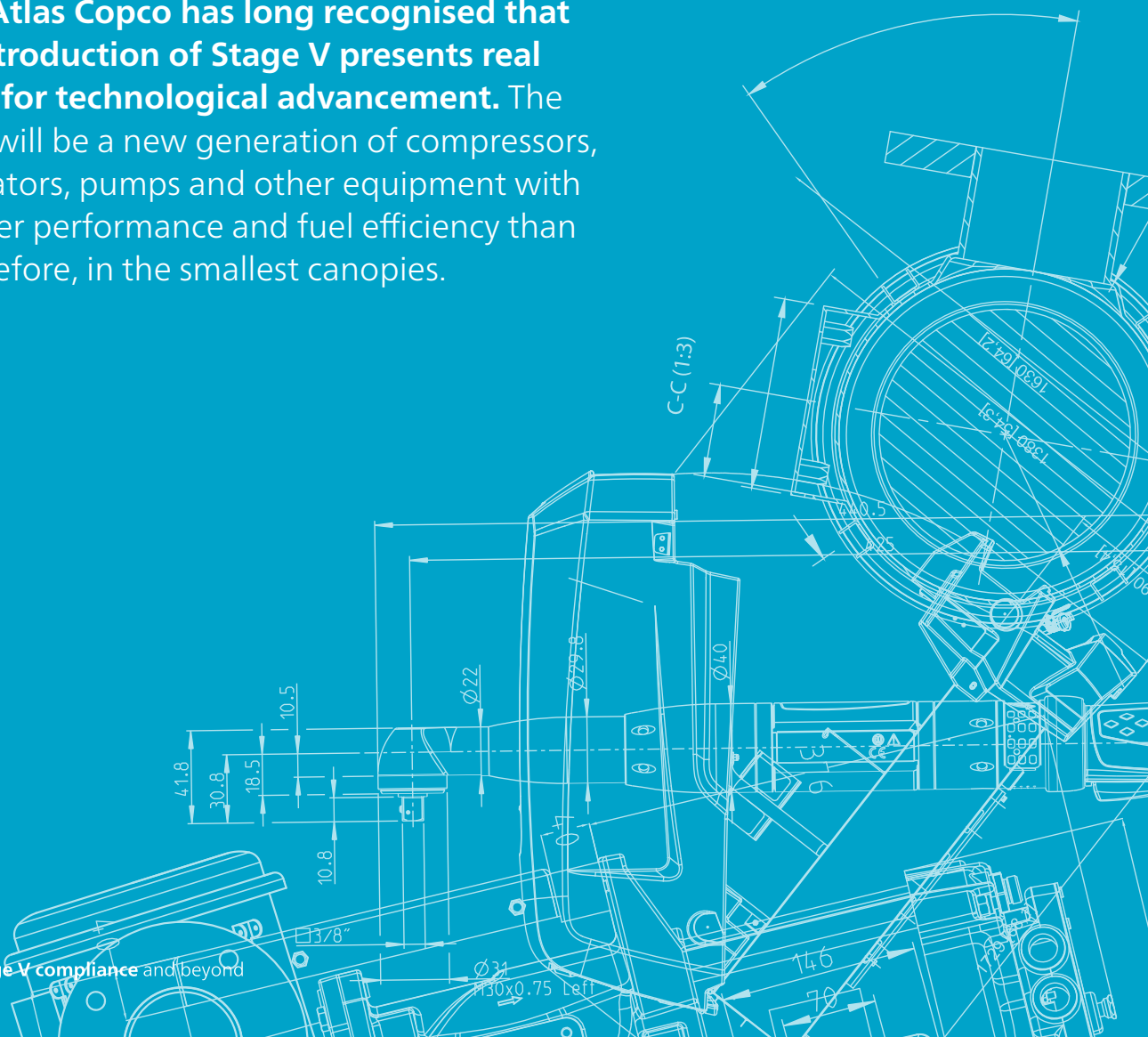


The European Commission's introduction of Stage V emissions standards for non-road machinery in 2019/20 is bringing new challenges for engine makers, including the integration of after-treatment systems and meeting particulate matter count.

