ANIQ

LATIN AMERICA EPD®

SECTOR ENVIRONMENTAL PRODUCT DECLARATION

Expandable Polystyrene (EPS) insulation board

Prepared by (practitioner)
Center for Life Cycle Assessment and Sustainable Design (CADIS)
Bosques de Bohemia 2, No. 9, Col. Bosques del Lago, C.P. 54766,
Cuautitlán Izcalli, Edo. Mex.
Tel/Fax: +52 55 26 02 96 94
www.centroacv.mx

Authors:
Juan Pablo Chargoy Amador
Nydia Suppen Reynaga

Keywords:
Sector EPD, EPS board, thermal insulation, EPD, LCA

Requested by (commissioner):
Asociación Nacional de la Industria Química (ANIQ)
Insurgentes Sur No. 1070, Col. Insurgentes San Borja, C.P. 03100,
México D.F.
Tel: + 52 55 52 30 51 00
www.aniq.org.mx

Center for
Life Cycle Assessment
and Sustainable Design

Index

Index of Tables

Index of Figures

1 Product related information

1.1 National Association of Chemical Industry (ANIQ)

The National Association of Chemical Industry (ANIQ, acronym in Spanish) is a civil association, incorporated on November 11, 1959. Now accounts for over 95% of private production of chemicals through Mexico around 220 companies of different sizes and activities within the sector that are voluntarily affiliates (ANIQ, 2014).

1.2 ANIQ and the environment

The Responsible Care program, created in Canada, was adopted in Mexico in 1991 through ANIQ, making it the first country in Latin America to implement it. ANIQ has adapted Responsible Care principles to Mexican context and developed the Integral Responsibility Management System (SARI, acronym in Spanish). This is a chemical industry voluntary initiative. SARI intends to incorporate in business management of the ANIQ member companies a continuous improvement approach within environmental, health, and safety aspects (ANIQ b, 2014).

ANIQ encourages that Responsible Care philosophy be implemented in member companies, but also in other stakeholders in the chemistry sector value chain as suppliers, manufacturers, distribution, clients, among others. ANIQ members are committed permanently to develop actions that lead to a responsible management of energy, resources, wastes, as well as risk assessment in factories (ANIQ b, 2014).

Besides, ANIQ has coordinated different working groups, in order to companies in the sector are properly informed and updated on the issues of interest for the sector. One of those working groups is the Commission of the Plastics Industry, Responsibility and Sustainable Development (CIPRES, acronym in Spanish). This commission is focused on promoting the adoption of a comprehensive culture about plastic; generating elements for decision with a vision oriented to plastics sustainability (ANIQ b, 2014).

CIPRES defines and coordinate actions in three main areas: a) legislation, b) education and culture c) communication. CIPRES promotes actions which encourage changing the perception of plastics and emphasizing its contribution to the welfare of society in general (ANIQ b, 2014).

Another working group within ANIQ is Climate Change commission. This is integrated by several companies that asses and discuss issues related with this environmental impact considering economy and technology. The main objective of this commission is to define the posture of chemical sector about legislation, normative and other related programs (ANIQ b, 2014).

1.3 Intended use

To provide sectoral information regarding to environmental performance of EPS insulation boards to clients and relevant stakeholders within the building sector.

1.4 EPD program information

This Sector Environmental Product Declaration is registered in the International EPD System Latin America and has been performed in accordance the requirements of ISO 14025, EN 15804, Product Category Rules (PCR) Insulation Materials 2014:13 version 1.0 (2014/04/16). EPD of construction products may not be comparable if they do not comply with EN 15804. This EPD will be valid for three years from verification date. This Sector EPD covers average values for two EPS insulation board companies (NOVIDESA and FRIGOCEL) and two producers of EPS beads (Polioles and IDESA) which are ANIQ members. Hence, the declared unit is not available for purchase on the market.

1.5 Product specifications

The insulation board is a rectangular prism-shaped piece made of rigid expanded polystyrene foam (EPS) (FRIGOCEL, 2014). EPS has a flame retardant that does not propagate flame. There are panel presentations which incorporate two galvanized steel poles (NOVIDESA, 2014).

The manufacturing process starts with raw materials reception (mainly EPS beads). The beads are subjected to an expansion process, subsequently a molding process is carried out and finally boards are cut into different thickness. It is possible to incorporate a metal frame to give extra support plate, in this case it is called insulating panel.

