.				GWP Investment		Tons CO^2 Eq.
				SIP		9.63
				Stud Wall		5.87
				Add'l Energy Invested		3.75
GWP Reductions (compared to Stud Walls)	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	U.S. Average
Total	1.83	1.49	1.25	0.84	0.67	0.99
Payback Period in Years	2.0	2.5	3.0	4.4	5.6	3.8
Savings Over 50 Years	91.4	74.4	62.3	42.1	33.6	49.6

Climate Matters

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.

Energy Savings Provided by using SIPS Single Family Homes - Canada				Energy Investment		Millions Btu's
				SIP		167.4
				Stud Wall		105.8
				Add'l Energy Invested		61.7
Energy Savings (compared to Stud Walls)	B.C	Alberta	Ontario	Quebec	N.W. Terr.	CAN Average
Conductive Energy Loss	2.8	4.8	3.4	4.3	7.8	4.0
Air Leakage Energy Loss	10.0	17.5	12.2	15.5	28.2	14.5
Total (including energy production & delivery)	15.8	27.5	19.3	24.4	44.4	22.9
Payback Period in Years	3.9	2.2	3.2	2.5	1.4	2.7
Savings Over 50 Years	791	1377	963	1218	2222	1145

Global Warming Potential (GWP) Reductions Provided by using SIPs Single Family Home - Canada				GWP Investment		Tons CO^2 Eq.
				SIP		8.05
				Stud Wall		4.50
				Add'l Energy Invested		3.55
GWP Reductions (compared to Stud Walls)	B.C.	Alberta	Ontario	Quebec	NW Terr.	CAN Average
Total	0.89	1.55	1.09	1.37	2.51	1.29
Payback Period in Years	4.0	2.3	3.3	2.6	1.4	2.7
Savings Over 50 Years	44.6	77.7	54.3	68.7	125	64.6

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

© 2016 EPS Industry Alliance
The EPS Industry Alliance publishes technical bulletins to help inform building professionals on the performance characteristics of expanded polystyrene (EPS) building products. The information contained herein is provided without any express or implied warranty as to its truthfulness or accuracy.

EPS Industry Alliance 1298 Cronson Blvd. Suite 201 Crofton, MD 21114 800-607-3772 **www.epsindustry.org**