Sector Building materials comprise a tremendously broad product sector, potentially encompassing almost all materials and chemicals imaginable. In order to efficiently accomplish the desired scope of work in a relatively brief time frame, we sought to clearly articulate what to include in the product sector definition. Our definition statement is as follows:
A broad definition of building material includes any material from which a structure or building is made and encompasses any number of materials both building specific and improvised. This definition includes any number of materials ranging from industrial products such as glass and steel to natural materials as simple as straw to salvaged items such as cardboard and tin cans. The type of materials used in buildings varies widely based on regional and economic considerations.
For the purpose of this study, building materials are considered as existing within the realm of consumer products, including but not limited to products manufactured or processed with the intended or common end use as a component of a building or structure. This study limits consideration to building components which can be reasonably considered as permanent components of buildings including fixed elements such as framing, sheathing, and decking and excluding non-fixed elements such as drapery and furnishings.

Life cycle of products in the sector

The building materials industry is incredibly large and varied with a wide range of materials serving myriad functions. The global building materials market was projected to exceed
US$391 billion by the close of 2010; Asia-Pacific is the largest market for building materials, accounting for approximately 35% of the global market in 2007.4 The sector overview below describes key chemical and material flows for major material classes within the building industry. Existing data is not sufficient to address the extent to which chemicals used during production of material feedstocks and throughout the production process remain present in final products. For this reason, a precautionary approach is taken for the material classes detailed below; all chemicals involved in or produced throughout the lifecycle of material production are included.

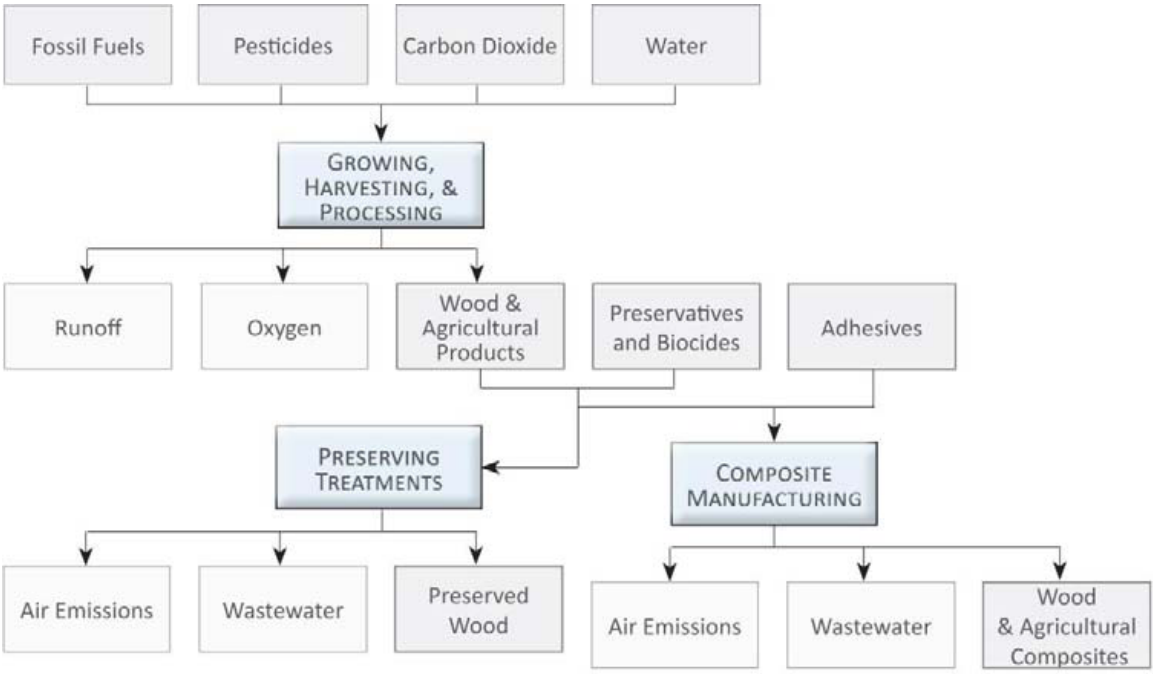
Solid and Composite Wood and Agricultural Products

Building materials considered in this category include treated and untreated solid wood products along with a variety of composite wood and agricultural products including plywood, oriented strand board (OSB), and particle board. Materials in this category are used in structural applications in the form of solid or composite framing and sheathing elements, and as finishing elements such as flooring, cabinetry, and casework. Added during manufacture of wood and agricultural products may be emitted from treated and composite wood and agricultural products at varying levels throughout a product□s life.

The ability to determine chemicals used to grow forest and agricultural products largely depends on the level of transparency in the supply chain of these products. The origin of

forestry and wood products, and in turn, the methods by which they are produced is often difficult to determine in the absence of third party certifications, and even these are only as useful as the transparency of their respective metrics. Forestry management in the absence of third party certification is subject to strength of policy and institutional frameworks present in the place of origin, which may be difficult to determine even when the origin of a product is known.

Typical Forest Products Materials Flow



In addition to raw wood and agricultural products, a variety of other chemicals and raw materials are used to produce treated lumber and composite wood products. Chemical releases to the environment result from both the mining of minerals used to preserve wood, including arsenic, copper, and chromium, and from the extraction and processing of oil and natural gas used to produce adhesives, including phenol-formaldehyde and ureaformaldehyde.