The plate is placed on walls and ceilings in order to isolate thermal and acoustically buildings.
EPS boards are installed as insulation in walls, and ceilings (NOVIDESA, 2014). It supports drywall systems, paints and finishes like pastes without solvents. For the presentation without steel is recommended a metal deployed in surface for better anchorage (FRIGOCEL, 2014). Table 1 shows the main technical specifications of EPS insulation boards.
EPS beads are produced by two companies in Mexico, also ANIQ members: Polioles and IDESA.

Figure 1. Expandable Polystyrene (EPS) insulation board.

Specification		Range
Thermal conductivity	(W/m • K)	0.034 – 0.037
Density	(kg/m^3)	10 – 24
Thickness	(cm)	2.5 - 20

Table 1. EPS board specifications.

1.6 Product certifications

Companies affiliated to ANIQ have achieved the following certifications and recognitions for EPS insulation board (NOVIDESA, 2014):

• Fideicomiso Para el Ahorro de la Energía Eléctrica (Trust Saving Electricity), label for products with savings and energy efficiency.

• Credits to obtain Leadership in Energy & Environmental Design (LEED) certification from the US Green Building Council.

• Compliance with Mexican standard NOM-018-ENER-2011 Building Thermal insulation –Characteristics, limits and test methods. Concerning the rational use of energy resources throughout thermal insulating.

• Compliance with ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

EPS beads suppliers affiliated to ANIQ also have achieved certifications as: UL94 Plastic components, Expandable Polystyrene. Concerning to flame retardant properties of the pearl.

1.7 Functional unit

The functional unit (FU) is 1m^2 of insulation material with thickness that provides an average thermal resistance (RSI) of 1 m2 K/W in a building with a service life of 60 years.
The average parameters considered were:

• Thermal conductivity (λ) = 0.0363 W/mK
• Density = 15.90 kg/m3
• Weight = 0.5773 kg

2 Content declaration

This section presents the relevant materials and chemical substances of EPS insulation board. Table 2 presents the formula, function, description, relative weight, CAS number of the product´s content and also shows these substances are not listed in the "Candidate List of Substances of Very High Concern" (SVHC), this list includes 144 substances.

Some substances from the candidate list will be prioritized for authorization and be included in "SVHC authorization list" those substances will not be allowed to be used, placed on the market or imported into the EU after a date to be set unless the company is granted an authorization. The updated list at April 2013 contains 22 substances on SVHC authorization (CIRS, 2012).

Substances of very high concern (SVHC) under the European Union regulation for the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) are identified as substances that may have serious and often irreversible effects on human health and the environment (CIRS, 2012)..

CIRS (2012) considers SVHC as those substances which are: carcinogenic, mutagenic or toxic to reproduction (CMRs); persistent, bio-accumulative and toxic (PBTs); very persistent and bio-accumulative (vPvBs); seriously and / or irreversibly damaging the environment or human health, as substances damaging the hormone system.

Substances	Formula	Function	Description	Relative Weight %	CAS No.	SVHC
EPS beads **Poly (1-phenylethylene)**	$(C_8H_8)_n$	Main component. Used in molding processes with steam.	Plastic Material self-extinguishing shaped pearl impregnated with pentane as a blowing agent.	70.5	9003-53-6	Not listed
Pigment **Carbon black**	C	It is used to color the finished product.	It is used to color the finished product.	0.002	1333-86-4	Not listed
Galvanized steel	----	Gives support to panel.	Steel with a protective zinc coating in order to prevent rusting.	29.5	----	Not listed

Table 2. Product content declaration.

3 Environmental performance related information

This declaration is an environmental product declaration in accordance with International EPD® System. It presents the environmental performance of the EPS insulation board in an objective and standardized way.

The results of the Life Cycle Assessment (LCA) study of EPS insulation board are presented for each life cycle stage. LCA was performed with average data from companies affiliated to ANIQ.

3.1 Evaluation method

The factors employed to calculate the selected environmental impacts, except for Global Warming Potential, was taken from CML 2 baseline 2000 EPD V2.05 method (developed by Center of Environmental Science of Leiden University) as it is also described in the cited PCR. For Global Warming Potential were used the factors from Intergovernmental Panel on Climate Change (IPCC) for a range time of 100 years.

The LCA was carried out according to the Product Category Rules (PCR) 2012.01 version 1.2 for Construction Products and CPC (Central Product Classification) 54 Construction Services.