This e-guide takes you along the route to Stage V emissions standards compliance, introducing cleaner and better-performing diesel compressors, generators, light towers and dewatering pumps while also taking a look at the transition to alternative drive technologies such as battery and electric driven solutions.

While some industrial suppliers are struggling to come to terms with the impact of new engine architectures on the products they offer, **Atlas Copco has long recognised that the introduction of Stage V presents real scope for technological advancement.** The result will be a new generation of compressors, generators, pumps and other equipment with a higher performance and fuel efficiency than ever before, in the smallest canopies.



European Stage V non-road emissions standards

The European Commission's desire to improve air quality, and therefore protect the health of European Union citizens, has resulted in a progressive approach to emissions standards for non-road mobile machinery.

Since the late 1990s, the staggered introduction of emissions legislation has resulted in limits for engines across a wider range of power outputs and applications, while engine manufacturers have faced tighter procedures in order to obtain type-approval of their products for EU markets.

Now, the Stage V diesel engine regulations – due to be implemented in 2019/20 – will be extended to include the smallest compression-ignition engines (below 19 kW) and all larger engines (greater than 560 kW), setting a minimum stringency over the entire power range. Stage V will also continue the path towards reduction of particulate and NOx emissions. The main difference is that for the first time there will be a limit on the number of particulates for several categories of engines between 19 and 560 kW. In practice, this will drive the adoption of diesel particulate filters (DPFs) and associated equipment for engines in this power range.

The standards will apply to a wide range of traditional mobile equipment in construction, such as portable compressors, wheeled loaders and excavators. They will also apply to mobile generators – including wheeled trailers and models that are designed to be moved to different work locations, such as those commonly used by equipment rental companies.

But the introduction of Stage V is not all about emissions: it has brought about an opportunity for performance advancement through the insertion of new technology. Indeed, over the past couple of years, Atlas Copco has been working closely with engine suppliers to deliver more productive and reliable machinery, with lower through-life costs.

“Atlas Copco provides customers with a clear pathway to compliance, offering an unrivalled range of next-generation compressors, generators, pumps and light towers that will offer better performance and value than ever before. Atlas Copco goes beyond stage V and offers technology that is clean, efficient, smart and connected.”

Looking at the wider picture, Stage V highlights the fact that EU legislators expect industry to play a central part in improving air quality and assisting in the fight against climate change. Atlas Copco is committed to reducing its carbon footprint and helping to deliver a more sustainable future.

The journey to Stage V compliance

The introduction of Stage V legislation for non-road machinery takes effect incrementally – in January 2019 for engines below 56 kW as well as engines of 130 kW and above, and from January 2020 for engines from 56 to 130 kW. The legislation will basically be valid for all mobile industrial equipment powered by compression-ignited or spark-ignited engines.

The incremental nature of EU emissions standards means that Atlas Copco, together with the engine manufacturers, has had long-distance visibility of the new requirements. That said, no single 'best technology' approach to compliance has emerged, as engine makers have had to consider varying customer priorities across the power range. Perhaps the biggest impact, for instance, comes in the 19 to 37 kW engine range – where common-rail fuel systems and exhaust after-treatment are being applied for the first time.

With the European Commission setting the rules for Stage V, the legislation applies to all countries within the European Union, and it is up to the local authorities in each country to ensure the rules are followed. Countries in Europe that are not members of the European Union, for example Norway, Switzerland and soon the UK, will most likely choose to follow the same rules.

The rules have been developed with an emphasis on technologies that reduce harmful substances in exhaust gases. Stage V will only allow about 3 to 4 per cent of the limits allowed by Stage I, which was introduced as late as 1999. Compared to Stage IV, which is the current legislation, Stage V will not only limit the overall mass of particulate matter in the exhaust gas, but also the number of particles emitted through a particulate filter.