Manufacturing preservative-treated and composite wood and agricultural products involves the addition of various chemical preservatives and adhesives. Chemicals are released to the environment during wood treatment processes and during manufacturing of composite wood products in the form of run-off, air emissions, and soil contamination and may pose health risks to workers in manufacturing plants. Some

of these chemicals remain present in final products where they may be introduced to construction workers, consumers, and the environment through skin absorption, inhalation of dust, off-gassing, and leaching.
Common chemical preservatives currently in use include chromate copper arsenate (CCA).
Though banned from consumer products in the United States, CCA is still used in many applications such as permanent wood foundations, lumber used in commercial construction, plywood used in residential and commercial buildings, marine applications, and exterior applications such as utility poles and farm fencing. Chemicals from wood preserving facilities may enter the environment as water soluble chemicals such as arsenic salts, and may remain present in soils around preserving facilities.
Ammonium copper quaternary (ACQ), copper azole, and micronized copper are copper-based wood treatments that have largely replaced CCA in consumer applications.
Copper is toxic to many aquatic organisms and may leach from treated wood over time. Although micronized copper treatments minimize leaching from treated wood to the surrounding environment, the mining of copper remains a lifecycle consideration due to chemical releases to workers and the environment during raw material extraction.
Agricultural pesticides may also be used to preserve wood as both a surface treatment and pressure-treatment.12
Common chemical adhesives currently in use include phenol-formaldehyde and ureaformaldehyde.
Phenol-formaldehyde is widely used as an adhesive in interior and exterior plywood, OSB, and glue-laminated lumber. Urea-formaldehyde is more often used in interior grade medium-density fiberboard (MDF) and particle board. In addition to upstream impacts associated with the production of formaldehyde binders, formaldehyde in composite wood products is released to environment through the process of off-gassing. Another adhesive, polymeric diphenyl methylene diisocyanate (PMDI or MDI) is starting to being substituted for formaldehyde-based adhesives in particleboard.

Steel

Steel is a widely used in structural applications for many building types as structural steel members or as reinforcing in concrete construction. Galvanized steel, which involves coating steel with a layer of zinc, is used as sheet steel and fasteners. Stainless steel is made by dissolving significant quantities of chromium and other metals into iron during production and is used in fasteners, cladding, fixtures and hardware, and in certain structural applications. In
2009, the top three regions producing crude steel were China, the European Union, and Japan, which together accounted for approximately 67% of global production. The top three consumers of steel were China, the European Union, and the United States

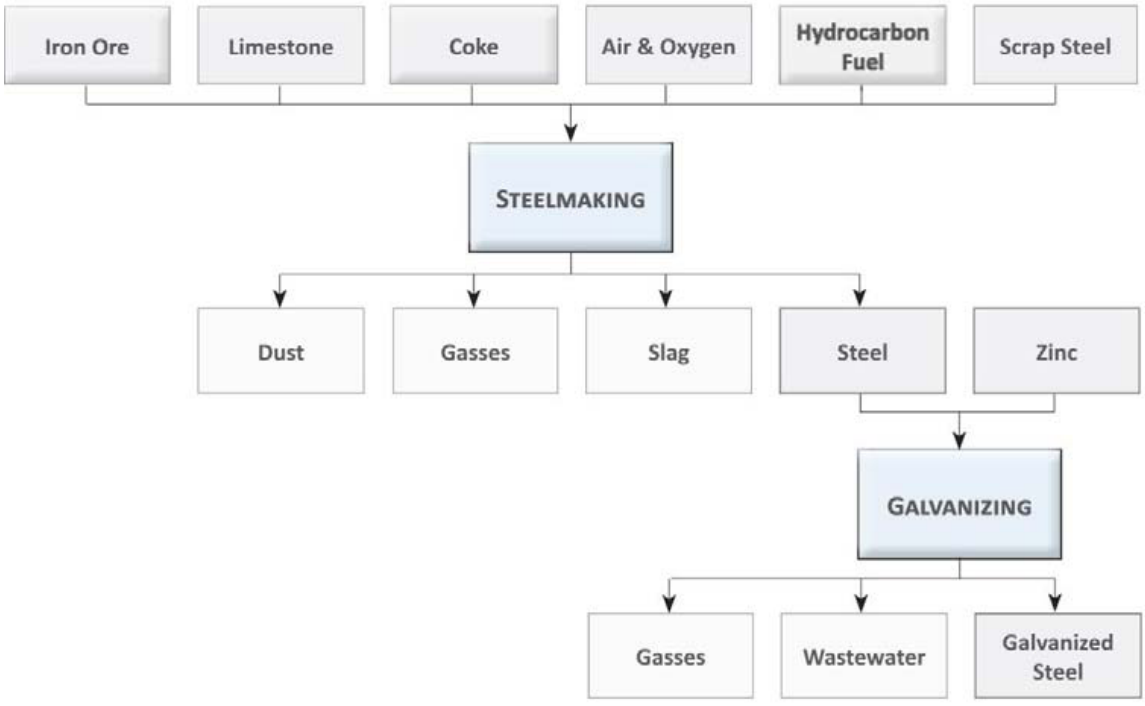
Chemical use in steel production occurs primarily during raw material extraction and processing, and manufacturing. While steel itself is generally considered inert and, as a finished product, is not known to release significant quantities of chemicals into the

environment, chemicals employed during steel manufacturing and finishing may affect workers and the environment.

Mining of raw materials for steel including iron ore, coal, and limestone may introduce chemicals to workers and the environment in the form of run-off and air emissions from fuel combustion. Coke, produced from bituminous coal, plays a significant role in steel production.
Emissions from coke ovens include polycyclic aromatic hydrocarbons, benzene, Bnaphthylamine, cadmium, arsenic, beryllium and chromium. Water used in the cooling process may contain potential carcinogens and is considered hazardous waste.

Another point of entry of chemicals into steel production occurs during the galvanization process which uses zinc to form a protective coating. Chemicals may be introduced to workers and the environment during zinc ore mining in the form of run-off. Heavy metal contaminants including lead, cadmium, chromium, copper, silver, and selenium may be released during the zinc smelting process. Cooling and rinsing water used in the galvanization process may also introduce chemicals into the environment. Over time, zinc coatings on galvanized metal wear away and enter the environment.