According to the UN CPC classifications system, EPS insulation board has the CPC code 54650, which categorize the product in section 5, as a construction product, within the subclass 650 for insulation services.

3.2 Functional and declared unit

The functional unit is 1 m^2 of insulation material with a thickness that provides a design thermal resistance R = 1 and with an expected average service life of 60 years. The unit for the functional unit is kg.

3.3 System boundaries

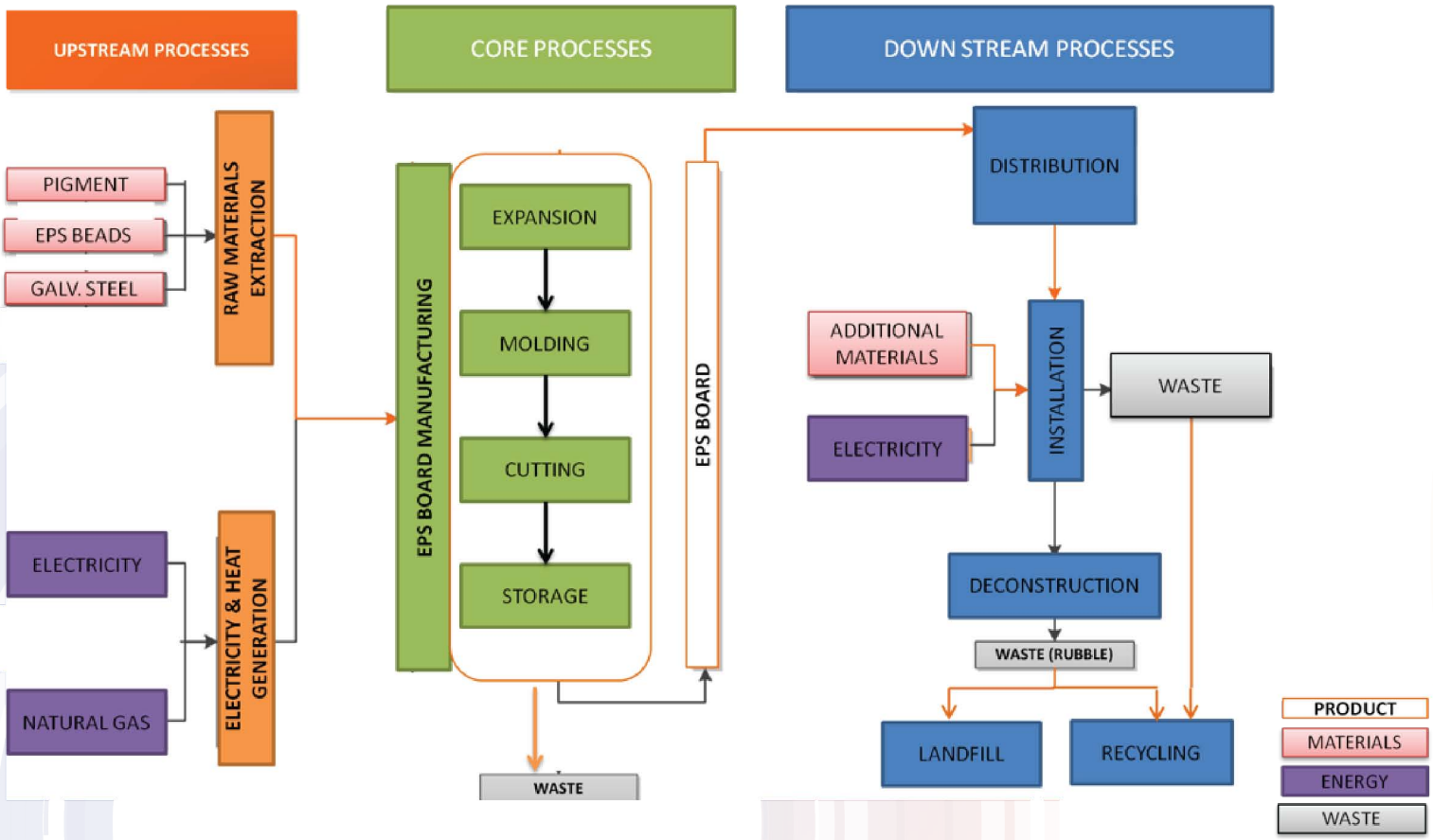
The system boundary defined for this EPD was a cradle to gate with options. During the life cycle of EPS insulation board the Upstream, Core and Downstream modules were considered agreeing with General Program Instructions (GPI) as described in Table 3 and Figure 1.

