

New vehicle technology delivers 30% carbon savings



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Full text

Technology Company Artemis Intelligent Power has for the first time publicly revealed a new type of hybrid car and truck transmission based on revolutionary technology it has developed in Scotland. The technology is poised to shake up both the automotive industry and the rapidly growing renewable energy industry.

The Edinburgh based research company has been developing the innovative hydraulic hybrid car transmission in Edinburgh for the past two years, deploying its patented Digital Displacement® technology. The Energy Saving Trust confirmed that independent tests on a prototype car, based on a BMW 530i, had doubled the MPG in city driving compared to the same car with a manual transmission. Overall, including highway driving, the prototype had 30% lower CO2 emissions than it had before the company fitted its energy saving transmission.

The development costs for the prototype were shared by the Department for Transport, through a technology programme run by the Energy Saving Trust.

Artemis's goal is to make hybrid cars an economic, not a lifestyle, choice. Rather than using electric motors and batteries like other hybrid cars, the Artemis car uses its Digital Displacement® hydraulic motors to drive the wheels and compressed gas to store energy. This makes the company's hydraulic transmission potentially much more durable, lighter and cheaper than electric hybrids. In most vehicles the company expects substantially better fuel savings than electric hybrids.

In the just-completed 22 month project, Artemis developed new transmission components and technology, then switched them with the standard manual transmission. The new transmission is automatic, but apart from this the new components fit in the same space as before so the car looks and feels the same as it did before.

It is thought that commercial vehicles rather than passenger cars will be the first on-highway vehicles to be fitted with the new transmissions. The Artemis Digital Displacement® technology is built on reliable hydraulic components, especially important for intensively used vehicles like trucks and vans. Commercial vehicles make up almost 20%¹ of road traffic in the UK, but contribute disproportionately to the country's emissions because of their higher weight and high annual mileage.

Bosch Rexroth, the global supplier of components and systems for industrial and factory automation and mobile applications, has purchased the worldwide rights to use the company's Digital Displacement® technology in on-highway vehicles.

Another international manufacturer has also signed up to use Artemis's technology off-road - a major global supplier of hydraulic systems to the construction, agricultural and handling machinery industry.

The birth of Artemis's technology was at the University of Edinburgh as part of the Wave Power research programme led by Professor Stephen Salter. The technology, which the company calls Digital Displacement®, embeds patented computer control into proven and robust hydraulic pump and motor designs. The novel computer control makes the machines dramatically more efficient and useful than traditional hydraulics, while maintaining their inherent reliability, low cost and high power density.

Artemis already holds many international patents on its technology and is filing more every month. Artemis has brought together top class engineers from across the UK and the world, many of whom have higher degrees.

The company has maintained over 30% annual growth for each of the last five years, and is now attracting outside investment to help it expand into the rapidly growing renewable energy sector. Artemis plans to replace wind turbine mechanical gearboxes with its hydraulic technology. Independent studies show that 30% of wind turbine downtime is due to mechanical gearbox failures. The increasing demand for wind turbines to be sited offshore is encouraging wind farm developers to look ever harder at gearbox reliability as maintenance costs are much higher offshore. Artemis has already begun developing the components for full size wind turbines.

Some of the initial wind turbine work is being supported by the Carbon Trust, and Artemis says the progress they are making is already getting the attention of some of the larger turbine manufacturers and purchasers.

¹ 19.4%, source 2006 Transport Statistics of Great Britain

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In the long term, Artemis intends to play a major role in the growing renewable energy technology industry in Scotland and the rest of the United Kingdom. The company believes that existing manufacturing capability and a willingness to adopt new technology can build a worldwide export industry.

Comments

Dr Michael Fielding, Project Manager for Low Carbon R&D project, Artemis

"Department for Transport funding managed by the Energy Saving Trust and the support of the Trust have allowed us to develop aspects of the technology for this market and to build prototype demonstration vehicles. These vehicles have been an essential tool in engaging vehicle manufacturers and Tier-1 partners, and in securing the investment needed to take full commercial advantage of the technology and to accelerate its journey to market."

Dr Win Rampen, Managing Director, Artemis

"As energy prices continue to rise, the demand for energy-efficient technology increases. The unprecedented efficiency and controllability of our Digital Displacement® technology enables hydraulics to be applied to many new applications, wherever high powers need to be controlled at high efficiency. Highway vehicles, off-road machines and renewable energy are just some of the industries where we expect to make a significant commercial and environmental impact. "

Philip Sellwood, CEO, Energy Saving Trust

"This project has designed a new system allowing hybrids to be more practical and economic for every day use. With over 25% of the UK's total carbon emission produced by road transport every year, these advances in technology are vital. With over 80% of people believe that climate change is having an impact on the UK right now it is important to bring more technologies like these to the market place."