Steel and Galvanized Steel Materials Flow



Insulation

Materials used as insulation vary widely and each type of insulation has unique manufacturing processes and chemical composition. Common types of insulation include fiberglass, rigid foams, spray-in-place foams, mineral wool and cellulose. Chemicals may be introduced to workers and the environment during mining of raw materials, manufacture of insulation and its components, and installation. Chemicals may be released to workers, consumers, and the environment during all life-cycle stages including useful life, and end of life.

Rigid and spray-in-place foam insulation

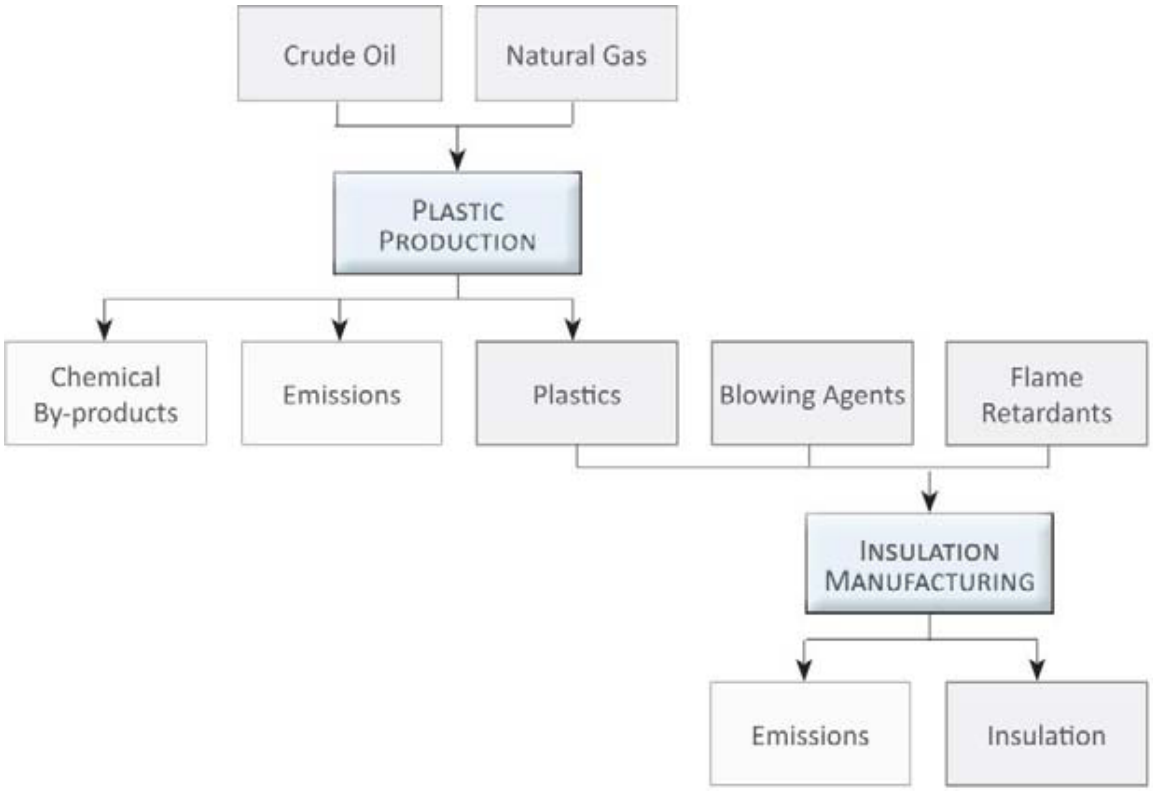
There are three major types of rigid and semi-rigid insulation: Extruded polystyrene (XPS), Expanded polystyrene (EPS), and Polyisocyanurate (Polyiso). XPS and EPS are manufactured using crude oil and natural gas to produce benzene and ethylene, respectively, which are then converted to styrene monomer. Various blowing agents are then used to create polystyrene foam. XPS uses HCFC-142b (hydrochlorofluorocarbon) as a foaming agent during manufacture.

HCFC-142b replaced the more harmful greenhouse gas CFC-12 (Chlorofluorocarbon), but is still an ozone-depleting greenhouse gas. HCFCs are now being phased out due to their ozone depleting potential and are already banned in some countries including the European Union, though others, including Canada, Mexico, and the Unites States still allow for their use.21 EPS uses pentane as a blowing agent. Air and water emissions from the production of polystyrene and its intermediate chemicals include benzene, chlorinate organic compounds, hydrocarbons, and metals.

Over time, blowing agents entrained within the cells of foam insulation may escape to the environment at varying levels. Virtually all polystyrene insulations, including XPS and EPS, are treated with HBCD (Hexabromocyclododecane), a brominated flame retardant. HBCD is a persistent bioaccumulative toxin which can be found worldwide in humans, wildlife, and the environment. The degree to which insulation products contribute to these levels throughout their lifecycle remains unclear.

While polystyrene packaging materials can be recycled into XPS, only EPS which was previously building insulation can be recycled as such. CFCs contained within older foams in existing buildings may enter the atmosphere at end of life if improperly disposed of, and chemicals may enter the environment in case of building and landfill fires or other burning of foam insulation.

