10-step guide to a greener and more efficient production

Introduction

Compressed air production consumes a large amount of energy, which impacts a company's **bottom line** as well as the environment.

However, there are some things businesses can do to **immediately and sustainably** make compressed air generation less expensive and more environment friendly.

This 10-step guide will help companies lower their energy consumption and carbon footprint, which will translate into **direct savings**. In some cases, these savings will be substantial.

Best of all, while all of the 10 steps will save money in the long run, some of them **cost very little to implement**. In fact, after you finish reading this guide you will be able to take meaningful action right away to make your production greener and more efficient.

This interactive guide is meant to increase your awareness of ways in which the generation and use of compressed air in a production environment can become much more efficient.

In addition to help you better understand the design and operation of compressed air systems, the guide will also allow you to make more informed decisions and ask the right questions as you make future purchasing decisions.

This document was compiled for compressed air users, and the calculations it contains are estimates meant as a guide. We still recommend a detailed audit by compressed air specialists who can best assess a compressed air system's optimal savings potential.

Why reduce carbon?

Not a day goes by without reports on the devastating impact of climate change on our planet – and the increase of carbon in the atmosphere contributes to this problem.

More and more people are demanding that their governments take action, which is leading to new legislation in many countries, such as tighter emission standard and carbon taxes.

At the same time, many companies have realized that making their production greener beyond government mandates is not just good for the environment but also for business – and that it can shore up their long-term success.

For example, reducing their carbon footprint by making their compressed air systems more energy efficient has the following benefits for businesses:

- Lower manufacturing costs
- Reduced carbon taxes
- Improved brand image, which helps attract customers, investors and talented staff
- Boost to employee morale
- Compliance with increasingly stringent environmental laws

The big question is how to make your production process more carbon neutral while at the same time maintaining a competitive edge.

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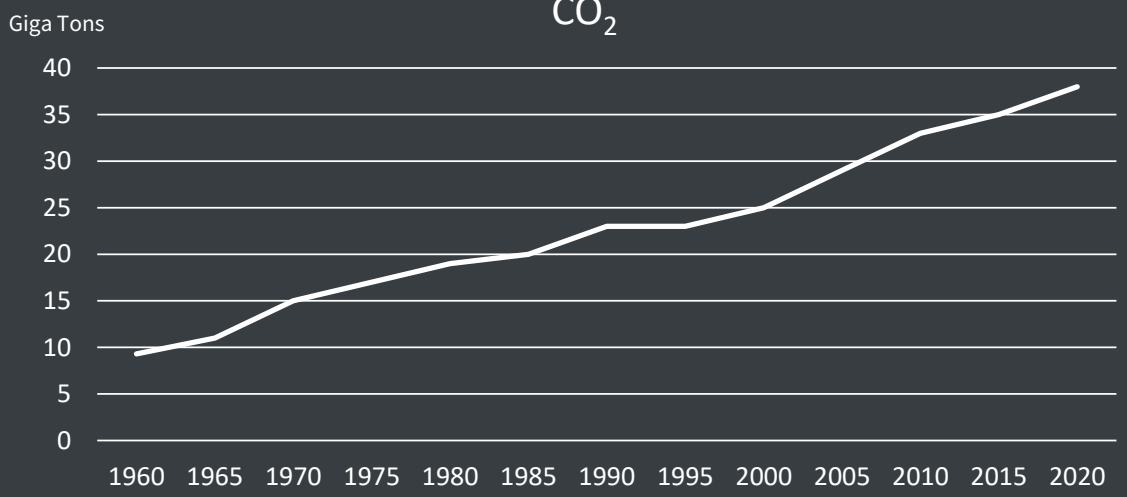
CO_2 levels are increasing in spite of the use of more renewable energy

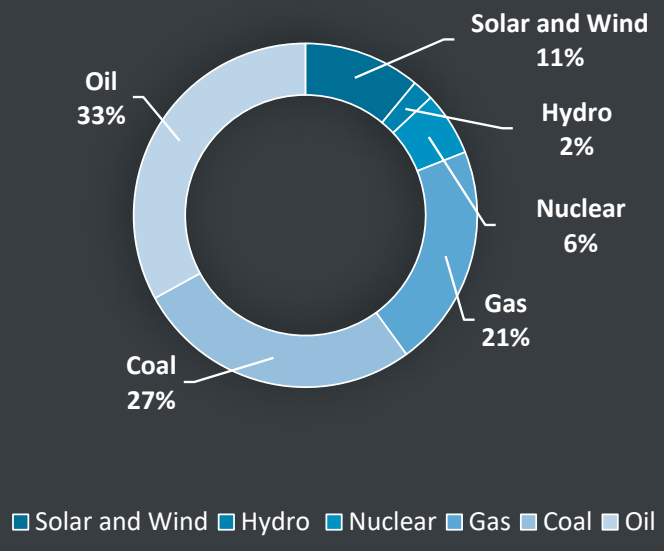


Most people believe that an increase in the production of sustainable energy will allow us to meet our future needs while also meeting our climate goals.

Realistically, however, that won't be enough. Instead, we also have to curb the global energy demand at a time when the world population keeps increasing.

Over 80% of energy used today is created by fossil fuels. To meaningfully reduce that reliance on carbon-based energy, we not only have to invest in renewables but also reduce our energy demands and make more efficient use of the energy we use.

Energy Source



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CO_2 levels are increasing in spite of the use of more renewable energy

Solely focusing on producing more green energy will not solve the problem. At best, it will slow the increase of carbon in the atmosphere. To address climate change in a meaningful way, we have to pay at least equal attention to energy reduction. That is the only way to allow us to achieve a **carbon neutral economy** in the near future.

Compressed air is a **highly effective and safe form of energy** for powering production equipment or processes. Unfortunately, generating compressed air traditionally consumes a lot of energy. However, most companies do not realize that there are also **tremendous energy savings potentials** here that will allow them to drastically reduce their carbon footprint.

In addition to recovering the wasted heat from air compression, they can also make compressed air production much more efficient.

In fact, **many companies waste up to 50%** (or more) of the power required for compressed air generation, for example through the inappropriate use of compressed air or inefficient system designs.

So how can we eliminate these inefficiencies, design more efficient compressed air systems and make a meaningful contribution to a cleaner environment?

A compressor installation that consumes 500 kW for 8,000 operating hours per year represents a yearly energy consumption of 4 million kWh or 2828 Metric tons of CO_2. The possibilities for recovering substantial amounts of waste heat via hot air or hot water are real.

As much as **94% of the energy** supplied to the compressor can be recovered

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10-step guide to a greener and more efficient production

This 10-step guide allows companies to drastically reduce their energy requirements and their carbon footprint while also saving money and the environment.

Some of these steps can be taken right away and require hardly any financial commitment while others involve infrastructure investments that will pay off in a big way down the road.

This guide should not be seen as a one-off exercise, but rather as a continuous process to maintain peak production efficiency.

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1. Application & Installation

2. Storage & Distribution

3. Air Quality

4. Volume & Flow Pattern

5. Core Technology

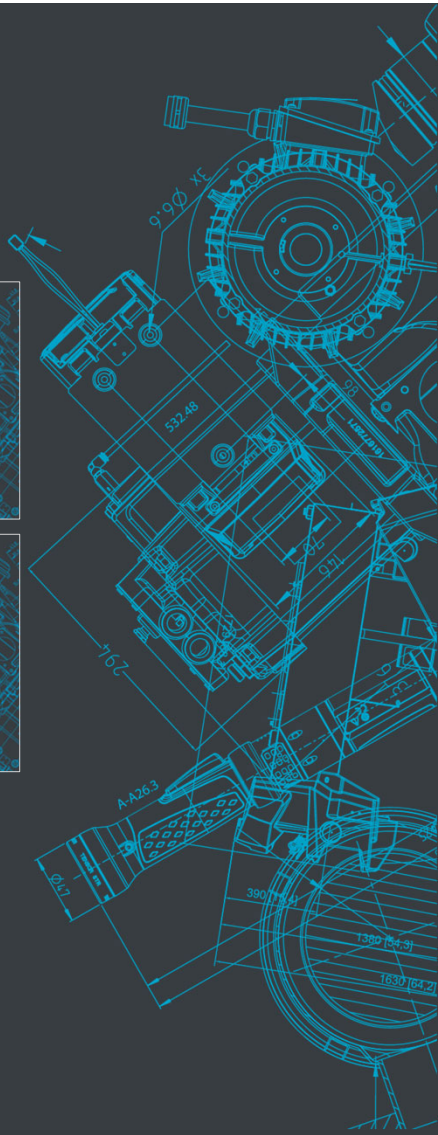
6. Equipment Control

7. System Control

8.Energy Recovery

9. System Maintenance

10. Remote Monitoring



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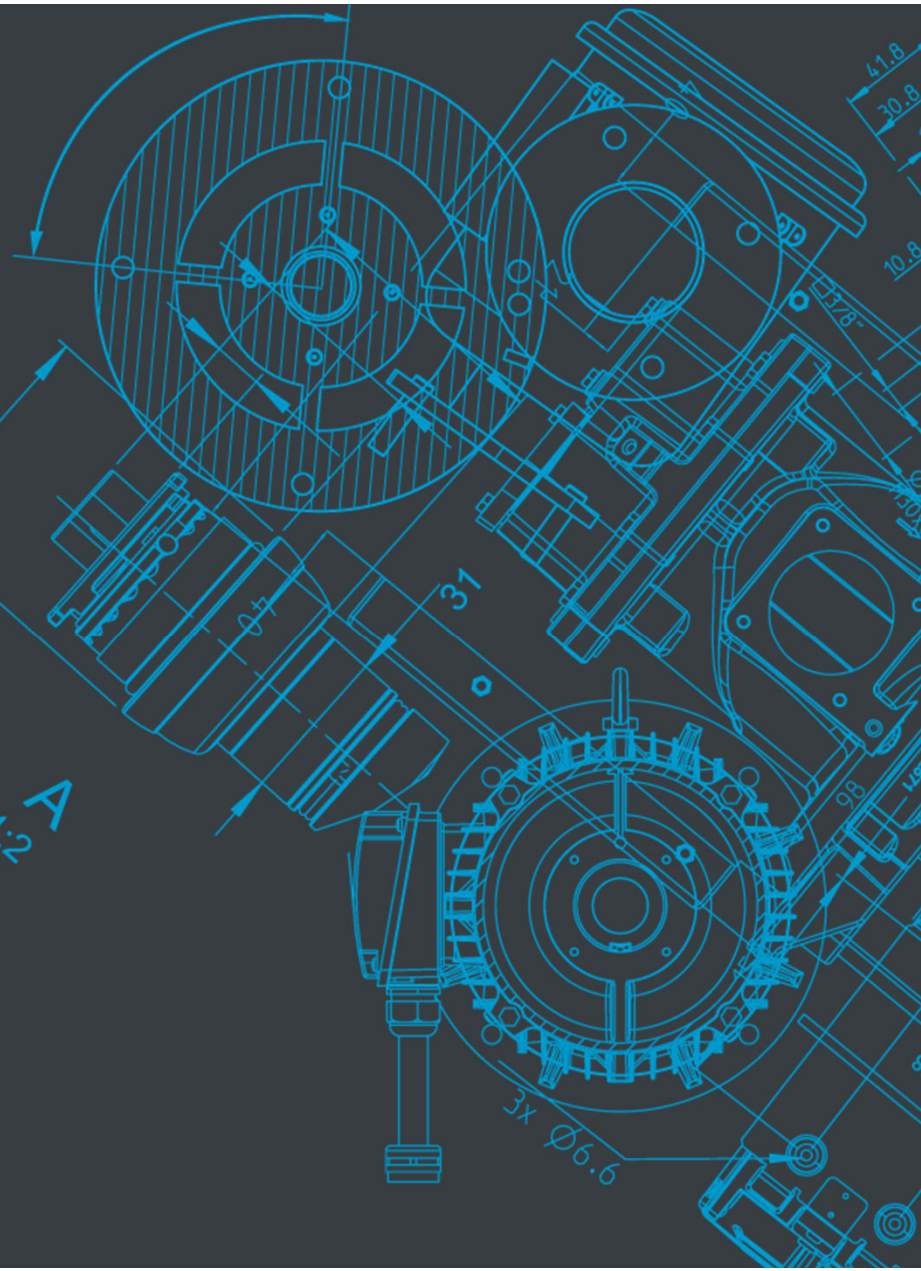
1. Application & Installation



Understanding your application

Before expanding, replacing or improving an existing compressed air system, you should first look to eliminate waste in the current system.

A common mistake is to base the selection of new equipment on the size of the existing hardware and then simply scale it up to take into account anticipated growth.

However, in many cases, you may actually be able to invest in smaller equipment – and therefore save a lot of money – as long as you eliminate existing inefficiencies.

So, let's take a look and see what you can do to make your compressed air system much more efficient.

Note: You don't have to do all of these things in a particular order or at once, although you would save the most if you did. However, you should definitely first look into optimizing your current system before you do anything else. That is not only easiest (and least expensive), but it is also essential to understanding your actual compressed air demand, which will likely be much lower than you think.

5 factors to consider

Volume

Pressure

Dust

Water

Oil

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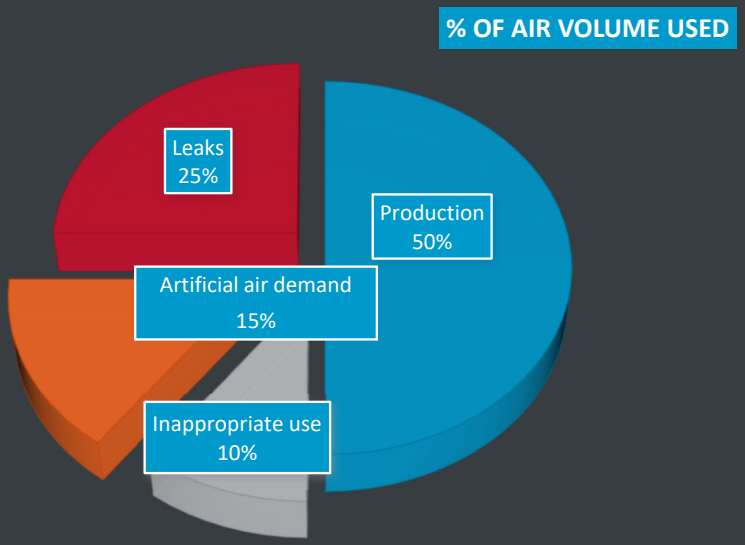
Understanding your air usage

- Market research continues to make it clear that the mayority of compressed air systems in use today are inefficient and because of this, often limit their own productivity and product quality.

- The value trapped in poorly designed and operated air systems, just in the U.S. markets alone, was estimated to range from ***$1 billion, to as much as $3.2 billion (2001)*** in energy costs. That's a lot of wasted power.



With most installations, only 50% of the air that you pay for gets used for production

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Isolate equipment when it is not in use

Make low-cost investments that can reduce cost. Using a simple manual or electronic isolation valve.

Isolate any production equipment that is not in use to reduce the potential for equipment leakage.

It is like turning off the lights when you leave a room in your house. You know it makes sense but how many people forget to do it. Wasting money, energy and increasing their household carbon footprint.

