



PVC PIPE

THE PROVEN SOLUTION FOR
AMERICA'S WATER INFRASTRUCTURE



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EXECUTIVE SUMMARY

PVC pipe has revolutionized water infrastructure around the world for the past 70 years.

When municipal governments replace their aging pipes near the end of their service life, they increasingly turn to PVC to supply their residents with clean, safe drinking water. And the reason is simple: PVC is the best material for the job.

- **Seven decades of experience** have conclusively shown PVC pipe safely delivers clean drinking water to communities throughout the U.S. and the world. This is reaffirmed by PVC pipe's compliance with NSF 61, a standard recognized by the U.S. Environmental Protection Agency that sets minimum health effect requirements to avoid impurities or chemical contaminants in drinking water systems.¹
- **PVC pipes are built to last.** Academic research shows that PVC pipe can remain in operation more than 100 years – and has an extremely low failure rate.²
- **The durability of PVC piping is unparalleled.** PVC pipe's inherent corrosion-resistant properties drastically reduce the need for costly repairs and replacements commonly required for pipes made from other materials, especially cast iron, ductile iron, concrete, and steel.³
- **PVC pipes use less energy.** Total energy consumption for PVC pipe over a 100-year period is 2.4 times less than ductile iron when accounting for manufacturing, transporting, installing, and required replacement costs.⁴
- **PVC pipe is easy to install and cost-effective,** making it an ideal choice for rural communities where municipal water infrastructure does not exist. Millions of Americans in sparsely populated regions have access to potable water as a result.⁵
- **PVC saves U.S. taxpayers millions.** Towns and cities around the country have found that ductile iron is significantly more expensive than PVC pipe—up to 70% more in some cases.⁶ This can translate to significant savings for communities that choose PVC pipe.

Despite these documented benefits, opponents of PVC pipe have done their utmost to discourage governments from utilizing the material for water infrastructure. This report will provide a science-based overview of PVC pipe and fact-check the false claims of the material's ideological critics.

Access to clean, safe water makes modern life possible. It's a key measure of progress against poverty, death, and disease.⁷ Credible scientific research, combined with decades of real-world evidence, lead to one conclusion: PVC pipe is a proven safe and sustainable material on the market today that offers tremendous benefits to U.S. taxpayers. And it will continue to lead the way in modernizing America's water infrastructure for the next 100 years, and beyond.

SECTION 1 ○

PVC PIPE: DECADES OF SAFE WATER DELIVERY

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PVC PIPE: DECADES OF SAFE WATER DELIVERY

PVC was first used to deliver drinking water in Europe in the 1930s.⁸ Experts quickly recognized that the polymer was appropriate for intensive applications because of its durability and heat resistance. Its composition and smooth internal structure made it ideal for water delivery.

These first-generation PVC water pipes were still in use over 70 years after installation. Since then, significant progress in the design and construction of PVC pipe greatly expanded its ability to deliver safe, clean drinking water to consumers.

A young girl with brown hair is drinking water from a chrome faucet. She is wearing a floral patterned top. The background is a bright, sunlit kitchen.

The safety of today's PVC pipe is established by its compliance with the rigorous NSF 61 standard.



What is NSF?

- NSF is a certification organization that is independently audited to ensure its product evaluations are impartial. For over 70 years, the organization has earned the trust of regulators, industry, and academic scientists.
- NSF uses exhaustive testing methods to establish independent standards – to which all water pipe materials, including PVC, must adhere – assuring the safety of clean drinking water.

What does NSF 61 do?

- NSF 61 is the recognized standard in the U.S. that ensures the safety of drinking water piping.⁹
- The NSF 61 standard specifies contaminant limits for **all** drinking water contact materials, which are subjected to extensive safety testing, such as rigorous extraction tests, before they can be certified.¹⁰ This applies to all pipe materials – including iron, copper, cement, and PVC, among others.
- NSF 61 and several American Water Works Association (AWWA) standards “have been developed to prevent the degradation of drinking water due to contact with piping materials.”¹¹ All drinking water pipes, including PVC pipe, must meet these standards.
- Manufacturer certification to NSF 61 means PVC pipe does not add harmful contaminants to drinking water while in use conveying water to U.S. homes and businesses.¹²