Rigid, Semi-rigid, and Spray Foam Insulation Materials Flow



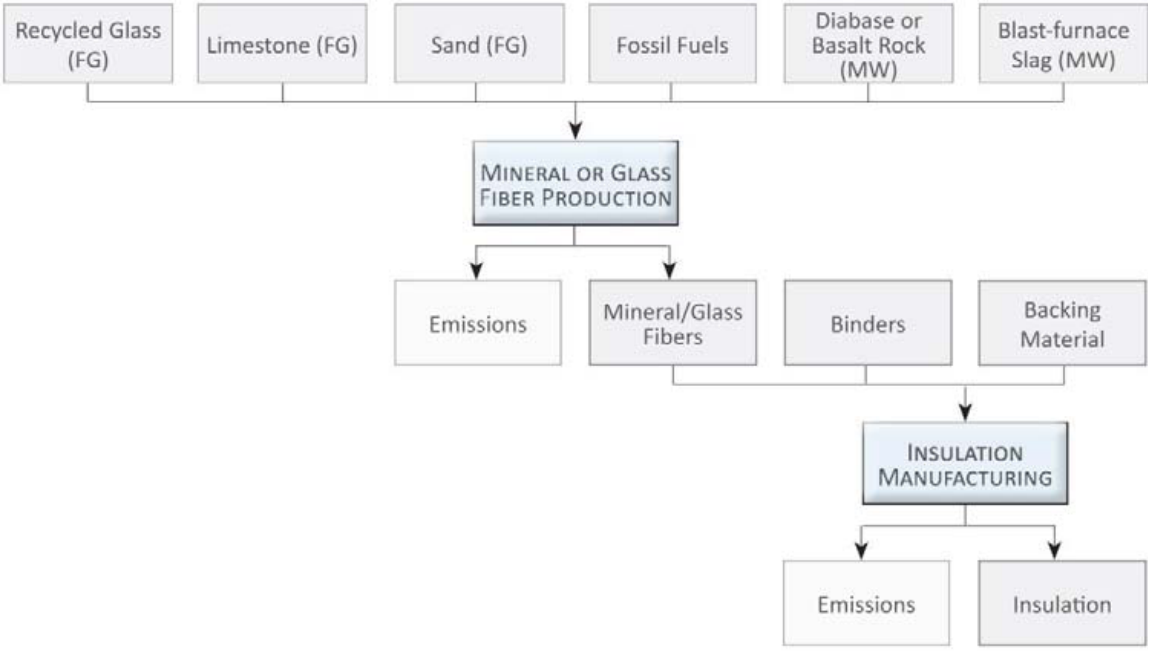
Fiberglass and Mineral Wool Insulation

Fiberglass insulation is made from sand, dolomitic limestone, and borax, which are mined and used to manufacture glass. Post-industrial glass cullet from plate glass manufacturing, and post-consumer glass bottles may also be used as a glass source. Molten glass is then spun into thin strands which are immediately coated with a binder. The glass fibers are then shaped and cured into batts or blankets which may be backed with foil or craft paper or used as loose-fill.

Mineral wool insulation may be made from diabase and basalt rock or from slag from iron-ore blast furnaces (slag wool). As with fiberglass insulation, molten minerals are spun into thin fibers and coated with a binder. The binder used in most fiberglass and mineral wool insulation is often phenol-formaldehyde; the production of which produces toxic intermediate chemicals as described in the section above describing wood products. Formaldehyde free binders are also available.

Chemicals may be introduced to the environment as emissions from mining operations and glass melting furnaces.30 Production of phenol-formaldehyde binders involves toxic intermediate chemicals which may be introduced to the environment or workers. In addition, formaldehyde may off-gas from insulation materials once they are installed in buildings affecting both workers and occupants

Fiberglass and Mineral Wool Insulation Materials Flow



Asbestos and Other Insulation Materials

Vermiculite is sometimes used as insulation and may contain asbestos depending on where it is mined. Additionally, asbestos, discussed below was once a common ingredient in certain types of insulations and may continue to pose threats during demolition and disposal of construction waste. Urea formaldehyde foam insulation (UFFI) is no longer in use due to indoor air quality concerns associated with the off-gassing of formaldehyde.

Concrete

In 2008 China accounted for 54% percent of the 2,857 million tons of cement produced globally. India and the United States are a far second and third, respectively, in production.

According to the same report, 94% of cement produced is consumed domestically. Of the 6% traded, China is the largest exporter, followed by Japan and Thailand, and the United States is the largest importer, followed by Russia and Nigeria

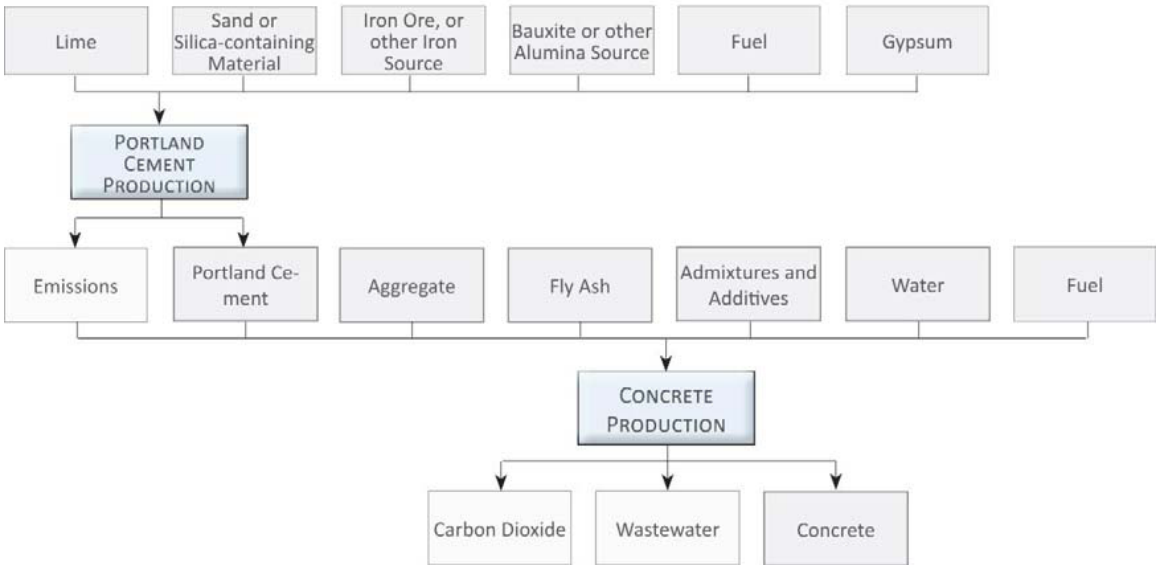
Cement is the most energy intensive ingredient in concrete. Its production begins with the mining of raw materials including the following: a source of calcium such as limestone; a source of silica, including shale and clay; calcium sulfite, such as gypsum; and iron and alumina from bauxite and iron ores or certain waste materials. These materials are heated to extremely high temperatures. Chemical emissions from cement kilns vary according to environmental controlsemployed at each plant and the type of fuel used. Common fuel types include coal and coke, and natural gas. Additionally, many

cement plants incorporate various forms of waste as fuel sources including tires, waste oil, and other potentially hazardous materials. Emissions from cement kilns may include other hazardous substances such as chromium, arsenic, and mercury.

