

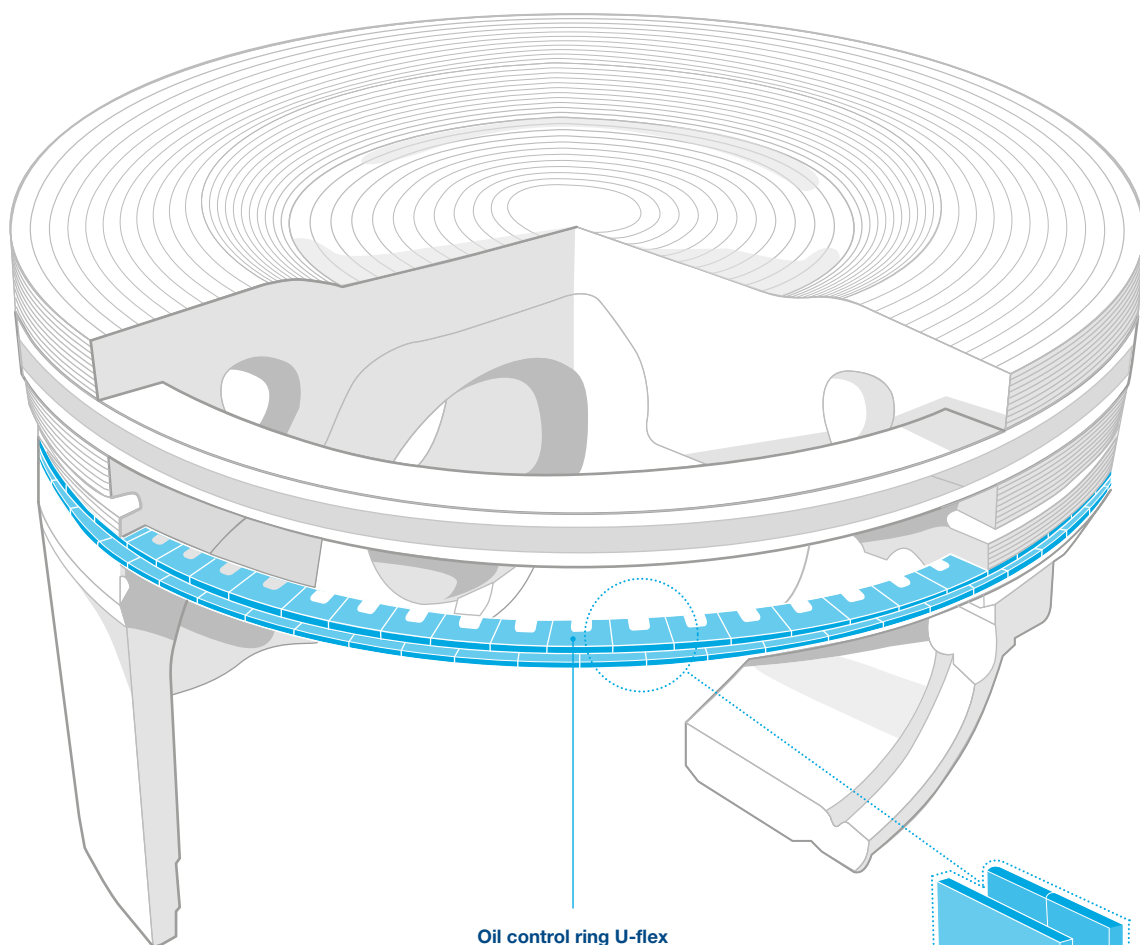
MAKING A FUTURE WORTH LIVING

U FOR BETTER AIR

Global climate change means that we need to rethink things – including the way our mobility looks. Indeed, every single component that the automotive industry develops today can impact the climate of the future. Good solutions today are therefore also the better ones for tomorrow. And the Paris Agreement in 2015 made it official: the world of tomorrow needs us to limit the global temperature rise to below two degrees Celsius. This is a daunting undertaking that calls for effective cooperation on the part of every stakeholder in public policy, science, economy, and industry. And a task that can be accomplished primarily through one avenue: by reducing anthropogenic carbon dioxide (CO₂).

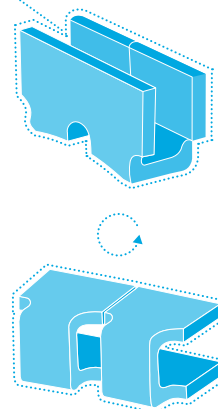


E-mobility will be a key component if the mobility of the future is to be sustainable. Yet even the combustion engine has its place in such a future. According to current predictions, global vehicle production will continue to grow and the demand for components and systems for combustion engines will also further increase along with it. This is due in part to the countless regions of the world lacking important basic conditions, such as a comprehensive power grid, that are required for e-mobility to successfully gain a foothold. On the other hand, the combustion engine is still justified as an efficient solution in the long-haul commercial vehicle sector.