PVC pipe has unmatched performance properties:

- PVC pipe does not corrode internally or externally, even after decades of use. PVC pipe doesn't require chemical additives to drinking water to inhibit corrosion, either.¹³
- PVC pipe isn't prone to scaling or tuberculation,¹⁴ a form of internal corrosion and biofilm contamination that can occur in other piping materials,¹⁵ which can create a breeding ground for harmful bacteria such as Legionella¹⁶ and E. coli.
- PVC pipe's non-corrosive qualities prevent loss of clean water and seepage of sewage in regions with corrosive soil conditions.¹⁷

PVC pipe is often used as a core component of water wells—giving rural communities access to safe and clean water, as PVC drinking water well components must also meet rigorous ANSI/NSF standards.¹⁸

CASE STUDY

Walkerton, Ontario: In 2000, *E. coli* had infiltrated the municipality's iron-pipe water network. Purging it from the system was extremely difficult. Ontario's Ministry of the Environment called it “the most extensive remediation effort undertaken.” 1,800 buildings were disinfected, 5,000 water samples were administered, and every private well and cistern had to be inspected. As a result, Walkerton, part of the Municipality of Brockton, replaced iron pipes with PVC.¹⁹





PVC: THE CLIMATE-FRIENDLY PIPE MATERIAL

As consumers grow more concerned about the impacts of climate change, governments are implementing measures to reduce greenhouse gas (GHG) emissions quickly and permanently. Water utilities around the United States have identified PVC pipe as an important tool in this broader sustainability initiative.



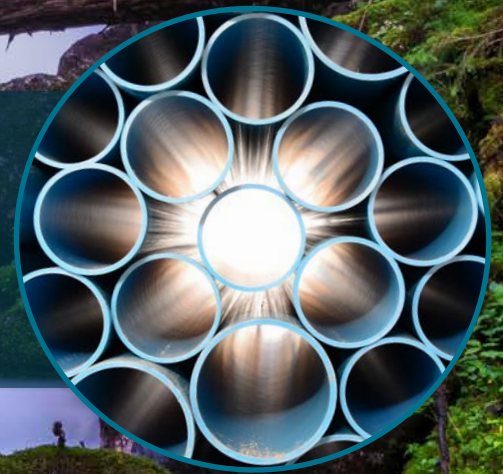
The facts underscore PVC's sustainability benefits:

- PVC has an overall lower carbon footprint than other pipe materials like iron, cement, and clay based on total life cycle energy usage.²⁰ This is because PVC pipes require much less energy to manufacture and transport, and they can operate for more than a century and need fewer replacements over their lifetime .
- PVC pipe is lightweight, making it easier to transport and install—resulting in fewer GHG emissions from trucks and cranes.²¹
- PVC pipe systems require less energy to pump water, resulting in cost, energy, and carbon savings throughout their service life.²²
- PVC pipes also have significantly lower total GHG emissions during production than other pipe materials.²³ Recent studies conservatively estimate that PVC sewer pipe applications have approximately 45% lower greenhouse gas emissions than reinforced concrete and 35% lower than ductile iron.²⁴
- Plastic pipe, such as PVC and CPVC, helps create sustainable systems – including rainwater harvesting, subsurface irrigation, greywater reuse, and residential fire sprinkler systems.

PVC CAN BE RECYCLED !

PVC can be recycled over and over again. Because of its unique composition, PVC can be mechanically recycled into many other PVC products.²⁵ And since PVC pipe is so durable, with a lifespan of more than 100 years, most of it has yet to enter the recycling stream. All PVC pipe in North America is produced through closed-loop manufacturing using internal regrind PVC scrap and integrated back into the product, significantly reducing waste from the manufacturing process.

PVC pipe manufacturers can regrind scrap during production and integrate it back into the manufacturing process, significantly reducing waste from operations.²⁶



SECTION 3 ○

PVC PIPE IS BUILT TO LAST



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PVC PIPE IS BUILT TO LAST

Communities across the U.S. lose billions of gallons of water per day to aging infrastructure.²⁷ In fact, some cities lose at least half their treated water before it reaches residents' taps.²⁸

This creates significant costs for taxpayers and often serious public health risks. The good news is that many municipalities are solving both problems by installing durable PVC pipe.

