



Sustainable Vinyl:

One material, virtually **endless** possibilities

The Facts About Today's Vinyl

Vinyl is composed of ingredients from nature; chlorine, based on common salt, and ethylene from natural gas. By employing further chemistry, vinyl can be made flexible, rigid or semi-rigid; clear or colorful; thick or thin. Part of the beauty of affordable, energy efficient, versatile vinyl is that it can literally last a lifetime. With long life cycles and natural fire resistance, it's highly sustainable. No wonder vinyl is a major component of products used for residential and commercial construction, wire and cable, consumer items and healthcare.

Vinyl Abounds Today

Look around. You'll see that vinyl is very much a part of your world today...no matter where you live or what you do. Vinyl has a proud and rich history of providing solutions to society's needs.

Safer water supplies and sustainable building products are vinyl:

- Do you prefer clear, fresh water over rusty, contaminated water? When it comes to water, the choice is clear. Thanks to vinyl, tough, durable pipes provide safe and reliable water supplies. Vinyl pipes used for infrastructure have been in use for over 30 years and show no signs of degradation.¹

- Building products like siding, decking, windows, doors and skylights use vinyl for its toughness, superior weathering properties and flame resistance. The NAHB has cited "Lifetime" as the expected life expectancy of vinyl siding on a home.²
- Some windows and siding have been in use for more than 40 years.
- The auto industry uses vinyl for instrument panels and door panel coverings.
- Other contributions include shatter-resistant clear containers, collection of blood in vinyl blood bags and food packaging and safe storage.

During World War II, vinyl came to the rescue and sustains today:

- Flame resistant vinyl wire insulation provided to the Navy for ships in WWII helped to solve the issue of uncontrolled flame spread on ships – saving military lives.
- Today, vinyl continues to save lives with its natural flame resistance, making it a mainstay in many potentially dangerous applications. Office buildings have stringent requirements for materials housed in the plenum space. Vinyl materials can be formulated to pass rigorous smoke and flame tests per the National Fire Protection Agency (NFPA) standard, 90A.

Vinyl's Popularity Grows

One of the most versatile polymers today, vinyl or PVC (polyvinyl chloride), is the third largest plastic consumed globally. Manufacturers consumed 77 billion pounds in 2007 and project an annualized growth rate of 5% per year. The U.S. and Canada consume about 19% of the total global demand (about 14.3 billion pounds in 2007³). According to the American Plastics Council, over 70% of vinyl is used in building and construction.

Vinyl windows and doors have enjoyed growing popularity as well. Since the first vinyl windows were introduced to North America in the early 1950s, vinyl has continued to gain market share due to desirable physical properties and design versatility. Vinyl windows offer a unique blend of energy efficiency, ease of maintenance and low cost. Today vinyl windows account for 67% of residential window shipments in the U.S., 27.8 million windows in 2010⁴, per the chart to the right.

About Life Cycle Assessments

The health and environmental aspects of vinyl have been more closely examined than those of any other plastic or polymer. Several industries and organizations have commissioned a range of life cycle assessments based on various applications. Consensus is that vinyl performs consistently with other polymers and natural materials with respect to environmental and sustainable criteria.

A U.S. Green Building Council PVC Task Group, in February 2007, stated, "No single material shows up as the best across all human and environmental impact categories, nor as the worst." Also, a 2001 Department for Environmental, Food and Rural Affairs (DEFRA) study in the UK, and a 2004 European Commission study demonstrated that PVC was no more environmentally

Vinyl Stems from the Salt of the Earth

Vinyl is a derivative of salt and hydrocarbons, either from natural gas or crude oil. Naturally occurring salt is the source of chlorine. Hydrocarbons are the source of ethylene. Together, chlorine and ethylene make up the building blocks for PVC, which is unique because a significant part (57%) of this polymer is made up of chlorine. Other polymers, like polyethylene and polypropylene, are derived almost entirely from natural gas or crude oil.