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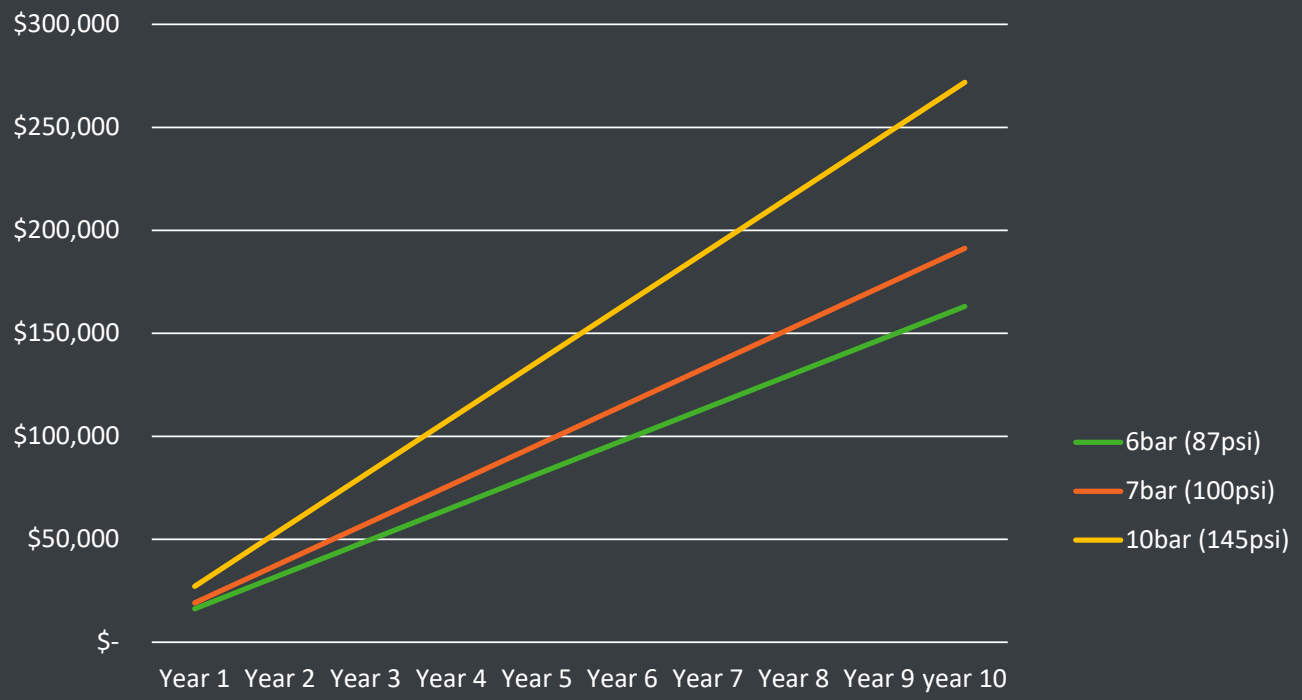
Watch your pressure

There is a simple rule when it comes to compressed air: More pressure means more energy consumption, which means a bigger electric bill and carbon footprint for you.

And, unlike the initial investment you make in your equipment, these costs will keep adding up.

That's why you always have to be mindful of the pressure you generate. This is not something you should do once a year, either.

The better you monitor your pressure, the more quickly you will be able to investigate expensive increases and take the necessary steps to reverse them.



Example 1000 cfm
470 l/s
1700 m^3/h

Based on a single shift operation & 2000 hours per annum

6bar (87psi) =	$16,310
7bar (100psi) =	$19,130
10bar (145psi) =	$27,190

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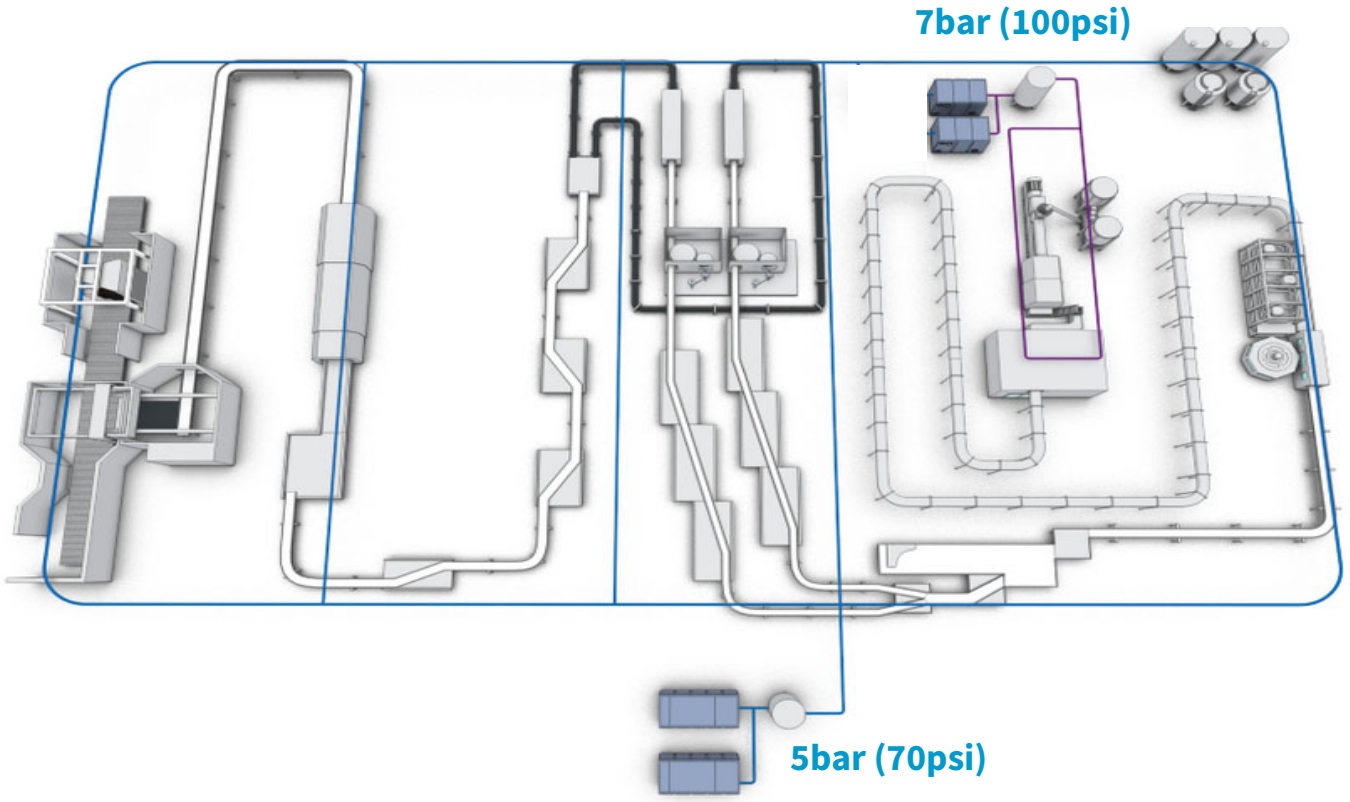
Keep your working pressure as low as possible

The working pressure of your system directly affects the power required to supply the compressed air. A higher working pressure means a higher power requirement and, as a result, higher energy costs and a larger carbon footprint.

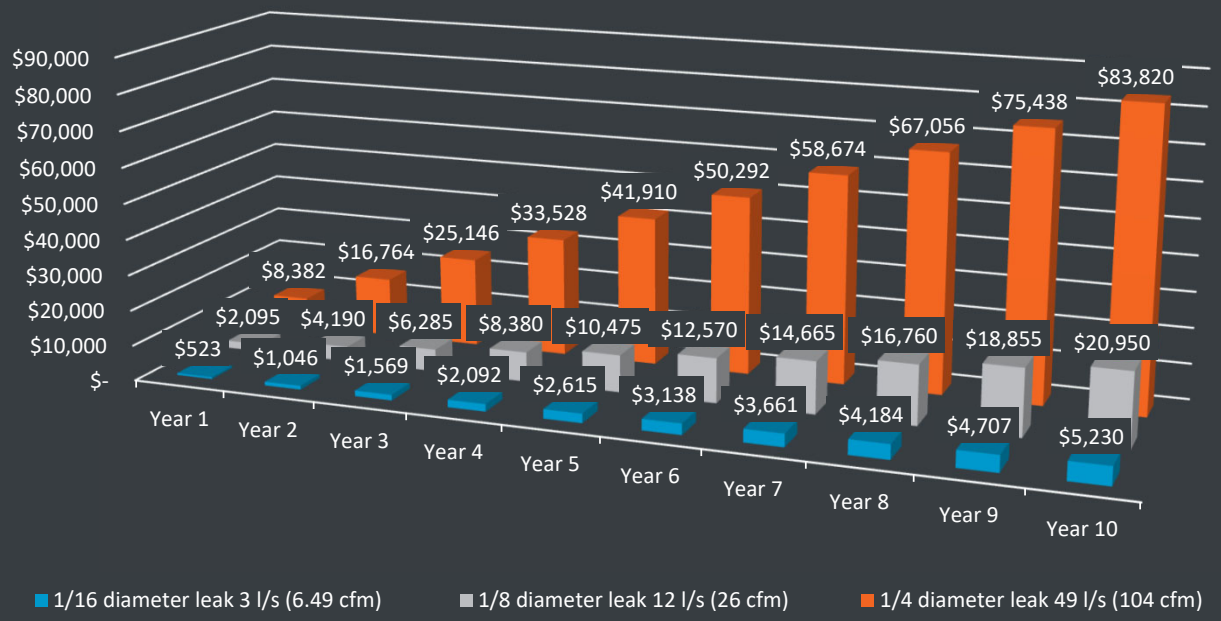
On average, you need 6% more power for every 1bar (14,5psi) of higher pressure.

In addition, a higher air pressure also strains pneumatic components, reduces their operating life and adds to your maintenance costs.

Tip: Before you increase your working pressure to compensate for a pressure drop, first find out what caused the drop and eliminate the source of the problem if possible.



Consider separate compressed air systems if the majority of the production requires a lower pressure than the highest-pressure requirement.



Source: Compressed Air Challenge.

Assumes $0.05 per kWh, constant operation, 6,9bar (100psi) and a typical compressor.

Manage your leakage

Leaks may cost you significant amounts of capacity and money each year.

An air leak consumes 42% more air at 8,3bar (120psi) than at 5,5bar (80psi) this is considered artificial demand that results in a reduction of compressed air capacity and increased energy costs.

Example:
1/16 in. air leak at 5,5bar (80psi) consumes 2,5l/s (5.36cfm)
1/16 in. air leak at 8,3bar (120psi) consumes 3,6l/s (7.62cfm)

Timer drains on compressors, air receivers or in production are a big part of this wasted air. Most timer drains use ¼ inch discharge line, investing in a no loss drain could potentially save an estimated $700 annually (0.05kWH)

Escaping air impacts your bottom line, on average 25% is wasted when not maintaining leakage within your facility. For help on how to address your leakages contact your local sale expert.

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Some like it hot – but not compressors

Keep cool

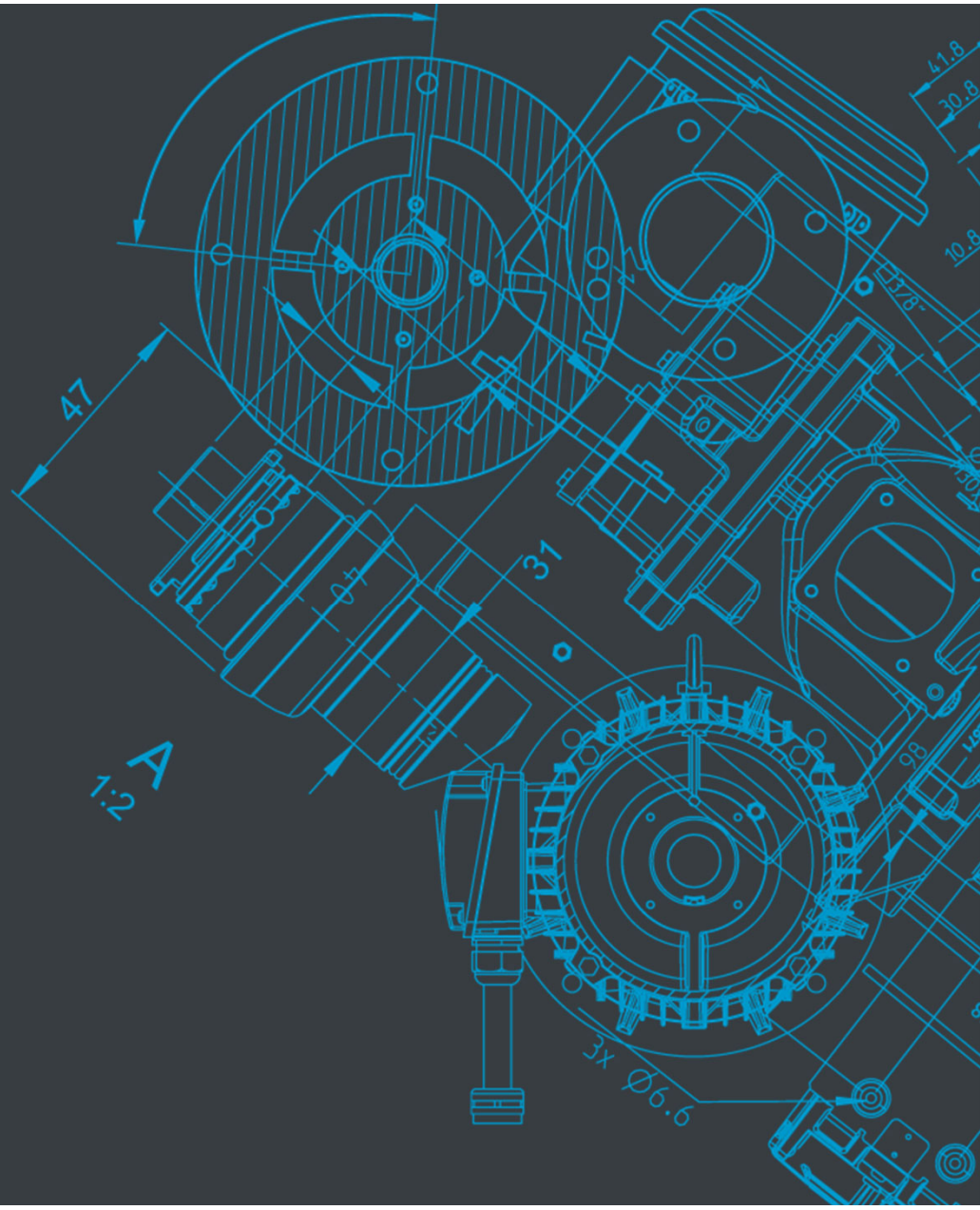
The location of your compressors impacts their efficiency. Because the air density is lower in hot temperatures, it takes more power to compress air in those environments. To ensure that your compressed air equipment is most efficient and uses the least amount of energy, install them in the coolest location in your facility and make sure that any heat generated is properly removed from the compressor room.

