7 Myths About PVC – **Debunked**

Myths about PVC are as common as they are misleading

There are few construction products or raw materials that generate as much unnecessary controversy as polyvinyl chloride, commonly known as PVC. However, the "controversy" over PVC comes in the form of misconceptions and myths that have proliferated over its decades of use. Like most myths, the ones about PVC are often sourceless or based on a lack of understanding; yet, they gain a false credibility through repetition.

No matter what the myths are, the vast majority of construction professionals – manufacturers, product distributors, specifiers, and contractors – can attest to the safe, consistent performance of PVC in a variety of construction products, including roofing membranes, pipes, siding, and window frames to name a few. For decades, PVC has also been used in life-saving and life-giving applications in a vast array of industries, from medical and pharmaceutical uses to food packaging and transportation.

The PVC industry has taken every opportunity to debunk the many myths about this material. These efforts are often filled with citations of numerous and wide-range studies by respected third parties and take great pains to point out that the perceived dangers of PVC are universally overblown. It is also widely recognized that the alternatives to PVC often require high-negative-impact, immensely extractive industrial practices that are detrimental to the environment.

In an effort to address issues of concern with PVC, there are, listed below, seven common myths, each of which is countered by the science that underlies PVC.

MYTH #1

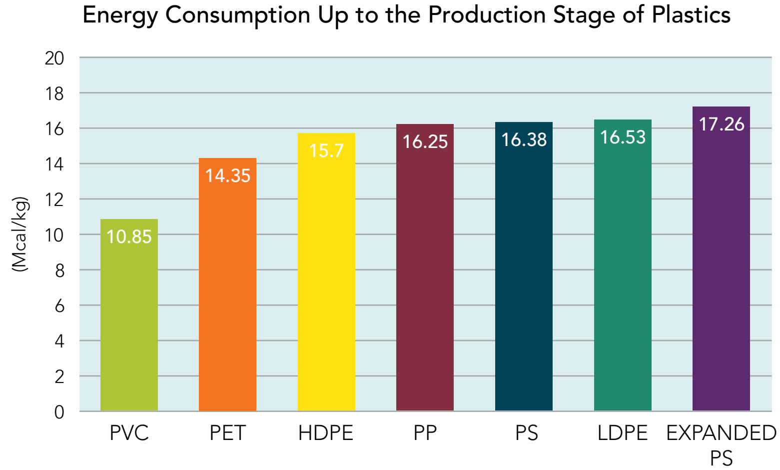
The alternatives to PVC are "greener" and their production, shipping, and use have less of an impact on the environment.

PVC (sometimes simply referred to as "vinyl") is perhaps best-known for its durability, but it also receives high marks for its sustainable attributes. PVC is extremely low-maintenance, easily recyclable, and it doesn't off-gas or leach harmful chemicals if it comes in contact with water. In addition, the PVC manufacturing process does not require a great deal of energy and the PVC itself is lightweight, which dramatically cuts down the carbon footprint of producing and shipping PVC products. Plus, PVC has relatively good thermal performance, which means it has *low thermal conductivity* (it resists heat transfer), and a good R-value per inch, especially when compared to possible replacement materials like aluminum or wood. Aluminum, particularly, is notorious for its bad thermal performance. For the life cycle "cradle-through-use" assessment, PVC outperforms alternatives like aluminum.

PVC measurably reduces cooling loads in buildings when it is used as a roofing material. In a 2001 federal study, Lawrence Berkeley National Laboratory (LBNL) measured and calculated the reduction in peak energy demand associated with a vinyl roof's surface reflectivity. Compared to a dark-colored roof on a Texas building that was studied, LBNL found that a retrofitted vinyl roofing membrane "delivered an average decrease of 42° F in surface temperature, an 11 percent decrease in aggregate air conditioning energy consumption, and a corresponding 14 percent drop in peak air conditioning energy consumption." In this case, the use of reflective PVC contributed to lowering the energy use of the building. In warm, southern climates where cooling costs are high, PVC can deliver substantial energy savings.