Fly ash from coal-fired power plants may be used as a substitute for cement in concrete mixtures. Emissions from coal-fired power plants often contain heavy metals which may also be present in fly ash. Chemical composition of fly ash is directly related to the type of coal burned and may contain varying levels of mercury and other heavy metals such as arsenic, cadmium, chromium, and selenium.

Aggregates used in concrete vary and often include a combination of crushed stone and sand.
Depending upon source, some aggregates in concrete may contribute radon in concrete.38
Other chemicals resulting from aggregate production may include air emissions from fuel combustion and run-off from quarrying operations. Certain recycled materials may also be used as aggregate (such as scrap tires and demolition waste). Determination of the chemical properties of aggregates depends upon origin and policies governing the place of origin.
Admixtures are chemicals which are added to concrete mixtures to control qualities such as curing time, workability, freeze resistance, and resistance to cracking. Chemicals such as
sulfonated melamine-formaldehyde, sulphonated naphthalene formaldehyde condensates, alkyl benzene sulphonates and methyl-ester-derived cocamide diethanolamine, along with various nano-particles and biocides may be added to concrete. Chemicals used in admixtures vary widely and are not easily identified through current labeling practices

Typical Concrete Materials Flow



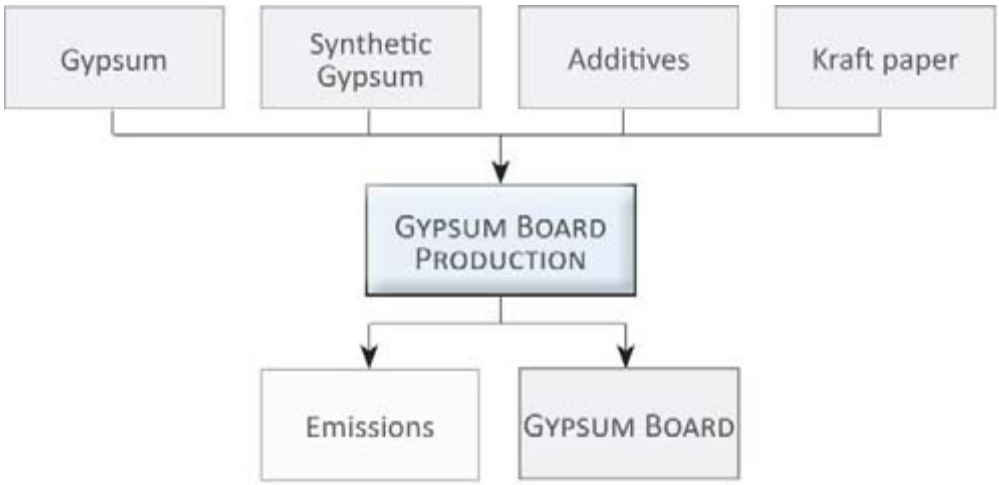
Wall Board

Gypsum board is the most commonly used type of wallboard.
Chemicals may enter the environment as air and water emissions from gypsum mining operations and paper production. Calcined gypsum is produced by heating raw gypsum which may result in air emissions including sulfur oxides, nitrogen oxides, and VOCs. Synthetic gypsum, or flue-gas-desulfurization (FGD) gypsum is a byproduct of chemical scrubbers in coalfired power plants. Sulfur dioxide emissions contained in flue-gas are exposed to calcium carbonate. A chemical reaction creates calcium sulfite which is converted to gypsum by oxidizing it with water.

There is some controversy about potential heavy metal content in synthetic gypsum, but no definitive research has been performed. Chemical contaminants may be found in drywall where materials other than gypsum are added as fillers or flame retardants. Older drywall may contain asbestos and poses a risk during demolition or repair.44 In early 2008, some drywall produced in China was found to emit sulfide gasses.

As with other building materials, the ability to assess chemical content of drywall is largely dependent on transparency in sourcing. Some third-party certifications address synthetic gypsum content in gypsum board where it is considered as post-industrial recycled content.

Gypsum Board Materials Flow



Resilient Flooring

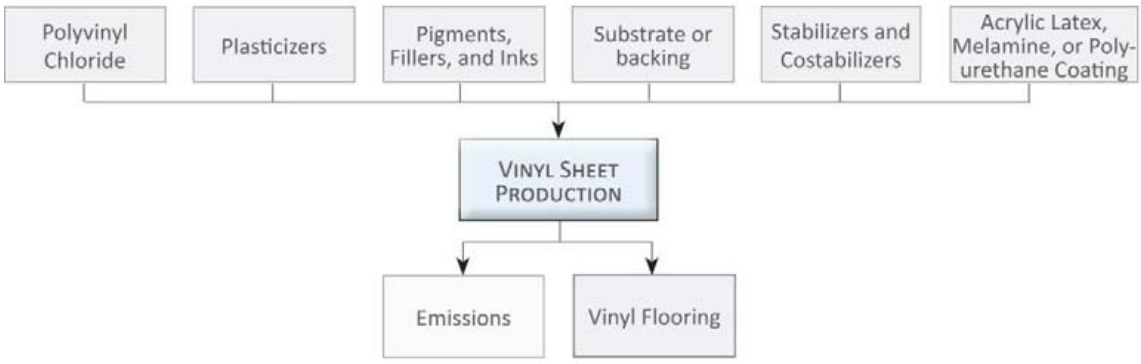
Vinyl flooring is one of the most widely used resilient flooring products on the market. It is composed primarily of polyvinyl chloride (PVC) resin and additives including stabilizers, plasticizers, pigments, and various fillers. Chemical pathways for release into the environment occur at all lifecycle stages from raw material extraction to end of life.