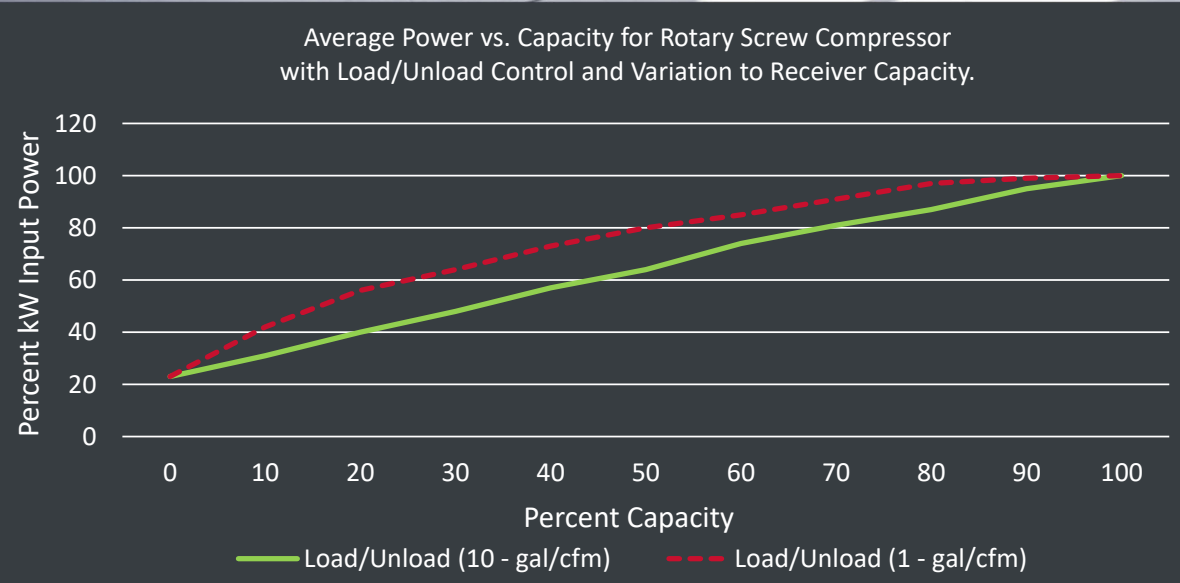
Tip: Every 5°C rise in air temperature results in a 2% loss in efficiency, so keep your compressors cool!

Keep clean

Just because many compressors *can* operate in dirty environments doesn't mean that they *should*. A lot of dust in the air will result in blocked filters. Because every 3 millibar pressure drop in the intake filter increases power consumption by approx. 1%, a dirty compressor room can quickly add to your electric bill.

2. Storage & Distribution





The importance of air storage

The size of the air receiver and pipework can directly impact energy consumption.

Air receivers reduce the cycling time of air compressors, which increases their reliability and longevity.

A larger air receiver – or stored volume in your pipework – can reduce the operating pressure differential of your compressors and therefore your power consumption and your carbon footprint.

Tip: Lowering your pressure differential by 0.5bar (7,25psi) could reduce the energy consumption of your compressor by up to 3%.

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Flow Controller / Regulator

Lowering pressure using only VSD (Variable Speed Drive) control. VSD technology is considered the most efficient partial load screw compressor available. Some manufacturers say the accuracy of the control at a required pressure set-point can be lowered to a minimum required pressure.

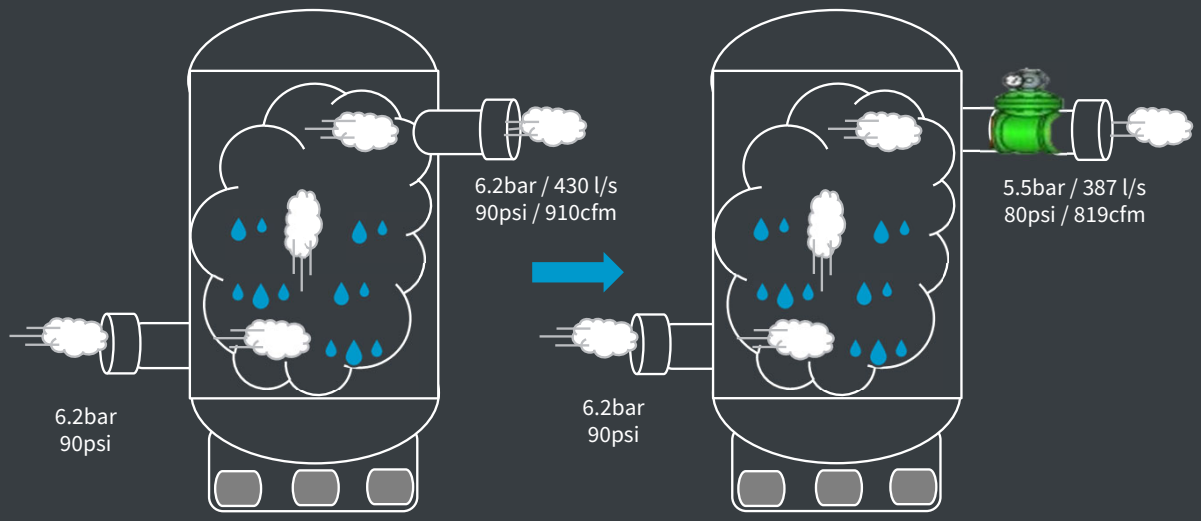
It's not as simple as lowering the discharge pressure to maximize energy reduction from artificial demand while reduced compressor power.

Systems need stored energy or compressed air storage:

Stored Energy depends on two factors:
Receiver size storage and pressure between the storage pressure and the needed minimum target pressure.

(Vgas = Vrcvr x (Psto-Ptar) / Patm)

Vgas = storage volume (scf)
Vrevr = receiver volume in cu. ft.
Psto = storage pressure (psig)
Ptar = target pressure (psig)
Patm = atmospheric pressure (psia)



1. 6.2bar (90psi) average system pressure = 430 l/s (910 cfm)

2. 5.5bar (80psi) average system pressure = 387 l/s (819cfm)

Flow controller or plant regulators perform to reduce waste, lost to artificial demand and controlling compressed air storage while maintaining a consistent supply pressure. Applied properly with VSD you can balance air supply and demand.

Without the VSD you are not able to address the potential savings by optimizing the compressor discharge pressure.

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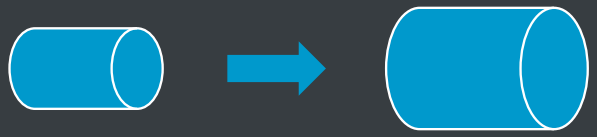
Review the design of your compressed air pipework

As their operations grow, companies often simply extend their pipework to meet the needs of new equipment. The system grows like a tree with new branch lines spreading out all over a production facility.

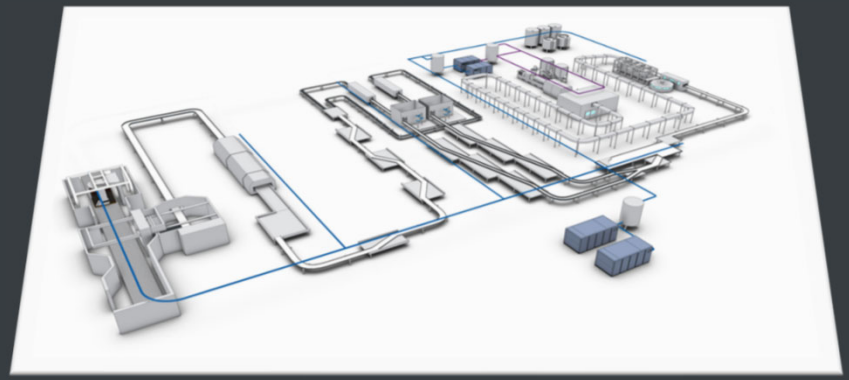
However, this increasing air volume causes pressure drops in the system. Too often, that pressure drop is compensated by increasing the operating pressure of the existing air compressors or purchasing new ones. But there are two much simpler (and less expensive) ways to address these pressure drops and keep the carbon footprint small.

1. Increase the size of the main distribution pipework diameter. This will increase the stored volume and also reduce air velocity to reduce pressure drop.

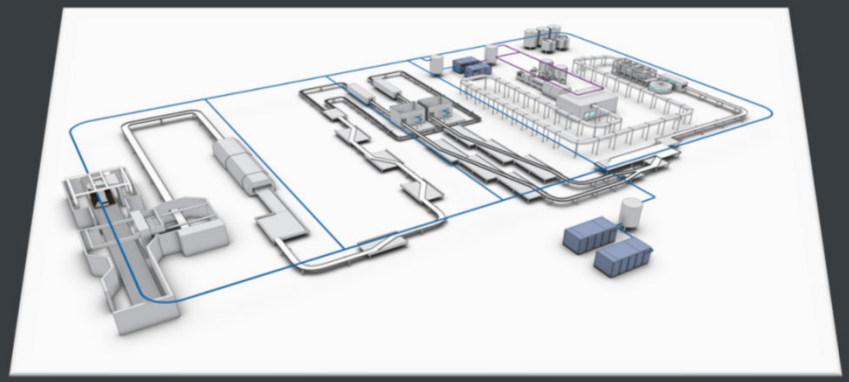


2. Convert a dead-end pipework system into a ring main pipework system. This increases the overall system volume and helps smooth out the pressure loss from sudden air demand surges. In addition, it allows the air to flow from multiple directions, which lowers the internal velocity and therefore also the pressure drop.

Dead End Distribution System



Ring Main Distribution System



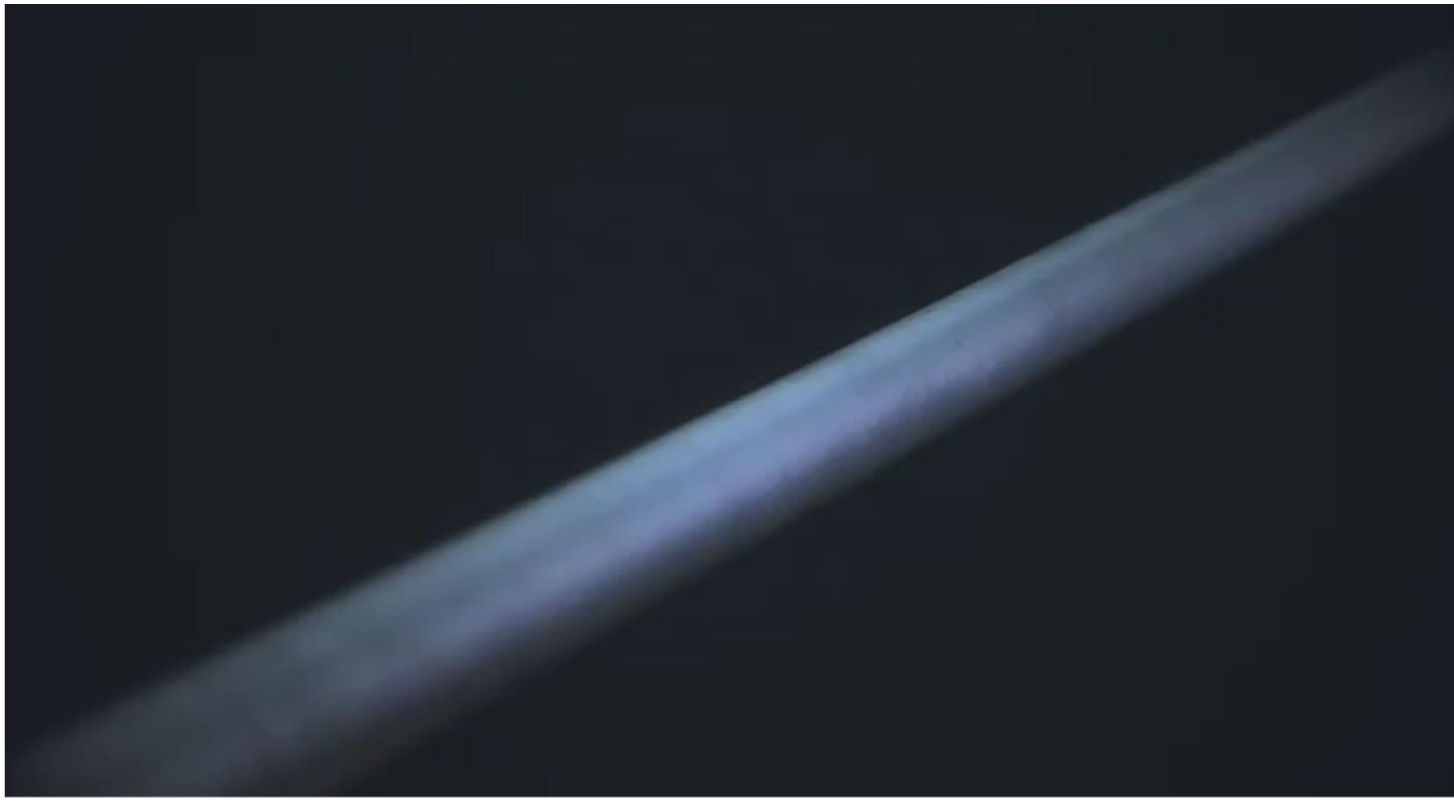
Plug your leaks!

The simplest and most effective thing you can do to increase the efficiency of your compressed air network, save money and reduce your carbon footprint is to plug any air leaks in your system.

It is estimated that the average production facility loses up to 20% of the compressed air it generates to leaks. In other words, your compressed air system is very likely leaking money. In fact, some companies are running compressors that only make up for the air lost to leaks.

That is another reason why simply turning up the air pressure is a terrible idea.

You may be able to find big leaks by simply walking through your facility and listen for hissing sounds. For others, carry out a leak detection survey on your pipework distribution system to eliminate leakage in pipe joints. Then you can perform a flow demand survey to avoid measuring artificial air consumption.



Did you know?
By lowering your system pressure by just 0,3bar (4.35psi), you can reduce your pipework leakage by 4%.