Testing of in-service water systems from around the world shows that PVC pipes have a service life in excess of a century.²⁹

“Ductile iron pipe should have a lifespan of 100 years, but [Deputy Director of Utilities Braxton Copley] said the city has seen a large number of breaks in pipes that are only 40 to 50 years old.”

TOPEKA CAPITAL-JOURNAL³⁰

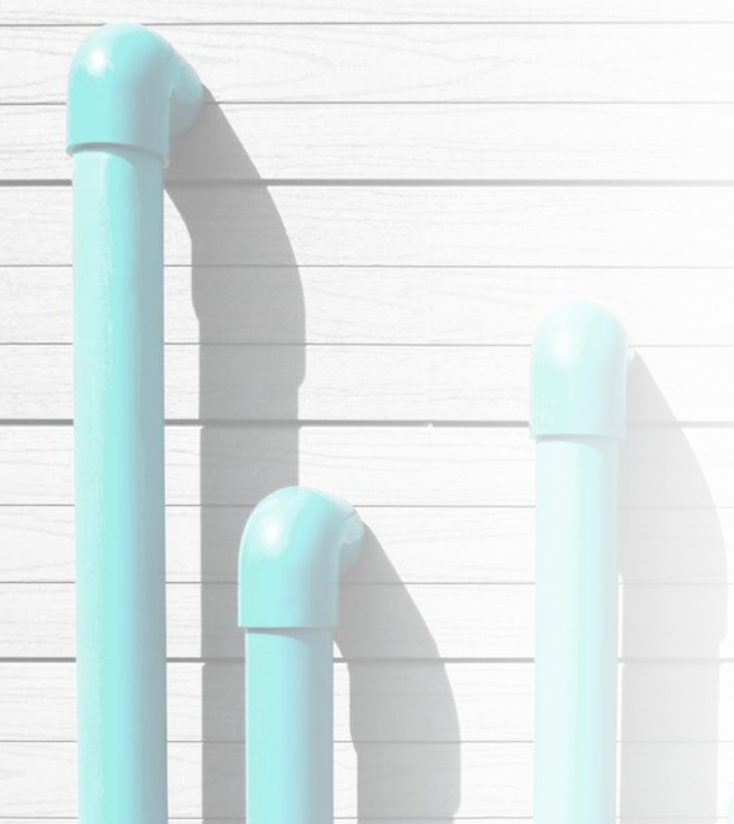


PVC pipe has the lowest overall failure rate

compared to five other commonly used piping materials, according to Utah State University's Buried Structures Laboratory.³¹

FACT: Corrosive soils affect 75% of water utilities. A pipe's durability and corrosion resistance significantly impact its life cycle. Ductile iron pipe may last as little as 11-14 years in moderately corrosive soils, requiring several replacements over 100 years.³²

As of 2018, failing iron pipes accounted for more than 85% of water main breaks in Topeka, Kansas. Just 4.5% were associated with PVC piping, even though 25% of the system is made up of PVC pipes.³³





PVC pipes had a failure rate 2.5 times lower than traditional materials in Indianapolis, Indiana, resulting in significant cost savings for area taxpayers.³⁴

“Since PVC pipe can be ... less expensive than iron pipe, [and] lasts longer with greater pumping efficiency, it’s the best choice to replace America’s drinking water systems.”

— Bruce Hollands, Executive Director, PVC Pipe Association³⁵

PVC vs. Iron Data 2018:

TOPEKA PIPE BREAKAGE

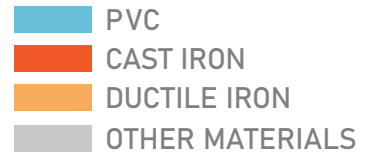


Fig. 1: Topeka's pipe system is 39% cast iron, 27% ductile iron, 25% PVC, with the remaining made of various other materials.