Technical

In the project, Artemis replaced the standard transmission of a BMW 530i with a hydraulic one built around their efficient computer-controlled Digital Displacement® hydraulic pumps and motors. As well as saving fuel by optimising the engine speed, energy that would otherwise be lost when applying the brakes is captured and stored under the floor in a hydraulic accumulator about the size of a diver's air bottle. The engine can actually be switched off and the car driven just from the stored energy, further decreasing its emissions.

All this means that Artemis's Digital Displacement® hydraulic hybrid transmission has the fuel economy benefits of an electric hybrid, but with some distinct advantages. It is about a third the size and weight of a similar electric hybrid transmission. And by being a series rather than parallel architecture, and by storing captured braking energy in a simple hydraulic accumulator instead of a battery, full power is available instantly, even with the engine off. Usually a costly secondary storage device, an ultra-capacitor, is needed to provide full power in an electric hybrid, and the car industry has in recent years been struggling to allay doubts about the sustainability and environmental damage caused by these.

To power the vehicle, Artemis has fitted a Digital Displacement® hydraulic pump and two Digital Displacement® motors, one driving each rear wheel. The three machines are coordinated by a central Transmission Controller Unit that also reads the driver's pedal and controls the engine, taking information from a variety of sensors located around the car. Each Digital Displacement unit has a controller located behind panels in the car's boot. The units peak at 97% efficiency, and the Digital Displacement technology ensures that they maintain higher efficiencies than any other hydraulic machine around over all parts of their operating map.

The car demonstrated in Edinburgh today has a petrol engine, and the Artemis technology can be used equally well with diesel and biofuel engines.

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Editorial notes

Artemis Intelligent Power Ltd performs contract research, consulting, and technology licensing associated with development and applications of Digital Displacement® hydraulic power technology, and other innovations in the control and transmission of fluid power. The company employs 25 people in Edinburgh, Scotland.

The Energy Saving Trust is one of the UK's leading organisations set up to mitigate the damaging effects of climate change. It aims to cut carbon dioxide emissions - the main greenhouse gas causing climate change - by promoting the sustainable and efficient use of energy. It is the independent organisation providing advice for people to help reduce their energy use and acts as a bridge between government, consumers, trade, businesses, local authorities and the energy market. It provides impartial information and advice and has a network of advice centres in the UK specifically designed to help consumers take action to save energy.

The project was assisted by the Energy Saving Trust's Low Carbon Research and Development Programme, part of the UK Government's 'Powering Future Vehicles' strategy funded by the Department for Transport. The aim of the programme is to support the transition to low carbon transport by providing incentives through grants for the demonstration of innovative low carbon technologies.

The Department for Transport's aim is transport that works for everyone. This means a transport system which balances the needs of the economy, the environment and society. The Department for Transport provides leadership across the transport sector to achieve its objectives, working with regional, local and private sector partners to deliver many of the services. The Department for Transport provides the funding for the Low Carbon Research and development programme, which is currently managed by the Energy Saving Trust.

Q&A

Q. How confident are you in the results of these fuel consumption and emissions tests?

A. The tests were conducted at Millbrook Proving Ground, one of only two locations in the UK officially approved for emissions testing by manufacturers. After running in the new car with the standard six speed manual gearbox, we had it benchmarked by Millbrook. After the installation of the Artemis Digital Displacement® hybrid system, the same car was tested again at Millbrook, giving the results shown on the attached sheet.

Q. There are frequent reports that people are getting poorer than expected fuel consumption from their hybrid cars. Can Artemis technology do anything about this?

A. Most people drive their cars harder (with somewhat more aggressive acceleration and braking) than is performed for the official European test cycle. Electric hybrids are not very efficient at regenerating braking energy, because of the difficulty of charging the batteries effectively during a few seconds of braking. Although there is a potential solution in supercapacitors instead of batteries, this adds much more cost. The Artemis hydraulic technology can store braking energy very quickly in a low cost hydraulic accumulator. The result is that it is very fuel efficient in "real world driving".

Q. How is this technology going to get to the car and commercial vehicle market?

A. For road vehicles, the technology has been licensed to Bosch, who have a large team of engineers in Detroit and in Germany working with us on it. Bosch is already a major supplier to nearly every vehicle manufacturer in the world. Bosch is also one of the largest global manufacturers of hydraulic machines, including at a factory in Glenrothes.

Q. Why are you using a high power luxury car to demonstrate a green technology?

A. The engine of the BMW is of similar power to medium size commercial vehicles, where we anticipate the first application of the technology. In Artemis's old location at Edinburgh University, we did not have room to work on a commercial vehicle.

In addition Artemis have been working with BMW to investigate the potential of the technology. The results of this study have appeared in a paper by BMW, in which the Artemis Digital Displacement® technology showed the best fuel consumption of all the options considered.

