

Prices for Argon Have More than Doubled in the Past 5 Years

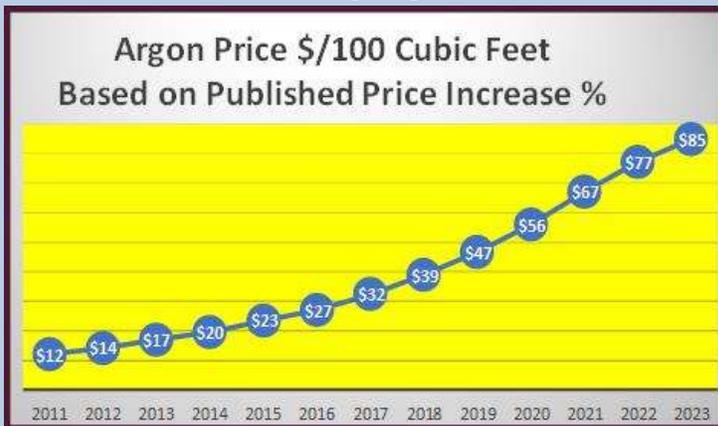
Argon Gas Market Volume Growth Predicted to be 4.9% Through 2026

It's used more than just for welding. Increasing demand for Argon gas in the food/beverage and pharmaceutical industries across the world, is causing high usage. Changing weather will expand Argon use to insulate double and triple pane windows is driving up demand.

Helium is in very limited supply. Argon is being used to replace Helium in various welding applications. The very high price of Helium helps drive the growing use of Argon.

PRICES: Argon is only 0.93% of the air; the other gases, Nitrogen 78%, Oxygen 21%. CO₂, which gets all the publicity, is next at only 0.038%; yep ~25 times less!

Manufacturers extracting Argon from air must first liquefy all the air! The graph left



is based on Argon price increase announcements by the few North American manufacturers. (See Appendix for details.) They have the ability to expend up to 100 million dollars capital for a production plant. They must also have the liquid gas storage tanks, liquid gas trucks and industrial gas sales capability to market the 99%, Nitrogen and Oxygen. Many

smaller gas liquefaction plants cannot justify the extra ~20+% cost for the two additional distillation columns and chemical processing needed to extract Argon. That is one reason for the high Argon price.

Argon Supply is Tight as Producers Consolidate

This pie chart shows a major change in US Argon production with the recent acquisition of US Industrial Gas producers by two European companies. Air Liquide (France) bought Airgas and Linde AG (Germany) merged with Praxair.



US based Air Products is the other major producer. Matheson Tri-Gas have been acquiring US gas distributors/producers for a number of years. They are owned by Japan Oxygen. Another German company, Messer, is buying a few plants the FTC required be divested because of one merger.

Air Products announced a 20+% Argon price increase effective September 2021 following a 35% increase in 2020. The limited number of suppliers usually follow increases. Argon prices have increased about 20% each year since 2017. Until 2020 where it's 35%! Compounded that's over double in 5 years!

GET READY FOR ARGON ALLOCATION! That's What Happened A Few Years Ago.

Several years ago, a manufacturer of aluminum horse trailers was told they would only get 70% of their prior year purchase of Argon. Their choice was to make ~30% less trailers or BUY our, inexpensive, patented Gas Saver Systems (**GSS**.) They elected to reduce their shielding gas waste and made the smart choice by purchasing 100 **GSS**'s for all their MIG welders! They found no need to reduce production and were able to buy all the Argon needed. **GSS** details follow.

Supplier Consolidation Brings Major Changes!

The merger of 4 industrial gas producers has two companies with over 70% of the American Argon Capacity! If you thought doubling of Argon and Argon/CO₂ Shielding gas prices recently was excessive- - HOLD ON TO YOUR WALLET!



Using the data presented in a “*gasworld Magazine*” US Argon Market Report, the Argon production capacity shows the German company, Linde AG in 2019 finalized the acquisition of my old company, Praxair (*who divested of their welding and cutting businesses in 1985 and changed their name.*) In combination, Linde AG and Air Liquide, a French company, who bought Airgas, now have a combined Argon production capacity of over 70% in America!

