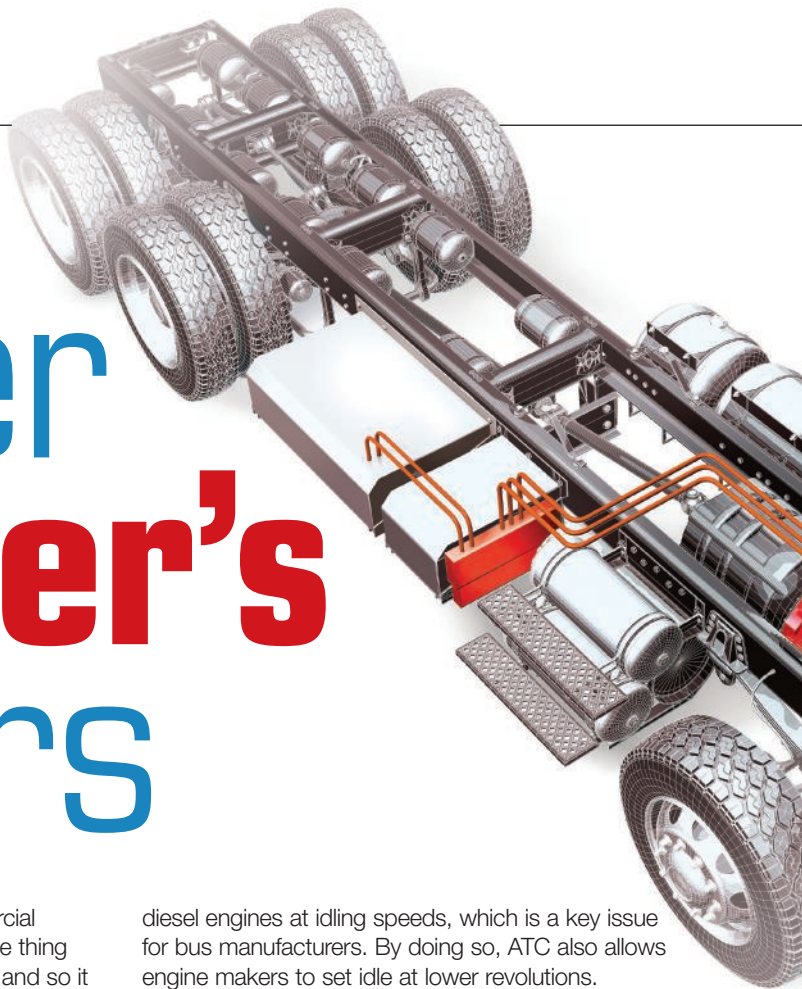


Under starter's orders



When it comes to commercial vehicle development, one thing often leads to another – and so it is with Cummins Generator Technologies' CorePlus motor-generator. Last August, *Transport Engineer* reported on its use not only in hybrid-vehicle drivetrains, but also as a high-efficiency electrical power source – typically 30kW, compared with the 5kW from automotive alternators – for driving engine ancillaries and external equipment. That cuts engine parasitic losses and ultimately reduces fuel consumption and CO₂ emissions.

However, the company's Peterborough CorePlus R&D base has now taken the concept one step further, with the launch of its ISG (Integrated Starter Generator). Unveiled at the recent Electric Vehicle Symposium, in Barcelona, the new device brings the prospect of fuel saving start-stop systems significantly closer for trucks and buses with large-displacement, heavy-duty diesel engines.

Unlike Cummins' existing motor-generator, which can be de-clutched from the diesel engine when used in a hybrid-drivetrain, the ISG is permanently attached to the engine crankshaft. So it acts as a high-torque starter motor, which makes it ideal for start-stop. It also has the potential to provide a power boost – for example, on hill climbs, giving truck and bus manufacturers the opportunity to downsize to smaller engines.

"The ISG has a number of possible differentiations for OEMs," states Cummins Generator Technologies' new product manager David Moorhouse. "Not only can we provide it with our CorePlus power electronics, a high torque and efficiency, and a high level of integration [with an engine], but also with our active torque cancellation (ATC)."

ATC counteracts vibrations typically found on

diesel engines at idling speeds, which is a key issue for bus manufacturers. By doing so, ATC also allows engine makers to set idle at lower revolutions. Additionally, it offers the option of shutting down cylinders during tick over – further reducing fuel use.

The ISG's start-stop capabilities have already stirred interest among city bus operators, reports Moorhouse. "We've produced an engine start demonstrator. The next step would be to develop a start-stop system with an OEM for the bus market. It's something customers are demanding." However, he believes primary customers for the ISG will be the engine manufacturers themselves, because the system is even more tightly integrated with the engine than the motor generator.

Perfectly formed

As for dimensions and weights, the ISG prototype shown in Barcelona extends engine length by some 127mm. But ongoing development will see that figure reduced on production versions, asserts Moorhouse. Additional weight, however, is likely to remain at around 80kg.