Table 3. The life cycle of EPS insulation board divided into three process modules according to GPI.

GPI Modules		Life cycle stages	Module Information
UPSTREAM	PRODUCT STAGE	A1. Raw Material Supply	• Extraction and processing of raw materials. • Electricity, steam and heat generation from primary energy resources, including their extraction, refining and transport.
		A2. Transport	• Average transport of raw materials for building product from supplier's plant to production site gate.
CORE		A3 Manufacturing	• Manufacturing of building product. • Treatment of waste generated from the manufacturing processes.
DOWNSTREAM	CONSTRUCCION PROCESS	A4. Transport	• Transport of building product from manufacturer to storage. • Transport of building product from storage to building site.
		A5. Installation process	• Installation of the product at the building site. • Production and transportation of ancillary materials. • Energy required for the installation. • Disposal of the waste from installation process.
		B1. Material emission from usage*	• EPS insulation board does not generate emissions during this stage.
		B2. Usage stage *	• The usage stage does not require consumption of materials and energy.
		B3. Maintenance*	• EPS insulation board does not require maintenance throughout its service life.
		B5. Repair*	• It was assumed that there was no damage to the walls during the product service life, thus no repairs were considered.
		B4. Replacement*	• EPS insulation board does not require replacement during the services life of the building.
		B5. Refurbishment*	• It was not considered any remodeling to the building.
	END OF LIFE	C1.Deconstruction	• Dismantling or demolition of the product from the construction, including initial on-site sorting of the materials.
		C2. Transport	• Transportation of the discarded product accounts for part of the waste processing, e.g. to a recycling site and transportation of waste e.g. to final sorting yard or disposal.
		C3. Waste processing	• Collection of waste fractions from the deconstruction and waste processing of material flows intended for reuse, recycling and energy recovery. • Materials for recycling or energy recovery processing.
		C4. Disposal	• Transport from construction site to landfill or recycling. • Waste treatment or disposal.

**According to manufacturer, EPS insulation board does not require maintenance or replacements during the reference service life in the building (60 years). Thus stages from B1 to B5 were not considered.*

Figure 2. Processes included in modules.



Module	Assesed (MA) Not asseded (MNA)
A1. Raw material supply	MA
A2. Transport to manufacturer	MA
A3. Manufacturing	MA
A4. Transport (distribution)	MA
A5. Installation process	MA
B1. Material emission from usage*	MNA
B2. Usage stage *	MNA
B3. Maintenance*	MNA
B5. Repair*	MNA
B4. Replacement*	MNA
B5. Refurbishment*	MNA
B6. Operational energy use	MNA
B7. Operational water use	MNA
C1. Deconstruction	MNA
C2. Transport	MA
C3. Waste processing	MNA
C4. Disposal	MA
D. Benefits/loads beyond system boundary	MNA

Table 4. Descripciton of modules assessed and not assessed in the EPD.

**According to manufacturer, EPS insulation board does not require maintenance or replacements during the reference service life in the building (60 years). Thus stages from B1 to B5 were not considered.*

3.4 Cut-off and allocation principles

Air emissions, water discharges and solid waste were allocated considering the production rates, all unit processes were considered, thus no cut off principles were applied.

3.5 Data quality

Table 5. Data quality aspects.

Time-related coverage	Direct data collected are representative of 2012. Background data for electricity correspond to 2012; background data for oil and transport was obtained from international data bases which were updated in 2010.
Geographical coverage	Most data was collected from sources in Mexico. Some data unit processes from international producers was collected or adapted.
Technology coverage	An average technology mix was considered.
Precision	For most unit processes a weighted average was calculated.
Completeness	All the relevant information and data needed for interpretation was available and complete.
Representativeness	Data reflects the overall situation of EPS insulation boards in Mexico. Data collection considers geographic situation and Mexican context along life cycle stages.
Consistency	The LCA methodology was applied consistently in all phases of the study, also assumptions and calculations were consistent.
Sources of the data	Different data sources were used: for specific data the company provides information of the process, average from a specific process and also averages from main suppliers. Regarding to generic data previous LCA information and Ecoinvent 2.0 data base were used.