Engine makers have looked at several ways of combining different techniques to achieve the Stage V emissions limits. As with Stage IV, an exhaust after-treatment system (EATS) with selective catalytic reduction (SCR) is needed. This means that diesel exhaust fluid (DEF) is injected into the exhaust stream to reduce the NO_x levels. For Stage V, one solution would be to combine modules of diesel oxidation catalyst (DOC), diesel particulate filter (DPF), SCR and ammonia slip catalyst (ASC). This, together with the heat management devices on the engine, will provide excellent uptime through an optimised regeneration strategy. Furthermore, a common-rail fuel injection system featured in Stage V engines could lead to an improved fuel efficiency and optimised combustion process. The common-rail fuel injection system will also provide significant noise reduction, which is mainly important for machines such as generators that operate in urban environments.

In addition to the development of new emissions technologies, the engine makers have also been working closely with OEMs to ensure optimal operational performance. Much consideration has been given to installation, reliability, maintenance and fuel efficiency. These collaborative efforts mean that new industrial machines installed with Stage V-approved engines will deliver exceptional value for money through low total cost of ownership.

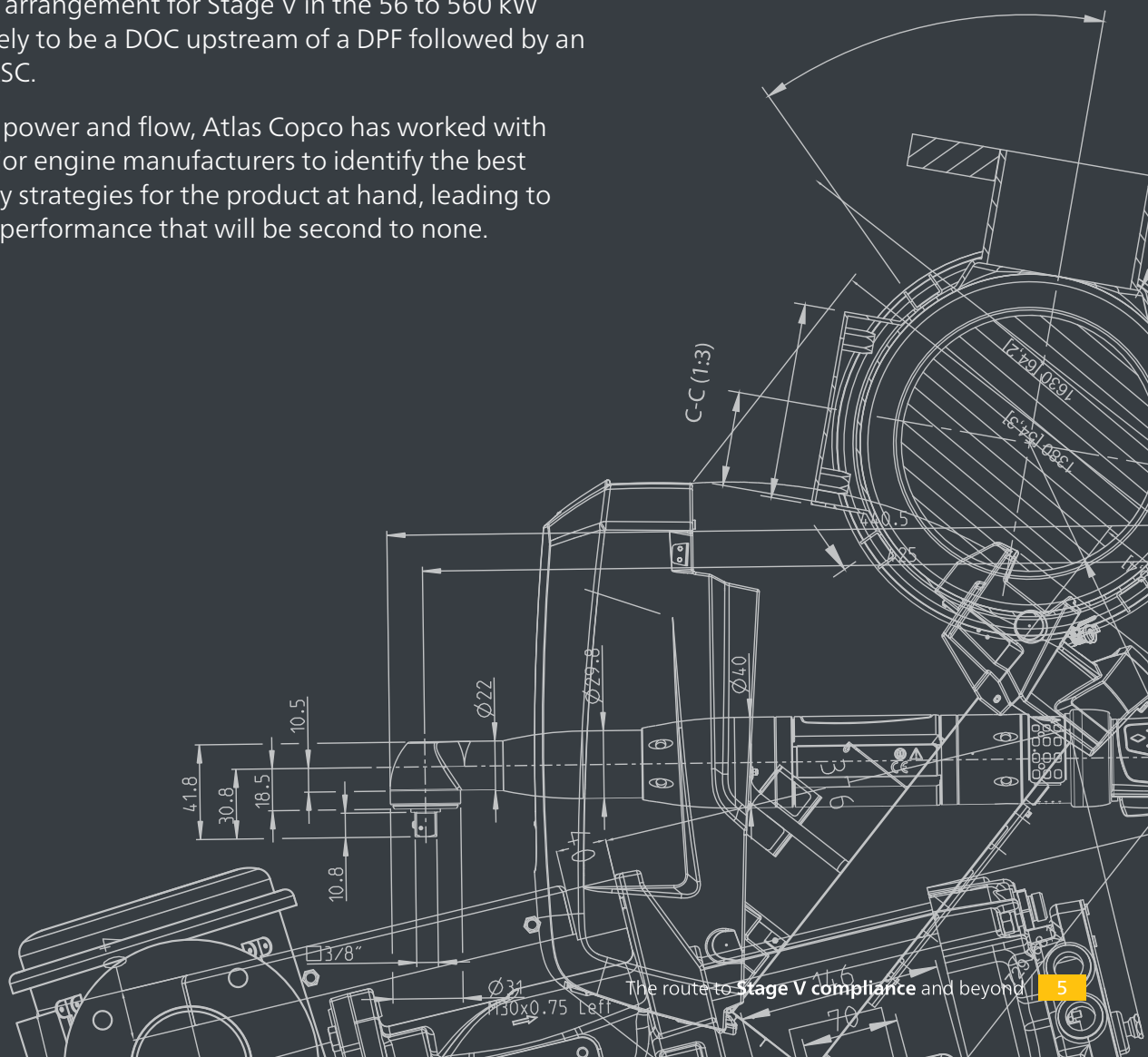
Engine strategies under consideration

Stage V effectively calls for the use of a DPF in the after-treatment system. The reduction in PM mass limit and the introduction of a particulate number count for diesel engines between 19 and 560 kW makes it extremely difficult to achieve Stage V emissions compliance without a filter.

The rules mean that manufacturers of smaller engines, under 56 kW, are covered for the first time and, as such, many of these suppliers might not have previously developed an after-treatment technology solution. It's likely that the well-understood performance of a DOC and DPF combination, selected by many suppliers on engines over 56 kW at previous stages in EU emissions legislation, will emerge as the technology of choice for manufacturers of 19 to 56 kW engines.

Higher up the power output scale, the most common after-treatment arrangement for Stage V in the 56 to 560 kW band is likely to be a DOC upstream of a DPF followed by an SCR and ASC.

Across air, power and flow, Atlas Copco has worked with all the major engine manufacturers to identify the best technology strategies for the product at hand, leading to emissions performance that will be second to none.



Introducing Stage V on portable air compressors

Atlas Copco offers a range of portable compressors across small, medium and large air categories, all of which have been impacted by Stage V legislation to a greater or lesser degree. In each case, the company has been working with the engine suppliers to ensure that the route to compliance will be smooth and orderly, with transition and Stage V-ready engine strategies plotted through to 2020 to ensure that customers always have a solution.