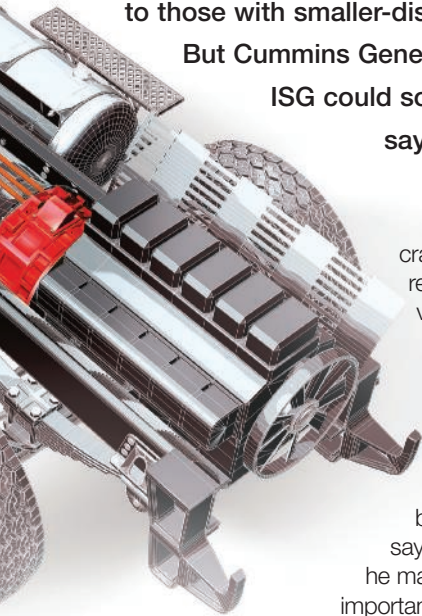
Looking at the detail, with its high torque, the ISG is well-suited to start-stop in city buses and delivery trucks, not least because of reduced engine cranking time. "You get a much smoother start [with ISG], because it spins up very quickly," explains Moorhouse. "You'd also be able to stop or align the engine at just the right point, so you spin it only once [to start] rather than the three times normally required with a gear-driven starter motor." Reduced



Above: CGT's CorePlus motor generator (in red) was created for hybrid applications, but has now been developed as the Integrated Starter Generator (ISG, pictured right)

Until now, start-stop systems on European commercial vehicles have been restricted to those with smaller-displacement diesels.

But Cummins Generator Technologies' ISG could soon change all that, says Brian Weatherley



cranking times mean reduced demand on the vehicle's battery, too.

Furthermore, an ISG wouldn't need a bigger battery to turn it over.

"You're not driving with it: it's only for starting and for a boost, now and again,"

says Moorhouse. Indeed, he makes the point that it's important not to confuse ISG with a hybrid. "With hybrids, you

need a huge battery. However, the ISG is a power generation system with an integrated starter function for conventional vehicles." So, while its fuel-saving potential won't match that of a full hybrid, it's still capable of delivering a 10–15% improvement.

The ISG might also offer other advantages for a start-stop system – for example, reducing wear and tear. Up to 30 starts an hour on a truck or bus in heavy traffic would be punishing for conventional equipment. Further, replacing the starter-motor with an ISG could improve engine packaging, particularly on rear-engine buses and coaches. And Moorhouse claims that the ISG will be zero-maintenance. "Our target is to achieve a 10-year life, which is longer than the current average age of PSVs [public service vehicles] operating in Britain."

Equally important, the ISG could replace the alternator and its belts, while also providing considerably more power. That means it could satisfy the clamour from users for more electrical power on vehicles – for example, for additional air con and Wi-fi in buses and coaches, and in specialist military, construction and off-road vehicles.

"We've identified those markets that are power hungry," confirms Moorhouse, who reports that further ISG applications might include refrigerated trucks and cement mixers.

Meanwhile, although at the Electrical Vehicle Symposium, the ISG demonstrator was shown connected to a standard Cummins engine flywheel housing, Moorhouse insists that its development was



independent of the Cummins engine business. "It doesn't have to be Cummins-specific. The integrated starter generator bolts up to the end of the crankshaft." That said, with Cummins Generator Technologies part of the same global power company as Cummins engines, it's clearly in a strong position to understand the needs of commercial vehicle engine manufacturers, as well as truck and bus OEM and operators.

So, when can we expect real integrations? "We're spending an awful lot of money to accelerate the development of this," answers Moorhouse. "And to take the ISG to production will continue to require significant investment." However, Cummins Generator Technologies is planning to deliver prototypes throughout this year for customers in both commercial civilian and defence applications.

"I don't know which will get to volume first," offers Moorhouse, "but there's a lot of pull from ... engine manufacturers. They're saying 'I want a start-stop solution' or 'I want to downsize my engine'."

ISG looks set to fly and to have a significant positive impact on the development of even more frugal heavy-duty diesel engine designs in the not too distant future. **TE**

Mercedes-Benz claims that with ISS (idle stop/start) on the Euro 6 175bhp 3-litre diesel Canter, a 3% fuel saving is possible

Start-stop so far

Though common on cars and vans, start-stop systems have been noticeably absent in larger commercial vehicles, at least in Europe. Mercedes-Benz is one of the few manufacturers to offer such an option on a truck above 3.5 tonnes.

Although previously offered on selected Atego middleweight vehicles, Mercedes-Benz UK says: "With the introduction of Euro 6, the only model with engine stop-start is the Fuso Canter, where it's referred to as ISS [idle start/stop]. On Euro 6 Canter 6C, 7C and 9C models, ISS is a standard fitment."

For the record, the heaviest Euro 6 Canter available with ISS will be the 8.55-tonne 9C18 chassis with a 175bhp four-cylinder 3-litre diesel engine. Mercedes-Benz claims that with ISS in place, a fuel saving of up to 3% can be achieved, depending on the duty cycle.