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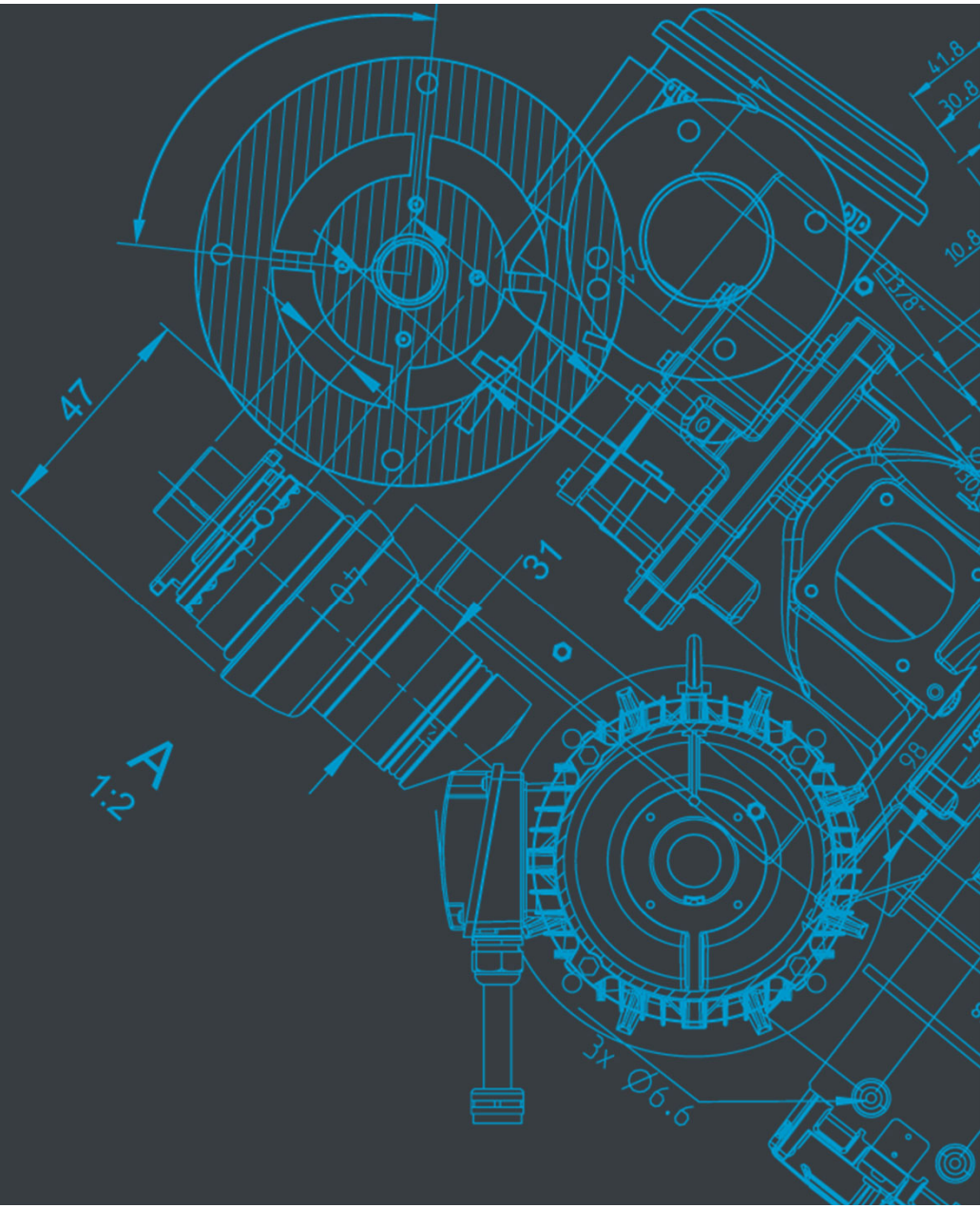
3. Air Quality



Know your air purity requirement

Clean air has its cost – both in terms of energy and money. That's why you should always know which air purity your applications require. If you clean up the air too much, you'll waste energy and unnecessarily strain the environment, if you clean it up too little, you can jeopardize your production quality and reliability.

By selecting the correctly sized air treatment products, you can minimize the pressure drop, which will reduce your compressor's power consumption.

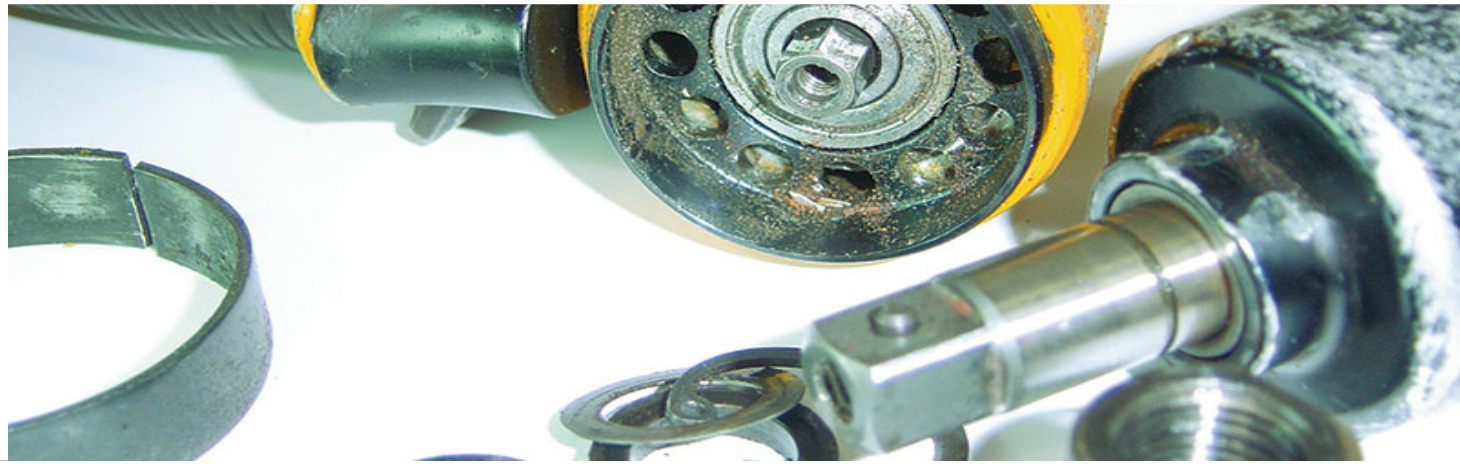
Also make sure that you choose the correct drying technology to avoid wasting energy and increasing operating costs. For example, using a heatless desiccant dryer instead of a drum-type air dryer will increase the system energy consumption by 20%.

Tip: Don't filter your air more than necessary. By adding filters, you increase the pressure drop and your expenses!

The importance of air treatment

While you don't want to overdo it, the proper air treatment is important and will not only increase the quality of your air but also the service life of your equipment.

The reason is that atmospheric air contains water vapor and dust. When that air is compressed, the concentration of these contaminants also goes up and they have to be filtered out to protect your equipment and guarantee the required air purity.



Dust

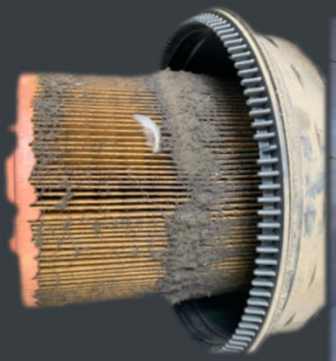
Dust (Particle contamination) can come from many different sources. This dust blocks the intake filters of compressors reducing the compression efficiency and increasing power consumption. To minimize this power loss requires increased replacement of air intake filters, or the best solution is to avoid the dust contamination by placing your air compressors in a clean environment or install ductwork to the inlet of the compressor to bring a clean air supply to the unit.

Corrosion in pipework creates another form of particulate pollution in your compressed air network, This can be avoided by drying your compressed air so that corrosion does not happen.

Dust can also come from desiccant material in air dryers. Regular filter cartridge replacement is required to minimize pressure drop. Fitting a pressure differential gauge on inline filters can help manage your pressure drop by visualizing when the filter cartridge requires replacement.

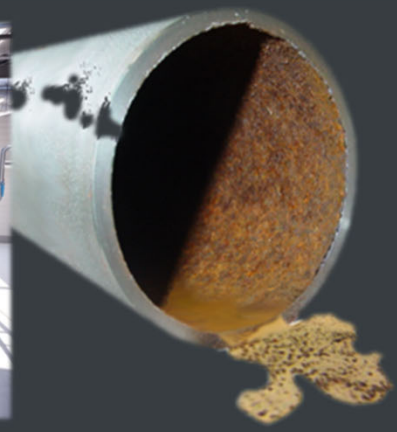
Avoiding dust contamination is more energy efficient than dealing with the consequences

Dust in the atmosphere



Desiccant Dust

Dust from corrosion



Oil

What about oil contamination in ambient air?

Ambient air has very small traces of oil these appear in the form of water vapor, hydrocarbon vapors, natural particles and airborne particulates coming from vehicles and industrial sources. However, in contaminated areas, oil content does not normally exceed 0.003mg/m³. This is borne out by tests conducted by the TÜV near a factory with heavy machining activity (including turning, milling, grinding and drilling). Heavy vehicular traffic and a garbage incinerator were in the vicinity.

When operating oil-free air compressors, this extremely low level of atmospheric oil is washed away by the condensate in the intercooler and aftercooler, resulting in pure oil-free air for your process.

Oil from your compressor

Oil lubricated or injected compressors do have oil carryover that enters the compressed air system. As temperatures rise so does the amount of oil carryover. Typically, compressor manufactures quote oil carryover levels of 2-3 PPM (Part per Million) oil carryover based on standard operating conditions, but this will rise dependent on the compressor operating temperature, and the condition of the oil separator within the compressor. Depending on your production or process requirements multiple filters may be required to remove the oil

Each filter increases pressure drop, requiring your compressor to work at a higher operating pressure. Increasing power consumption and your carbon footprint. If you require clean oil free air consider replacing your oil injected air compressors with oil free air compressors.

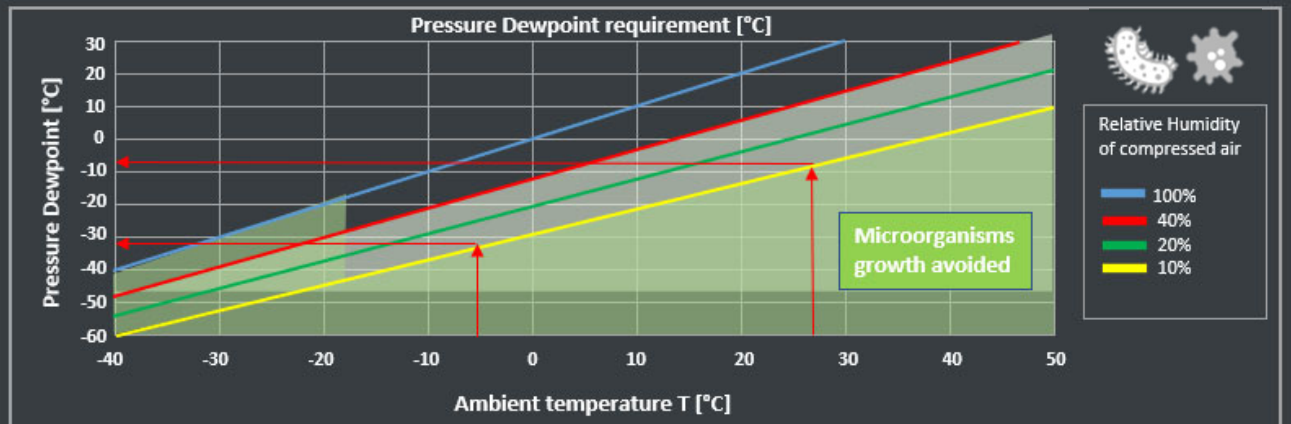
Micro-Organisms

Users of compressed air, certainly in more critical applications, are normally in the best position to specify the required quality and purity of the utilities like compressed air. They are consequently responsible to issue the correct specification for the supplier of compressed air equipment. The supplier, in turn, is responsible to provide equipment according to the required purity.

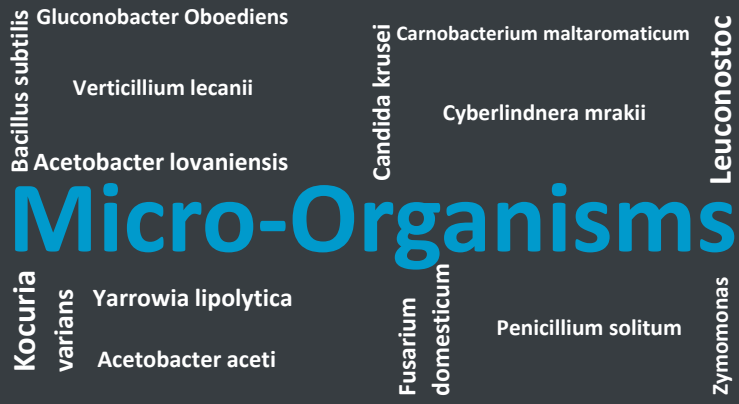
In hygiene critical applications like food & beverage, a compressed air pressure dew point (PDP) of -40°F/°C is very often specified. These sensitive applications are trying to reduce the risk of micro-organism growth in the final product and therefore also eliminate potential sources of contamination by utilities like compressed air. Food companies nowadays are rightfully concerned about food safety.

For low dew point requirements different technologies can be used like heatless twin tower desiccant dryers, heat regenerated blower type dryers, heat of compression twin tower, heat of compression rotary drum, refrigerating dryers etc.

Some drying technologies, designed to achieve a fixed and very low dew point, can consume 10 to 20% of its connected compressor power. The yearly required energy cost for these drying technologies can represent up to 13000,-Euro per 100kW installed compressor power.



[1] Compressed air is assumed to be cooled down to ambient temperature.
[2] Red line corresponds with minimum Pressure Dewpoint requirement to avoid bacterial growth in the compressed air.
[3] At T <-18°C no microorganisms activity.



Selecting the right dryer for your compressor

Compressed air networks consist of much more than compressors, and to maximize their efficiency – and your savings – selecting the right equipment is key.

Dryers for example, play a major role in the production of high-quality air. They eliminate the moisture it contains and thereby protects the downstream equipment. However, they also greatly contribute to the energy consumption of such a system.

When choosing a dryer, two main factors have to be considered: technology and size. Selecting the wrong model or picking a dryer that is too large can unnecessarily increase your energy consumption and operation costs, while a dryer that is too small may inadequately safeguard your equipment.

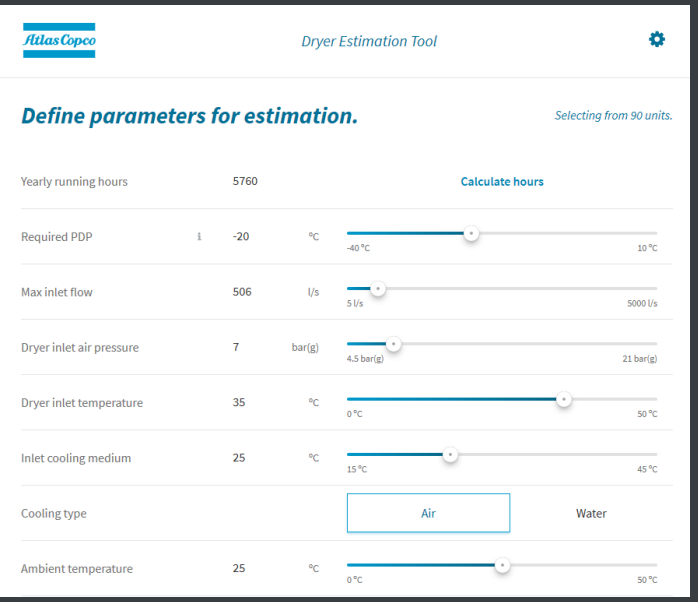
The type of dryer you need mainly depends on the targeted dew point. If it is very low, then you will likely require a desiccant dryer. However, since these are less energy efficient, they are not the best choice for applications with a regular dew point. In that case, you probably need a refrigerant dryer.