In terms of power output categories, less than 19 kW will remain mechanical engines with no after-treatment, while greater than 19 kW will see the introduction of electronic engines with an electronic controller and after-treatment attached. That 19 kW border is an important break in the product line: the mechanical solutions are capable of meeting Stage V requirements without the need for after-treatment, therefore representing a less complex engine architecture with fewer packaging considerations. That's why Atlas Copco has been challenging engine suppliers to help make the most efficient compressors in the world below 19 kW to broaden their range of end-user applications.

While the specifics of the new compressors are under wraps, the collaboration with key engine partners could help deliver efficiency savings of around 18 per cent to enable an engine of less than 19 kW to comfortably power two typical breakers. Such a performance would represent optimal efficiency for customers, as the price difference between a mechanical engine below 19 kW and an electronic engine above 19 kW could be as much as 50 per cent. The mechanical solution represents a lean, low-weight engine that meets all requirements.



Need to get a lot of work done? Atlas Copco's two-tooler package pairs up two new, fuel-efficient RTEX pneumatic breakers with a lightweight XAS 48 Stage V portable air compressor for a **small, but powerful package**.

In the medium and large air ranges, meanwhile, the migration from Stage IV to Stage V emissions legislation has been less of a jump. The EU's ambition to reduce NOx and particle matter could be seen many years ago, and the compliance process for Stage IV was very much delivered with Stage V in mind. Neither Atlas Copco nor the engine suppliers wanted to go through another round of redesigning machines, so future-proofing was built in.

What does that mean in reality? Well, on the large compressor range, for instance, it was clear that Stage V would require the addition of a diesel particulate filter. The packaging requirements of such an addition were considered, meaning there was no impact on the dimensions of machines. This commitment to maintaining or even reducing the size of equipment is unique to Atlas Copco, and reflects a long-standing investment in advanced engineering and design capabilities that other OEMs can not match. It is a vital consideration in the rental sector, where compressors of up to 750 kg can be driven away by customers without the need for a special licence, while further up the power output scale, any additions in size and weight can result in the need for specialist transport machinery, which adds further to cost.