3.6 Environmental profile of the product

3.6.1 Use of resources

Table 6 shows total consumption of resources, the data describes the consumption under four categories: renewable primary energy resources, non-renewable primary energy resources, and net fresh water. The results are reported for each life stage process modules, as required for the EPD system according to the General Program Instructions (GPI): core, upstream and downstream modules.

Table 6. Total consumption of resources associated to the production of EPS insulation board.

Parameter	Unit	Upstream Processes	Core Processes	Downstream Processes	Total
Total use of renewable primary energy resources					
Fossil	MJ	44.24	0.2635	45.87	**90.37**
Nuclear		2.101	0.0167	5.574	**7.691**
Biomass		0.0019	8.05E-07	0.0139	**0.0158**
Total use of non- renewable primary energy resources					
Biomass	MJ	0.2171	0.0005	0.4898	**0.7074**
Wind, solar, geothermal		0.0153	0.0001	0.0910	**0.1064**
Water		0.0109	6.44E-05	0.0335	**0.0445**

Table 7. Parameters describing resource use in the life cycle of board.

Use of renewable primary energy excluding renewable primary energy resources used as raw materials	0.8582	MJ
Use of renewable primary energy resources used as raw materials	0	MJ
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	0.8582	MJ
Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	98.0752	MJ
Use of non renewable primary energy resources used as raw materials	0	MJ
Total use of non renewable primary energy resources (primary energy and primary energy resources used as raw materials)	98.0752	MJ
Use of secondary material	0	kg
Use of renewable secondary fuels	0	kg
Use of non renewable secondary fuels	0	kg
Net use of fresh water	0.0445	m^3

Table 8. Other environmental information describing waste categories.

Hazardous waste disposed	0.2177	kg
Non hazardous waste disposed	2.7260	kg
Radioactive waste disposed	0.0001	kg

Table 9. Other environmental information describing output flows.

Components for re-use	0	kg
Materials for recycling	1.2402	kg
Materials or energy recovery	0	kg
Exported energy	0	MJ

3.6.2 Potential environmental impact

Figure 2 shows the potential environmental impacts of EPS insulation board according to the requirements of the selected PCR.

Figure 3. Contribution of each process module to the potential environmental impact.