Chlorine is found everywhere and is an essential component of the human body. It was first described as chlorine in 1774. Sir Humphry Davy identified it as an element in 1810.

In 1872, vinyl was first produced by a German chemist, Eugen Baumann. In 1913, Friedrich Heinrich August Klatte developed a commercial route to vinyl chloride, but the material was limited by its extreme rigidity. In 1926, Dr. Waldo Lonsbury Semon, a researcher for B.F. Goodrich, discovered plasticized PVC, which made it flexible. He received several patents, and the product was used for golf balls, shoe heels, rain suits and shower curtains.

Vinyl is an extremely versatile polymer that can be used in everything from building and construction including pipes, siding and windows, to healthcare, such as blood bags and catheter components.

Shipments of Prime Windows 2010 – 2012 Forecast (Millions of Units)

Total Construction	2010	2011F	2012F
Vinyl	27.8	29.4	33.1
Wood	8.9	8.7	9.3
Aluminum	2.8	2.4	2.8
Fiberglass	1.4	1.5	1.8
Other	0.7	0.8	0.9
Total	41.6	42.8	47.9

Source: [AAMA/WDMA 2010/2011 U.S. Industry Market Studies](#)

unacceptable than the alternatives. Vinyl windows, doors and skylights provide years of performance scoring favorably in life cycle assessments.

Conditions Impacting Sustainability

PVC is formed through industrial processes. At the end of its service life, the material is available for reuse, recycling or disposal. As with any product, there are four conditions for sustainability:

Carbon Neutrality

Carbon neutrality is the consideration of the amount of carbon released into the atmosphere as a result of the manufacture and use of the product in its intended application. While carbon neutrality is the ideal goal, practical consideration is to use the lowest carbon generating material available.

Carbon Content: By its very nature vinyl contains less carbon than most alternatives since it is roughly half chlorine and half carbon. The carbon comes from ethylene, which today is derived from either crude oil or natural gas. Ethylene can also be made commercially by the dehydration of ethanol made from renewable resources.

It is not practiced commercially today because this route is more expensive than ethylene derived from crude oil or natural gas. PVC, made from ethanol and salt, would be derived completely from renewable resources – a 100% bio-based product.

Carbon Resulting From Embodied Energy: The energy used to manufacture vinyl, process it into an application (like a vinyl window), ship it for installation and then maintain the product over its useful life can also require carbon in the form of energy or other products required for maintenance. When compared to alternative plastics, vinyl consumes 20% less energy versus other plastics during the manufacturing



No Harsh Chemicals for Cleaning—just Soap and Water

Windows, doors and flooring made from vinyl are not only durable, they are also easy to maintain. Known for its low maintenance, simple soap and water cleanup is usually all that is needed to keep vinyl looking good for generations, making vinyl a popular choice by home and commercial property owners.

process. The properties of vinyl make it easy to process, and its outstanding energy efficiency, durability and low maintenance characteristics contribute to very low carbon requirements over its life cycle.

Vinyl has excellent energy efficiency, can last for over 50 years and has very low maintenance requirements making it a perfect choice for building and construction applications.

Controlled Waste Management System

In a controlled waste management system, the amount of material going into the waste stream is minimized and a concentration of material not naturally occurring is avoided.

Most of the U.S. and Canadian installed base of vinyl windows and patio doors are still in productive use in millions of homes and will be for many years to come. To enhance future sustainability opportunities, AAMA's Vinyl Material Council (VMC) sponsored a vinyl window recycling case study in 2008 to evaluate possible strategies for making post-consumer recycling viable on a broad scale. The results of this study are summarized in a white paper entitled, [Avoiding the Landfill: The Recycling of Vinyl Windows and Doors](#).

Closing the Loop

Because scrap vinyl, used in the manufacture of window and door profiles, can be melted and reformed repeatedly, it has long been the industry's practice to recover production trimmings and scrap and return them to their vinyl extrusion supplier or local recycler for reprocessing into the same or other products. When the vinyl trimmings and scrap are returned to the original vinyl extrusion supplier, this is called closed-loop recycling. Most vinyl extrusion suppliers practice closed-loop recycling.