Ultimately, the aim has been to provide portable air customers with a smooth transition to Stage V, either through the use of transitional engines or new Stage V-ready designs. But on top of meeting the emissions standards, there has also been an opportunity to introduce innovation, which brings extra value to customers.

Firstly, Stage V engines are likely to be more efficient than their Stage IV predecessors. This has been achieved in several ways, depending on the engine supplier. Some engine makers, for instance, have decided to move the exhaust gas recirculation (EGR) valve, which performed an emissions role on previous engines but increased fuel consumption. As after-treatment technology has evolved, the EGR valve can be removed, while still allowing the engine to comply with stricter emissions standards. Initial development testing of Stage V engines shows that this simple design alteration could improve performance by as much as 2 per cent – therefore lowering fuel costs. Meanwhile, Atlas Copco has used the transition from Stage IV to Stage V emissions standards as a chance to accelerate development of new compressor elements, further impacting performance enhancements.

Overall, the introduction of Stage V should be viewed as an opportunity for technological advancement, offering CAPEX savings through more compact design, better utilisation and higher resale value, and OPEX savings through less fuel consumption, lower maintenance costs and higher productivity. And as adoption of the new standards moves closer, Atlas Copco customers can be confident that a clearly defined route-map towards compliance is in place.

Introducing Stage V on power generators

Most engines installed in generators comply with Stage IIIA emissions standards, and so the leap forward to Stage V has a big impact. Also, generators – in the main – require constant- rather than variable-speed engines, which in turn requires different technical solutions. As constant-speed machines account for only a small percentage of the overall industrial engine market, that means progress towards Stage V compliance has been slower.

However, Atlas Copco has been working with its partners on Stage V solutions for generators for several years. These conversations have focused on areas such as the design and packaging of after-treatment systems. These considerations will have an impact on the size, performance, fuel efficiency and cost of Stage V-compliant machines, and all of these factors are currently being assessed in ongoing trials.

With a wide technological gap between Stage IIIA and Stage V, Atlas Copco has thought long and hard about how to implement a smooth transition towards the phased adoption of the new standards in 2019/20. One solution has been the development of the flagship QAS 5 generators, which come with optimised Stage IIIA engines. QAS 5 Stage V-compliant engines will become available in the near future, offering a clear pathway to Stage V adoption and beyond.

The **QAS 5 range** represents a technological leap in its own right. The first five models – new versions of the QAS 80, 100, 120, 150 and 200 generators – all include the optimised Stage IIIA engines, a high-capacity fuel tank and integrated variable-speed drive motor to power the cooling fan. These features combine to provide users with a more than 5 per cent reduction in fuel consumption compared to the industry average for equivalent models, resulting in a lower carbon footprint. The QAS 5 generators deliver a significant reduction in noise levels, with one-fifth lower noise perception than comparable generators, which is an important consideration when excessive noise generated by portable energy equipment is becoming increasingly unacceptable in urban environments.

On other ranges – such as QES – similar complementary strategies are being employed, resulting in the use of transition engines in certain power ranges, with Stage V-compliant models set to follow in the short term.

Meanwhile, in certain power outputs, Stage V compliance could be achieved through the use of highly innovative dual-power strategies. Here, big power nodes could be covered by two smaller engines working in tandem. Atlas Copco already has extensive experience of this technology, having launched its TwinPower operating principle in 2016, based around the concept of two generators, with two independent engines, fitted inside one box.

The **QAC 1450 TwinPower**, launched in April 2018, is the latest model, featuring two compact 725 kVA generators, powered by V8 engines with double bearing alternators. This configuration, with its fast-paralleling system, allows the two generators to work independently or in parallel with each other. This provides far more flexibility, contributing to fuel savings and a lower overall cost of ownership, as well as a 15 per cent reduction in carbon footprint compared to a single-engine generator.