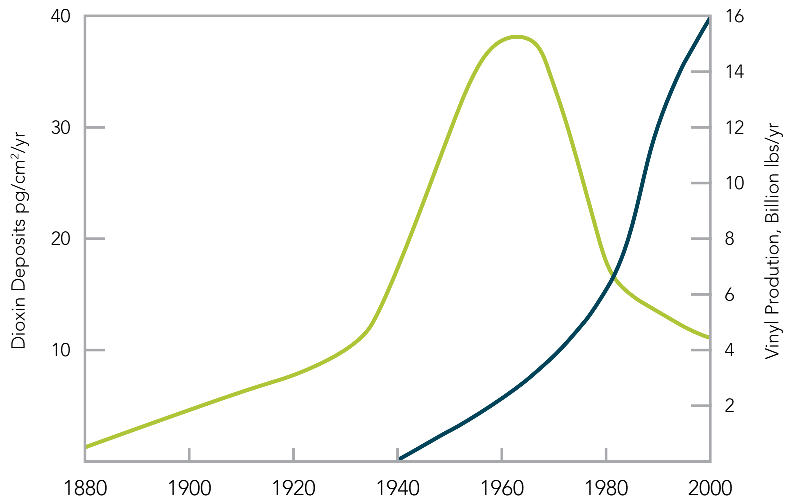
On the subject of carbon footprint, the CO2 emissions created by PVC manufacture are minimal when compared with metal, glass products, or – in the case of waste pipe – the cementitious products that would have to be created to replace PVC. (The CO2 emissions from the creation of cement today, even without the need to make more to replace PVC, already accounts for 5 percent of the industrial world's CO2 output.)

Energy Consumption Up to the Production Stage of Plastics



Source: Prepared from "A report on LCI date for petrochemical products", PWNI

Dioxin Declining as Vinyl Production Rises



According to a report from National Research Council Canada that looked closely at the energy impact of manufacturing PVC roof membrane, if you take into account the local product mix (type and thickness), the average CO2 generated per square meter of membrane produced varied by state from about 4.0 kg/square meter of membrane to less than 5.0 kg/square meter. However, the report observed, "the CO2 generated in the production of the [PVC] materials is a one-time event." When examining the environmental "pay-back period" for CO2 (the time it takes to recover the "environmental investment" of CO2 generated during production of the membrane), the payback periods are remarkably beneficial for PVC. Assuming a life expectancy of 20 years for PVC roof membrane, the report states, "on average, across the USA, the CO2 investment would pay for itself almost twelve times over a 20-year service life."

Additionally, PVC is comprised of 57 percent chlorine, which is derived from industrial-grade salt, an extraordinarily abundant material. The chlorine can be chemically unlocked from salt through simple industrial processes. (Even among other plastic alternatives to PVC, which are heavily dependent on petroleum, PVC shines for its low carbon footprint.)

The alternatives to PVC in common construction applications do not stack up as well in terms of their cost or performance. Whether it's in roofing, plumbing, or structural members (like window frames), alternatives to PVC often require the use of copper, steel, aluminum, or wood. When compared to copper, steel, and aluminum products, PVC is made from a raw material that has a much lower environmental impact. Copper, steel, and aluminum all require a great deal of energy to manufacture, which means they have a very high embodied energy. The mining and manufacturing processes for each of those products are widely known for highly negative environmental impacts that far exceed the low impact of the PVC manufacturing process.

MYTH #2

The PVC manufacturing process is highly poisonous, releasing dioxin and causing cancer.

Dioxin is a highly toxic chemical, but its presence in the environment has declined sharply in the last three decades. This has occurred while PVC production has increased by 300 percent. If PVC were the source of dioxin in the environment, dioxin levels would have risen over time, not declined.

