Generic Gypsum

Product Selection and Description

Gypsum board, also known as “drywall” or “plaster board,” consists of a core of gypsum surrounded with a paper covering. Several varieties of gypsum board products are available; each is comprised of a specially formulated gypsum plaster mix and facing paper specifically developed for the intended application. These gypsum board products include regular gypsum wallboard, moisture-resistant gypsum board, and type-X fire-resistant gypsum board.

For the BEES system, 0.9 m^2 (1 ft^2) of 13 mm (½ in) gypsum wallboard, joint tape, joint treatment compound, and wallboard nails are studied. The bulk density of wallboard is assumed to be 769 kg/m^3 (48 lb/ft^3). Gypsum wallboard is assumed to be nailed to wood studs, 41 cm (16 in) on center.

Flow Diagram

The flow diagram below shows the major elements of the production of this product, as it is currently modeled for BEES.

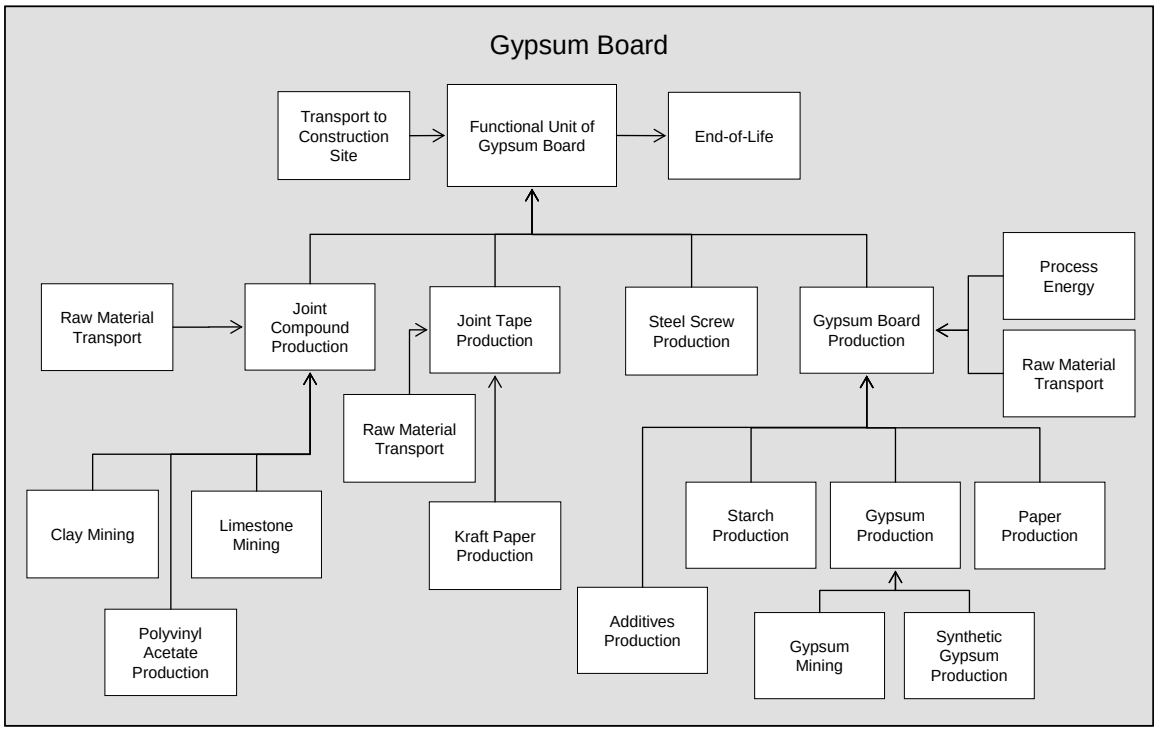

Figure 1: Gypsum Board System Boundaries

Raw Materials

Drywall primarily consists of gypsum that is mixed with additives and backed on both sides with kraft paper. The following Table shows the proportions of materials used in producing drywall.

Table 1: Gypsum Board Constituents

Constituent	*Kg/m^2 (lb/ft^2)*	*Mass Fraction*
Gypsum	8.326 (1.705)	85 %
Paper	0.981 (0.201)	10 %
Additives	0.294 (0.060)	3 %
Starch	0.196 (0.040)	2 %
Total	9.796 (2.006)	100 %

Data for the production of each of these raw materials comes from both the U.S. LCI Database and SimaPro.