My personal experience with industrial gas companies in Europe indicates they don't care about the welding hardgoods or welding filler metals businesses! (*In fact, Air Liquide sold their welding*

hardgoods businesses when they bought Airgas!) In Europe they sell gases, their sales/engineering support people are trained on selling/servicing gases and the senior management far prefer a business that has:

- 1) No raw material cost,
- 2) No inventory except cylinders (*which in Europe they only rent,*)
- 3) No obsolescence, spoilage or product shrinkage,
- 4) Prohibitive barriers to entry (*very high cost for a competitor to enter or expand,*)
- 5) Prohibitive costs to import gas from places like China-etc.!

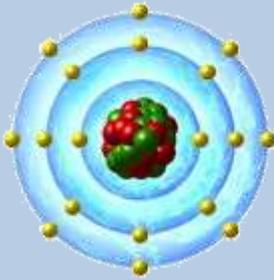
When I managed a Market Development effort for what was Linde (*renamed Praxair soon to be Linde again*) we were the largest Argon producer at the time with >50% Argon production capacity. From market research, we knew 60+% of the welding shielding gas bought was wasted!

Our WA Technology business is focused on reducing that waste with our low cost, patented products and knowledge!

The following provides some perspective on the cost issues related to Argon (*and Helium*) shielding gas and mixtures that include these gases. It also presents an inexpensive solution to cut gas waste and cost.

ARGON

Argon is the third most abundant gas in air, after Nitrogen and Oxygen. Argon is



less than 1%, (0.93%) and is produced by liquefying air and then separating Argon out in large distillation columns. Several steps are required to achieve welding grade purity. AWS A5.32, "Specification for Welding Shielding Gases" defines 99.997% required purity and a maximum moisture of 10.5 parts per million (ppm) for liquid and gaseous Argon. A first stage distillation column produces what is called "Crude Argon" containing 1 to 2.5% Oxygen and 1 to 2% Nitrogen. The "Crude Argon" can be reacted with

Hydrogen to eliminate the Oxygen. Another, "Pure Argon" distillation tower is then used to remove the remaining Nitrogen and Hydrogen. This process and the extra capital equipment needed to produce Argon are very expensive. Many gas liquefaction plants built over the years did not include this extra capital cost.

Of interest, some companies have tried to market, "Crude Argon" for welding. The small amount of Oxygen present is typically not a problem when welding steel. However, the Nitrogen can be a significant problem. An American Welding Society (AWS) Journal research article defines that 2% Nitrogen in the shielding gas is sufficient to produce internal porosity in single pass welds and as low as 0.5% produces porosity in multipass welds. The researchers used a bubble chamber and mixtures of shielding gas with various amounts of Nitrogen. They conclude, for his single pass welds, shielding gas should not contain more than 1% and preferable 0.5% maximum Nitrogen.

Production Capacity: The pie chart on page 1 from "*gasworld Magazine*" shows the North American Production capacity of the various Industrial Gas manufactures. The chart shows two companies dominate the market. Argon is a byproduct of Oxygen and Nitrogen production; companies must manufacture and market those gases to make Argon production economically viable. When very large volumes of Oxygen were being consumed by the steel industry, US Linde (*renamed Praxair*) installed large gas production facilities at these mills. They mostly supplied oxygen in pipelines to the mills. The large gas liquefaction plants were equipped with the added capital investment to produce Argon.

As the American steel industry reduced in capacity, the amount of oxygen needed did not require operating these plants at high capacity. However, the demand for Argon was high and growing (as it is today.) To satisfy customer demand, the plants were occasionally operated to mostly produce this 0.93% content product, Argon! Production is not economical in this situation.

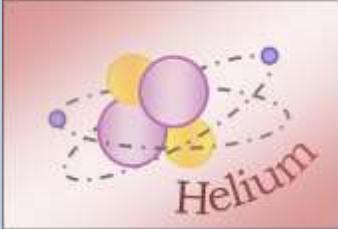
Even at high Argon prices, the electric power and capital equipment investment required to liquefy air, to sell only 0.93% while venting 99% is not justifiable.

