



# SCANIA

# PRESS info

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## Innovative hybrid bus concept from Scania improves fuel efficiency by 25 percent

**Scania is starting extensive operational trials of a unique hybrid-electric powertrain designed to improve fuel economy and emissions by at least 25 percent. Fuelled by ethanol, it reduces fossil CO<sub>2</sub> emissions into the atmosphere by up to 90 percent compared to diesel. All parts used, including the energy storage modules, have a design life of 10-15 years.**

Scania's new hybrid powertrain is the result of a five-year research programme conducted at the Scania Technical Centre in Södertälje, Sweden. The development of the new technology is based on an overall perspective of the public transport system, including the need to attract more passengers. The new series hybrid powertrain opens numerous opportunities to improve the attractiveness of future city buses.

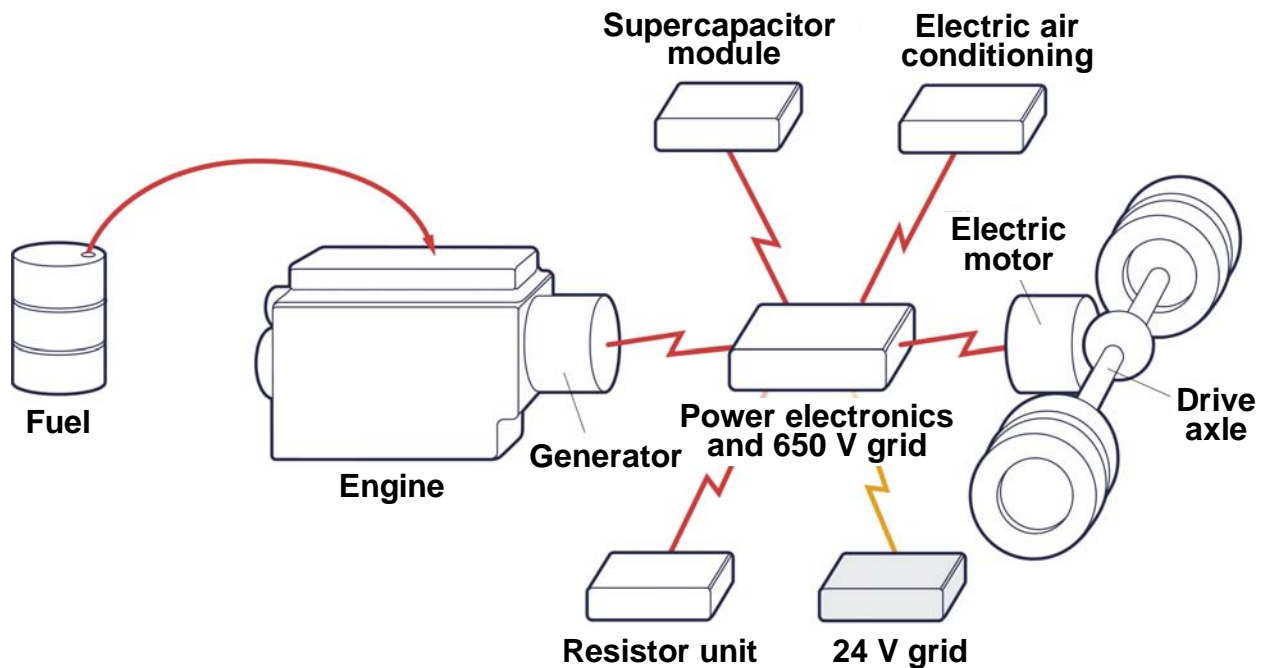


*Scania ethanol hybrid bus in operation*

### **Series hybrid**

Feasibility studies showed that a series hybrid platform is suitable for intensive urban operation with stop-and-go driving due to the high degree of regenerative braking. This results from the powerful electric propulsion motor, which supplies all the propulsion power but also regenerates a large proportion of the energy when the vehicle is braking.

The main components of the powertrain are shown in the following figure. The engine is a regular Scania diesel-ethanol engine.



*Scania series hybrid powertrain*

A powerful electric generator is mounted on the engine. A similar unit is powering the rear axle, doubling as a motor for propulsion and generator for braking. In addition there are auxiliaries that are driven mechanically or electrically.

### **Extensive real-life testing**

The series hybrid powertrain will be subjected to extensive operational trials in six conventional 3-axle, 13.7-metre Scania OmniLink city buses with Scania diesel-ethanol engines.

The series hybrid powertrain has been installed in place of the standard engine-gearbox assembly, and energy storage is integrated in a module on the roof.

The two-year trials will take place with partial support from the Swedish Energy Agency in collaboration with Stockholm Public Transport (Storstockholms Lokaltrafik SL) – the regional public transport authority in Stockholm – and Swebus, the operator. Concurrently with these operational trials, further feasibility studies are being conducted on future bus concepts.