TwinPower offers a sound strategy for Stage V compliance at the upper end of the power outputs, while the engine manufacturers decide on new engine architectures for their largest and most powerful constant-speed models.



The unique QAS VSG (Variable Speed Generator), the generation 5th of QAS 5 and the innovative QAC TwinPower, covering all power needs.

In order to overcome the potential low load issues on Stage V engines like wet stacking or after treatment saturation, which impacts the performance of the generators, Atlas Copco has also seized the opportunity to launch the first ever variable-speed generator called **QAS VSG**. The unique technology QAS VSG works between 950 and 2550 rpm integrating an Energy Storage System to increase Peak power capabilities by 70% and will ensure that the power pack works at the optimum speed level regardless of the load. In addition to reliability and performance under Stage V, QAS VSG will bring several end-user benefits, including 40% fuel savings, 40% less CO2 emissions, +70% Peak power capabilities vs nominal power, high fleet utilization, low noise under low loads and compact footprint. This is an important consideration in space-constrained metropolitan building sites.

Whatever the outcome of ongoing technical discussions, Atlas Copco has in place the required depth of range and the technical expertise to ensure that customers are provided with a smooth transition to Stage V across the power range. Ultimately, customer needs will be met through sustainable productivity and increased operational flexibility, along with compliance with environmental and regulatory obligations – whatever the model choice.

Introducing Stage V in Light towers

Light towers are a key piece of equipment on construction, mining and outdoor public event sites, providing illumination for numerous applications and projects that need to be carried out in a safe manner during hours of darkness or poor visibility.

In terms of power source, diesel-driven light towers remain very popular, accounting for as much as 75 per cent of the market. They are widely seen as the ideal solution when working in remote locations, where access to electricity is limited or non-existent.

The diesel engines used to power light towers typically have a rated output from 3 to 6 kW, providing more than enough power to run the metal halide or LED lamps for extended periods

of time. These engines are much smaller than those used for other Atlas Copco products such as compressors and generators, and therefore feature a less complex engine architecture. This has made the transition to Stage V compliance far simpler than in other sectors, with no need for additional after-treatment to meet emissions standards. Indeed, from April next year, all diesel-driven light towers will be Stage V compliant, with the new engines continuing to offer exceptional levels of fuel efficiency and reliability.

The Atlas Copco’ HiLight range offers this and much more.

While diesel remains the primary power source for light towers, there is a full range of complementary technologies that are better suited to certain applications. Electric-only light towers like the **HiLight E3+** are a good solution for work sites with reliable and accessible grid connection, ensuring that lighting operations are carried out without the interruption of refuelling or additional maintenance required to service mechanical parts. These electric-only light towers are regularly used on metropolitan construction sites, as they are typically quieter and smaller than diesel-powered models.

Battery-powered LED light towers are also coming to the fore, with advances in lithium-ion technology resulting in improved energy density. Atlas Copco’s new **HiLight Z3+** battery-powered light tower, for instance, offers up to 20 per cent more depth of discharge in comparison to AGM and OPzV battery types, with a maximum energy density of 190 Wh/kg compared to 50 Wh/kg, and a lifetime of 5,000 cycles; equivalent to twice that of



the best alternative technologies. This delivers best-in-class performance in terms of running hours, reliability and total cost of ownership, providing a 40 per cent advantage over diesel hybrid systems in terms of overall energy efficiency.

Looking further forward, solar-powered light towers offer the potential of truly environmentally friendly illumination in urban areas. This remains an active area of research and development within Atlas Copco, but solar technology requires further development to overcome a range

of issues. For instance, the batteries can be unpredictable in terms of the power they can accumulate from solar panels. Furthermore, the replacement of solar panels is quite expensive, and their endurance for 24/7 x 365 operations remains unproven.

Solar-powered light towers can also prove rather difficult to install, mainly because a large work surface is required to maximise the number of solar panels to reduce recharging time.

For the time being, then, diesel, electric and battery power look set to continue to make up most of the market for light towers. This provides Atlas Copco customers with a full set of complementary technologies, whatever the application.

