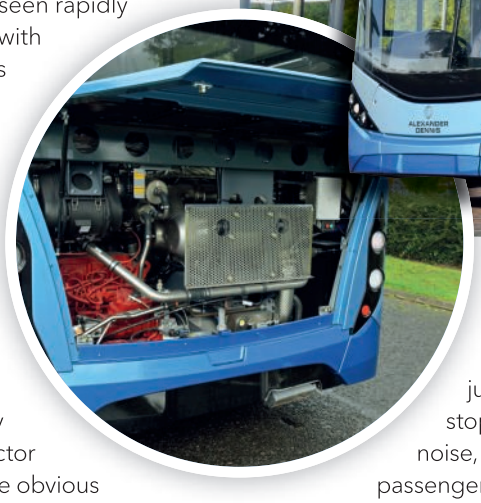
STOP START

Familiar on new cars and light commercials, engine stop-start systems work reliably and seem to deliver worthwhile fuel savings. So why are they virtually unknown in HGVs, and unusual in PSVs? And what will happen to the few such systems that are out there: will they be overtaken by hybrid and electric driveline rivals? Toby Clark enquires

The initial justification for stop-start systems was in terms of fuel consumption and air quality. Those forces have proven powerful; the need to comply with urban-based emissions testing cycles has made them standard equipment on cars in Europe. Even the notoriously conservative US 'light truck' sector (including pickup trucks and SUVs) has seen rapidly increasing adoption, with about 20% of vehicles sold in 2017 having stop-start fitted.



The air quality benefit is significant, particularly in applications with many stops, such as an urban bus route. As Kevan Browne, European on-highway communications director of Cummins says: "The obvious point is that when the system stops, no emissions [are] being produced. The more intense the bus operation, the greater the saving. For example, an 8% saving has been well-proven in central London double-deck buses running at low average speed (7-8mph) for around 16 hours a day, with multiple pauses for bus stops, traffic lights and pedestrian crossings per hour. This translates into a CO_2 reduction of 4-6 tonnes per year, and saves £2,500-£3,000 in fuel costs per year per bus."

The other justification for stop-start is reducing noise, for the benefit of passengers or other road users. However, this is seen as less of an issue for trucks.

Certainly, for an artic on a trunking schedule, there is little benefit to be had from stop-start. Nevertheless, the duty cycle for a truck or bus in urban conditions is harsh, and the period when the vehicle is at idle can be substantial.

Cummins does offer a true automatic stop-start system on its four-cylinder B4.5 and six-cylinder B6.7 Euro VI diesels, such as with ADL's Enviro 400 double-decker with Voith or ZF automatic transmission. Says Kevan Browne: "Around 1,500 buses with this system are in operation in the UK today. The engine is specified with the stop-start enhancements and upgraded starter motor. The OEM then adapts their battery charge and air system controls to align with the stop-start cycle." Cummins is also offering stop-start on B6.7 engines for the US truck market.

Whatever their justification, stop-start systems require careful engineering and should only operate when the conditions are right. Phil Rootham, pre-sales technical manager at Scania, explains: "With a large-displacement engine, it is about understanding how much fuel

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Adrian Felton

you're consuming, whether [the engine's] warm or cold, how many ancillaries you've got going – compressors, air conditioning, alternators – and you've got to balance that with oil dropping to the bottom." Doing so requires engine controls to communicate with the transmission and braking systems, and with ancillaries such as the air reservoir.

"The Cummins system is designed for a maximum of 30 stops per hour," says Browne, "but typically this will not exceed 18 stops during normal operation. The OEM can trim the system to operate in all circumstances – such as all stops in traffic – or just for bus stops and only aligned to the door opening. This flexibility allows the system to be configured to the operational scenario."

A DIFFERENT APPROACH

Other manufacturers have taken a different approach. Adrian Felton, city mobility manager at Volvo Bus, says: "There have been two real trains of thought in the bus industry. One is to make diesels as efficient as possible. That takes us into micro-hybrids, with electrification of some components, and stop-start technology." Volvo's offering is an automatic engine idle shutdown, usually set to actuate after 3-5 minutes without an accelerator pedal signal.

"There is also the move into full electrification; that has been Volvo's clear strategy for about ten years." Volvo has sold around 2,000 hybrid buses in the UK; they can travel up to 800m in zero-emissions mode. That, adds Felton, "for us has really taken away the need for stop-start technology in diesel vehicles."

However, stop-start systems are nearly universal in hybrid vehicles. As Scania's Phil Rootham says: "An electric machine sits between the bell housing and the gearbox. You can theoretically pull away silently – you can manage [the stop-start phase] better to make sure you yield positive results."

Ideally, the kinetic energy dissipated as heat when braking should be captured and used to accelerate when the vehicle starts again. This is the idea behind energy recovery systems (ERS), such as Eaton's Hydraulic Launch Assist (HLA) from 2002, which used a hydraulic accumulator to store and then release energy, apparently improving both braking and acceleration.

A similar system is used in some forklift trucks. In addition, BorgWarner recently announced its Eco-Launch system for front-wheel-drive automatic cars in the US (pictured above), designed for use with stop-start systems and promising "fast, smooth launches during restarts".

Similarly, electric-based 'micro-hybrid' systems can offer energy recovery and better stop-start capability. Trials of Renault Trucks' Urban Lab 2 prototype 19-tonne rigid confirmed "significant gains" in fuel consumption through many means. Truck systems included a Valeo 48V reversible electric machine (a combined motor and generator) that recovers 'free' energy during overrun or braking to drive electrical accessories or augment engine torque.

The latest generation Audi A8 passenger car demonstrates other potential features for heavier vehicles. It relies on a conventional pinion-type starter motor for cold starts, but adds a 48V belt alternator starter (BAS), also known as an integrated starter generator (ISG), for start-stop duties. This also allows the vehicle to coast with the engine off at speed for up to 40 seconds, starting the engine again as soon as the driver presses the throttle. It even features 'predictive convenient starting': as soon as the vehicle in front moves, the engine starts, even if the brake is still pressed.

Ultimately, it seems that the lines between stop-start and mild- or micro-hybrid systems will be blurred. Future systems have the potential to reduce fuel consumption while lowering emissions, improving driveability and making vehicles more refined for the driver and passers-by. TE

HYDRAULIC HYBRID ENERGY RECOVERY SYSTEMS

A hydraulic ERS can also form the basis of a hybrid driveline. Colorado-based Lightning Systems has developed a system called LightningHybrid, designed for trucks in "heavy-duty drive cycles like delivery, transit and refuse". The system "safely and efficiently regenerates braking energy in composite hydraulic accumulators, which are a fraction of the cost and weight of batteries".

Vehicle braking powers a hydraulic pump/motor connected to the final drive via a clutch. It moves fluid from a low-pressure reservoir to a high-pressure accumulator, compressing a nitrogen-filled bladder which acts as a spring. When the vehicle needs to accelerate, the pressurised fluid is released, driving the truck. The system is designed for vehicles over 5 tonnes gvw, and can even be retrofitted; it is typically mounted below the load area, between the gearbox and differential. UPS has undertaken trials of the system in the US and UK, and has ordered 50 delivery vehicles for use in the Chicago area.