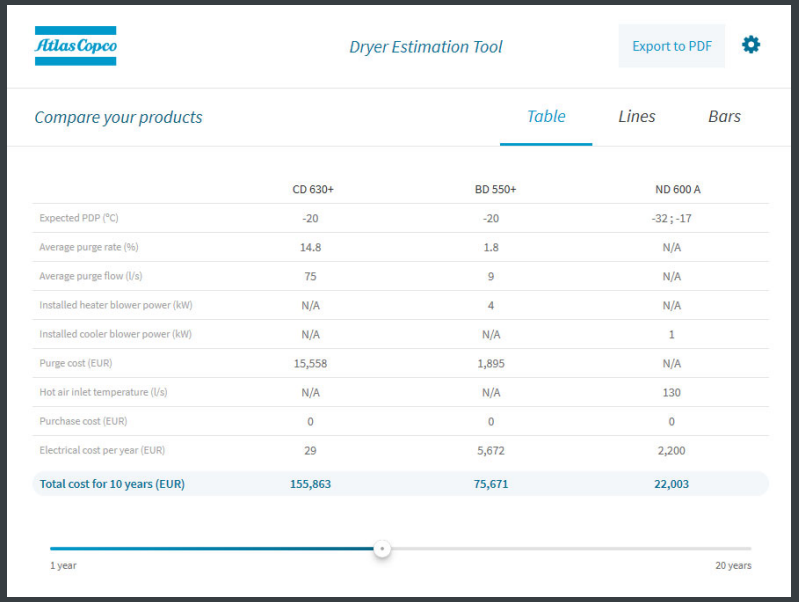
Once you have identified the type of dryer, there are lots of ways you can find energy savings. For example, refrigerant dryers are also available with the highly efficient variable speed drive technology, while a desiccant dryer with the option of dew point dependent switching can offer large savings.

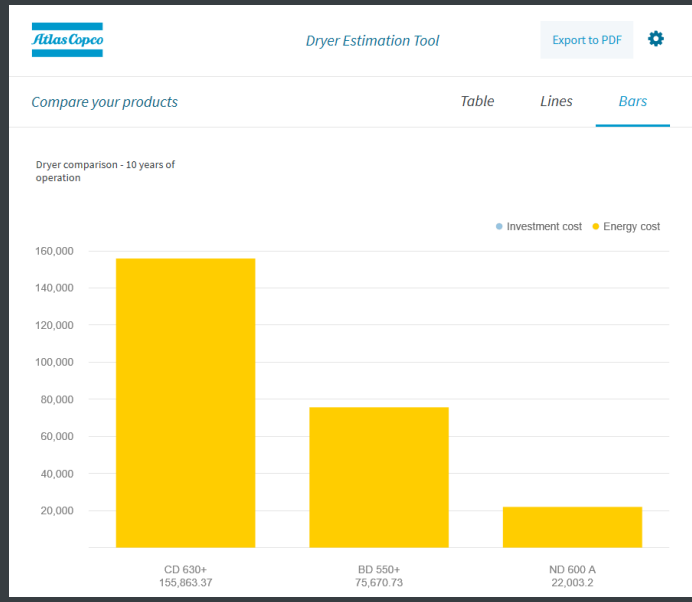
Dryer Estimation

When we talk about carbon reduction in compressed air, we first need to understand that dryers play a part in correctly sizing a compressed air system. By selecting the right technology, you could have an opportunity to decrease the size of your air compressor(s), resulting in equipment cost saving, energy savings. While lower carbon footprint.

On the example below. Note the impact of the purge flow on the operating cost but also that the heatless dryer is consuming 15% of the compressed air generated. By eliminating the purge flow, it may be possible to install smaller air compressors, reducing power consumption and carbon footprint.







Calculation based on 0.1 Euro / kWh

CD = Heatless purge regeneration

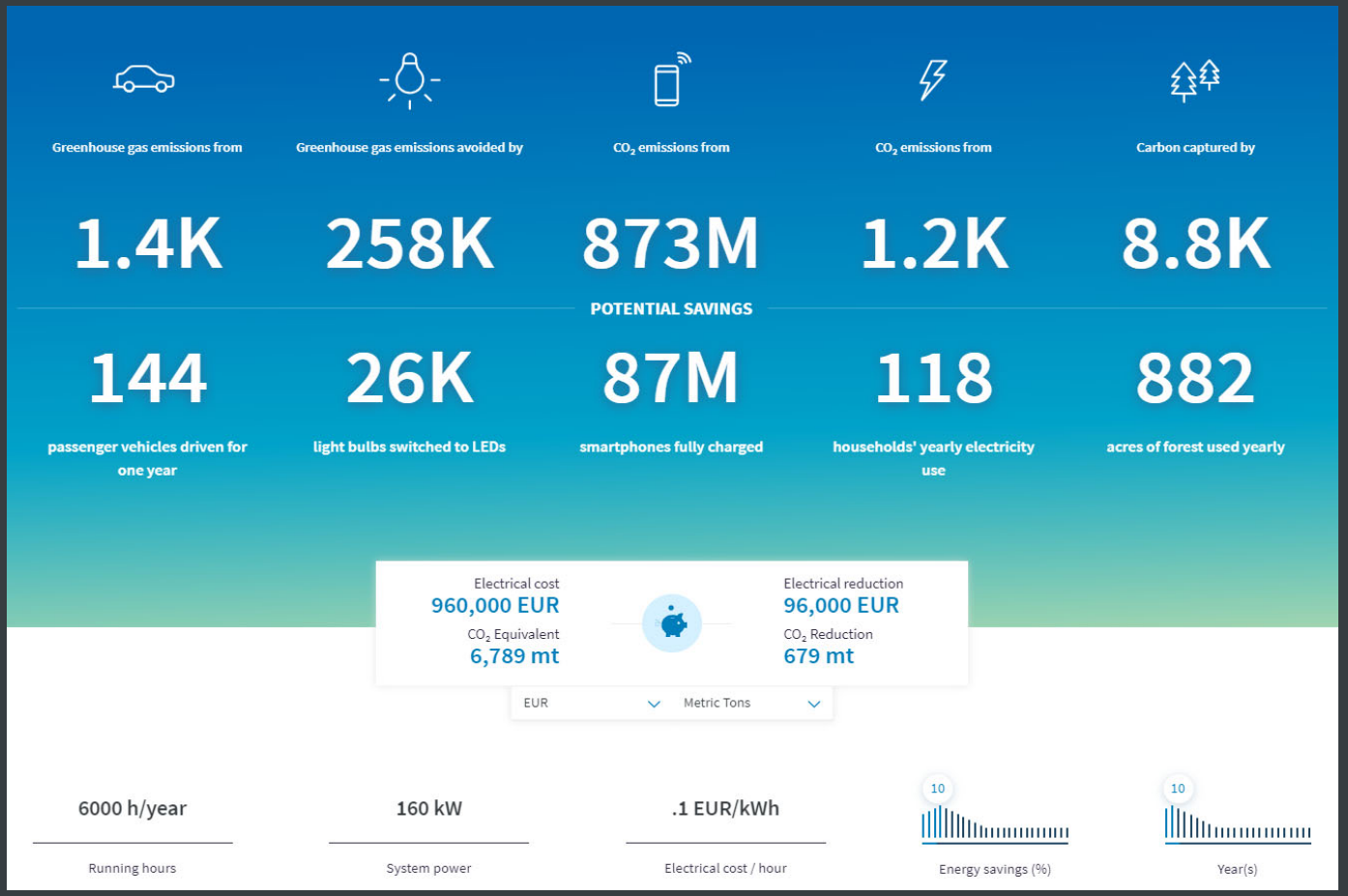
BD = Blower heated purge regeneration

ND = Heat of compression regeneration (only available for oil-free air compressors)

Carbon Reduction

Carbon reduction estimator is an effortless way to calculate your production environmental impact. Taking the example from the Dryer Estimation Tool, we showed when selecting the right technology this not only reduces electrical cost but will lower your carbon footprint as well. Heatless desiccant dryers consume a lot of air during the purge cycle, when replacing with a heated blower purge or zero purge in this example you could not just save money and reduce your carbon footprint but potentially reduce the size of your compressed air system.

Examples show the existing system and the reduction that could be saved when eliminating purge cycles from heatless dryer technology.



Class	A			B		C
	SOLID / DIRT Particle size in micron			WATER @ 7 bar / 100 psi Pressure Dewpoint		OIL (including vapor)
	0.10-0.5	05.-1.0	1.0-5.0			
	Max number of particles per m3			° C	° F	Mg /m3
0	As specified			As specified		As specified
1	≤ 20 000	≤ 4	≤ 10	-70	-94	≤ 0.01
2	≤ 400 000	≤ 6000	≤ 100	-40	-40	≤ 0.1
3	–	≤ 90 000	≤ 1000	-20	-4	≤ 1
4	–	–	≤ 10 000	+3	+38	≤ 5
5	–	–	≤ 100 000	+7	+45	> 5
6	–	–	–	+10	+50	–

Know your air purity classes … or talk to somebody who does

The ISO 8573.1: 2010 table defines the various air quality classes. The standard also determines that these air purity classes shall be designated by the following nomenclature:

A= solid particle class designation
B= humidity and liquid water class designation
C= oil class designation

Tip: Put together a spreadsheet with the air requirements of your individual production equipment. Check the flow requirements to see whether you need a central drying system designed (sufficient for most requirements) or point of use dryers (needed for higher requirements).

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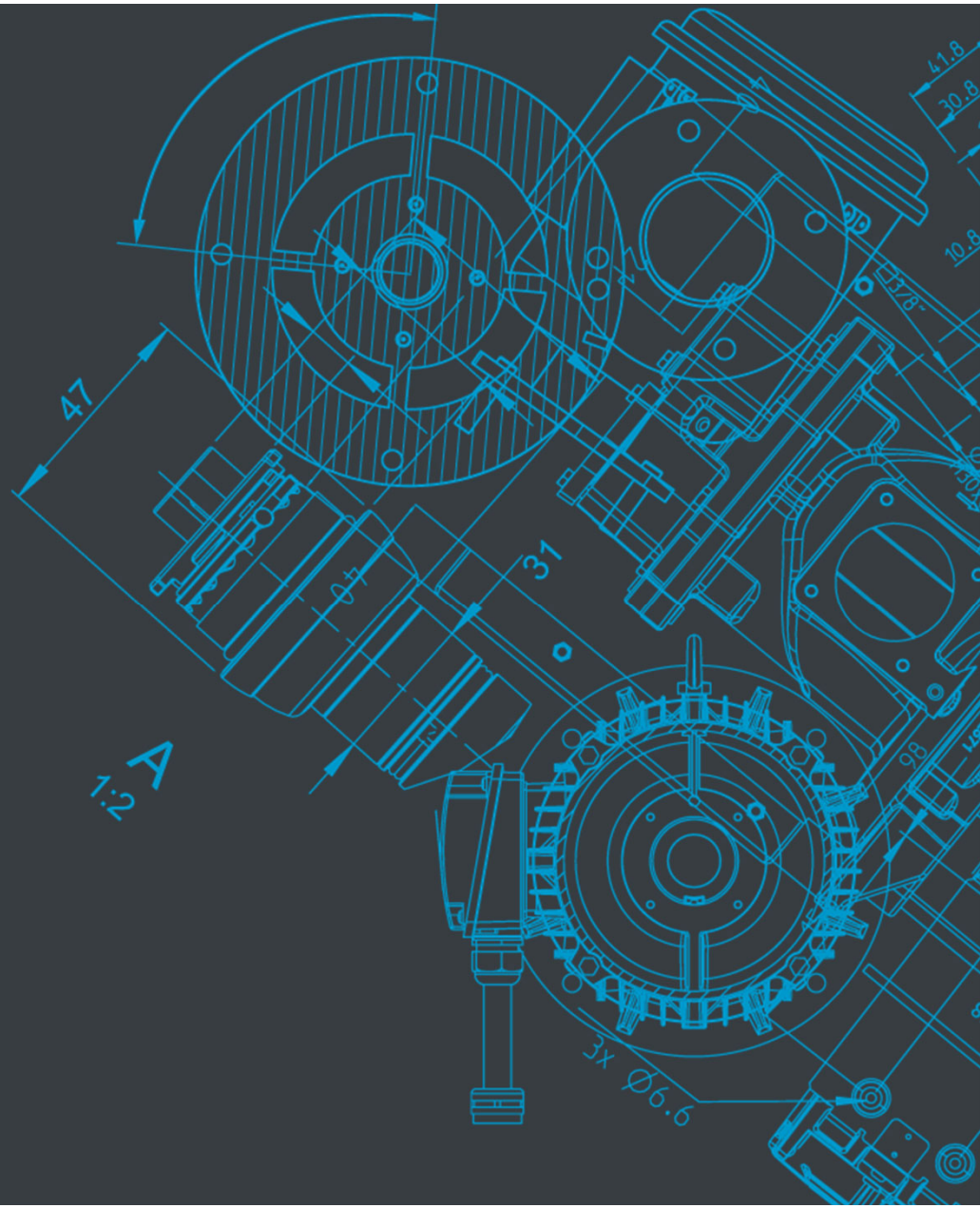
4. Volume & Flow Pattern



Understanding your air demand – the key to a greener production

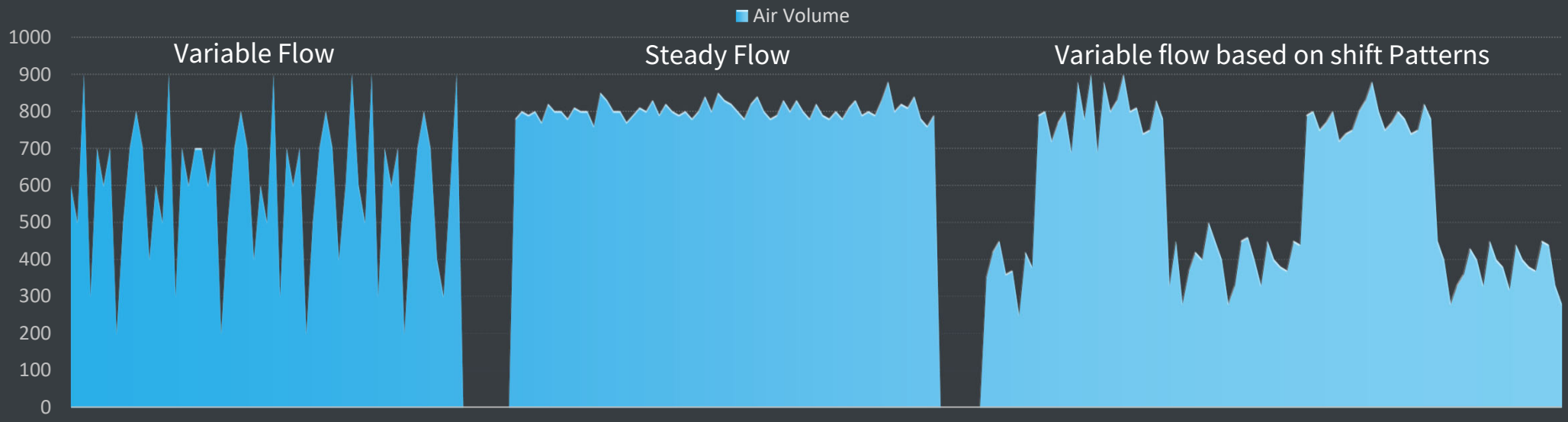
By better understanding your air demand, you may be able to save a substantial amount of money the next time you make an investment in a compressor. If you eliminate the inefficiencies of your compressed air network, your next compressor may need to be a lot smaller than you think – or you may not even need a new one at all / just yet.

When it is time to invest in a new compressor, make sure to be aware of the flow patterns within your operation, operational shifts also has to take into account i.e., your peak production periods on weekdays and if you have lower demand on nights and weekends.

Even the most efficient compressor may not be your most profitable solution in all cases. For example, while variable speed drive compressors are nearly always a great solution for operations with varying air demand, a less expensive fixed-speed compressor may be the perfect choice for production environments with a stable air demand. In addition, there may also be situations in which a mix of compressors is best.