The same situation exists in the current economy; Argon demand growth is reported to be far exceeding growth of Oxygen and Nitrogen. Some gas production plants are operating inefficiently to produce Argon and that the industrial gas producers are adding Argon capacity in attempt to meet demand.

HELIUM

Unlike Argon, there is virtually no Helium in earth's atmosphere. Helium is a limited worldwide resource. The small amount of Helium available on Earth is produced by radioactive decay in materials like those in granite. Helium is obtained as a byproduct in a limited number of natural gas deposits where it is present in quantities that make it economical to extract.

Helium escaping from balloons, etc does not stay in the atmosphere. It's so



light, it leaves the earth's atmosphere and goes into outer space (only 0.0005% is in air!) Helium prices are high and increasing demand for applications such as medical MRI body scanners, are increasing. Crude Helium prices increased 135% in 2019.

Not only are the prices high, because of limited supply, availability of Helium is being allocated to a percentage of prior year use in some areas.

If you are using Helium or Helium Argon shielding gas mixtures, limited availability may be as important in reducing gas waste, as cutting cost.

BOTTOM LINE

Expect shielding gas prices to rise. The barriers for companies to enter the business are so large it can't happen just because of high Argon market prices. Argon is less than 1% of the air around us. It is obtained by liquefying air and then distilling Argon from that liquid. The cost of compressing and liquefying air is the major production cost. Unless a company has the ability and resources to market the Oxygen and Nitrogen it is not cost effective to only produce Argon. Even with high Argon prices manufacturers cannot justify the energy waste of liquefying then evaporating and venting the other 99% of the liquid air! They must sell it all!

To sell the Oxygen and Nitrogen requires a very large capital investment in not only liquification plants, but also cryogenic liquid gas tank trucks and large cryogenic tanks to store liquid gas in essentially huge vacuum bottles. Even the best insulation causes some of that liquid gas to vent from the tank if not used daily. Gas is also compressed and put in high pressure cylinders.

It's not viable to transport this liquid by ship from overseas. Even if that could be done, Argon is in short supply even in China where it is essential for processes such as MIG welding aluminum and TIG welding any material!

The cost of adding two expensive distillation columns to a gas liquefaction plant is very high and becomes a significant cost of a production plant. Many smaller gas liquefaction plants can't justify these extra distillation columns!

WHAT CAN YOU DO?

FIRST: HOLD ON TO YOUR WALLET-ARGON PRICES WILL INCREASE

SECOND: CUT YOUR ARGON (AND ARGON/CO₂) SHIELDING GAS WASTE!

Appendix Argon Price Increase Data:

The Argon price increase data in the graph on page 1 mostly came from that published by Air Products, the only large Industrial Gas Company that is US Based.

The Linde Division, where I worked in a new headquarters building as no one wanted to come back to work NYC in the prior 50 story building at 270 Park Avenue. That



included myself having managed a Linde R&D Lab in NE OH where cost of living was much less! The Market Development Group I formed and was Director, was funded 2/3 by the Industrial Gas businesses and 1/3 by the Divisions Welding/Cutting & Filler Metal business. A main focus was promoting the use of very profitable Argon where we had ~60% of the US and Canada production capacity. Argon is essentially a byproduct of the liquefaction of air that is distilled into Nitrogen, Oxygen which comprise 99% of air and third largest gas Argon at 0.93%.

We had about a 30% gases market share but dominated the sale of Oxygen to steel mills building very large plants supplying Oxygen piped to the mill. This made it economical to add the extra distillation columns that produced crude Argon and chemical process to remove Oxygen and a second column Nitrogen to make 99.9+% pure Argon. What we did not sell ourselves was sold to the other industrial gas companies at wholesale prices. We controlled the market price! Welding was a major consumer and my Groups Task was to develop programs to promote Argon use for MIG welding shielding gas over CO₂ (*it was plentiful coming from chemical waste streams and far less profitable, even for distributors.*)

The Industrial Gas business was essentially an oligopoly. Barriers to entry are huge so difficult to enter. Bulk liquid gases delivered to large fabricators by the producers were sold on a several year contract bases. The contracts where complex allowing price increases based of electric power cost increases, the key cost in liquefying air. But there was usually a limited time period for the buyer to look for another supplier if a cost increase occurred. That was very difficult. Also, we would NOT break each other's contracts so prices were very equal and high. To avoid FTC investigation of manufacturers acting as if colluding or setting prices we would all publish pending price increases in the wall street journal with a very short time before implementation.