Petrochemicals are a major ingredient in vinyl flooring. Ethylene, a derivative of natural gas or petroleum, is reacted with chlorine, a derivative of sodium chloride, to produce diochloroethane (ECD). ECD is converted to vinyl chloride monomer and hydrochloric acid through a cracking process. Vinyl chloride monomer is then polymerized into PVC using a variety of methods.

Exposure to vinyl chloride monomer is linked with a form of liver cancer. While vinyl chloride monomer residues can be found in very small amounts in finished PVC products, exposure is more likely to occur in manufacturing and processing facilities. In North America and Western
Europe, the introduction of closed-loop polymerization processes have been widely adopted by industry, significantly limiting worker exposure to vinyl chloride monomer. However, older production technologies persist in some low- and medium-resource countries.48 Exposure levels are tightly controlled in the United States and other OECD countries.49 However, as with other product sectors, health and environmental impacts associated with the production of vinyl flooring and its feedstocks depend on the location of manufacture and the strength of policies and regulations in place in each location.

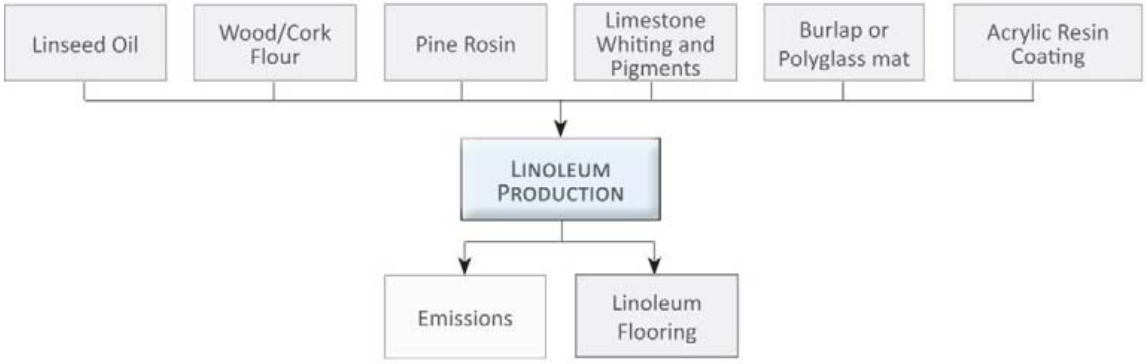
Additives used in the production of vinyl flooring are another point of entry for chemicals.
Phthalates, including di-2-ethylhexyl phthalate, may be used as plasticizers along with flame retardants, smoke suppressants, and biocides. Heavy metals including lead and cadmium may be used as stabilizers; however the use of cadmium in vinyl floor production is declining and was phased out in European Union in 2001. The precise composition of vinyl flooring varies by manufacturer and production location.
During use phase, vinyl flooring has been found to off-gas chemicals including aromatic hydrocarbons, aliphatic hydrocarbons, and halogenated hydrocarbons. At the end of life, recycling of vinyl flooring is minimal, though a few flooring manufacturers do recycle it. Concentrations of legacy chemicals such as cadmium which exceed current regulations may limit recycling potential. Older vinyl flooring may contain asbestos posing risks to occupants and construction and demolition professionals.

Vinyl Flooring Materials Flow



Linoleum is primarily made from linseed oil from flax seed, rosin binders, wood and cork flour, fillers, and drying agents which are combined with pigments and synthetic or natural backing fiber to create flooring. Primary chemicals involved with the production of linoleum are associated with the agricultural and forest products as describe previously as well as through drying agents and additives. Additionally, VOCs are released during the oxidation of linseed oil.

Linoleum Flooring Materials Flow



Siding and Exterior Cladding

Siding and cladding is another major category of building materials which includes many of the materials mentioned in previous categories and includes diverse materials such as PVC, wood, fiber cement, various metals including steel and aluminum, masonry, and ceramics. Vinyl siding is one of the most common siding materials due to primarily to its low cost, availability, and perceived maintenance reduction. Vinyl siding, along with flooring and piping, is one of the largest uses of PVC and is the most common residential siding material in the US and Canada.

Like other PVC products, vinyl siding may contain a variety of additives including phthalates and flame retardants which pose risks humans and the environment. Chemicals associated with

Specific Substances of Concern in the building products sector

Formaldehyde

Formaldehyde is produced naturally in the environment at low levels through the oxidation of hydrocarbons. It is also manufactured by the chemical industry and is incorporated in a wide range of building products, such as composite wood products and insulation. Formaldehyde is classified as a Group 2B carcinogen (probable human carcinogen) by the International Agency or Research on Cancer (IARC).
Wood-based building materials that involve the use of formaldehyde in their production and mitt formaldehyde during their use are major contributors to formaldehyde emissions in the construction process. Wood-based products, such as medium-density fiberboard (used in rawer fronts and cabinetry), particleboard and hardwood plywood paneling (used in subflooring and cabinetry), and softwood plywood (used in exterior construction) are among the cost likely building materials responsible for formaldehyde emissions. Certain insulation materials also contain formaldehyde.

Exposure to formaldehyde can potentially occur at the production, site application and use stages of a product. The rate at which products like composite wood or textiles release formaldehyde varies over time and will generally decrease as products age. Initially following installation, high indoor temperatures or humidity can cause increased release of formaldehyde room these products. The primary routes of exposure of formaldehyde that can result in acute health effects are inhalation and absorption through the skin.