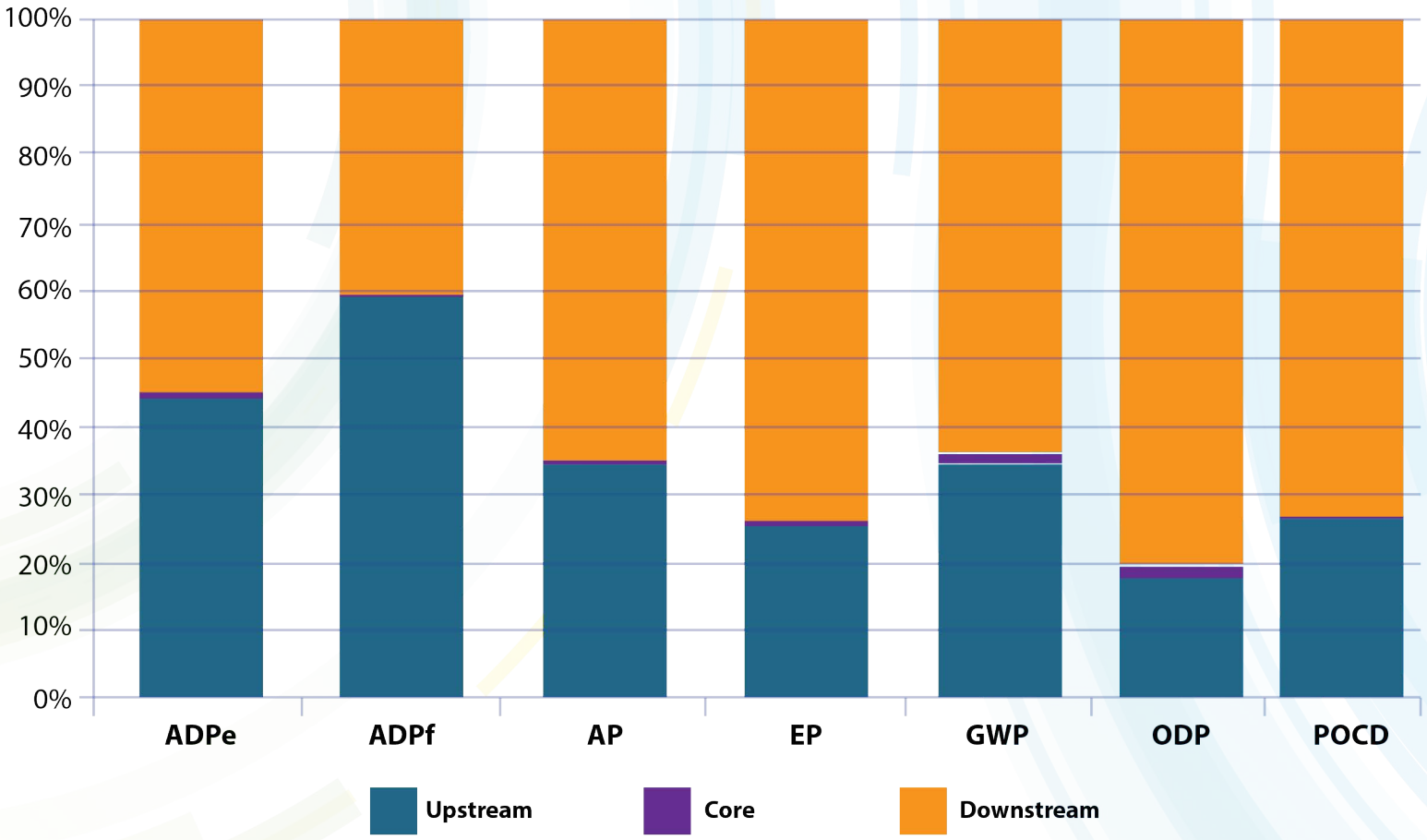


Table 10. Potential environmental impact of the production of Rolan rockwool insulation board by process module.

Impact category	Unit	Upstream Processes	Core Processes	Downstream Processes	Total
Abiotic depletion elements potential (ADPe)	kg Sb eq	0.0216	0.0001	0.0271	0.0489
Abiotic depletion fossil potential (ADPf)	MJ	44.2382	0.2635	45.8662	90.3679
Acidification potential (AP)	kg SO_2 eq	0.0101	0.0001	0.0191	0.0292
Eutrophication potential (EP)	kg PO_4 eq	0.0011	2.76E-05	0.0033	0.0044
Global warming (GWP)	kg CO_2 eq	1.871	0.0577	3.424	5.353
Ozone layer depletion (ODP)	kg CFC-11 eq	5.73E-08	2.67E-09	2.46E-07	3.06E-07
Photochemical oxidation (POCP)	kg C_2H_4	0.0005	3.72E-06	0.0015	0.0020

Table 11. Description of the range/variability of LCIA results.

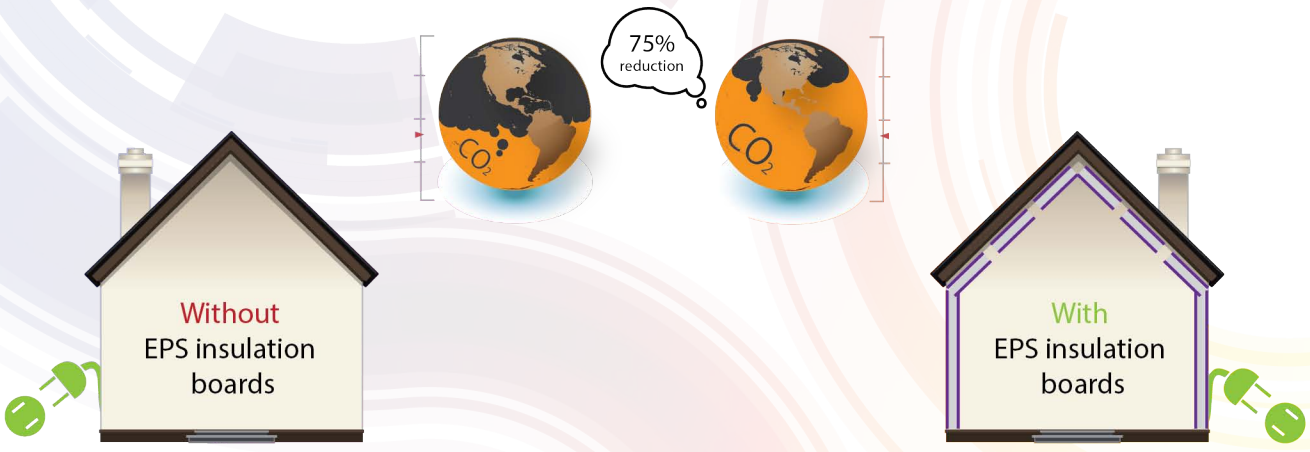
Impact category	Unit	Average fluctiation +/-	%
ADPe	kg Sb eq	0.0196	34%
ADPf	MJ	36.3913	40%
AP	kg SO_2 eq	0.0049	15%
EP	kg PO_4 eq	0.0006	12%
GWP	kg CO_2 eq	2.2091	35%
ODP	kg CFC-11 eq	1.13E-07	32%
POCP	kg C_2H_4	0.0008	34%