Introducing Stage V in dewatering pumps

Atlas Copco is committed to develop efficient and environmentally friendly products that are small and light enough to make them easy to transport, wherever they are needed. That's why Atlas Copco dewatering products are found across industrial sectors, including construction, general dewatering, well-point applications and flood relief.

The knowledge gained during many decades of experience of research and development and product introduction underpins what is a broad centrifugal and piston pump range, supported by diesel engines from many of the world's leading suppliers. The **PAS** centrifugal dry-prime pumps, for instance, have emerged as the chosen solution for construction, general dewatering, drainage and emergency applications, thanks to their dry-prime capabilities of high efficiency and instantaneous pumping from the moment the switch is turned on.



There is a diesel-driven PAS range suitable for any dewatering application.

As with many of the other dewatering ranges, the impact of Stage V on the PAS range depends on power categorisation of the engine. Medium-flow products currently use Stage 3A diesel engines, while many of the high-flow products with up to 160 kW maximum engine output already feature Stage 4 models. The route to Stage V compliance is therefore more technically complex within the medium-flow product range. New product ranges – up to 400 kW maximum output – will come with Stage V engines as standard.

As a result, Atlas Copco has been leading discussions with the engine makers to ensure the optimal integration of new engines into the dewatering range. This is resulting in valuable opportunities for technology insertion, as engineers optimise power nodes to maximise performance and reliability. The impellers and casings, for instance, are being refined to ensure that new Stage V engines can provide the required RPM, regardless of the condition of the water being pumped. This optimisation process – effectively squeezing out every extra percentage point of performance – will result in Stage V products with higher efficiency and better through-life performance.

There are also opportunities in terms of size and weight. New Stage V-ready engines and associated equipment will offer the chance to apply stronger and lighter materials that can be packaged in innovative ways. This will ensure that customers continue to benefit from space-saving and flexible design.

The implementation of Stage V also represents an opportunity to look at how digitalisation can continue to improve the performance of dewatering products. In the last few years, there has been a growing demand from end users for intelligent digital solutions capable of providing accurate and timely information on pump performance. As a result, Atlas Copco has developed the FleetLink telematics system, which is designed to optimise fleet usage, reduce maintenance costs and ultimately save time and money. FleetLink enables customers to remotely communicate with their pumps 24/7, using state-of-the-art digital monitoring tools such as geo-fencing, remote function lock-out and automatic reporting. The development of new Stage V-ready products presents an opportunity to introduce smaller and more powerful sensors, with faster data connection, allowing customers to gain even greater insight into pump performance, wherever they might be.

The overall message to customers is simple: Stage V will result in the development of next-generation pumps that are more compact, versatile, durable and efficient than ever before. And in combination with the latest rapidly advancing digital monitoring software, it will offer Atlas Copco pump users a best-in-class performance over the full lifetime of the products.



Beyond Stage V: from diesel to alternative power sources

The desire to improve air quality, and therefore protect the health of European Union citizens, will see a continuation of efforts to reduce emissions from non-road mobile machinery, even after the introduction of the Stage V regulations. This is resulting in a noticeable trend towards non-polluting and connected air, power and flow solutions that are reliant on alternative power architectures such as electric and battery, among others.

This trend is particularly pertinent in urban applications, with a growing number of local authorities in Europe clamping down on the use of diesel equipment in metropolitan areas through the introduction of low emissions zones. While the speed and magnitude of this conversion is geographically determined, there can be little doubt that society's perception of diesel particulates in connection with health-related issues will continue to grow.

Excessive noise generated by portable energy equipment is becoming increasingly unacceptable in urban environments and industrial work areas, and this also presents opportunities for new engine architectures.

Atlas Copco is responding to this change in a number of ways, for instance by releasing a full range of electric driven compressors.

It is important to remember that there are some limitations for more electric architectures for compressors, though. Such equipment requires access to a reliable grid, which is more easily achieved in urban rather than rural areas. For the latter, with a transportable compressor, diesel is likely to remain the more realistic option. That said, Atlas Copco has launched a full range of electric driven compressors, both with variable speed drive technology as fixed speed variants.