Wood Preservatives

Wood preservatives contain active ingredients and solvents and can result in adverse health effects if exposed to excessive amounts. There are two major types of wood preservatives: oil based and water-based

Creosote and pentachlorophenol (PCP) are two oil-based treatments commonly used to treat construction materials such as railroad ties and utility poles.

Chromated copper arsenate (CCA), ***ammonium copper quaternary*** (ACQ), copper azole and micronized copper are water-based treatments. CCA contains arsenic, a chemical
Shown to cause skin and lung cancer after prolonged exposure. ACQ has more recently Been used heavily in industry and is less considerably less toxic.
Wood preservatives are poisonous to pests and insects, and protect wood products from environmental deterioration. They may also be hazardous to humans and the environment.

Wood preservatives may be spray-applied, resulting in minute droplets of the product which may remain suspended in the air after application posing an inhalation risk to workers. Certain types of preservative products use volatile petroleum-based solvents as vehicles for the preservative compound, which evaporate from the treated wood as the product dries.
Exposure to high concentrations of petroleum-based solvents can cause narcotic effects and loss of consciousness.
Chromated copper arsenate (CCA) was used in pressure-treated wood products for sixty years and has largely been withdrawn from North American consumer markets. Government and public attention to the issue of health hazards from CCA-treated wood, both national and international, has been growing steadily over the past few years. In March 2003, EPA finalized avoluntary agreement with preservative manufacturers to ban the production of CCA-treated wood for most residential uses.57 However, the ban does not prohibit the sale of CCA-treated wood produced prior to the ban, nor does the measure address existing structures, and CCAtreatedwood is still used in certain commercial and industrial applications In the United States, a warning label must be displayed in locations where CCA-treated wood is sold. The EPA has also removed CCA from its list of approved chemical pesticides.

Non-arsenic based alternatives to CCA include alkaline copper quaternary (ACQ), copper azole,which replace the arsenic in CCA with a high level of copper and organic co-biocides.58 Though considered less hazardous by composition, major health and environmental concerns are associated with copper extraction and processing, and disposal. Leaching of copper from treated wood can harmful environmental effects, specifically to aquatic organisms.59
Micronized copper quaternary (MCQ), is a relatively new preservative treatment marketed as an environmentally preferable alternative to soluble copper treatments. MCQ is a variation on copper-based organic formulations.60 The MCQ treatment process uses micronized copper particles which are injected into wood. This method reduces leaching, is non-volatile, and eliminates surface residue.

Chlorinated Plastics

Chlorinated plastics, including PVC, are of special concern due to their global distribution and use and the hazards associated with them.63 PVC is the most widely used chlorinated plastic polymer in the United States, with 12.8 billion pounds produced in the U.S. alone in 2010, and 47.5 billion ton global production capacity. The building industry is responsible for more than 75% of that PVC use. PVC is the only major building material that is an organochlorine, aclass of chemicals that breaks down slowly and can remain in the environment long after disposal. Controversy exists regarding environmental and health concerns related to PVC's production and the exposure of users to phthalates, VOCs and other additives. As such, governments and organizations in Europe and North America have explored restrictions and pvc voidance programs. Chemical releases associated with vinyl production may occur in all stages of PVC□□ life cycle.

Environmental and health impacts of the manufacturing stage include ethylene and chlorine gas production, feedstock production, polymerization, formulation and molding. During use phase, chemicals used during the manufacture of PVC products may be released into the indoor or outdoor environment. At the end of useful life, PVC is typically incinerated or placed inland fills, where unintended by-products may leach into surrounding terrestrial or aquatic environments. While initiatives aimed at promoting PVC recycling have increased recycling rates, recycling of post-consumer PVC remains limited and is considered difficult due to the range of additives in products.
Health concerns of PVC and other chlorinated plastics include the release dioxins, a family of chemicals containing known human carcinogens. Dioxins are created during the production and manufacturing processes and when chlorinated plastics are burned, either accidentally or intentionally, during disposal. For example, in the UK municipal incinerators account for 20%of dioxin releases, with accidental fires accounting for 19%69. Proper incineration can control exposure to dioxins, using temperatures over 850□ Celsius and using proper air controltechnologies, however standards for incineration vary. Controversy exists regarding the extent to which the chlorine present in PVC correlates to dioxin formation and release.

Asbestos

Asbestos is a fibrous mineral that occurs naturally in many parts of the world. It has a number of mechanical characteristics, which have made it desirable for use in building materials. It is extremely strong, is resistant to fire and chemical destruction, does not conduct heat or electricity, and is lightweight. The health concerns associated with asbestos are numerous.71
When asbestos fibers are inhaled, they remain in the lungs for an extended period of time, causing inflammation, irritation, and diseases including lung cancer, mesothelioma asbestosis, and other potentially life threatening diseases, which may not show up until well after exposure.

Exposure to asbestos may occur during mining, manufacturing, construction, and during removal of asbestos during renovation and demolition.