4 Additional information

4.1Carbon footprint reduction

During 2011 ANIQ requested to CADIS a study that calculates the carbon footprint of electric consumption in social interest housing due to air conditioning and heating in Mexico. The main conclusion of the study was:

EPS insulation boards installed in social interest houses located in different regions in Mexico reduce by 75 % carbon footprint associated to air conditioning and heating (Chargoy, Sojo, & Suppen, 2012).



5 Information about the organization and the verifier

EPD Programe:	International EPD System Latin America. Additional information about the International EPD system and PCR for the assessment of the environmental performance of products is available on www.environdec.com www.epd-latinamerica.com
PCR base document:	EN 15804:2013 / Product Group: Multiple UN CPC Codes PCR Insulation Materials 2014:13 / version 1.0 Date: 2014/04/16 Valid until:2017/07/02
Registration no:	S-P-00695
EPD validity:	3 years (August 5, 2018)
EPD valid within the following geographical area:	Worldwide
PCR review conducted by:	The Technical Committee of the International EPD® System. Full list of TC members available on www.environdec.com/TC
Independent verification of the declaration and data, according to ISO 14025:	☐ Internal / ☒ External / EPD process certification Marcus Wendin Miljögiraff E-mail: Marcus@miljogiraff.se Web page:www.miljogiraff.se Mobile: +46-733-248185 c/o Lusthuset, Södra Larmgatan 6, 411 16 Göteborg, Sweden.

For further information about the product and the company please contact to:
Rubén Muñoz García
Asociación Nacional de la Industria Química (ANIQ)
Tel: + 52 55 52 30 51 00

The LCA study and the present EPD have been developed by the Center for Life Cycle Assessment and Sustainable Design (CADIS), www.centroacv.mx

6 References

ANIQ. (2014). Asociación Nacional de la Indusria Química. Retrieved junio 2014, from Nosotros.

ANIQ b. (2014). Asociación Nacional de la Industria Química. Retrieved from Comisiones: http://webpublico.aniq.org.mx/Comisiones/Paginas/Home.aspx

Chargoy, J. P., Sojo, A., & Suppen, N. (2012). Huella de carbono de placas aislantes de EPS. México, DF: Centro de Análisis de Ciclo de Vida y Diseño Sustentable.

CIRS. (2012). REACH Authorization 2013..Updated in April 2013. REACH Authorization 2013. Retrieved from http://www.cirs-reach.com/Testing/REACH_SVHC_Authorization_Process.html

FRIGOCEL. (2014). Placa de poliestireno. Retrieved from http://www.frigocel.com.mx/frigocel.htm

International EPD System. (2013a). General programme instructions for the international EPD system 2.0 (p. 69).

International EPD System. (2013b). Product Category Rules Construction products and CPC 54 construction services (pp. 1–31). Sweden.

NOVIDESA. (2014). IKOS panel aislante. Retrieved from http://www.novidesa.com.mx/es/content/ikos

7 Glossary

European Commission number
Is a unique seven-digit identifier that is assigned to chemical substances for regulatory purposes within the European Union.

CAS number
The most authoritative collection of disclosed chemical substance information, containing more than 74 million organic and inorganic substances and 64 million sequences. CAS Number is a numeric identifier that can contain up to 10 digits, divided by hyphens into three parts.

Abiotic resources
Natural resources (including energy resources) such as iron ore, crude oil and wind energy, which are regarded as non-living.