Depend of Vinyl for Longevity, Durability

Vinyl's toughness and durability make it the most widely-used plastic for building and construction applications like siding, windows, single-ply roofing membranes, fencing, decking, wall coverings and flooring according to Chemical Market Association, Inc. (CMAI).

Vinyl doesn't rust or corrode. It resists dents. Vinyl windows, doors, skylights, fencing and siding don't require painting or staining once they leave the factory and arrive at your home or business. Vinyl's longevity and durability are confirmed through AAMA's certification and testing programs for vinyl windows, doors and skylights. [VMC Users Guide: AAMA Profile Certification Program](#)

Post-industrial Recycling Produces Results

Post-industrial recycling includes the recycling of converted vinyl material from industrial end users into the same or different end-use applications. This is also widely practiced within the vinyl industries.

According to a 1999 Principia Partners study, 80% of the rigid post-industrial vinyl available to be reclaimed is recycled.

Types of post-industrial end-use applications include, but are not limited to:

- Non-pressure pipe
- Fencing and decking substrate
- Molding
- Gutters
- Artificial Christmas trees
- Hose
- Seawall
- Cooling tower baffles/trays

Sustainable Solutions

All aspects of life are connected, and we are joined by the same great cycles of water, air, elements and energy. Humans have done amazing things with the substances and living things found on our planet. Often, these activities have given little consideration to the long-term effects and broad-scale consequences for humankind. Sustainable development may be the next step in human evolution. This approach involves considering ecological, economic and social dimensions through a systems perspective recognizing that all elements are intimately inter-related, integral to the whole and cannot be substituted. Sustainable development involves working with nature; using materials wisely in ways that do not erode natural processes that provide for our long-term well being.

As the use of post-consumer recycled content becomes an increasing requirement in end-use products due to state and local regulations or voluntary programs like LEED®, the ability to recycle windows may become a natural extension of this trend. As demonstrated commercially in Europe, and as part of the VMC's U.S. case study, vinyl windows are recyclable. Currently, post-consumer window and door recycling is done on a limited basis today in the U.S. and Canada but is growing each year. As more green and sustainable programs take hold, window recycling may become a natural part of this evolution. As such, the VMC remains committed to finding ways to help support and increase the recycling of post-consumer vinyl windows, doors and skylights.

Zero-Emissions

This condition is designed to ensure that persistent organic compounds from the whole life cycle do not result in systematic increases in concentration in nature. Once again, PVC's outstanding durability and recyclability help ensure persistent organic compounds are not released during the life cycle of this product. In addition, the low maintenance feature reduces the potential release of materials coming from cleaning agents and emissions from coatings.

Zero-Accumulation of Toxic Materials in Nature

This condition refers to ensuring that no accumulation of toxic

materials occurs in nature as a result of the life cycle of a vinyl window. Vinyl, as evidenced by its use in blood bags, is not a toxic material. The vinyl compound does not contain any heavy metals or phthalates, which have been noted as concerns for some applications. Also, the stabilizer used in the vinyl compound is tin, a common material used in food cans. Therefore, vinyl windows do not pose a threat regarding a potential accumulation of toxic materials in nature.