Factors for consideration in control selection

Air volume
Compressed air demand pattern
Stored system Volume
Required pressure



Changing compressed air volume requirements can have a drastic impact on your compressed air installation efficiency!

The examples on the left show the difference between a correctly designed compressed air system, compared to a system that is designed just based on the maximum air requirements of a factory.

Example 1

Installation with two Centrifugal ZH1000 air compressors, One unit is supplying air to the factory while the second is a standby unit. While the centrifugal compressor is very efficient when operating between 75 to 100% load, due to the large fluctuations in air requirements the system efficiency is only average during the day and poor during the night shift as the compressor is oversized for the lower air demand at night.

Example 2

This installation combines two compressor technologies to maximize energy efficiency. The two centrifugal ZH400 air compressors can meet the factory's maximum air demand. One ZH400 is running at 100% load to meet the base load requirement during the day, while a ZR700 VSD rotary screw compressor equipped with variable speed drive (VSD) control is supplying the fluctuating air demand. While the Rotary screw technology does not have the volumetrically efficiency of the centrifugal technology, the ZR700 VSD uses less power as the VSD drive allows it to match power consumption to the air demand requirements, Lowering energy requirements and ultimately making it a greener solution.

Wasting Energy — Energy Efficient

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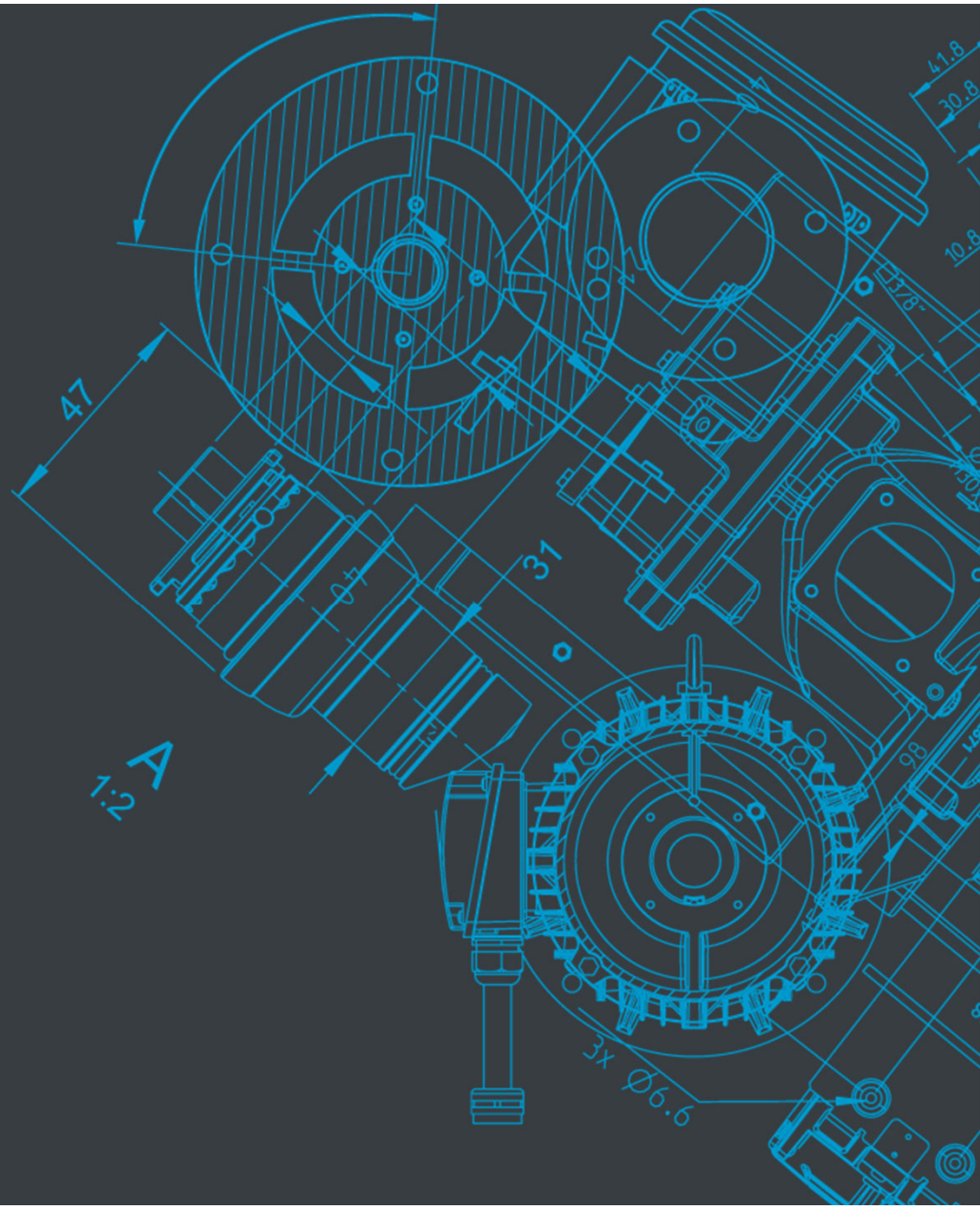
5. Core Technology



Green investments save energy and money

While some of the steps described above merely involve the elimination of inefficiencies or simply giving you a better understanding of your own compressed air system, some of the ways in which you can save energy and money involve an initial investment cost.

However, before you investigate making those investments, it is absolutely necessary that you first need to have a very firm grasp of your current system, its demand, flow pattern, etc. Otherwise, chances are that you will waste a lot of money, for example on a compressor that produces too much air for your applications or a dryer you do not need.

That being said, the right investments will pay off over time.

While it is true that the most efficient air equipment may come with a steep price tag – including our premium products – in the long run (and these machines are built precisely for the long run), they will save you money.

Keep in mind that energy expenses make up the vast majority of the total cost of ownership of a compressor or other compressed air equipment. These costs dwarf the initial investment and all maintenance costs.

So do not let a high price tag scare you. If you buy cheap compressed air equipment, you will pay more in the end – and harm the environment in the process.

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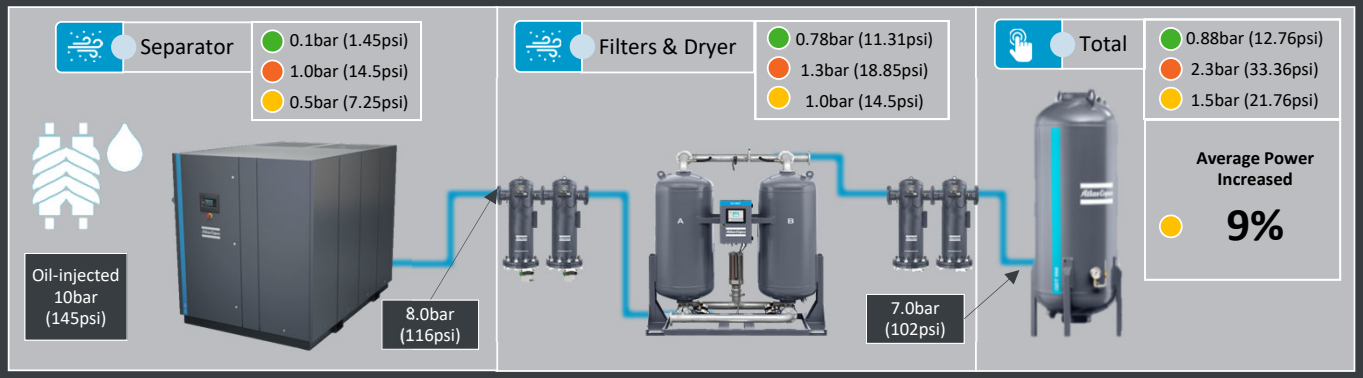
Different compressor types and their benefits

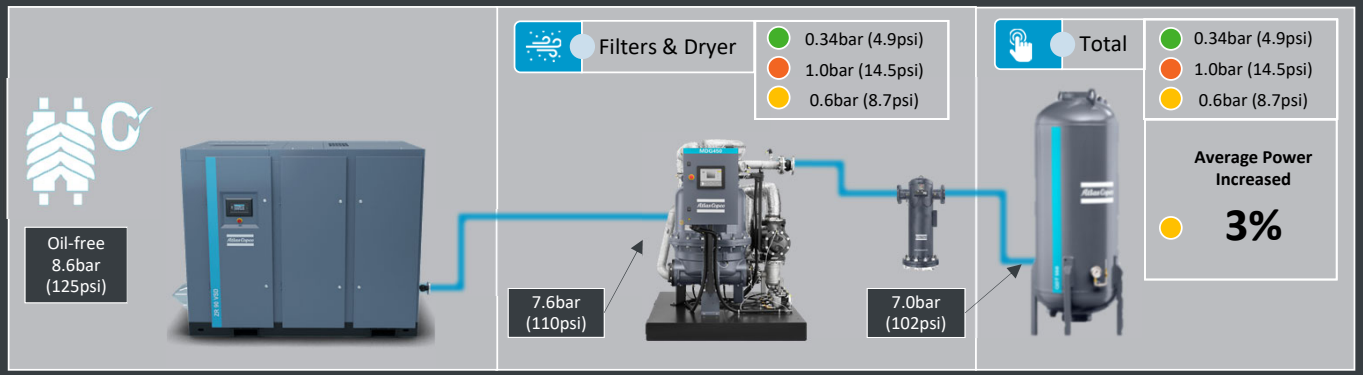
There are many different types of air compressor, and each have different advantages based on the operating pressure and air volume requirement. Here is an overview of some of the main technologies to serve as your starting point in determining which machine is right for you.

- Piston compressors: Highly efficient on load and off load but requires extensive maintenance. It is the most efficient technology on the day you purchase it but will gradually become less efficient every day after that due to sliding contact creating wear.
- Scroll compressors: Mainly used in applications requiring small and clean oil free airflows. Best used in intermittent air demand applications. They are simple and easy to maintain.
- Tooth compressors: Oil-free rotary tooth compressors are used for small to medium-sized applications and usually only come in the range from 15 to 55 kW. Good for both intermittent and continuous duty applications.
- Screw compressors: These compressors are the most popular type of compressor for the Industry but are used in many different applications from small workshop applications with intermittent demand to large industrial applications with continuous 24 hours per day demands. Screw compressors are available in oil-lubricated and oil-free technologies. They both can maintain efficiency for a wide range of flows.
- Centrifugal compressors: This is the most efficient technology for large volumes of compressed air. But It's only efficient if it is running continuously, therefore only suitable for applications with stable air demands.

Oil lubricated or oil-free technology



Clean Dirty Average



Clean Dirty Average

Three reasons to switch to Oil-free Technology

1. Reduce the risk of product or process contamination. Resulting in loss of revenue

2. Reduce your carbon footprint. By eliminating the requirements for oil filtration, you can operate an oil free compressor at lower pressure reducing power consumption and fit an energy saving heat of compression dryer further reducing your carbon footprint.

3. Reduce maintenance cost and waste by reducing the number of filter elements thrown into land fill or incineration.

PRESSURE DROP

EVERY BAR = 6% POWER INCREASE

*** 1bar = 14.5psi**

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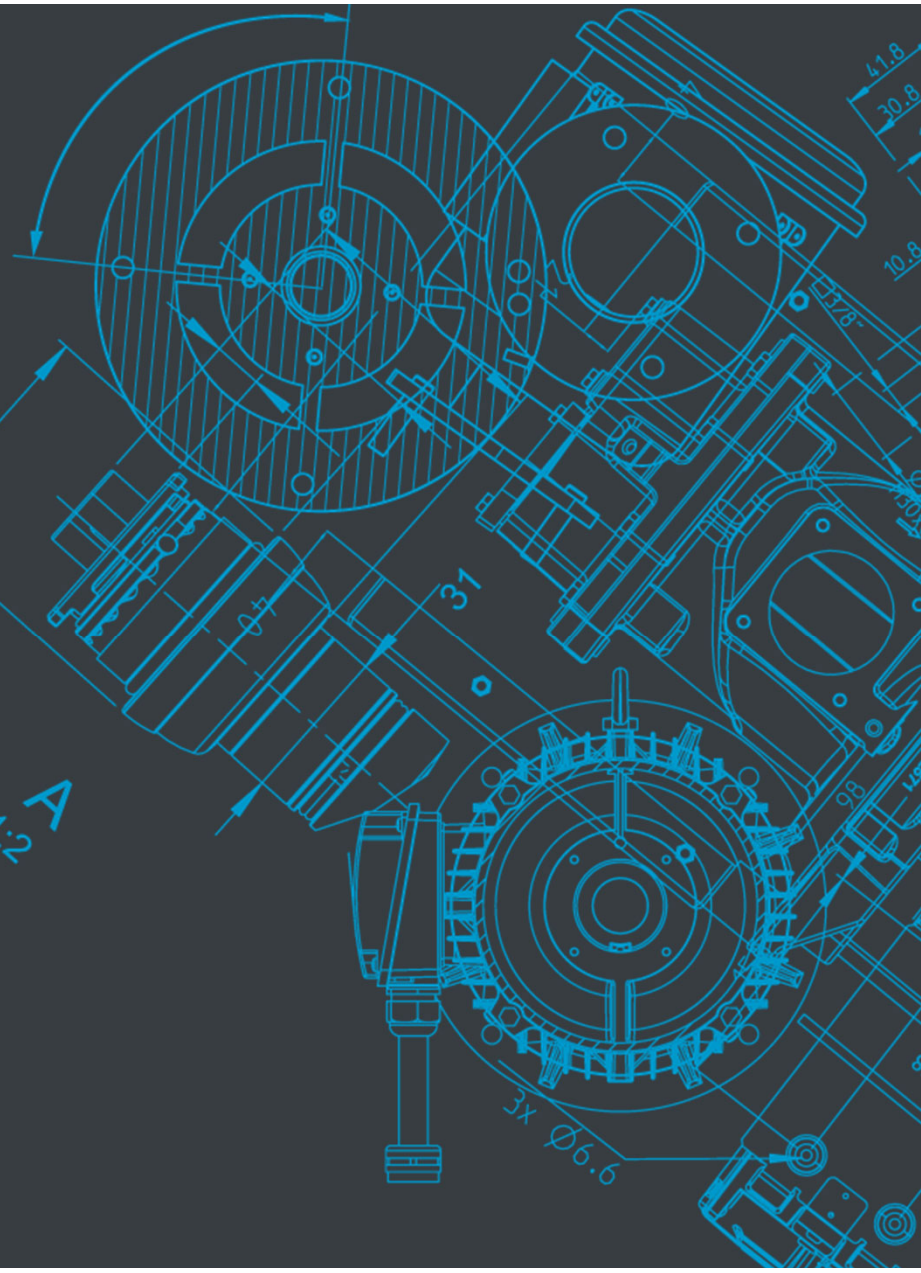
6. Equipment Control



Power is nothing without control

Once you pick the right compressor, you next have to think about how to control it. It is very important to keep in mind that, while the efficiency of your compressor is the foundation for the efficiency of your entire compressed air network, there are other important factors as well. You can only get the most out of your system – and therefore enjoy maximum savings – if you select a control system that matches your needs. There are different methods of control – and once again it depends on the flow pattern to determine which one is best for you.