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Q. What kind of vehicles will it be used in first?

A. The case for hybrids in general is strongest in vehicles with relatively large engines that travel a lot of miles each year in urban traffic, such as delivery vans and buses. These vehicles typically also have much shorter production lead times than passenger cars.

In tests at Millbrook Proving Ground, the BMW demonstrator used less than half the fuel of the manual gearbox equivalent, in similar stop/start conditions (European urban cycle).

Q. So why are all the currently available electric hybrids passenger cars?

A. Although many companies are experimenting with electric hybrids for commercial vehicles, they are faced with two problems, one technical and one economic. Sufficiently powerful electric machines are very heavy, and commercial vehicles, unlike hybrid cars, have to make clear economic sense to the purchaser. Artemis Digital Displacement® hydraulic hybrid technology is lighter and cheaper than electric hybrid technology.

Q. Other companies have experimented with hydraulic hybrid buses and cars in the past, but have failed. Why?

A. It has been possible for a long time to use conventional hydraulics for vehicle transmissions, and they are used in many off-road vehicles such as agricultural and construction machines. However, most road vehicles are running at much less than full power (typically less than 20%) for most of the time. At low power, conventional hydraulic machines are quite inefficient, so fuel consumption in normal driving is poor. The key to the success of the Artemis Digital Displacement® technology is its high efficiency across the whole power range.

Q. Will vehicles using this technology offer the same performance as standard cars?

A. The Artemis technology gives the manufacturer the possibility of improving acceleration relative to the standard car, because the engine can be maintained at its optimum power point throughout the acceleration.

Q. What are the benefits of Artemis Digital Displacement® technology in wind turbines?

A. A bit different from the benefits in vehicles. The main advantage is in robustness and reliability. Most of the wind turbines you see standing still while their neighbours are rotating are suffering from failure of their mechanical gearboxes. Instead of gearboxes, in heavy duty industrial applications where robustness is paramount hydraulic transmissions are often used. However, they have not been widely used in wind turbines for the same reason as in cars: most of the time the wind speed is relatively low and so conventional hydraulics is inefficient, reducing the power output in moderate winds. Artemis technology overcomes this problem, and provides other major benefits associated with grid stability.

Artemis Digital Displacement® transmissions are much smaller and lighter than equivalent mechanical gearboxes for large wind turbines.

Higher reliability and lighter weight are particularly important for offshore wind turbines.

Q. How is this technology going to get to the wind turbine market?

A. Artemis is currently in discussions with two major wind turbine manufacturers.

Q. Can you use this technology in rooftop windmills?

A. The engineering challenges and economics of rooftop devices are quite different from those of large wind turbines. In general, the bigger the wind turbine the more benefits we bring.

Contacts

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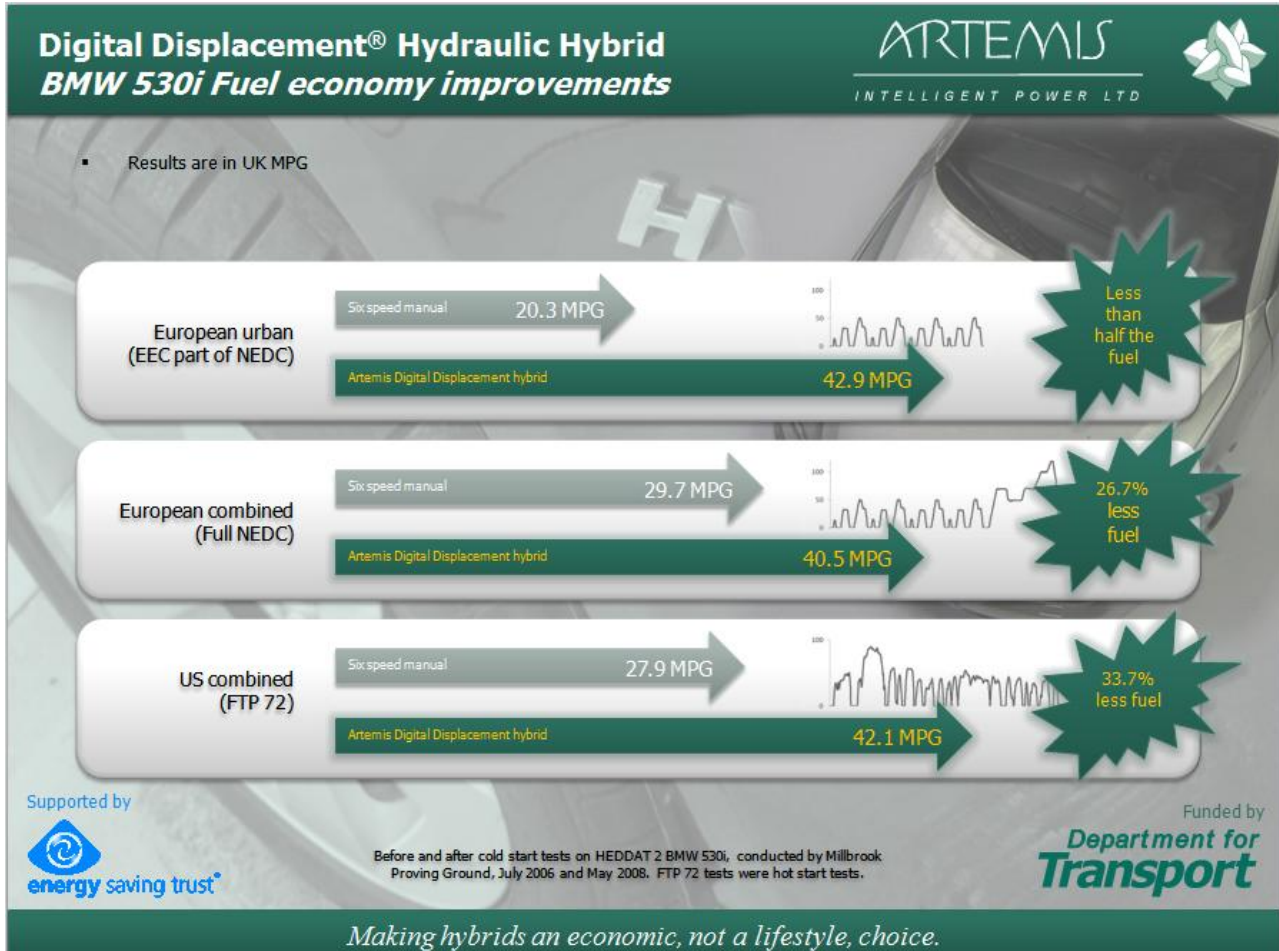
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Images