Why the decline? The US Environmental Protection Agency (EPA), which regulates and tracks dioxin levels in the environment, points to regulation and voluntary industry actions. According to the EPA, dioxin emissions in the United States *decreased* by about 80 percent between 1987 and 1995, primarily due to reductions in air emissions from municipal and medical waste incinerators.

PVC has been associated with dioxin because it can be a minute byproduct of the combustion of PVC *if* it is not combusted efficiently; however, when combusted efficiently, PVC can be effectively broken down into water, carbon dioxide, and hydrogen chloride – largely harmless byproducts. Today, if PVC is incinerated (and not recycled, as it should be), the dioxin emissions from waste incinerators are due to *how* something is burned, not *what* is burned.

Where does the vast majority of dioxin the environment come from? It's not from PVC. According to EPA's "Dioxin Inventory", landfill fires are the chief culprits of the release of dioxin into the environment. The EPA determined this by mapping high dioxin concentrations and noting that areas of high concentration corresponded to areas affected by open waste burning. According to the EPA, waste incinerators (medical and municipal) are another source of dioxin; however, commercial-scale incinerators showed no relationship between the PVC content of the waste and dioxin emissions. According to the EPA, the largest determinants of dioxin formation are the incinerator's operating conditions, including combustion efficiency, post-combustion flue gas temperatures, and the presence of iron or copper, which can act as catalysts. Chlorine content alone is not responsible for creating dioxin in incinerators.

Other sources of dioxin include paper and pulp mills, municipal incinerators, cement kilns that burn chemical waste, and the manufacturing of some chlorinated pesticides.

MYTH #3

PVC is highly flammable, and when burned in waste heaps or in accidental fires, PVC off-gases toxic fumes, dioxins, and hazardous chlorine gas.

The myth about vinyl off-gassing toxic fumes can be easily addressed by pointing out three widely recognized properties of vinyl. 1) Vinyl building products exhibit superb fire performance, in large part because the material is *self-extinguishing* when the source of the flame is removed. 2) Vinyl building products are based on a naturally

fire-retardant polymer, and 3) the vinyl that is most prone to exposure during fires – roofing membrane – is often treated with additional flame retardants, which makes vinyl "slow to catch fire" and can dramatically reduce the spread of fire in the event of a building ignition. So, the question of off-gassing is partially addressed by the fact that vinyl doesn't burn very well. (In fact, the U.S. fire death rate has been steadily *decreasing* during a time when vinyl and other plastics have achieved dominant market share.)
Further, a report called "PVC Protects People in Accidental Fire," produced by Kaneka Research Associates, found the following about PVC in combustion:

- PVC's fire-retarding and self-extinguishing features are unique among various plastics.
- PVC radiates less heat in combustion, causing less spreading of fire to other materials.
- PVC generates less smoke in combustion, compared to other common building materials.

As for questions about whether PVC generates combustion gas, the same study found that:

- PVC generates hydrogen chloride in combustion, but the generation of carbon dioxide and carbon monoxide is proportionally reduced, and is slightly less than wood.
- PVC doesn't generate toxic hydrogen cyanide and aldehyde compounds.
- Hydrogen chloride is not as anesthetic as carbon monoxide. Additionally, hydrogen chloride serves to provide an escape signal with its pungent odor.

When PVC does combust, its contribution of toxins is "insignificant," according to third-party organizations that have conducted research on the combustion toxicity of vinyl products. According to the Vinyl Institute, "most fire scientists recognize that the largest hazard in a fire is carbon monoxide… The mix of gases produced when vinyl products burn, including hydrogen chloride, is very similar in terms of combustion toxicity to those of other common building materials when they burn." Though hydrogen chloride is an irritant gas, it is nowhere near as dangerous as the chemical dioxin or carbon monoxide, the release of which is often, and wrongly, attributed to vinyl.