VOCs

Volatile organic carbons (VOCs) are compounds that readily volatize into the air under typical conditions of use. Volatile organic compounds (VOCs) include a large number of chemicals which volatilize out of products into the surrounding environment. This volatilization results in elevated concentrations of VOCs in the indoor environment.
Building materials known to emit
VOSs include certain composite wood products, insulations, carpets and flooring, and many paints, coatings, and adhesives. VOCs in building materials include chemicals which are known or suspected human carcinogens, contribute to liver, kidney, and central nervous system damage, and cause a number of other adverse health effects.77
Common VOC compounds released from building materials include formaldehyde, acetaldehyde, toluene, isocyanates,

xylene, and benzene. In addition to affecting indoor air quality, certain VOCs are regulated due to their contribution to photochemical smog

PBTs

Another prominent class of chemicals of concern includes persistent bioaccumulative toxicants
(PBTs). PBTs are compounds that both persist and bioaccumulate in the environment and are considered toxic. PBTs are associated with a range of known or highly probable serious human health effects, including cancer, endocrine disruption, immune system disorders, impaired brain development, and birth defects. A variety of PBTs are used in building materials or are a byproduct of the material life cycle. Common types of PBTs present in building materials include heavy metals (such as lead, mercury, etc.), halogenated flame retardants (HFRs),
perfluorochemicals (PFCs), and dioxins.
Polychlorinated biphenyls (PCBs) are another PBT of concern in building materials. PCBs were widely used in caulking paints, coatings, and sealants from the 1950s until the 1970s. Several investigations in Germany, Sweden, and Finland have demonstrated relationships between
PCBs in sealants and levels in indoor air and settled dust, as well as in soil around the foundations of buildings containing these materials.78 Though widely banned from use in most dissipative applications in the late 1970s in the United States, Canada, western Europe and
Japan, there is increasing awareness of PCB legacy issues in older structures.

Radioactivity of Building Products

The concentration of natural radionuclides (naturally occurring radioactivity) in building materials vary significantly from one country to another and from one place to another in the same country. Radiation exposure of the population increases with the use of building materials containing above-normal levels of natural radioactivity. Naturally occurring radionuclides are present in significant amounts in building materials, such as gypsum, red clay bricks, marble, sand and cement products, and in recycled industrial waste products.79 Exposure to internal radiation during the use stage of building products via radon off-gas and its decay products can pose adverse human health affects, affecting the respiratory tract

Existing CiP Information Systems

There are many existing channels for information provision and use related to CiP in building discussion of the information source types, there are some interesting trends in the provision and use of data that should be noted. These trends were noted consistently across the literature review, surveys and interviews conducted for this case study. They include:
 Information has been driven by government chemicals policy and various green building certification systems and standards.

 there are wide differences in the quality and quantity of information across types of materials.
 there is a lack of CiP information available specifically for countries outside of North America and Europe.
 Despite the growth of public databases and manufacturer declarations on building products, a majority of stakeholders depend upon MSDSs as a primary information source.
 Stakeholders referenced the potential of enhanced information exchange from the European Construction Products Directive and the REACH Directive.
 The proliferation of green building standards and certifications is providing a strong market incentive for manufacturers to offer more transparent information about their products.
 Growing numbers of green building councils in countries around the world have the potential to provide a platform for the dissemination of better CiP information.

Information Source Types

Material Safety and Data Sheets

The intent behind a MSDS is to provide workers and emergency personnel with data about potential health and safety risks of a material. Though hazardous chemical ingredients are listed, MSDSs are not a comprehensive source of information regarding chemicals in products. Hazardous chemicals present in low concentrations are often omitted from MSDS ingredient lists, and many chemical compounds are characterized as proprietary and are not disclosed to consumers. ISO, ANSI, and OSHA all publish guidelines for his generation of MSDSs, however reporting standards for MSDSs vary based on local regulations.

The EU REACH Regulation has established more stringent reporting requirements for safety data sheets. Annex II of REACH (EU Regulation EC No. 1907/2006), as further amended by
Commission Regulation No. 453/2010, mandates what information should be included in safety data sheets. Notably, safety data sheets will be required to list substances or mixtures classified as hazardous, persistent, bioaccumulative and toxic (PBT), or very persistent and very
bioaccumulative (vPvB), and substances of very high concern (SVHC).81 Table 2 provides general information on the types of information that are required for MSDSs under these various schemes.

Public Databases

This source category includes two general types of database. The first type includes searchable databases, either subscription-based or free, which store information about specific building materials. The case studies chosen for this category collect information on the chemical and material composition of building products and compare the contents to third-party published lists of chemical hazards and concerns. Information

about material contents and any associated hazards or concerns associated with a specific product are subsequently made available to the public. In both cases, the databases rely on manufacturers to provide information about a product or material. A second type of database includes published lists of information regarding chemicals in general. This includes any regulatory lists of hazardous or concerning chemicals often referenced by product-specific databases. These lists are produced by government agencies as well as non-governmental organizations and non-profits and are made publicly available, or in some cases, become the basis for legislative action. The lists may or may not contain information about what products are likely to contain a given chemical or material.

Standards and Certifications

This category includes published guidelines that address materials in one of two ways. These types of building standards generally address CiP-specific information through a prescriptive approach in which certain chemical contents in materials are restricted or discouraged. These standards serve primarily as a platform for raising issues associated with a few specific chemicals of concern in certain product classes. These types of standards do not provide CiP information about specific products and materials.

A second type of standard or certification looks at individual building products to determine properties based on a predetermined set of metrics. Individual products are then certified accordingly. Companies may then use the certification status as a way to validate claims about a product, and certifying organizations often provide a publicly available listing of all certified products.

Information Clearinghouses

For the purpose of this report, information clearinghouses are differentiated from databases based on the nature of information provided. While databases are considered to have primarily product-specific CiP information, clearinghouses have a much broader focus. As illustrated by the chosen case study below, these source types act as central servers for academic and technical reports on a wide range of issues related to the construction industry and beyond.

Reporting Initiatives

Reporting initiatives are of two general types. The first includes guidelines that are published to standardize the way in which information about an organization or product is conveyed. While other information source categories, such as standards and certifications, may produce documents for this purpose for internal use, this category addresses reporting initiatives whose sole purpose is to standardize the collection of information for a variety of potential end uses.

Trade and Industry Associations

These associations are membership-based groups of industry stakeholders. They represent the interests of their constituencies and often represent groups in legislative and regulatory matters. Trade organizations often function as a news and information

outlet for the industry they represent. Therefore, major issues regarding chemical regulations are often reported on through these outlets. Though some information about the composition of products represented by the association may be available, they do not generally publish product-specific
CiP information.