Air Products the only old US gas company continued that practice but the other much higher market share, none US based producers didn't bother. Apparently, no FTC concerns about colluding or acting as if you colluded to keep prices high! So up to 2021 published Argon price increases by Air Products were used to make the charts (page 1.) But for 2022 and 2023 comments for gas price increases in general (not just for Argon) were obtained from gas producers annual financial reports.

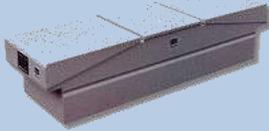
How to: CUT YOUR ARGON (AND ARGON/CO₂) SHIELDING GAS USE!

OUR PATENTED GAS SAVING PRODUCTS CUT WASTE 50+%

How Much Shielding Gas Can Our Gas Saver System Save in Your Shop?

The best way to show the gas savings and other benefits of our patented Gas Saver System (**GSS™**) is with examples from our industrial customers.

RKI, Inc a Texas truck box manufacturer evaluated the **GSS** system on a repetitive job, welding doors. They tested gas usage using two full gas cylinders. With their standard gas delivery hose, they welded **236 doors** with one full cylinder. Just substituting our patented **GSS** for their gas supply hose cylinder to wire feeder, maintaining the same flow settings, they welded **632 doors** with the other changes! That's a 63% reduction in gas use. Therefore, it would take 2.7 cylinders of shielding gas to weld 632 doors with their standard gas delivery hose.



After about a year of use they added 10 more welders and the purchasing manager called and asked for, “10 more the magic hose!”

Gas usage savings data from 14 other industrial fabricators is available at: http://netwelding.com/production_test_results.htm

Weld Performance Improvement:

A small shop owner, Al Hackethal, provided this feedback after he purchased a **GSS** for his MIG welder. He reported these findings:



“Well, I can't believe it. I never thought a hose could make that much of a difference. I had a small job that's been waiting for a while. The weld quality, and even penetration is considerable better. Almost no spatter! The weld seemed to be hotter and I turned my MIG down a notch.

Initially thought that my imagination had kicked in, but then realized that the gas I'm buying is actually working the way it's supposed to. Glad I found your website. This is one of the few things that really works better than any info could suggest. I understood the theory, though in practice I understood much better after the first couple of welds. Now I have better looking welds and almost no spatter, which means less grinding and finish work! In addition, the tip was cleaner after the job I just did.

This will provide savings in time, labor and maybe even consumables too. As a one-man shop there's never enough time for anything. Thanks for making products affordable”.

Auto Exhaust Mfg. with 6 Foot Gas Delivery Hoses Saved up to 40+%



The amount of shielding gas waste and therefore the potential **GSS** savings depends on a number of factors. The length and diameter of the shielding gas delivery hose determines the amount of excess gas stored when welding stops. The number of starts and stops are a key factor. The pressure in the gas delivery system is also important. However, a minimum of 25 psi is needed to maintain the Automatic Flow Compensation, which is significantly higher than the 3 to 7 psi needed for gas flow. Quality gas control systems use from 25 to 80 psi regulators. For pipeline gas supply 50 psi is often used also producing a high gas waste.

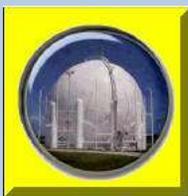
Tenneco manufactures automotive exhausts employing 128 MIG Robot Welders in one plant. They have only 6-foot shielding gas hose from the flow control at the gas source to the gas control solenoid. After a large number of tests of the **GSS** conducted during a Black Belt Lean Manufacturing Study, the welding engineer measured from 25 to 40+% shielding gas savings depending on the specific weldment. After the results, they quickly installed **GSS's** on all 128 of their Robotic Welders!