Higher quality images in PDF and JPEG format are available on request to m.fielding@artemisip.com.



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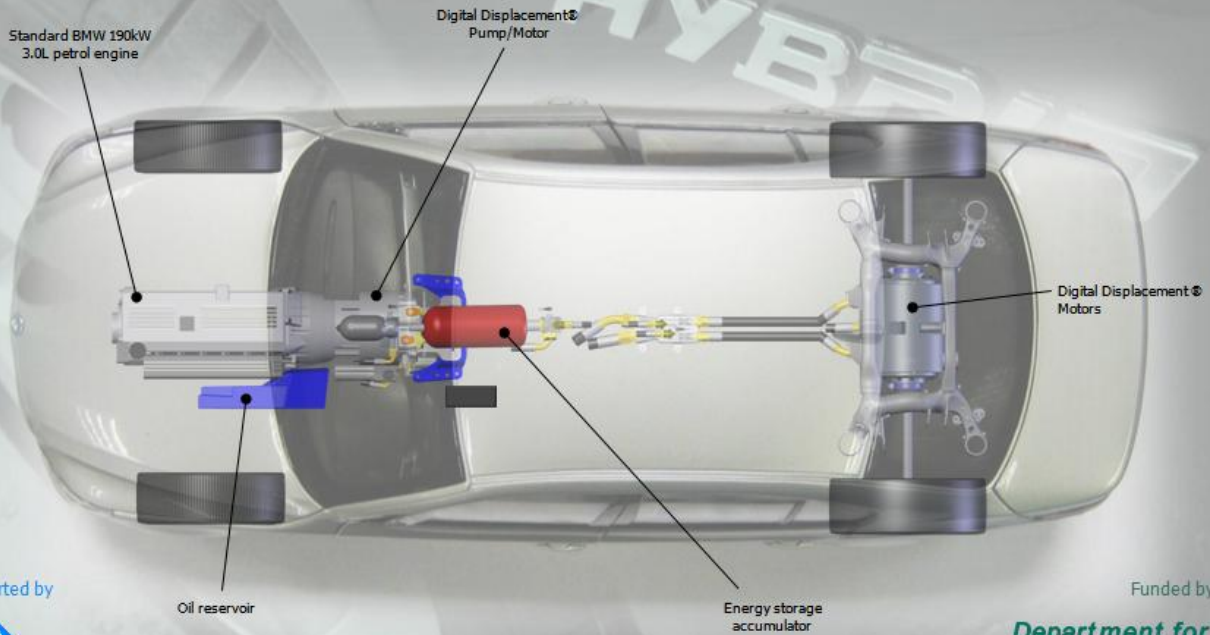


Digital Displacement® Hydraulic Hybrid BMW 530i Mechanical components

ARTEMIS
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- The world's first Digital Displacement hybrid, in a BMW 530i, fits in without major modifications and without cramping the passengers.



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Making hybrids an economic, not a lifestyle, choice.