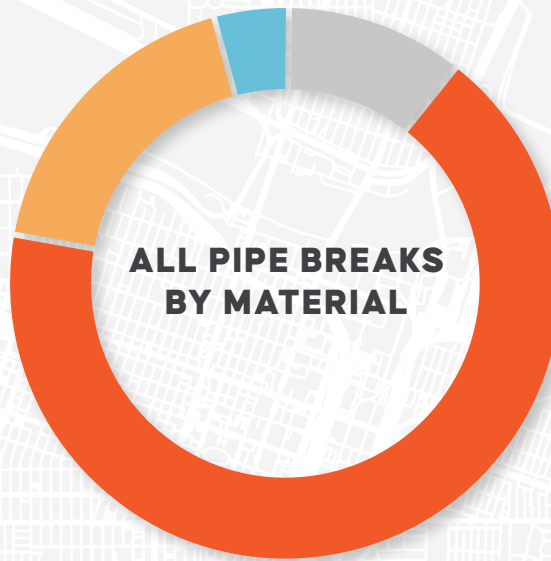


Fig. 2: In Topeka, 66.8% of all breaks occur in cast iron pipes, 18.4% in ductile iron, and just 4.5% in PVC pipes.

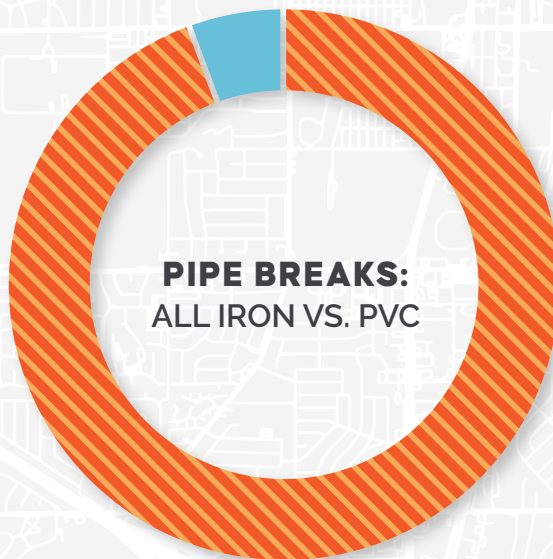


Fig. 3: All iron pipes (cast and ductile) fail 18x more frequently than PVC pipes.

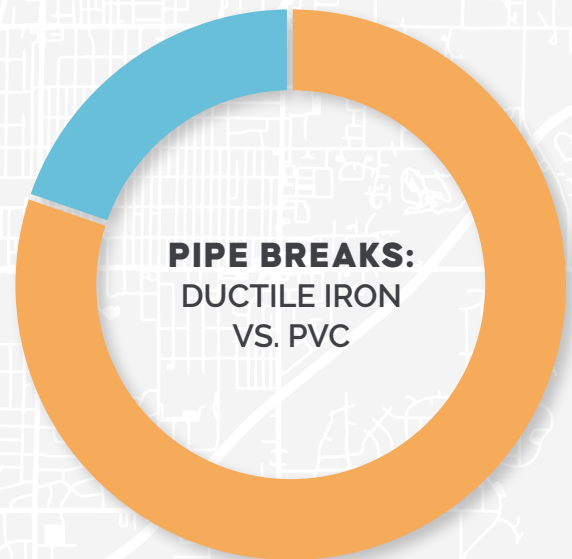


Fig. 4: Ductile pipe accounts for more than 4x as many breaks as PVC, despite the fact that ductile iron makes up roughly the same share of the system (27%) as PVC (25%)

Source: Topeka Capital-Journal

SECTION 4 ◦

PVC PIPE SAVES TAXPAYERS MILLIONS

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PVC PIPE SAVES TAXPAYERS MILLIONS

Failing water infrastructure is costly. Although most utilities aren't required to track water loss, those that do report troubling results. Atlanta, Georgia's water system, for example, lost almost one-third of the 35 billion gallons it supplied to residents in 2021, costing taxpayers nearly \$3 million.³⁶

Each day, the U.S. loses an estimated six billion gallons of treated water; that's enough to fill more than 9,000 swimming pools.³⁷ The problem is massive, but the facts indisputably show that PVC pipe saves American taxpayers money and significantly reduces water loss.