**Oil control ring U-flex
of the latest generation**

Thanks to its flexible design, the U-flex ring molds to the cylinder wall and is therefore extremely efficient at scraping the oil off—even at high engine loads, speeds, and temperatures. The ring thus has a favorable impact on the vehicle's oil consumption.



U AS IN UNIQUE IMPACT

These arguments are also part of the reason why MAHLE remains convinced of the combustion engine's viability and continues to optimize it. An intelligent mix of vehicles with conventional and alternative drives will be a crucial factor and can play a key role in achieving climate targets. With regard to the combustion engine, CO₂ emissions could be reduced by up to 10 percent per vehicle in the next three to five years by means

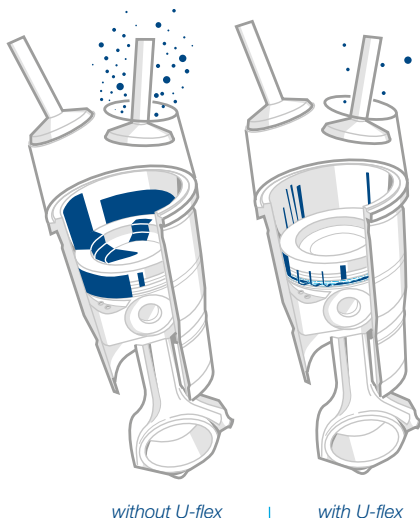
of MAHLE components alone. What will make this reduction possible in part is a small black ring. Seemingly unimposing at first glance, in reality it is a high-tech product with a big impact: the MAHLE U-flex Generation 1 (Gen. 1) oil control ring helps to significantly lower CO₂ and particulate emissions in vehicles, thereby promoting cleaner air and quality of life. For people and the environment.



A healthy climate and clean air for everyone—the goal seems simple. But achieving it is a challenge that calls for innovative ideas and sophisticated technologies. MAHLE has accepted this challenge. Our solution is in the detail—in the truest sense of the word. The latest generation of the MAHLE U-flex ring shows that even a small component, seemingly unimportant at first glance, can be the spark that ignites a major change for the world: by lowering carbon dioxide emissions and providing cleaner air, thereby significantly improving people’s quality of life.

Scraping the excess oil off

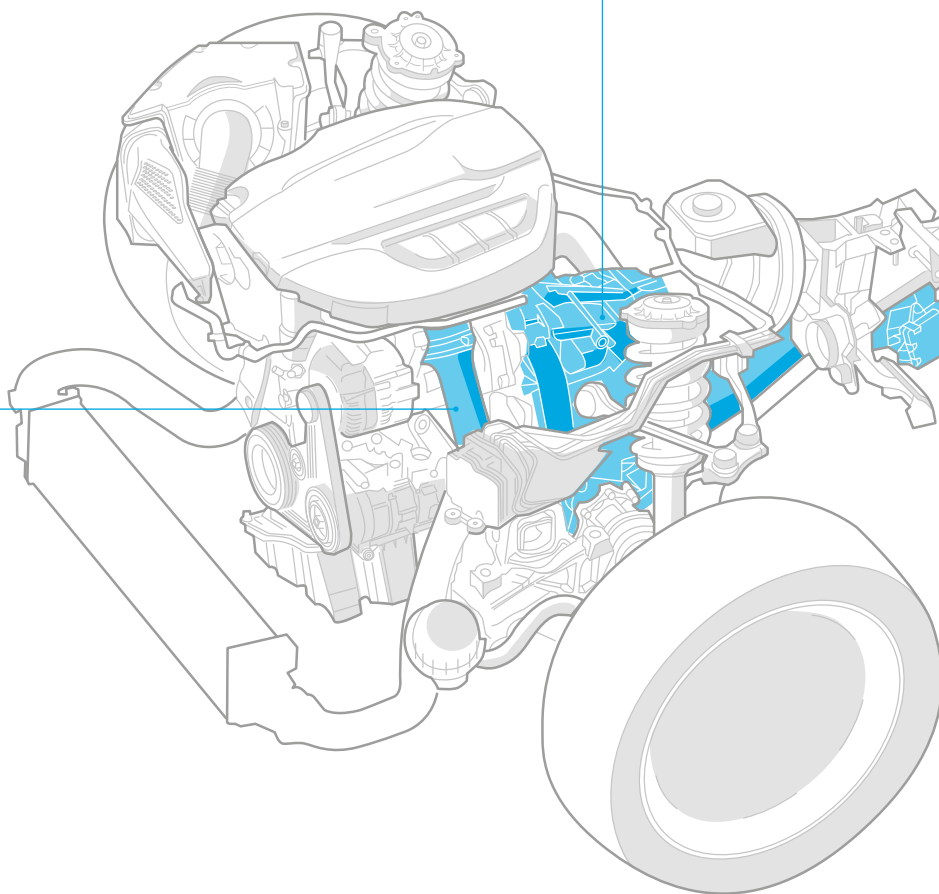
The U-flex Gen. 1 ring plays a major role in the piston group: it scrapes off the excess oil from the cylinder wall as thoroughly as possible. If oil enters the combustion chamber, oil ash, a hard, granule-like substance, is produced, along with other particulate emissions.