Manufacturing

Energy Requirements and Emissions. Gypsum board is produced using partially dehydrated or calcinated gypsum. The gypsum is fed into a mixer where it is combined with water and other ingredients to form a slurry or paste. The slurry is spread onto a moving belt of face paper and then covered with a backing paper. As the materials move down the production line, the edges of the face paper are folded over the backing paper to create one of several edge types. The board then progresses down the production line where it is cut into specific lengths. The individual boards are subsequently run through dryers. Once dry, the wallboard moves further down the line where it is trimmed to an exact length, paired with another board, bound on both ends with a labeling tape, and stacked in a bundle. The bundles are taken into the warehouse, where they are selected for shipment to either distributors or building sites.

The energy requirement for manufacturing is essentially natural gas used for the drying process - the specific amount of natural gas consumed is provided in the following Table.

Table 2: Energy Requirements for Gypsum Board

Energy Carrier	*MJ/kg (Btu/lb)*
Natural Gas	19.02 (8 196)

Emissions from the production of gypsum are included in the product data for the raw materials acquisition life-cycle stage. Emissions from manufacturing are based on U.S. EPA AP-42 emissions factors for gypsum processing. These emissions consist primarily of particulate emissions (known as PM-10) during the cutting and sawing stage in the plant. Only the PM-10 emissions are included in the manufacturing life-cycle stage data.

Table 3: Emissions from Gypsum Board Manufacturing

Emissions	*kg/m^2 (g/ft^2)*
PM-10	0.000027 (0.00251)
Filterable Particulates	0.000036 (0.00334)

Transportation. The transportation of the gypsum, starch, and additives to the gypsum board facility is taken into account, and assumed to require 80 km (50 mi) by truck. The paper used to back the gypsum board is assumed to be shipped in rolls 402 km (250 mi) by truck to the plant.

Waste. Approximately 2.25 % of the gypsum board produced is lost as waste during the manufacturing process.

Transportation
Transportation of gypsum board by heavy-duty truck to the building site is modeled as a variable of the BEES system.

Installation
Gypsum board may be attached to wood framing, cold-formed steel framing, or existing surfaces using nails, staples, screws, and adhesives appropriate for the application. Joints between gypsum boards may be sealed or finished using paper or glass fiber mesh and one or more layers of joint treatment compound. Joint treatment compound is available in ready-mixed or dry powder form. The ready mixed variety is usually a vinyl-based, ready-to-use product that contains limestone to provide body. Clay, mica, talc, or perlite are often used as fillers. Ethylene glycol is used as an extender, and antibacterial and anti-fungal agents are also included. The dry powder form of joint treatment compound is available in normal drying (dries primarily by evaporation) and accelerated setting (chemically setting) formulations.

Approximately 2.04 kg (4.5 lb) of wallboard nails are used for each 92.90 m^2 (1 000 ft^2) of wallboard.[1] Joints are assumed to be treated with 52 mm-wide (2-1/16 in-wide) paper joint tape and ready-mixed, all-purpose joint treatment compound. Approximately 62.6 kg (138 lb) of joint compound are assumed to be used for every 92.90 m^2 (1 000 ft^2) of wallboard.[2] About 12 % of the installation materials are assumed to go to waste, all of which is disposed of in a landfill.

Use
Gypsum board is assumed to have a useful life of 75 years, provided it is well maintained and protected. There are no emissions from the use of gypsum board and repairs required to patch holes or tears are not included in the product system boundaries.

End of Life
While there is some recovery of gypsum board at end of life, most of the material is disposed of in a landfill. No recycling is included in the system boundaries.

References
Life Cycle Data
National Renewable Energy Laboratory (NREL): *U.S. Life-Cycle Inventory Database*. 2005. Golden, CO. Found at: http://www.nrel.gov/lci/database.
PRé Consultants: *SimaPro 6.0 LCA Software*. 2005. The Netherlands.
USG Corporation, *The Gypsum Construction Handbook.* (Chicago, IL: USG Corporation, 2000). Found at http://www.usg.com/resources/handbooks/ViewGCH.do.

Industry Contacts
Michael Gardiner, Gypsum Association (Nov 2005 – Jan 2006)

[1] USG Corporation, *The Gypsum Construction Handbook.* (Chicago, IL: USG Corporation, 2000).
[2] *Ibid.*