Pleasanton, CA found PVC pipe to be 70% less expensive than metal pipes. City officials there noted PVC pipe doesn't require corrosion protection (unlike ductile iron pipe), its installation requires less labor, and that PVC pipe failures are "extremely rare" which helps keep operation and maintenance costs low.³⁸

"As mayor, it is my responsibility to explore options that will get our rate payers the best bang for the buck. The open procurement process, allowing the bidding of different pipe materials, not only forced suppliers to sharpen their pencils, it ended up saving the city of Burton over \$2 million by using PVC pipe instead of ductile iron (DI) pipe on our five-phase \$25 million watermain replacement project. Even if we would have chosen to use DI pipe, the open procurement process forced the cost reduction of the DI materials that would have saved about \$200,000 in the project."

*Burton (MI) MAYOR PAULA ZELENKO*³⁹



As more communities turn to PVC to safeguard their water supplies, demand for PVC pipe is growing exponentially. The market was valued at \$6.3 billion in 2021 and is projected to reach \$12.1 billion by 2031.⁴⁰

"PVC pipe projects have proven to bridge the gap of both new growth and lower life cycle costs and affordability," says Greg Baird, president of the Water Finance Research Foundation.⁴¹

- **FACT:** 66% of water supply pipes in the U.S. are 8-inches or smaller. Using PVC over ductile iron pipe in this size range could save \$21 billion in national pumping costs over 100 years.⁴²
- **FACT:** It takes up to 54% more energy to pump water through an 8-inch ductile iron (DI) pipe than it does through an 8-inch PVC pipe during the life of the piping system.⁴³



SECTION 5 ◦

THE CASE FOR OPEN COMPETITION IN WATER INFRASTRUCTURE

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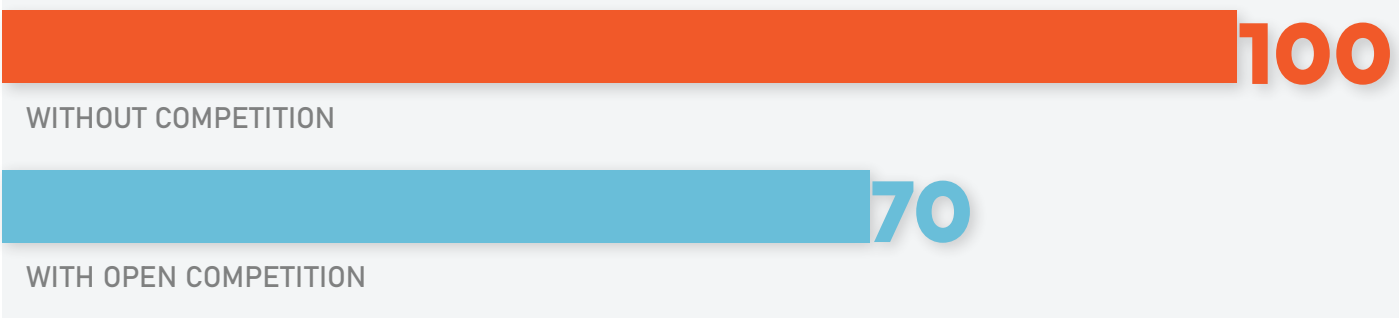
"Basic economic theory demonstrates that when firms have to compete for customers, it leads to lower prices, higher quality goods and services, greater variety, and more innovation."⁴⁴ *Translation: to succeed in a free market, manufacturers need to deliver high-value products at competitive prices.*

The same law of economics applies to the market for water infrastructure. If municipalities have a range of materials to choose from, that competition inevitably lowers the cost for local residents—taxpayers and ratepayers who finance water utilities.

PVC pipe's 100-year-plus service life⁴⁵ reduces water-main breaks and is **one of the most affordable pipe material options on the market.**

Cities save nearly 30% on material costs even when they don't select PVC pipe. This amounts to nearly \$100,000 in savings per mile.⁴⁶

THE EFFECT OF OPEN COMPETITION ON PROJECT COST



The ductile iron industry doesn't want competition. That's why it has lobbied for restrictions in cities across the U.S. that would exclude PVC from consideration for water-utility projects.⁴⁷

At the national level, **open competition could save U.S. taxpayers an estimated \$42.8 billion over the next 10 years.**⁴⁸

These savings come at a time when water-delivery costs are skyrocketing. U.S. Census data shows that local governments spent more than \$118 billion on water and sewer services in 2015.⁴⁹

As city utilities work to boost their water and sewer capacity by 25% to service the 80 million new Americans expected by 2051, these costs are likely to further increase.⁵⁰

FACT CHECKING FALSE CLAIMS OF PVC OPPONENTS

Competitors and a small group of activists have spread considerable misinformation about PVC pipe over the years. Here are some of their false and misleading claims – and the facts that discredit them.