Abiotic depletion potential
The decrease of availability of the total reserve of abiotic resources (minerals), due to the use beyond their rate of replacement. ADPe is the depletion of minerals within the category non-renewable resources, expressed in kilograms of antimony equivalents (kg Sb eq).

$$Abiotic\ depletion = \sum_i \frac{m_i}{Mi}$$

Abiotic depletion potential fossil (ADPf)

The decrease of availability of the total reserve of abiotic resources (fossil fuels), due to the use beyond their rate of replacement. ADPf is the depletion of fossil fuels within the category non-renewable resources, expressed in Mega Joules (MJ).

Acidification potential
This impact category addresses the impacts from acidification generated by the emission of airborne acidifying chemicals. Acidification refers literally to processes that increase the acidity of water and soil systems by hydrogen ion concentration. It is caused by atmospheric deposition of acidifying substances generated largely from emissions of nitrogen oxides (NOx), sulphur dioxide (SO2) and ammonia (NH3), the latter contributing to acidification after it is nitrified (in the soil).
Unit of indicator result is kilograms of sulfur dioxide equivalents (kg SO_2 eq).

Eutrophication
For Guinee et al. (2002) eutrophication covers all potential impacts of excessively high environmental levels of macronutrients, the most important of which are nitrogen (N) and phosphorus (P). Nutrient enrichment may cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems.

In addition, high nutrient concentrations may also render surface waters unacceptable as a source of drinking water. In aquatic ecosystems increased biomass production may lead to depressed oxygen levels, because of the additional consumption of oxygen in biomass decomposition (measured as BOD, biological oxygen demand). As emissions of degradable organic matter have a similar impact, such emissions are also treated under the impact category "eutrophication" which is expressed in kilograms of phosphates equivalents

of PO_4^{3-} equivalents.

Climate change
Is defined as the impact of human emissions on the radiative forcing (i.e. heat radiation absorption) of the atmosphere. This may in turn have adverse impacts on ecosystem health, human health and material welfare. Most of these emissions enhance radiative forcing, causing the temperature at the earth's surface to rise. This is popularly referred to as the 'greenhouse effect' (Guinee et al. 2002).

Global warming Potential
Is an index that attempts to integrate the overall climate impacts of a specific action (e.g., emissions of CH4, NOx or aerosols). It relates the impact of emissions of a gas to that of emission of an equivalent mass of CO2. The duration of the perturbation is included by integrating radiative forcing over a time horizon (e.g., standard horizons for IPCC have been 20, 100, and 500 years). The time horizon thus includes the cumulative climate change and the decay of the perturbation.

To compare the impacts of emissions of different greenhouse gases, each has been assigned a so- called Global Warming Potential (GWP) index, expressing the ratio between the increased infrared absorption due to the instantaneous emission of 1 kg of the substance and that due to an equal emission of carbon dioxide both integrated over time (Guinee et al. 2002). Unit of indicator result is kilograms of carbon dioxide equivalents (kg CO_2 eq).

Ozone layer depletion
Stratospheric ozone depletion refers to the thinning of the stratospheric ozone layer as a result of anthropogenic emissions. This causes a greater fraction of solar UV-B radiation to reach the earth's surface, with potentially harmful impacts on human health, animal health, terrestrial and aquatic ecosystems, biochemical cycles and materials. This impact category is expressed as kilograms of chlorofluorocarbon 11 equivalents (kg CFC-11 eq).

Photochemical oxidation
Photo-oxidant formation is the formation of reactive chemical compounds such as ozone by the action of sunlight on certain primary air pollutants. These reactive compounds may be injurious to human health and ecosystems and may also damage crops. Photo-oxidants may be formed in the troposphere under the influence of ultraviolet light, through photochemical oxidation of Volatile Organic Compounds (VOCs) and carbon monoxide (CO) in the presence of nitrogen oxides (NOx). Ozone is considered the most important of these oxidizing compounds, along with peroxyacetylnitrate (PAN). The units in which is expressed this impact category is in kg of ethylene equivalents (kg C2H4 eq) (Guinee et al. 2002).

LATIN AMERICA EPD®

EPS insulation board has a Certified Sector Environmental Product Declaration giving information about the environmental performance, contents and recycling which has been controlled and verified according to the requirements of the International EPD® System.

Registration number: S-P-00695

PCR Insulation Materials 2014:13
version 1.0
Date: 2014/04/16
EN 15804:2013
More information is available on:

www.environdec.com
www.epd-latinamerica.com