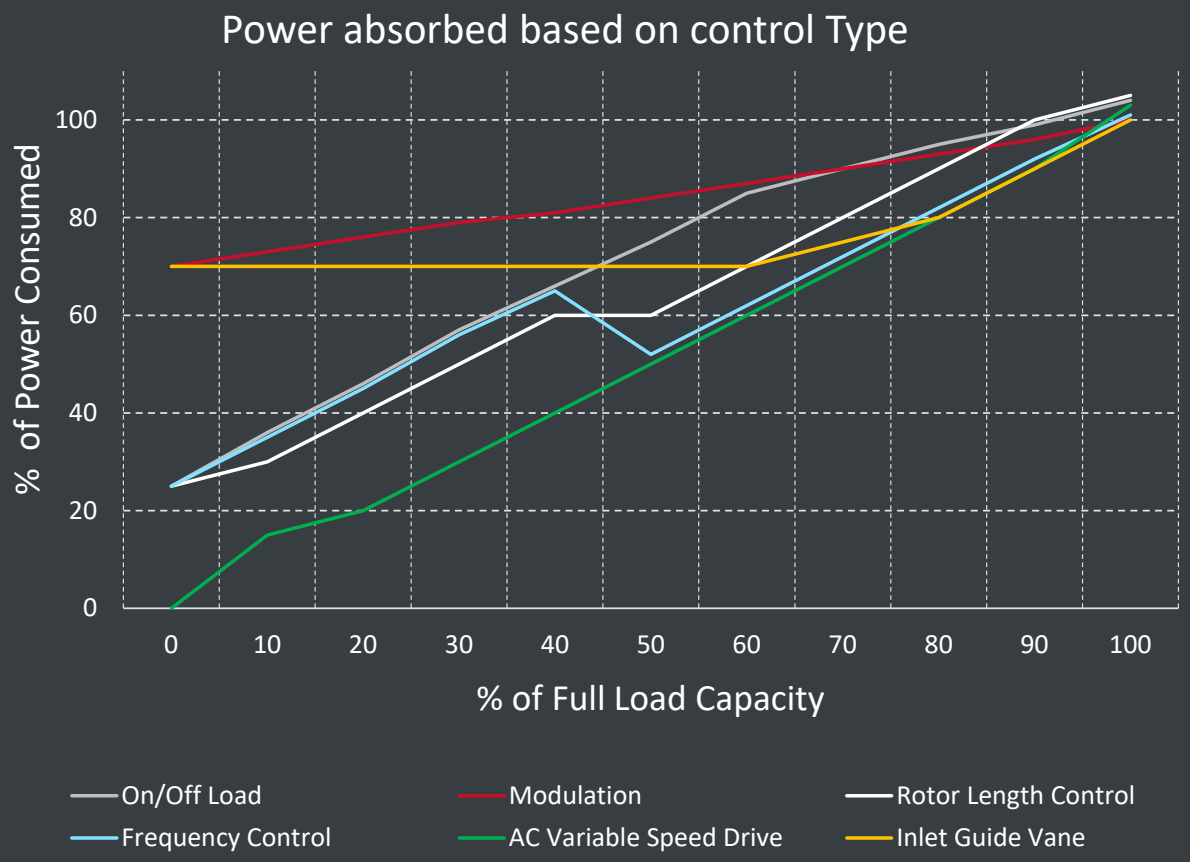
These methods range from very simple to highly sophisticated.
Some compressors are controlled simply by turning them **on and off (start/stop)**. This control method is primarily used with smaller, fixed-speed models.

When using the load/unload control technology, the motor of the compressor runs continuously but it unloads the compressor once the discharge pressure is sufficient.

Another method, also used with fixed-speed compressors, controls the inlet valve and regulates the output of the compressor in that way. This method, called modulation, is very efficient for operations with a constant air demand.

When that demand varies, however, compressors equipped with a VSD (Variable speed drive), which controls the speed of the motor, are the best solution and offers the biggest savings.

Ideally, an operation would use a combination of compressors, for example fixed-speed models that meet the base load and VSD-equipped compressors that efficiently deal with fluctuations in air demand.

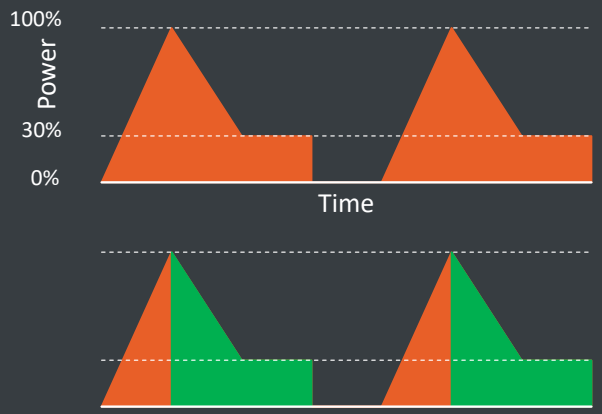


Picking the right controller

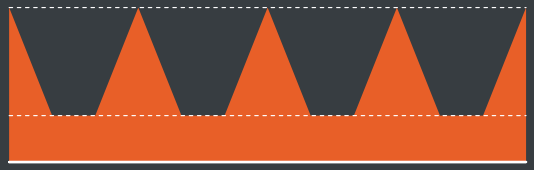
Advanced controllers, such as our Elektronikon®, can help you manage your pressure and optimize your power consumption with smart algorithms designed to minimize power consumption.

The red line represents the power consumption of a compressor fitted with an on load off load controller. When the compressor is off loaded the power consumption is still 25 to 35% of the full load power. When the machine off loads it will run for a certain period before the motor stops. This off load timer prevents too many stops and starts.

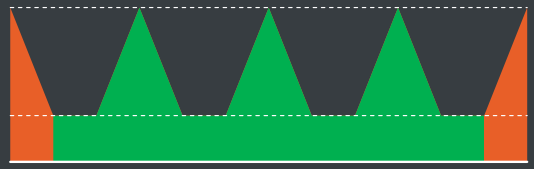
A compressor fitted with an advanced controller can calculate the volume of air used by the speed of the pressure drop. It can then calculate when the compressor will need to go on load again. In periods of low demand, the controller can immediately stop the compressor to reduce off load power consumption. Saving energy while maintaining reliability



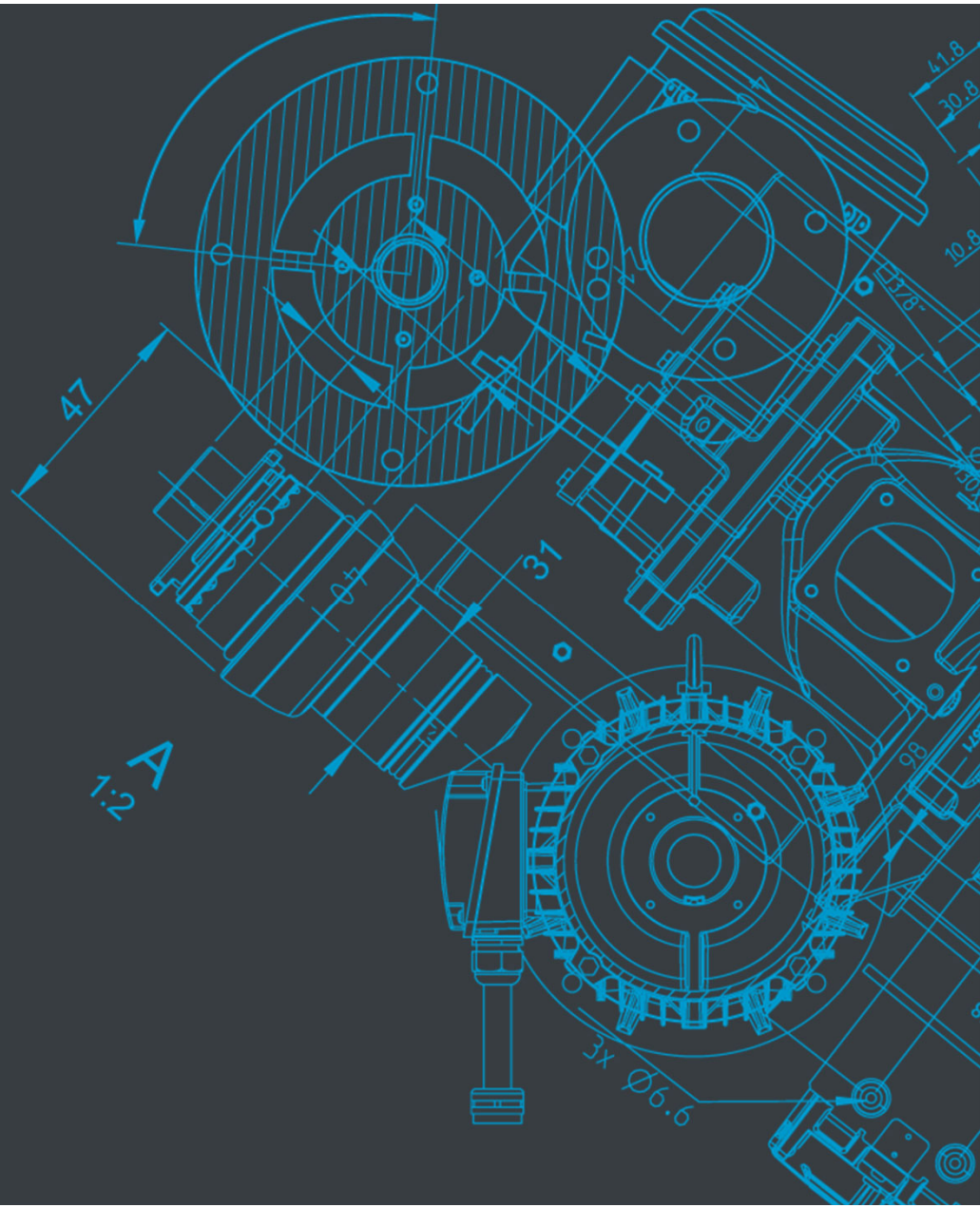
A compressor with a standard control and no timer feature will keep running during lunch breaks or even overnight when there is no production requirements. The compressor keeps operating wasting energy to feed air leaks.



A compressor fitted with multiple timers can be set to switch off during breaks and at certain times of the day when there is no air demand. Saving Energy



7. System Control



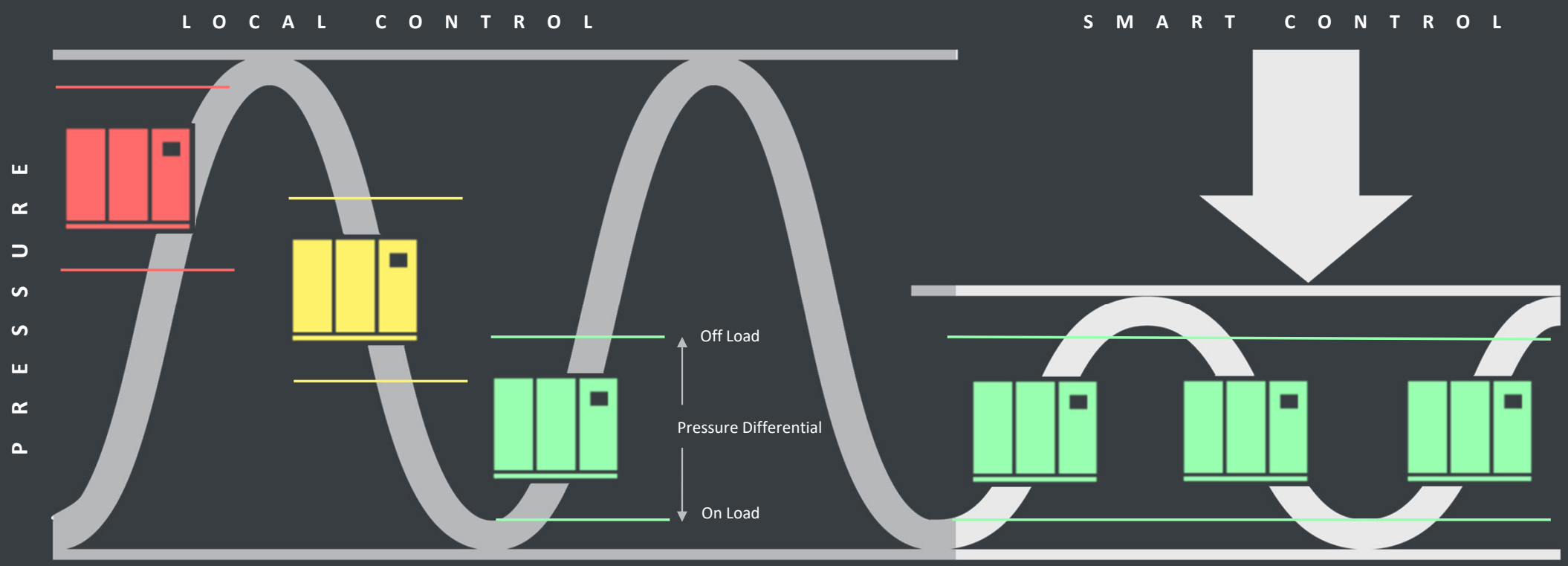
Optimize your compressed air system

In a compressed air system with multiple compressors and dryers, even the most efficient machines cannot reach their full potential without a central controller.

In that case, you should consider the use of a smart, central controller that accommodates different compressor technologies and control types to maximize energy efficiency, your savings and reduce your carbon footprint.

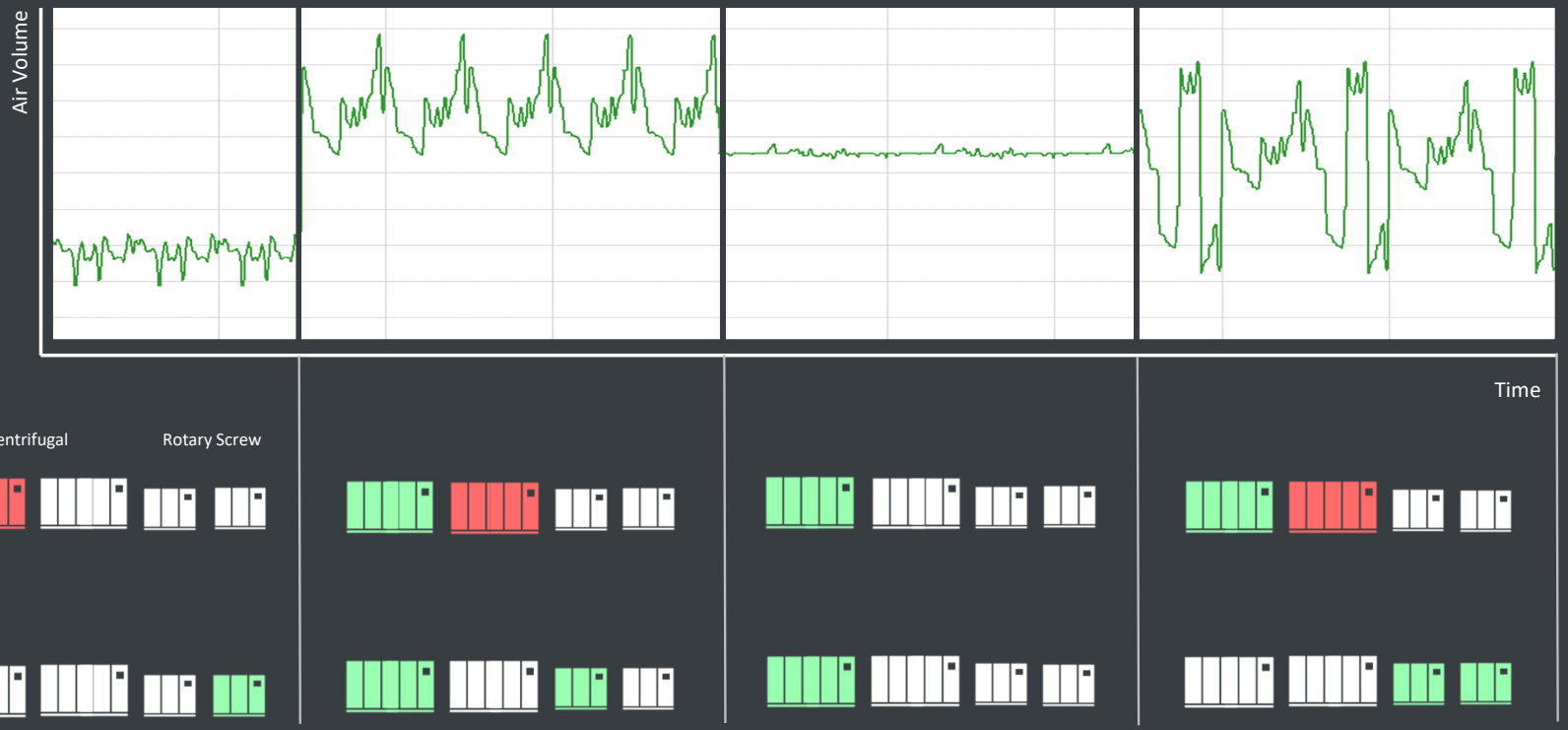
Our Optimizer 4.0 is a perfect example. It will not only prioritize the best compressor(s) for any situation but also increases the efficiency of the operation within the whole system by using the most optimum points possible, while reducing maintenance costs and helps you record your machine data.