MISLEADING CLAIM	PVC FACT
<i>PVC pipe leaches harmful vinyl chloride into drinking water . . .</i>	PVC pipe adheres to NSF 61, a standard recognized by the U.S. EPA that ensures the delivery of safe, clean drinking water. All pipe materials must comply with NSF 61. Over 10 million water quality control tests have shown the safety of PVC pipes. ⁵¹
<i>Melted PVC pipe from wildfires leach benzene into water supplies . . .</i>	<p>PVC pipe does not produce benzene during open-air combustion, including wildfires.⁵²</p> <p>Benzene is emitted by burning wood,⁵³ which is the likely source of municipal water contamination after a wildfire.⁵⁴</p> <p>Those contaminants likely enter the system via damaged service lines that connect buildings to the water main.⁵⁵</p> <p>Wildfires would not impact any water and sewer infrastructure pipe that is buried to a sufficient depth underground; it is insulated from heat generated above ground.</p>
<i>PVC pipe can't be recycled . . .</i>	More than 1.1 billion pounds of pre- and post-consumer PVC / vinyl materials are recycled annually in the U.S. and Canada, and post-consumer vinyl recycling has increased by more than 40% since 2014. ⁵⁶
<i>PVC pipe isn't sustainable . . .</i>	<p>PVC pipe has a service life in excess of 100 years,⁵⁷ reducing the need and use of additional material for replacement and maintenance.</p> <p>PVC pipe has the lowest carbon footprint compared to competing materials in gravity and pressure pipe applications.⁵⁸</p> <p>Excavated PVC pipe also has high recyclability potential – it can be recycled back into a pipe product and perform the same function as one made from virgin material.⁵⁹</p>



MISLEADING CLAIM	PVC FACT
<p><i>PVC pipe releases dioxins . . .</i></p>	<p>Dioxins are widely present in the environment from a broad range of sources, with the largest contributors being unregulated sources, such as forest fires, volcanoes, and common burning of wood.</p> <p>However, PVC resin production for pipes represents less than 0.2% of all US dioxin releases. This compares favorably to heavy equipment (approx. 2%), industrial wood burning (approx. 3%), and diesel trucks (approx. 5%).⁶⁰</p> <p>While the total US dioxin emissions from PVC manufacturing have been in decline for decades, levels have declined by more than 50% since as recently as 2009 thanks to continued investments in control technology.^{61 62}</p>
<p><i>PVC pipe contains plasticizers . . .</i></p>	<p>Rigid PVC pipes “certified by NSF do not contain phthalates or phthalate plasticizers.”⁶³ Plasticizers are used to make flexible vinyl products, not rigid PVC pipe.</p>
<p><i>PVC pipe containing organotin stabilizers should be avoided . . .</i></p>	<p>Throughout the U.S. and Canada, raw materials used to make PVC pipe can include heat stabilizers that contain tin.</p> <p>These stabilizers have been tested and deemed safe for use in potable water applications. Certification to NSF 61 would confirm that the organotin stabilizers used in PVC water pipe meet all federal drinking water safety requirements.⁶⁴</p>

SECTION 7
CONCLUSION

Municipal governments are increasingly turning to PVC pipe because of its unsurpassed performance and unbeatable value. They are basing their purchasing decisions on the facts and choosing PVC pipes to sustainably supply their residents with safe, clean drinking water.

And they have good reasons for doing so. Decades of sound science and experience make clear that PVC pipe is reliable, safe, affordable, and sustainable—helping communities protect public health, mitigate climate change, promote recycling, and save their residents millions of dollars along the way. The rapid growth of PVC water infrastructure shows what can happen when technological innovation and evidence-based policy help make all of our lives better.

SECTION 8

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