-30%

Lower raw particle emissions

The less oil that enters the combustion chamber, the less is burned, and the lower the raw particulate emissions. The number and mass of the particulates that enter the exhaust gas system decrease significantly—by 30 percent.

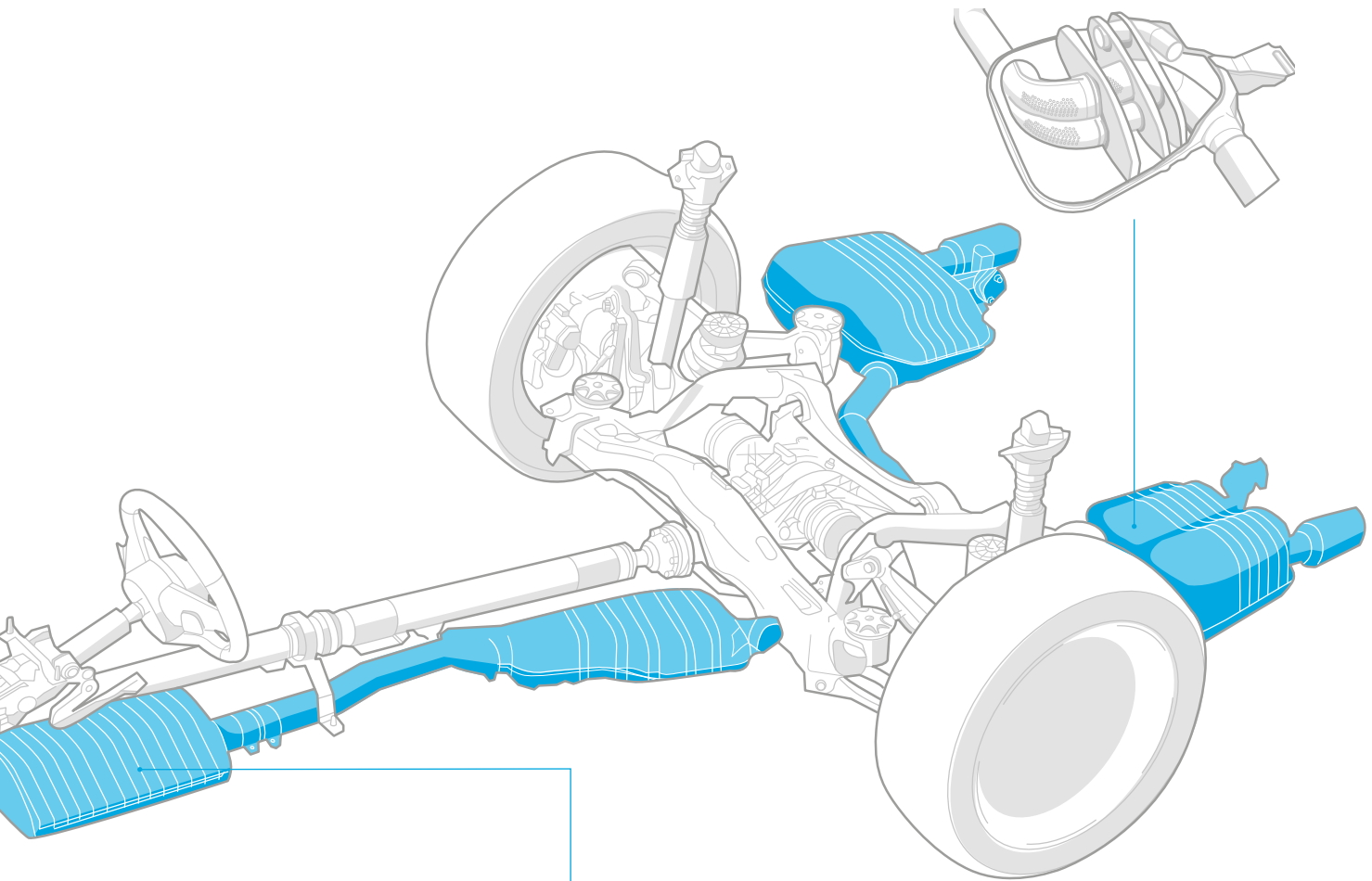


DID YOU KNOW?