In addition, the controlled amount of shielding gas delivered at the weld start, at a starting flow rate that DOES NOT pull air into the gas stream, may allow the elimination of preflow. With the **GSS** optimum starts are achieved without wasting valuable cycle time for preflow.

Since the **GSS** retains the systems higher gas delivery pressure, Automatic Flow Compensation is maintained. In Robotic Welding operations, high duty cycles can clog welding torch gas passages such as the gas diffuser and nozzle with spatter. The gas passage in the conduit often doubles as the hose holding the wire spiral liner and can partially clog with debris from the welding wire.

Major Industrial Gas Producer Reduces Helium Gas Waste:

Air Products is a leading producer of industrial gases purchased over 250 of our patented **GSS's** for their MIG and TIG welders to conserve Helium and save money! Argon Helium gas mixtures are used to fabricate aluminum cryogenic tanks. They also found the **GSS** custom extruded hose, because of its unique design, has a significant additional benefit. It has much less moisture permeability! Result, the elimination of porosity problems they previously always encountered in humid weather due to the hydrogen in water vapor!



Want more details on reducing gas hose moisture permeation and reduced hydrogen induced porosity? Email TechSupport@NetWelding.com

How Does The **GSS** Work?

Gas waste occurs every time you pull the MIG gun trigger, even if only to make tack welds or are inching the wire to cut off the end.



To keep flow at the preset level, the gas pressure in a cylinder regulator/flowmeter is set between 25 and 80 psi. Regulator/ flowgauges also operate in this pressure range. However, to flow shielding gas through the welder and MIG gun (or TIG torch) typically requires only 3 to 7 psi, depending on restrictions. Therefore, every time welding stops the pressure in the gas hose quickly raises to the regulator or the typical 50-psi pipeline pressure. The increased pressure stores up to 7 times the shielding gas as the physical hose volume. At each pull of the MIG gun trigger, the excess gas contained in the hose “blasts out” of the MIG gun nozzle (or TIG cup) at peak flows we have measured can exceed 200 CFH!

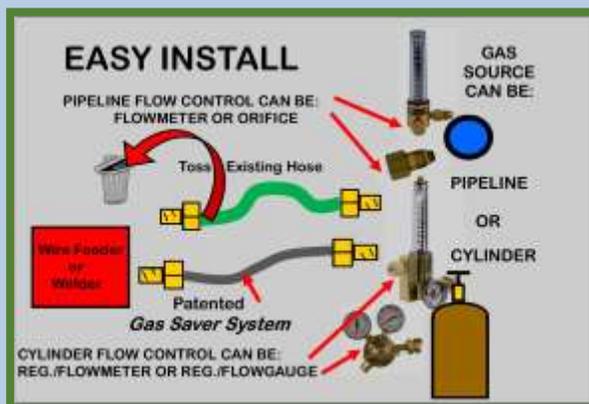
The patented **GSS** stores over 80% less gas than typical shielding gas hoses. Besides reducing wasted gas, the high flow causes air to be pulled into the turbulent shielding gas stream producing excess spatter and possibly internal weld porosity.



Turbulent shielding gas flow takes a short time to become smooth, nonturbulent (*laminar*) flow even after the starting peak gas surge reduces. That can take several seconds so at weld starts, when making short welds or tack welds you’re not getting all the benefits of the shielding gas purchased! The **GSS** incorporates a peak flow rate-limiting orifice in the welder/feeder hose end fitting, controlling peak flow rate and avoiding excess turbulence.

SUMMARY:

The **GSS** can cut shielding gas use in half or more by having 80% less stored gas. It uses a surge restriction orifice built in welder/wire feeder end that limits peak flow avoiding excess turbulence for better starts. Note, the orifice does not limit any practical flow set on the existing flow control device. A controlled amount of extra shielding gas is still quickly provided to purge the weld start area of air. Welders appreciate the starts.



IT'S EASY TO INSTALL: Replace the gas hose from cylinder or pipeline supply to welder/wire feeder with our patented **GSS**. It is available in various lengths at www.NetWelding.com The inexpensive **GSS** will pay for itself in a few months of use. With Helium mixtures, the payback is measured in weeks.