

Fact Sheet

Munich, May 2012

How does the electric-powered system for heavy good vehicles work?

- The system tested in the ENUBA project uses an overhead contact line system to supply power to heavy good vehicles (HGV) in a manner similar to trams or trolleybuses in cities and to electric trains in long-distance passenger service.
- A pantograph forms the point of contact between the overhead contact line and the vehicle.
- On electrified lines, it enables the vehicle to use electric power for propulsion purposes. On non-electrified routes, the HGV makes use of its hybrid diesel-electric drive system.

HGVs with hybrid drive technology for use on electrified routes

- The HGVs are always driven by an electric motor.
- On electrified routes, the electric motor takes its power from an overhead contact line. The pantograph transmits the power from the overhead contact line to the HGV's drive system.
- The HGV is also equipped with a powerful diesel engine for non-electrified routes. With optimum efficiency, this engine drives an onboard generator which in turn generates the power required to drive the electric motor.
- When overtaking other vehicles or operating on non-electrified routes, the vehicle can change over to conventional diesel engine operation or operation on an energy storage system.
- This combination of electric motor, diesel engine and optional energy storage system is called a 'hybrid drive' in transportation circles.

Power supply and energy recovery via overhead contact lines

- The overhead contact line is installed above the electrified lane and supplies power to the electric motors of hybrid HGV.
- The link between the local power grid and the overhead contact line system is formed by traction substations, which are located next to the route and spaced at distances of several kilometers.
- Inside these substations, transformers and power electronics equipment convert the alternating current from the local power grid into a direct current and feed it into the overhead contact line.
- The overhead contact line is a bipolar system, which means that like a battery it has two conductors that lead to the positive pole and the negative pole.
- The highly conductive steel rails for tramways and railways form the negative pole and conduct electricity back to the substation. However, since asphalt and concrete are very poor conductors, the negative pole for electric-powered HGVs has to be made part of the overhead contact line itself.

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- Just like trains, HGVs can also generate power during braking operations by converting the kinetic energy back into electrical energy.
- The operation of multiple electric-powered HGVs on a common overhead contact line enables braking vehicles to make their surplus energy available to other HGVs for acceleration. This has the effect of significantly lowering the energy requirement (power consumption) of the entire system.
- If all the vehicles on the electrified route section brake simultaneously, the surplus braking energy can also be fed back into the local power grid by means of special inverters and thus reduce the energy demand of the system as a whole.

Intelligent pantographs for the transmission of electrical energy

- Siemens has developed an actively moveable pantograph. This enables automatic connection to/disconnection from the overhead contact line at speeds of up to 90 km/h and also automatic compensation of all vehicle movements within the electrified lane.
- Depending on the operation mode, the pantographs can be raised or lowered automatically or even manually at the touch of a button.
- One of the ways in which the pantograph differs from that used on urban trolleybuses is its design. Trolleybuses have a relatively small, U-shaped collector shoe which prevents them from reconnecting to the overhead contact line after overtaking another vehicle.
- The pantographs on electric-powered HGVs are more similar to those of mainline locomotives. They are fitted with a very large, flat contact surface and can reconnect to the overhead contact line after overtaking another vehicle during operation - even at full speed.