Additionally, as noted elsewhere in this article, PVC does not represent a dioxin release risk every time it is burned. When burned efficiently, as we see in controlled industrial-grade incinerators, PVC releases water, carbon dioxide, and hydrogen chloride. In the event PVC ignites in an accidental fire, it is more likely to contribute to *stopping* the spread of the fire than releasing dioxin. In all cases in which PVC combusts, any dioxin emissions would result from how PVC is burned; not all combusting PVC is a dioxin risk.

Photo: Rewindo Fenster-Recycling-Service GmbH

The collection and recycling of replaced PVC window systems is common practice today. At the end of the process, modern heat-insulating windows are manufactured which save energy and improve internal climate conditions.

MYTH #4

PVC can't be recycled and is a significant contributor to the global accumulation of plastic waste.

Few products are more readily recyclable than PVC; in fact, PVC can be recycled many times over without degrading the component materials, enabling it to be used in multiple product life cycles. Many of the PVC products in use today are likely to contain PVC that has been reprocessed for use through a simple recycling process.

Today, you will find recycled PVC in a wide range of uses, from new consumer products such as cookware and sterile medical products, to car parts and speed bumps on residential streets.

With the versatility of PVC and its high recyclability, the manufacture of PVC may be one of the few manufacturing processes that can achieve true zero waste. Additionally, PVC can be blended into fuel. In 2010, Sita, a waste company owned by France-based Suez Environnement, stated that it was building 10 plants across the UK to convert end-of-life plastic into diesel fuel. At each plant, Sita will convert 6,000 metric tonnes (over 13,000 pounds) of mixed waste plastic per year to produce four million liters (more than one million gallons) of diesel fuel.

How exactly is PVC recycled? There are two main approaches. PVC can be "mechanically recycled", a process in which it is cut into very small pieces. Since PVC is a thermoplastic material, these pieces can be readily melted to form new products. (The word thermoplastic means that PVC becomes malleable when it is heated, and that it hardens again when it cools.) The second process is what's called "feedstock recycling" in which PVC waste is broken down to its constituent chemical molecules. Those molecules can be used again to make new PVC.

Another positive feature of PVC is how little of it has to be recycled at all, if the product is treated prudently at the end of its life cycle. That's because PVC products are both low-maintenance and long-lasting. Plumbing systems that use PVC regularly achieve service lives reaching over 50 years.

Finally, the myth that PVC is a sign of a throw-away culture could be ascribed to many products, but it shouldn't be applied to PVC. With the proper attention to reuse and recycling, PVC essentially *never* has to be thrown away.

MYTH #5

PVC can't be a green product – it is not natural, contains harmful chemicals, and the chlorine used in PVC is toxic.

Chlorine is a pervasive chemical in our modern lives. It is used in manufacturing, pharmaceutical processes, numerous household products, clothing production, and water purification. One of the reasons chlorine is so effective as a cleanser and purifier of water is chlorine's unique chemical configuration. It has a very high electron affinity that makes it a strong oxidizing agent, even though it is the 11th most common of the 107 elements, and it is found widely in both living and non-living things. In the form of chloride ions, chlorine is necessary to all known species of life. Chlorine helps to blast apart pathogen bacteria and viruses in the water supply; human civilization would suffer greatly and exist in a very diminished capacity without chlorine.

One of the reasons that chlorine may have gotten a bad reputation is that fact that chlorine gas, in concentrated form, is indeed dangerous. With that said, the chlorine that is used in PVC manufacturing actually comes from sodium chloride (common salt). This is a highly stable form of chlorine that should not be confused with chlorine gas. Though the chlorine gas and the caustic soda are both *chlorines*, per se, they represent chlorine in two distinctly different forms, and to confuse or conflate the two forms – one volatile and toxic, and the other a stable powder – is to misunderstand these important distinctions. You cannot obtain chlorine gas from burning PVC. The chlorine used in PVC production poses no more of a health threat than the chlorine used to purify water coming from your household tap.