A cascade control requires a large pressure differential to operate multiple compressors which of course leads to a large waste of energy. Below example shows the compressor in red is the lead compressor. If it cannot meet demand, then the yellow compressor will start and finally the green. This means that two out of three compressors are operating inefficiently. A smart controller manages all compressors within the same pressure band reducing the pressure differential and maximizing system energy savings.

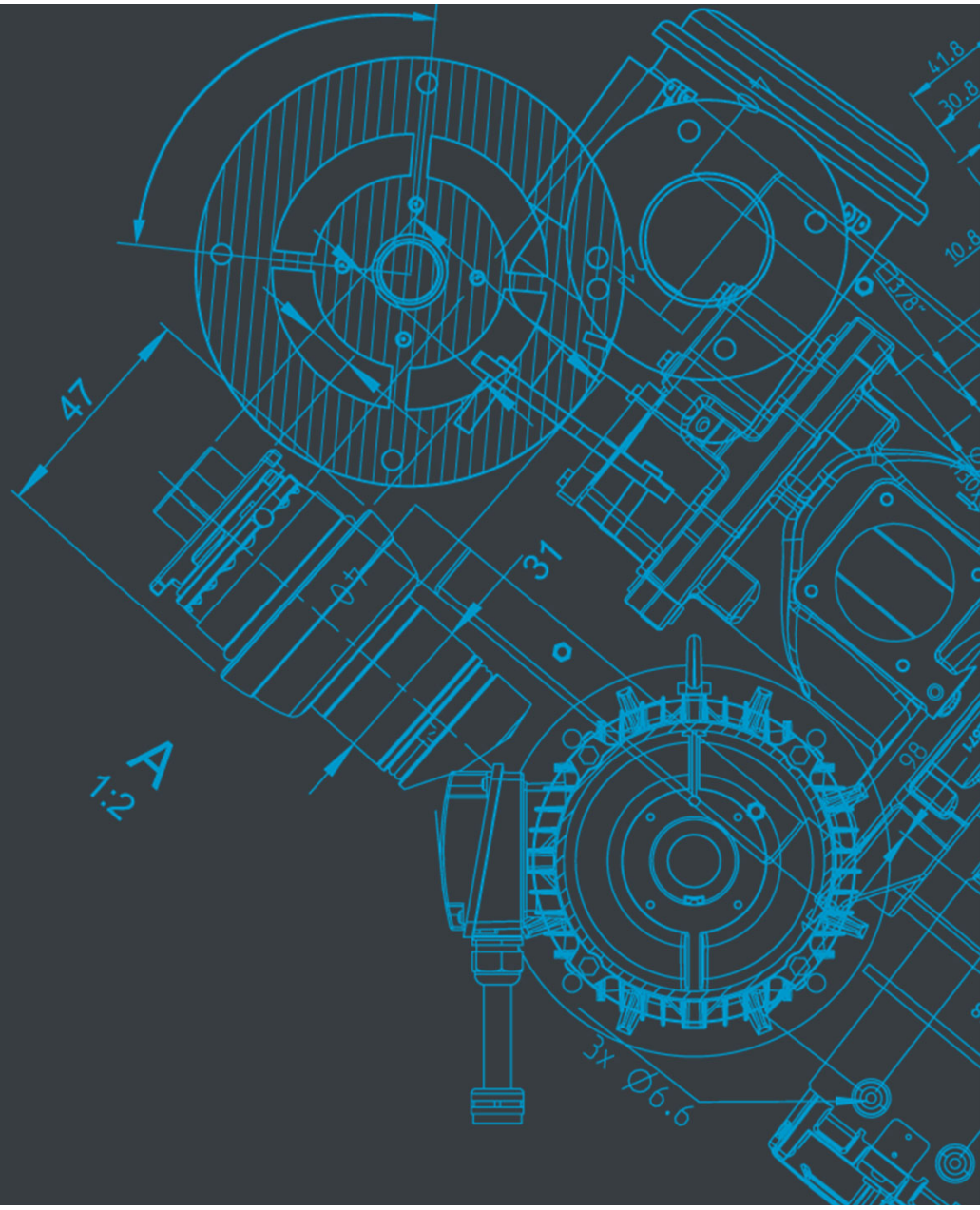


SYSTEM CONTROLLER

A smart central controller will select the correct size and technology of compressor to ensure the most efficient combination of compressors are meeting the air volume and pressure requirements, maximizing energy savings.



8.Energy Recovery



ENERGY RECOVERY

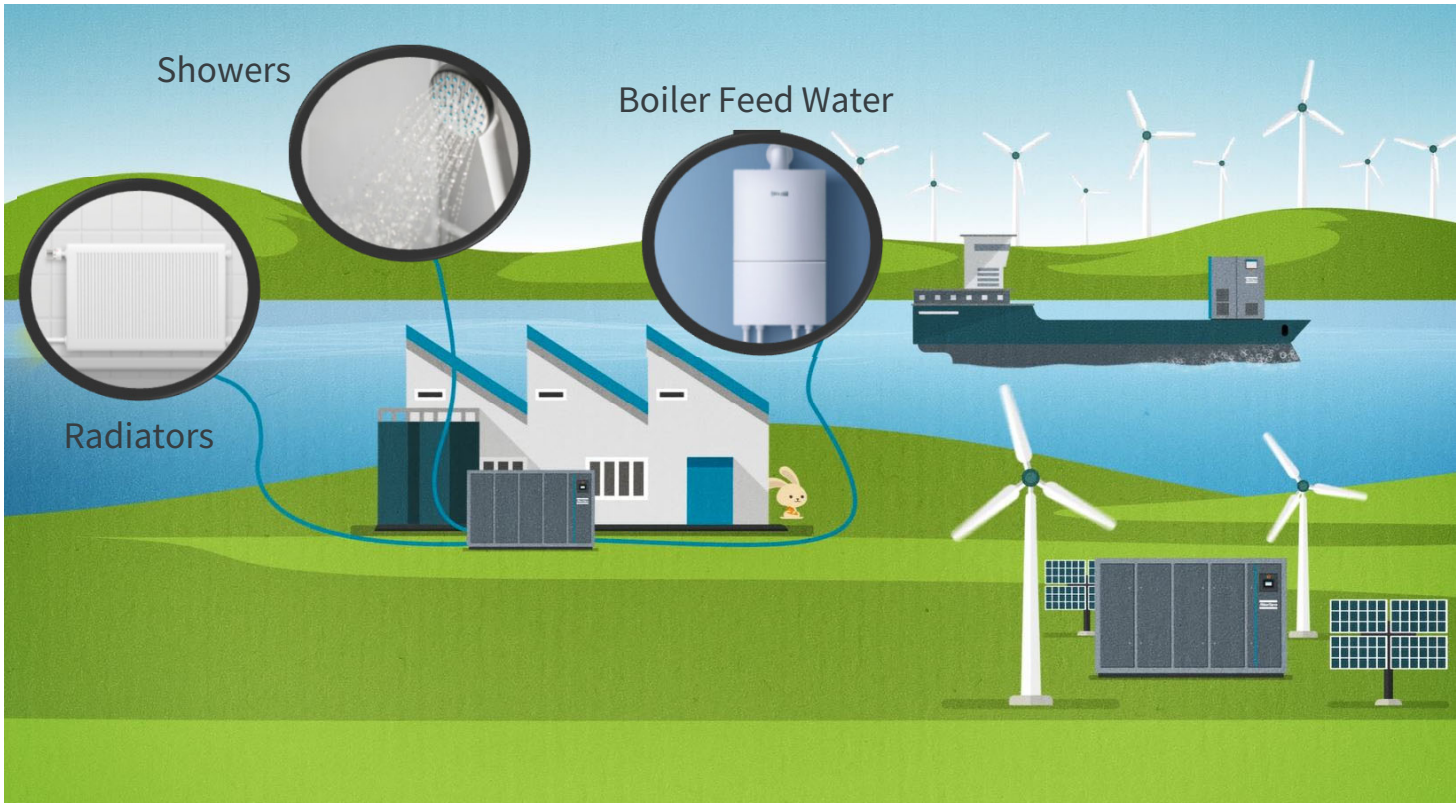
Compressing air generates a lot of heat. In fact, over 90% of the electrical energy a compressor uses is converted into compression heat. If you allow that heat to go to waste, you are literally allowing money to vanish into thin air. That is why energy recovery is the single best thing you can do to reduce your energy consumption.

Instead of wasting it, you can use that heat to warm your factory in the summer, cool it in the winter or even turn it into electricity.

Of those three methods, heat-to-heat is the most efficient with a 90% energy recovery rate. Heat-to-cold can get you a 60% recovery rate while heat-to-electricity yields a 10% return, which still beats just letting this potential energy source go to waste.

Why should I care about energy recovery?

Whether to maintain market share or to comply with sustainability standards, sooner or later you have to limit your carbon footprint. Many governments offer financial support for investing in energy efficiency.



To create a carbon neutral compressed air system, Use green electricity for your power supply and offset the cost by using energy recovery to reduce your overall power requirements and energy bill.

Being good for the environment can also be good for business

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ENERGY RECOVERY

DUCTWORK FOR SPACE HEATING

For countries with cold to moderate climates compression heat can simply be captured and routed to a place where it is useful with some ductwork. Potential energy recovered can be up to 75% of the motor power. Considering the need for space heating for approximately 60% of the year this would result in recovering approximately 40% of the energy used for compressed air generation.

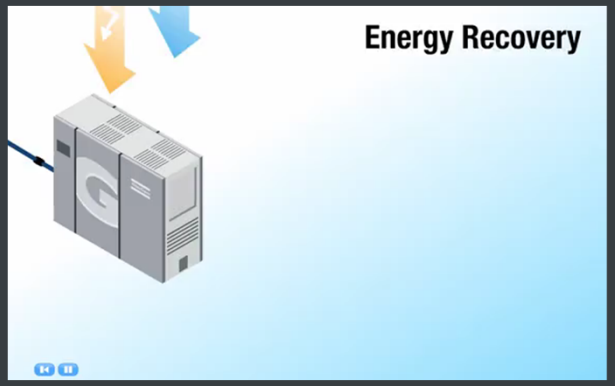
HOT OIL TO WATER ENERGY RECOVERY

Typically, you can recover 80 to 90% of the energy used for compression with an Oil to Water heat exchanger. This can be used to feed shower blocks or hot water radiators, or for maximum energy savings the how water can be used for production processes that require a constant supply of how water.

NOTE:

Energy recovery will vary based on the load cycles of the air compressor. Ideally fit energy recovery to units that are operating between 70 to 100% of capacity

AIR-COOLED
SPACE HEATING



AIR &WATER-COOLED
PROCESS HEATING

Limit your carbon footprint
Re-using the free-heat helps you reduce emissions which is positive for the environment

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9. System Maintenance

The role of system maintenance in a more efficient production

It is very important for companies to view maintenance as an essential component of an energy optimization system and not as a burdensome chore that sometimes shuts down production.

In the end, a well-maintained compressed air system will more than pay for the maintenance costs through energy savings.

And maintenance is even more crucial for compressors because they run all the time. … as opposed to, for example, your car, which you periodically take in for a checkup, oil change, etc.

Tip: You are **never** saving by delaying maintenance. Maybe you can avoid paying a technician or shutting down part of your production for a short time. However, in the long run, your energy costs will increase, and your equipment will suffer the consequences.

To keep our bodies fit we need to do regular exercise

To keep your compressed air installation efficient
you need to do regular maintenance

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10. Remote Monitoring

Peace of mind, not out of mind

Remote monitoring is an extremely useful tool that helps you to always keep an eye on your compressor. It allows you to optimize your equipment's performance from anywhere and receive messages alerting you to potential issues.

And, very importantly, it prevents you from forgetting your compressor, which is a very real concern for premium machines that run very well. While they offer peace of mind with regard to reliability and producing top-quality air day in and day out, they don't force their operators to think about them.

That is not an issue with remote monitoring.
In addition, it allows you to react more quickly when your energy consumption increases but not your output. While the monitoring system will not give you the answer, it will show you the need to investigate where your system may experience inefficiencies.

SMARTLINK

Knowing the status of your compressed air equipment at all times and being able to react on it, is the surest way to achieve optimal efficiency and maximum availability

Recommendations tailored to your needs

SMARTLINK **Energy** recommendations are uniquely based on the working parameters and performance of your compressed air installation. They show real opportunities and give practical advice to further improve the efficiency and reliability of your system.

Alerts can be sent to your computer or smartphone, and if reducing energy consumption is your priority, **SMART**LINK helps you with customized reports.

Save up to 30% with improved energy efficiency and comply with ISO50001

Atlas Copco

It pays to do the right thing

There is no reason not to take some or all of the actions described in our 10-step guide.

This is one of those cases by doing the right thing and helping our environment this will benefit your directly with substantial savings. That is no exaggeration: A large operation with a very inefficient compressed air network can save tens of thousands of euros annually by optimizing its system while significantly reducing the company's carbon footprint and making things easier for the maintenance staff.

To get the most out of this guide, don't just use it once and then forget about it or do a review of your compressed air system every couple of years.

You will get the most out of it if you make these steps part of the DNA of your business. Get your team involved in looking for air leaks or be aware of pressure changes.

Remind your staff that air costs money and should not be wasted. Make an investment plan that does not just consider your costs for one quarter or a year but rather takes into account a product's total cost of ownership.

And if you have questions, just turn to one of our experts. Atlas Copco will always be your partner when it comes to optimizing your compressed air system, saving money and making your production more efficient and environment-friendly.

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