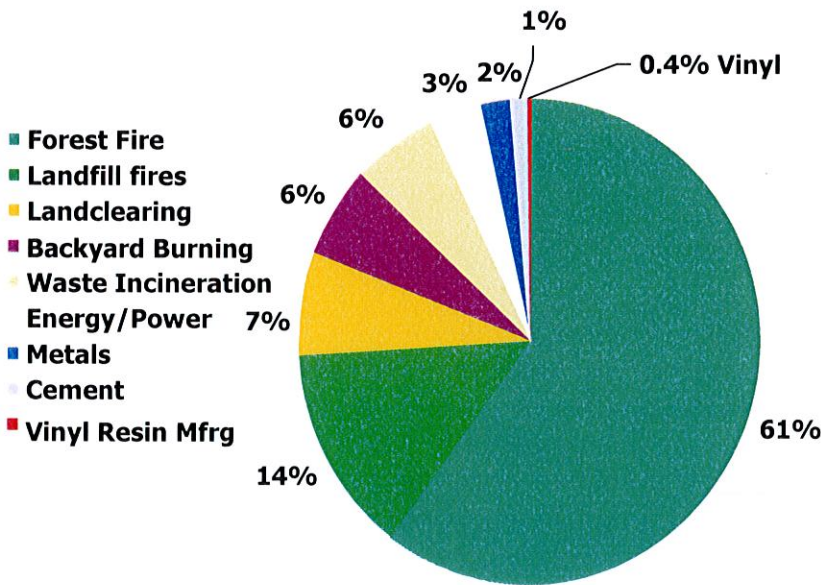
Cutting Condensation

Another key benefit of vinyl window systems is the ability to resist condensation that can lead to mold and mildew. Condensation tends to appear when moisture in the air settles on cold surfaces like glass. Since vinyl has low conductivity, the interior surface of vinyl windows remains relatively close to the room temperature and therefore less susceptible to condensation. In extreme cases, where non-vinyl window framing material has high conductivity, condensation can turn to frost or ice on the interior of a window. The ability to resist condensation is called condensation resistance factor (CRF). The lower the CRF, the more resistant the window is to condensation. Visit the AAMA website to calculate [CRF factor](#) in your area.

Myths and Truths About Vinyl

Vinyl provides low environmental impact

2000 Emissions



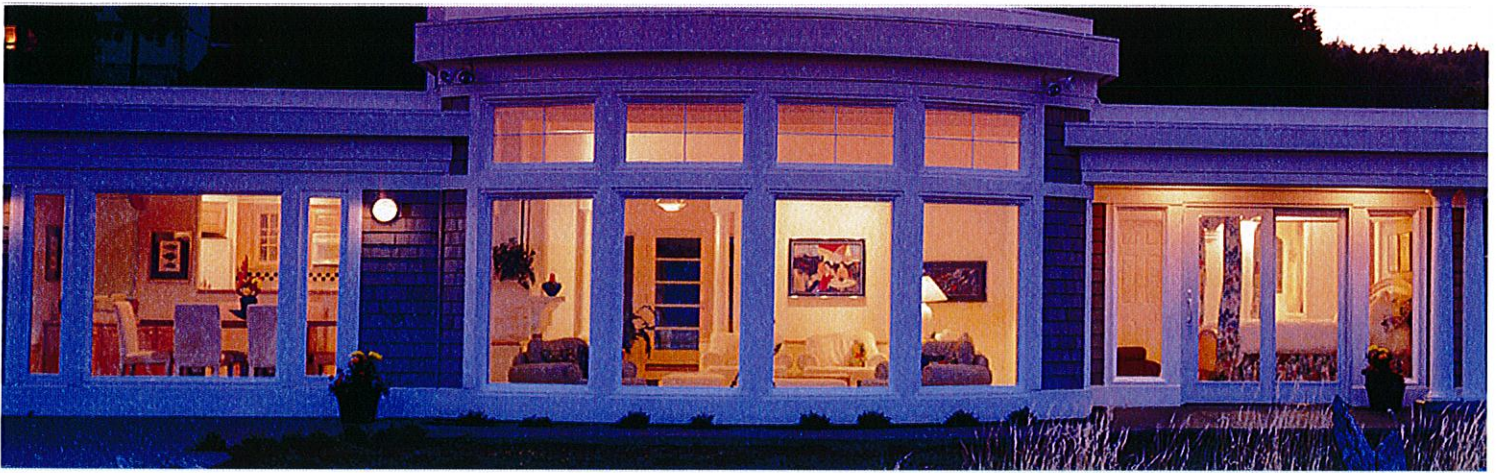
Source: [U.S. EPA Inventory of Sources of Dioxin in the United States \(External Review Draft 2005\)](#)

When considering vinyl for your next project, it's important to get the facts. That's why it's important to understand the truth regarding these myths about vinyl.