### **Flexibility with series hybrid powertrain**

A series hybrid powertrain is characterised by the fact that there is no mechanical connection between the engine and the propulsion motor. This gives considerable freedom in vehicle design and packaging for future bus concepts. Powertrain components can be located almost independently of each other, for example to optimise weight distribution and passenger space.

The Scania Hybrid Concept bus launched in 2007 was built to assess public interest in a new design concept for city buses combined with hybrid-electric propulsion and has since then served as a rolling laboratory. Powertrain components are located on top of each other at the very rear of the bus, with energy storage and auxiliary

functions integrated in the roof structure, which liberates space for an uncluttered passenger module that forms the middle section of the bus. The driver's station on top of the front axle forms its own module at the front.



With the wheels located at each corner and all-wheel steering, this bus has exceptional manoeuvrability, virtually without any swept areas when cornering. The modular build opens up for new types of city buses with fast and easy entry and exit and high passenger appeal. The modules are equally suitable e.g. for double-deckers and airport buses, as well as some potential new truck concepts, e.g. for refuse collection and urban distribution.

### **Powertrain design brief**

The design brief for the series hybrid powertrain include the following factors:

- Improved fuel economy and emissions in urban stop-and-go operation of some 25 percent.
- Added comfort with smooth stepless acceleration.
- Diesel engine used for power generation adapted to operate on ethanol with high efficiency.
- Ethanol operation cuts fossil CO<sub>2</sub> emissions by up to 90 percent.
- High-output powertrain with good performance adds to driver appeal.
- Storage module (supercapacitors), heating and ventilation and electrical air conditioning all roof-mounted.
- Powertrain equally suitable for biogas or natural gas engine, for which tank space is available on the roof, as well as for potential future propulsion concepts such as advanced engines, batteries and fuel cells.
- Uptime and quality guaranteed through exclusive use of components designed for heavy-duty operation.
- The powertrain concept is to be commercially viable both for Scania and its customers.

### **Power and performance**

To match the high power and torque of the Scania engine, high-output electric motors/generators had to be chosen. The electric propulsion motor provides full torque (2750 Nm) from start and the drive is completely stepless. The energy storage module featuring supercapacitors is also designed for high output and high cycle efficiency.

Besides the axle gear, no additional reduction gears are required due to the wide operating range of the propulsion motor (0-2400 r/min, full torque from start).

Acceleration is only dependent on the output of the electric propulsion motor and hence independent of the power provided by the internal combustion engine.

The operation of the propulsion engine has been optimised for maximum efficiency, minimum noise and minimum emissions instead of a trade-off between various parameters.

The efficiency of the generator is typically more than 90 percent, peaking at over 94 percent. The engine operates according to the diesel principle with a typical efficiency of between 40 and 45 percent. The efficiency of the propulsion motor is similar to the generator and slightly lower at very low speed.

Compared to conventional buses, overall fuel savings of some 25 percent can be achieved in urban operation as a result of the regenerative braking and optimised engine operation.

To live up to Scania customers' expectations regarding product quality, the components including the energy storage module have a design life comparable to that of the vehicle, i.e. a full 10-15 years. The components also have low maintenance requirements. Driving auxiliary systems electrically provides significant advantages. Robust electric solutions for auxiliaries like air conditioning, power steering and air compressor are likely to be in large-scale production within a few years.

### Technical highlights of Scania's series hybrid powertrain

Engine	Scania 9-litre diesel-ethanol engine
Power	198 kW (270 hp) at 1900 r/min
Torque	1200 Nm at 1100-1400 r/min
Generator	Voith ELVO Drive®, TFM Generator, water-cooled Continuous torque: 1250 Nm Continuous power: 220 kW mechanical from engine Maximum speed: 2400 r/min
Propulsion motor	Voith ELVO Drive®, TFM Motor, water-cooled Maximum torque: 2750 Nm, continuous torque: 1800 Nm Continuous power: 150 kW mechanical Maximum speed: 2400 r/min
Energy storage	Supercapacitors: 4x125-Volt Maxwell BOOSTCAP® modules, air-cooled Energy available: >400 Wh
Control system	Standard Scania CAN-architecture with added functionality for hybrid control
Maximum speed	78 km/h, depending on final-drive ratio
Development partners	Voith (hybrid-drive system) Carrier-Sütrak (electric air conditioning)
Sponsors	Vinnova Swedish Energy Agency

For more information and images:

- Go to [www.scania.com/media/hybrid/](http://www.scania.com/media/hybrid/) for the media site.
- At <http://imagebank.scania.com/> you can search for related images by entering "Hybrid 0906" in the "Quick search" field.
- Contact: Marcus Wik, Bus Predevelopment, tel. +46 70 7781968, email [marcus.wik@scania.com](mailto:marcus.wik@scania.com).