ELFA: Zero emissions – the cost-effective and smart way
Commercial vehicles go green!
siemens.com/elfa
Economical, ecological: the intelligent response to rising demands

People are demanding mobility to the same extent that large cities and megacities around the globe grow. The consequence: The amount of traffic and environmental load are continuing to increase, private transport has reached its limits and is increasingly becoming financially uninteresting for individuals.

Innovative traction systems from Siemens are an essential element in sustainably addressing these complex challenges. Such as ELFA the modular electric hybrid traction system with the highest degree of flexibility.

It allows vehicle manufacturers to individually configure the hybrid drive, which in turn allows operators to run city buses and all types of commercial vehicles with reduced energy, favorable costs and low emissions. At the same time, comfort for passengers and drivers is noticeably increased.

Summing up – a solution that addresses all requirements.

ELFA system advantages at a glance

- Significantly less energy consumption and emissions
- Emission-free operation possible in inner-city areas
- Noticeably quieter
- Higher degree of comfort through soft, jerk-free starting
- Extremely reliable and low-maintenance traction systems
- All components from a single source motor, generator, converter and control
- Modular hybrid system for a maximum degree of flexibility and cost effectiveness
- Well-proven technology
- Future oriented
Our competitive edge?
Forward thinking and a pioneering spirit

Well-conceived concept:
Minimum energy requirement – but with a maximum degree of comfort

City buses equipped with ELFA traction systems are significantly more efficient and comfortable than conventional buses. The reason for this is the well-conceived concept with the ELFA electric traction system as core. ELFA combines mobile energy generators – such as diesel generator sets and fuel cells – with high-performance energy storage devices. These allow the energy that is released when braking to be harnessed and stored. Just the diesel-electric hybrid concept alone provides enormous advantages. With this concept, the diesel engine drives a generator. This supplies an electric traction motor with energy using state-of-the-art power electronics (traction converter).

At the same time, the use of newly developed permanent-magnet synchronous motors provides operators with many advantages: A gearbox is no longer necessary, the overall efficiency is improved, and noise emissions and maintenance costs are simultaneously reduced. And of course, passengers also benefit from this. They can enjoy soft, jerk-free rides and are therefore noticeably more comfortable.

Innovation as core competence:
Siemens the global market leader

ELFA is a Siemens product – the global leader in large drives. We craft solutions for all types of applications based on more than 100 years of experience in drive technology and the power of innovation of our company. In our competence center for large drives, our experts work side by side to develop and produce drive systems for industrial plants, ships and rail vehicles – for subways in major cities around the world and also for high-speed trains such as the ICE and Velaro. The resulting synergies flow directly into ELFA.

The result is convincing: Components that are perfectly harmonized with one another and having the highest reliability are combined to form an optimum system – a system that also distinguishes itself as a result of the highest degree of efficiency. In the meantime, more than one thousand systems in the widest range of configurations around the globe have impressively verified this.
It makes sense to store and reuse braking energy

The decisive key to significantly reduce energy consumption for buses is to reuse the significant amount of braking energy that is generated in typical stop-and-go operation. Here, savings of over 50 percent are definitely feasible – and have already been able to be proven in various applications. ELFA intelligently uses this braking energy: Contrary to conventional buses where the energy is simply wasted, with ELFA, it is converted back into electrical energy by the regenerative operation of the traction motor and fed into an energy storage device – i.e. into high-performance capacitors or batteries. The energy yield is enormous, especially for city buses that are continually braking and accelerating.

Depending on the bus type and the application conditions, operating companies can profit from significant cost savings. This makes it quite clear why an investment in an ELFA traction drive has an extremely short payback time.
Efficiency has a name: ELFA

ELFA – the flexible drive system
Using ELFA, every energy mix is possible. It allows the vehicle manufacturer to configure the electric drive to address his individual requirements – he can freely select the internal combustion engine, fuel cell and energy storage device. For instance, fuel consumption and emissions can be significantly reduced through an optimum combination compounded by intelligent energy management. By the way: The dimensions of the traction motors and generators are oriented to the geometry of the automatic gearbox. This means that vehicle manufacturers can essentially keep their chassis design when switching over to hybrid technology. Further, the modules open up a multitude of combination options to address the requirement profile of every vehicle when it comes to weight, acceleration and speed.

Siemens UCaps – the high-performance capacitors
Special high-performance capacitors are used to store energy for hybrid vehicles with traction cycles that are characterized by frequent starting and stopping. These capacitors are called UCaps, which are charged especially quickly when braking and can be discharged again. The advantages of rugged UCaps when compared to batteries for hybrid vehicles: the high power density, the high efficiency and a service life that corresponds to that of the vehicle itself.