MYTH #6

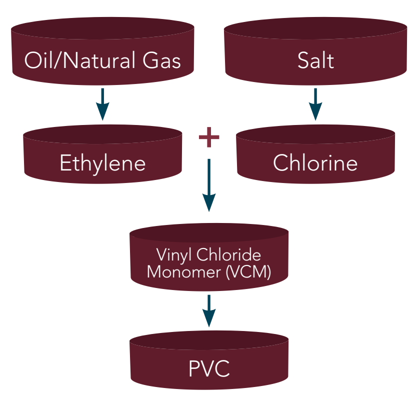
PVC is very expensive to manufacture, in part because of the exotic chemicals that must be used in its creation.

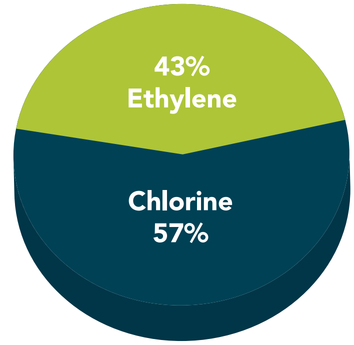
PVC is made from two very common chemicals, chlorine (common salt, a.k.a. sodium chloride) and ethylene (derived from natural gas), and there is nothing expensive or exotic at all about the PVC manufacturing process. To determine the relative costs of PVC, stop in to a home center or building material supplier and compare the price of a 10-foot piece of ½-inch PVC piping to the same pipe made of copper. The PVC will cost you under $2, and the copper will run over $15. The retail prices of these items reflect the substantial differences in the price of manufacturing and the cost of shipping. (A copper item is orders of magnitude heavier than a similar one made from PVC.)

A study entitled *"The Economic Benefits of Polyvinyl Chloride in the United States and Canada"*, conducted by Whitfield & Associates, found that the cost per foot of ductile iron and concrete may be comparable to PVC; however, installation costs are higher, particularly for concrete, since many more pipe joints are required. "Replacement and repair costs are much higher for concrete than for PVC pipe as well. Additional costs are imposed by the loss of water due to main breaks and pumping costs may be higher for these substitute materials," the report stated. It went on to say that "the net cost to consumers in the United States and Canada for the substitution of alternative materials for the PVC-based products that they currently use would be almost $17.7 billion dollars per year. In addition to these costs, we estimate that consumers would be forced to pay additional costs because producers of the substitute materials would need $5.6 billion in new investment to manufacture the incremental volume of substitute material, and incur the associated $2.8 billion per year in capital recovery charges. The avoidance of these costs is part of the benefit that PVC brings to consumers. Thus, the total direct and indirect benefits of access to PVC to consumers in the United States and Canada amount to over $20 billion per year."

The chemicals that make up PVC are not exotic in any regard. PVC contains 57 percent chlorine and 43 percent is ethylene. The chlorine is created through a process that chemically separates it from industrial-grade salt, or sodium chloride. The ethylene is derived predominantly from natural gas. (Ethylene is also the chemical given off by ripening fruit.)

Although chlorine in various forms can be an irritant and an oxidizing agent, the form of chlorine used in PVC manufacture is in a very stable form. And once PVC is made, it is





inert and no chlorine off-gases from the finished product, because it is chemically locked into the PVC.

MYTH #7

Plasticizers used in the manufacture of PVC pose a health issue, cause asthma, and are a bio-accumulative toxic substance.

PVC is naturally rigid when it is manufactured. In applications where the material must be malleable, like roofing, PVC manufacturers will add phthalates (plasticizers) to the PVC to soften the product. Phthalates not only make PVC flexible, but they can provide transparency and durability as well. In fact, to cite a typical quote, this one from a 2001 study on plasticizers by the Swedish National Board of Health and Welfare, "The risk in connection with plasticizers is clearly exaggerated."

