

# STRUCTURAL INSULATED PANELS REDUCE GLOBAL WARMING

## LIFE CYCLE BENEFITS OF SIPs



*The basic design concept for SIPs is elegant in its simplicity, and offers several advantages for constructing walls and roofs. There is general agreement that SIPs provide better overall air tightness and practical thermal performance than conventionally framed walls.*

- NAHB Research Center

### 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 Molders Association 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.

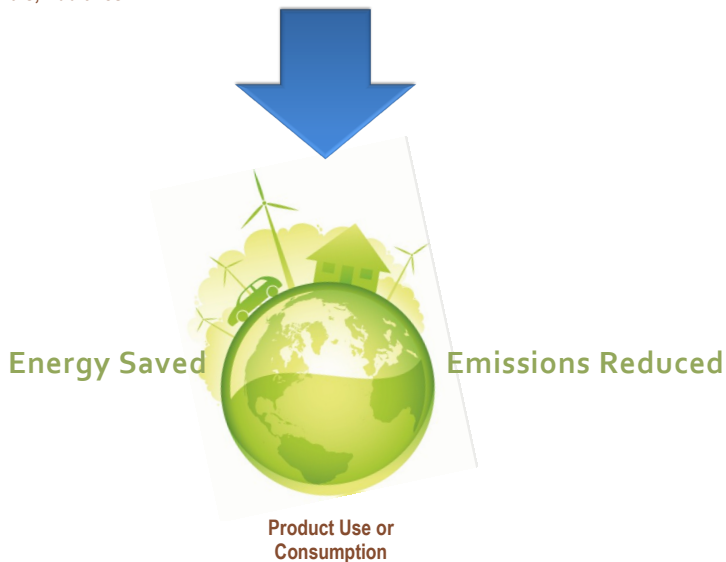
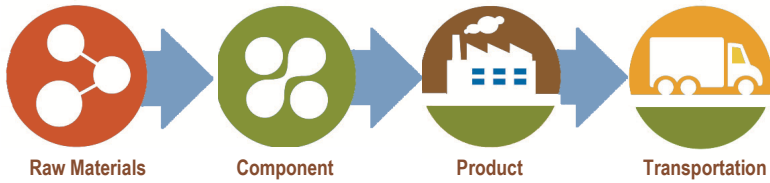
### PERFORMANCE MODEL

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 Used—Emissions Produced



## 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, 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.

## SIPs INNOVATION DELIVERS

The results of this SIP Life Cycle Analysis demonstrate an average savings of 9.9 times the amount of energy expended when using SIPs compared to traditional stick framing for a home in the U.S, and a reduction in global warming potential by 13.2 times the CO<sub>2</sub> 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 results were even more pronounced, returning the energy invested in 2.7 years, and the emissions in 2.7 years. 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<sub>2</sub> emissions throughout the production and transportation processes.

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 PAY BACK 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 CO<sub>2</sub> and includes contributors from emissions of fossil fuel CO<sub>2</sub>, methane and nitrous oxide, and is weighted for the relative potency of each contributor.

## U.S. Model

Energy Savings Provided by using SIPs Single Family Home - U.S			Energy Investment			Millions Btu's	
			SIP			177.1	
			Stud Wall			110.4	
Additional 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 and delivery)		24.8	20.7	16.8	11.2	8.6	13.2
<b>Payback Period in Years</b>		<b>2.7</b>	<b>3.2</b>	<b>4.0</b>	<b>6.0</b>	<b>7.8</b>	<b>5.1</b>
<b>Savings Over 50 Years</b>		<b>1242</b>	<b>1037</b>	<b>839</b>	<b>562</b>	<b>431</b>	<b>660</b>

*The use of SIPs increases the R-Value of walls and reduces air leakage to save energy.*



Global Warming Potential (GWP) Reductions Provided by using SIPs Single Family Home - U.S			GWP Investment			Tons CO <sub>2</sub> Eq.	
			SIP			9.63	
			Stud Wall			5.87	
Additional GWP 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
<b>Payback Period in Years</b>		<b>2.0</b>	<b>2.5</b>	<b>3.0</b>	<b>4.4</b>	<b>5.6</b>	<b>3.8</b>
<b>Savings Over 50 Years</b>		<b>91.4</b>	<b>74.4</b>	<b>62.3</b>	<b>42.1</b>	<b>33.6</b>	<b>49.6</b>

## Canadian Model\*

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

Energy Savings Provided by using SIPs Single Family Home - Canada			Energy Investment			Millions Btu's	
			SIP			167.4	
			Stud Wall			105.8	
Additional Energy Invested			61.7				
Energy Savings compared to Stud Walls		B.C.	Alberta	Ontario	Quebec	NWTerr.	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 and delivery)		15.8	27.5	19.3	24.4	44.4	22.9
<b>Payback Period in Years</b>		<b>3.9</b>	<b>2.2</b>	<b>3.2</b>	<b>2.5</b>	<b>1.4</b>	<b>2.7</b>
<b>Savings Over 50 Years</b>		<b>791</b>	<b>1377</b>	<b>963</b>	<b>1218</b>	<b>2222</b>	<b>1145</b>

Global Warming Potential (GWP) Reductions Provided by using SIPs Single Family Home - Canada			GWP Investment			Tons CO <sub>2</sub> Eq.	
			SIP			8.05	
			Stud Wall			4.50	
Additional GWP 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
<b>Payback Period in Years</b>		<b>4.0</b>	<b>2.3</b>	<b>3.3</b>	<b>2.6</b>	<b>1.4</b>	<b>2.7</b>
<b>Savings Over 50 Years</b>		<b>44.6</b>	<b>77.7</b>	<b>54.3</b>	<b>68.7</b>	<b>125</b>	<b>64.6</b>

\* 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.



# 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 Molders Association. 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".

## SIPs PATRON MEMBERS



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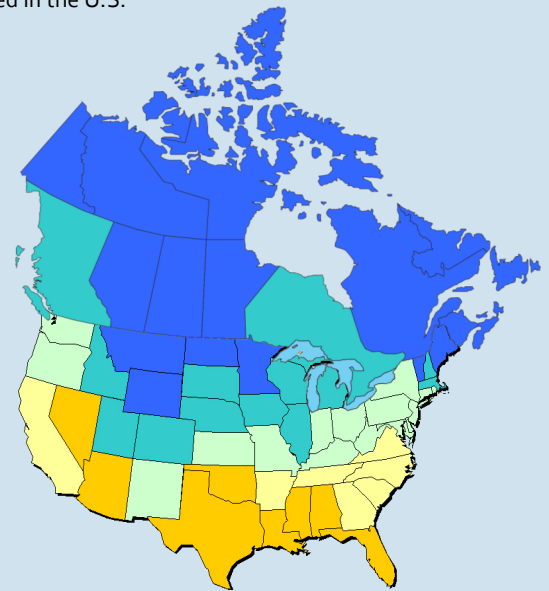
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# CLIMATE MATTERS

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.



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

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