Vinyl can't be recycled – FALSE!

Because vinyl is a thermoplastic, vinyl products can be melted and remolded repeatedly. Vinyl scrap, trim, and off-spec material recycled from the vinyl production process adds up to more than 1 billion pounds per year. According to the 1999 Principia Partners study, *Post-Industrial and Post-Consumer Vinyl Reclaim*, this means that 99% of all manufactured vinyl is made into products — avoiding the landfill. In fact, post-industrial vinyl recycling has proven so viable that its price is indexed in leading plastic industry publications.

The study also states that an estimated 18 million pounds of post-consumer vinyl are recycled annually. A tremendous amount of post-consumer material is not available because it is still in service as durable pipe, energy efficient window profiles and other products that last decades. Furthermore, many companies offer take-back programs and are increasingly exploring other opportunities.



2. Vinyl is a major source of dioxin – FALSE!

Dioxin is an unwanted by-product of incineration, uncontrolled burning and certain industrial processes. Through regulation and voluntary efforts, releases of dioxin to the environment have been dramatically reduced. processes. Through regulation and voluntary efforts, releases of dioxin to the environment have been dramatically reduced.

Vinyl is an extremely small source of dioxin, so small that levels in the environment would be essentially unchanged even if vinyl were not being manufactured and used every day in important products. The vinyl industry has studied and worked to reduce its contribution to dioxin.

In fact, according to the latest data from the U.S. Environmental Protection Agency (EPA), vinyl manufacturing creates only grams of dioxin per year, which equates to less than one-half of one percent of all dioxins generated annually.⁵ Other dioxin sources include forest fires, volcanoes, burning wood in fireplaces, vehicle emissions and manufacture of other building materials. Overall dioxin levels in the environment have been declining for more than 30 years, according to the EPA. During this time, production and use of vinyl more than tripled.

3. Vinyl contributes to the danger of building fires – FALSE!

Fire science shows that the greatest hazards in a building fire are heat and carbon monoxide (CO) – a lethal, odorless gas produced in abundance by virtually all burning materials. If any hydrogen chloride (HCL) – an irritant gas with a pungent odor – is released, it can serve as a fire warning.

Additional Sources

[AAMA's Vinyl Material Council](#)

[Vinyl Institute](#)

[Vinyl in Design](#)

[American Chemistry Council Dioxin Facts](#)

Endnotes

1. [Plastic Pipe and Fittings Association Sustainability web page](#)

2. Study of Life Expectancy of Home Components, [National Association of Home Builders \(NAHB\)](#), February 2007

3. [Chemical Market Association, Inc. \(CMAI\)](#)

4. [AAMA/WDMA 2010/2011 U.S. Industry Market Studies](#)

5. [An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the U.S.](#), Environmental Protection Agency

Furthermore, HCL sampling in real fires shows that it tends not to reach dangerous concentration.

Because the vinyl polymer is made from 57% salt, a plentiful natural resource which by its nature resists combustion, this can help slowdown fires and saves lives. Vinyl is one of the few materials meeting the stringent National Electrical Code of the National Fire Protection Association (NFPA) for insulating electrical and data transmission cables and the interior of airplanes.

4. Synthetic materials, like vinyl and other plastics, are bad for the planet – FALSE!

All materials, both natural and synthetic, have an environmental impact. A 2004 study of environmental life cycle analyses of vinyl and competing building materials by the European Commission found that vinyl offers environmental benefits equal to or better than those of other materials in many applications. The USGBC PVC Task Group reached similar conclusions in its draft report issued February 2007.

Vinyl: Sustaining Life...for Generations

Versatile, energy-efficient vinyl provides a vital role in the built environment and in sustaining the environment. Products made from vinyl can and do last for generations and contribute to sustainable buildings. As technology advances, vinyl will continue to evolve as a part of life.



Material Council Member

AAMA ZM-6
Created: March 2012