The advantages of the U-flex are even greater in vehicles that run on natural gas (CNG): CNG combustion does not involve particulate matter. The particulate emissions in the exhaust gas come entirely from combusted engine oil. The U-flex ring Gen. 1 works so efficiently that the CNG engine can be operated without a particulate filter while maintaining compliance with the strictest thresholds—yet another cost advantage for the driver.

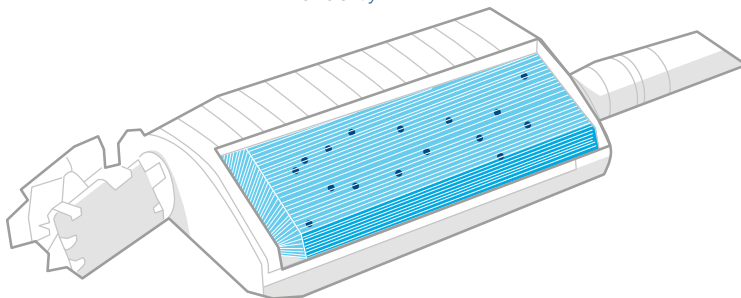
Lower maintenance cost

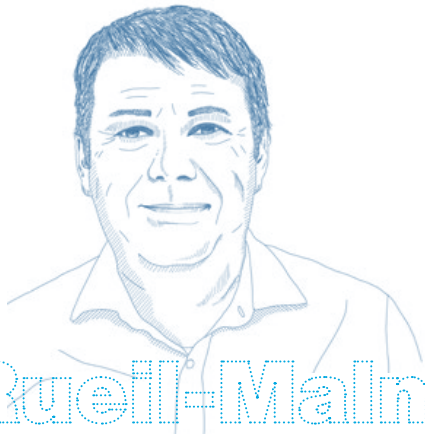
The result: a vehicle with U-flex oil control rings emits less CO₂ over its entire lifetime than a vehicle with conventional piston rings, thereby cutting costs in two areas—maintenance and fuel consumption.



Engine runs more efficiently

Fewer particulates means less wear on the particulate filter. That saves hard cash for drivers, since the particulate filter rarely requires maintenance or can even be operated maintenance free. The second direct consequence is that the particulate filter generates less counter pressure in the exhaust gas system, and the engine can run more efficiently.





Rueil-Malmaison

Remi Rabute,
MAHLE Global Product Expert
in Rueil-Malmaison/France

»You wouldn't know it by looking at this small, simple ring, but because it's so effective, we can use U-flex to save thousands of liters of oil today and in the future.«



Jundiaí

Rafael Antonio Bruno,
MAHLE Global Product Expert
in Jundiaí/Brazil

»U-flex is based on a tried-and-tested concept that is proving to be an important, relevant product for our time following our reengineering of Gen. 1: a piston ring that helps to make the air better for us all.«

»A piston ring
that helps to make
the air better
for us all.«



Stuttgart

Jochen Adelman,
Head of PCU Technology-Light Vehicles at
MAHLE in Stuttgart/Germany

»Primarily in Europe, we are confronted with increasingly strict public policy requirements regulating pollutant emissions. For us, there is no doubt that the combustion engine is a tried-and-tested technology that has a particular role to play in a more sustainable mobility. With solutions such as U-flex Gen. 1 we significantly improve the emissions footprint of the combustion engine.«



Murte de

Luis Sobral,
developer in process technology at
MAHLE in Murte de Portugal

»Our aim with U-flex Gen. 1 is to help our customers respond to the tremendous challenges posed by industry, public policy, and society with regard to climate protection.«

Innovations for a clean world

The U-flex ring Gen. 1 is just one of the components we have designed to make the combustion engine even more efficient.

MAHLE has developed a range of other solutions to further leverage the potential of the combustion engine. The combustion engine can play a key role in achieving climate targets.

=6%

Less friction means lower fuel consumption: MAHLE has optimized the power cell unit—the unit comprising pistons, piston pins, and piston rings as well as cylinder liners—to the point where it has even less friction and can work almost effortlessly using low-viscosity oils. Thanks to the fully optimized engine mechanics, consumption can be lowered by 6 percent.

Our latest generation of lightweight pistons, combined with a frictional-loss-optimized piston ring pack, results in a CO₂ reduction of more than 2 percent.

=2%

The energy efficiency of combustion engines can be further increased by regulating heat flows. This is precisely the job of the MAHLE liquid management module—a combined electric coolant pump and cooling circuit control that can save up to 2 percent in CO₂ emissions. Depending on the type, a short warm-up phase for combustion engine cold starts, rapid control of coolant flows, and the management of several circuits at different temperature levels for different components using just one pump.

100%

MAHLE has brought the first air conditioning system to use CO₂ (R744) as its refrigerant to the market. The refrigerant is 100 percent natural, climate-neutral, and environmentally friendly. The air conditioning system is already in series production in a major German manufacturer's luxury segment—securing a foothold in environmental protection for MAHLE.