For metropolitan construction areas, where an electrical grid is already available, the new E-Air compressor range is an alternative for diesel-driven units. Easy to install and connect, the electric engine has several advantages: no need for refuelling, no diesel emissions, less noise and lower maintenance needs. When it comes to total cost of ownership, the E-Air compressor range is a game changer.

With power and flow products, meanwhile, there is a similar push towards the development of new technology. While efficient diesels remain a core product offering, the increasing use of hybrid systems can be seen across generator ranges, while battery power offers great potential on smaller machines and other equipment. Indeed, Atlas Copco recently introduced its first-ever battery-powered LED light tower, which offers a run time of up to 32 hours. The HiLight Z3+ is powered by a lithium-ion battery and provides enhanced illumination for metropolitan construction sites, outdoor events and industrial areas. Zero noise during operation and the absence of engine emissions ensure full environmental compliance in urban locations.

HiLight Z3+ was launched after extensive research and development to provide best-in-class performance – not just in terms of running hours and noise, but also reliability, ease-of-use and total cost of ownership. The end result is that the HiLight Z3+ offers a 40 per cent advantage over diesel hybrid light-tower systems in terms of overall energy efficiency.

Again, though, while electrification has the potential to deliver noise and emissions benefits across the power and flow divisions, diesel will remain a crucial part of the product offering. While 32-hour battery performance for products such as light towers might be acceptable in applications with easy access to power, it wouldn't present a viable solution for isolated sites with poor access to the grid. In such environments, diesel-powered equipment is likely to remain the preferred technology for the foreseeable future.

Stage V is an **opportunity**, not a threat

In summary, then, it's clear that the introduction of Stage V emissions regulation for non-road mobile machinery will have an impact across industrial sectors. At first glance, the implementation of the new standards might appear complicated, but Atlas Copco has the products and technical know-how to help their customers increased performance, steer a clear path to where they want to be.

Indeed, Stage V should be viewed as a business opportunity, rather than a hindrance or threat. The introduction of the standards has led to a surge of innovation, resulting in cleaner and more efficient air, power and flow products, in addition to alternative technologies. Whether it is less fuel, better performance, smaller canopies, lower noise or improved reliability, Atlas Copco customers can profit from the journey to Stage V compliance and beyond.


Atlas Copco: your partner on the route to Stage V compliance

Still have questions?

Contact us today to learn more about the best solution for you.

www.atlascopco.com/StageV

Atlas Copco



Our air, power, light and flow solutions are ready for Stage V

Discover them all

<https://www.atlascopco.com/power-equipment>

Product portfolio

AIR COMPRESSORS AND HANDHELD TOOLS

READY TO GO

- 1-5 m³/min*
- 7-12 bar



VERSATILITY

- 5.5-22 m³/min*
- 7-20 bar



*Diesel and electric options available

PRODUCTIVITY PARTNER

- 19-116 m³/min
- 10-345 bar



HANDHELD TOOLS

- Pneumatic
- Hydraulic
- Petrol engine



GENERATORS

PORTABLE

1,6–12 kVA



MOBILE

9–1250* kVA



INDUSTRIAL

10–2250* kVA



CONTAINERS

800–1450 kVA



*Multiple configurations available to produce power for any size application

DEWATERING PUMPS

ELECTRIC SUBMERSIBLE

250–16.200 l/min



SURFACE PUMPS

833–23.300 l/min



SMALL PORTABLE

210–2500 l/min



Diesel and electric options available

LIGHT TOWERS

DIESEL LED AND MH



BATTERY LED



ELECTRIC LED



ONLINE SOLUTIONS

SHOP ONLINE PARTS ONLINE

Find and order the spare parts for power equipment. We handle your orders 24 hours a day.



POWER CONNECT

Scan the QR code on your machine, and go to the QR Connect Portal to find all the information about your machine.



LIGHT THE POWER YOUR SIZING TOOL

A useful calculator to help you choose the best solution for your power and light needs



FLEETLINK

Intelligent telematics system that helps optimize fleet usage, reduce maintenance costs, ultimately saving time and cost.