There has been a great deal of debate about phthalates and their potential health risks. An enormous amount of research has gone into determining if phthalates are hazardous. Today, after four decades of study, and an equal number of years in which phthalates have been pervasive in the environment, no party has shown that phthalates used in today's PVCs cause harm to humans when used as intended.

Phthalates have also been falsely attributed to the rise of asthma. Although asthma is undeniably a growing concern today, there have been wide-ranging studies to determine if phthalates contribute to it. The Institute of Medicine of the National Academy of Sciences has researched this topic, and as a result of its inquiry, phthalate plasticizers are not on the Institute of Medicine's list of more than a dozen chemical and biological agents where there is a known risk for asthma. Indeed, there is no substantive evidence to suggest that phthalates contribute to asthma.

Another anti-phthalate argument claims that phthalates persist in the environment and that they accumulate in the tissue of humans and other animals. The EPA, an organization that is known for its conservatism and bias for consumer safety, does not list phthalates as persistent, bioaccumulative, toxic substances, also known as PBTs. Today, PVC with phthalates is a widely used material in many medical products, which are highly regulated by the US Food and Drug Administration (FDA). These medical products have been used safely with patients over long stretches of time where evidence of phthalate poisoning would surely have emerged. Another aggressively cautious group, the U.S. Consumer Product Safety Commission, examined the risk of phthalates in plastic toys and found "no demonstrated health risk". Numerous studies have shown that phthalates used in PVC represent no risk to manufacturers, installers, or end users.

For years, the migration of phthalates from PVC has been blamed for the "fog" that accumulated on the inside of windshields of automobiles. Phthalates have little to no odor and have very low volatility, which means they do not easily evaporate. In two recent studies, two auto interiors were exposed to elevated temperatures. A report published in 2001 by Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) discussed the "new car smell" and suggested that the sources might present some risks to health. The CSIRO report listed nine substances found in new-car interior air that could be problematic in high concentrations. Neither vinyl nor phthalates are on the CSIRO list. The majority of these contaminants were from the adhesives in the carpeting and the foam in the seats.

In conclusion, after reading through the above sections of this article that dismantle and discredit the common myths surrounding PVC, it's surprising that these myths endure at all. The information that counters the myths is widely available, and it invariably includes reputable third parties, many of which have no vested or commercial interests in the studies' outcomes.

The idea that the alternatives to PVC are greener or more sustainable is easily countered by looking at the embodied energy of likely alternative products, all of which depend on extractive practices that degrade the environment.

The notion that PVC manufacturing is highly poisonous due to the release of dioxin can be readily refuted by the studies of very credible agencies such as the EPA and the FDA. There are widely cited reports that show that dioxin risk comes not from PVC production, but from the inefficient combustion of many products that also include PVC in poorly regulated or under-regulated circumstances.

The myth that PVC is highly flammable is readily countered by the fact that chlorine contained in PVC actually acts as a *fire retardant*, which inhibits the spread of flames. Plus, when the source of flame is removed, PVC is self-extinguishing.

The idea that PVC can't be recycled is countered by the wide recycling of PVC in its many forms and product incarnations. Indeed, there are few products more recyclable than PVC.

Some PVC critics claim that PVC can't possibly be a green product, because it is not natural and contains harmful chemicals, but those same critics can readily look at the chemical processes of the manufacture of PVC and see that chlorine and ethylene are two very common products that pose little to no risk when used as intended.

As for the claim that PVC is very expensive to manufacture, a simple comparison of the cost of PVC products to their copper, iron, steel, or many other alternatives will quickly explode that myth, as PVC is remarkably affordable by any comparison.

Finally, the most pervasive and consistent myth about PVC, that the plasticizers used in the manufacture of the product are harmful, has been disproved repeatedly in peer-reviewed journals and third-party studies in the United States, the European Union, and elsewhere.

Indeed, in its many forms, PVC has proven to be a marvel of modern manufacturing science.

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