Siemens PEM motors – the better alternative
An increased efficiency represents the main competitive lead of the PEM drive concept when compared to induction motors. This can be especially leveraged for inner-city driving cycles of city buses. As a result of the magnets, a magnetizing current is not required in the lower motor speed range, therefore achieving significantly higher efficiencies. Due to the high torque levels when driving and braking, these operating points have an especially positive impact on the energy balance. This is compounded by the fact that for the same torque requirement, a PEM requires a lower current. Put briefly, the costs are reduced over the complete lifecycle.

ELFA: Technical advantages at a glance

- There is no gearbox between the motor and rear axle
  - Better overall efficiency
  - Gearbox oil does not have to be changed
  - Lower weight
- Oil does not have to be changed (as there is no gearbox)
- Modular system (identical parts for production, power can be simply scaled based on the length)
- Lower weight (as there is no gearbox)
- Up to 50% lower fuel consumption when compared to conventional drives and therefore lower lifecycle costs
- Increased range of battery-powered electric vehicles using high efficiency PEM motors
TaxiBot – the taxiing robot:
TaxiBot is an international joint project: For the first time, the newly developed towing tractor pulls the vehicle from the gate to its takeoff position (pushback and taxiing). The tractor is controlled by the pilot and the aircraft requires hardly any modifications. During this time, the aircraft engines can remain shut down, which saves up to 1 ton kerosene for each towing operation. This also means that engine maintenance intervals can be extended. Assuming 12 towing operations per day, this results in a saving of approximately 3 million Euro per annum.

Yachts:
The Siemens ELFA hybrid system offers efficient drive technology for series and parallel hybrid systems, as well as for diesel-electric systems. Ships with single or double-shaft propellers can be equipped with this system. Siemens ELFA hybrid systems as well as diesel-electric systems are even suitable for more complex configurations involving several drive trains.

AGV – automated guided vehicle:
In container ports, these driverless vehicles transport containers weighing up to 60 tons from the dock-side crane to the container staging area. As a result of the higher maintenance and downtimes in operation, these typically diesel-electric vehicles offer enormous cost-saving potential. This is because when using a hybrid drive with energy storage device and start-stop function, the diesel generator set can be shut down. This means that the vehicle is immediately ready for use even with the diesel engine turned off.

Waste disposal vehicles:
Garbage collection trucks with ELFA hybrid drive open up enormous energy saving potential including the associated reduction in exhaust gases and noise. The hybrid drive fully leverages its advantages in the vehicle catchment area. Here, the diesel-generator set can be operated in a range where fuel consumption is at its optimum. When braking, the braking energy that would otherwise be wasted, is fed back into an energy storage device. This means that it can be used in an eco-friendly fashion for moving or for compressing waste.

City bus in Vienna:
Vienna is the first city to switch over to these leading-edge vehicles. The Austrian capital has had a bus line in the inner-city zone in operation since autumn 2012. This involves the first electric buses in Europe that have been manufactured in series production, where the complete energy demand is supplied from the onboard battery system. The batteries are charged in the bus terminal. The electric power is taken from the overhead line used by the streetcars via pantographs and fed to the battery charging device.
In the future, city buses will operate completely electrically as a result of increasing emissions in inner-city zones. Flexible Siemens ELFA traction systems already allow city buses to be operated with diesel-electric drives without requiring any additional infrastructure. The charging infrastructure required for purely electric buses can be established in parallel. With relatively low associated costs, diesel-electric buses can be modified to become purely electric. This allows a gradual entry into pure electric bus operation. These buses are “eBus ready”!

The path from “eBus ready” to “eBus”:

**Diesel-electric bus:**
- Diesel bus equipped with generator – driven by a diesel engine – and electric motor
- As a result of the high efficiency of the electric motor, costs can be reduced by 10% when compared to a diesel bus

**Hybrid bus:**
- Diesel-electric bus with energy storage device
- Costs can be slashed by up to 50% when compared to a diesel bus

**Electric bus:**
- A hybrid bus can be simply switched over by removing the diesel engine and the generator
- Additional increase in the size of the energy storage device

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**Diesel electric**
- Diesel engine
- Electric traction motor
- Combustion engine
- Generator

**Hybrid**
- UCap
- Diesel engine
- Electric traction motor
- Combustion engine
- Generator
- Energy storage

**Pure electric**
- Diesel-gen. set
- Battery
- Energy storage extension
- Electric traction motor
  
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From diesel electric to hybrid to fully electric (eBus). With Siemens ELFA “you can”.
Additional information:
siemens.com/elfa

You will also find additional information brochures and a technical description under Support on our web pages

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