

Electric and Hybrid Buses

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Disclaimer:

The conclusions and statements in this document are based on market knowledge of Finpro or drawn from information and data through desk research and interviews as well as underlying assumptions. Finpro assume no liability for the correctness of the information made – even if every attempt has been made to validate the data.

There are a lot of different transportation solutions within public sector, train, tram, bus etc. In this study, we focused only on the hybrid- / electric buses. Also e.g. trolleybuses use electric power, but as this technology has been utilized for decades, that was not in the scope of this study.

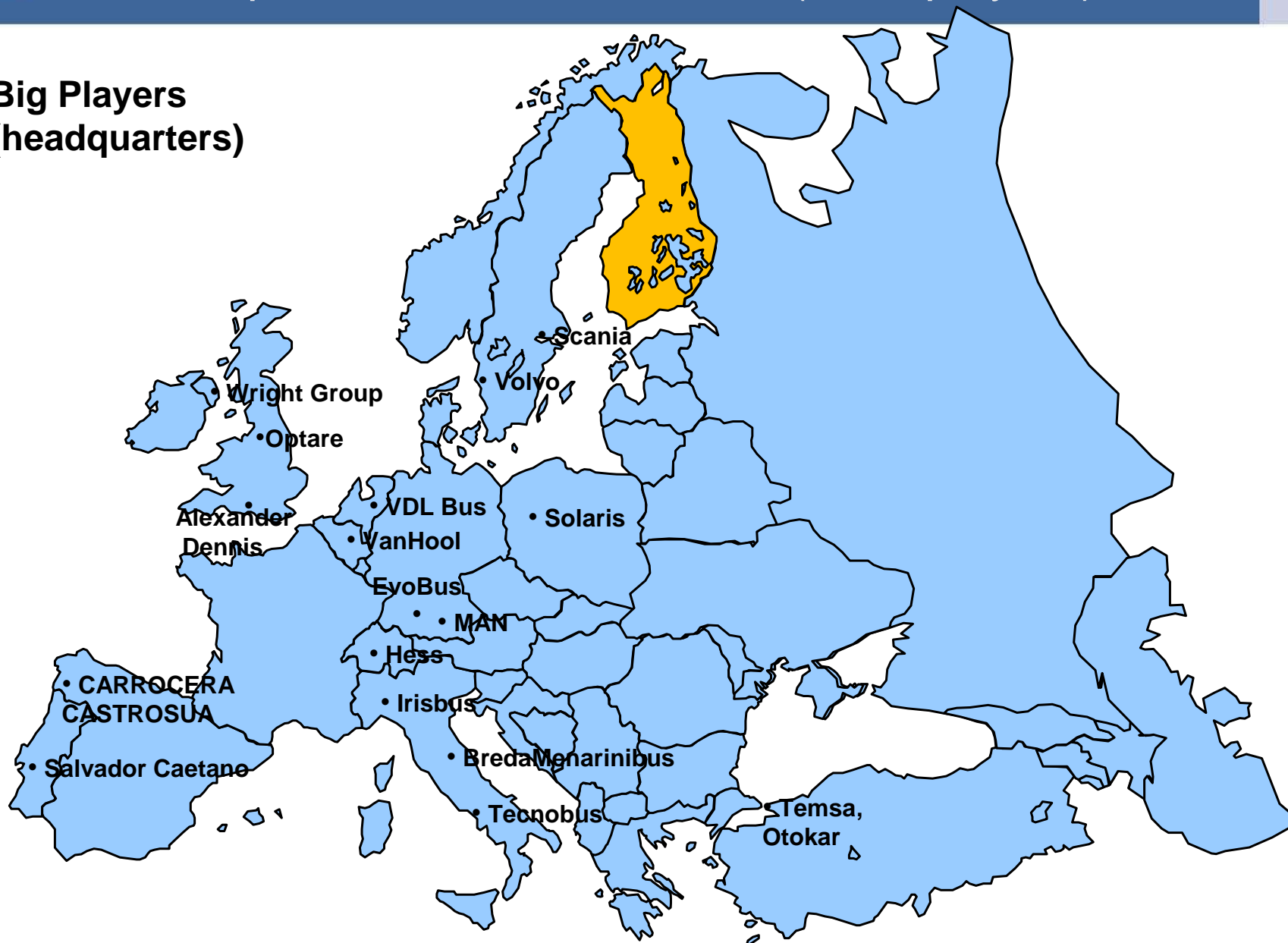
The largest producers of buses around the world are mostly companies that also have global positions as truck manufacturers, where the economies of scale in manufacturing and research and development can bring significant competitive advantage. This becomes more important as the market demands or is required to put in place new technology such as Euro V and VI compliant engines (lower emissions). Though, today buses share very little in their overall structure with trucks, although many systems such as engines, some axles, safety and electronics are common.

On the other hand many of the smaller bus makers can still gain access to the economies of scale and technology through sourcing – e.g. UK company Alexander Dennis sources engines from Cummins and can provide rolling chassis from MAN or Volvo. This then begins to effectively segment the OEMs into producers of integrated bus and coach products and assemblers that purchase a range of chassis and engines that are then built up to the customer's specification. In other worlds chassis and bodybuilding are much more separated than in normal car manufacturing.

Today there are considerably less manufacturers than there were even two decades ago and the sector has seen an almost continuous process of consolidation as products have become more complex and the requirements for economies of scale have become an increasing burden on what is a competitive industry. This trend is likely to continue, particularly as Indian and Chinese manufacturers begin to produce products that approach acceptable quality in export markets.

- ❑ Market push vs. market pull: Whereas in electric vehicles the end customers are still waiting and the development is driven by other players (manufacturers/utilities/governments), within the bus segment the drivers are the end customers, which in this case are the municipalities/cities.
 - > demand already exists !
- ❑ Earning logic different compared to electric vehicles. The public transportation ecosystem is in this case much simpler than the electromobility ecosystem with more value added services (new business models).
- ❑ In many countries (e.g. Germany) government supports cities to buy hybrid busses.
- ❑ As in the electric vehicles in general, also within bus sector there are lot controversial discussions concerning the development:
 - Hybrid vs. electric bus: Others say, that there will be also a pure battery busses in near future available whereas the others are sure, that the diesel engine is needed to help the electric drive also in the future
 - Hybrid vs. hydrogen bus: Most of the manufacturers see hybrid and electric bus as the ultimate solution, whereas Daimler believes Fuel Cell to be winning technology in the long run (10-20 years).
- ❑ The public transport – city busses – is seen as the best place for battery-swapping-systems. Where private cars drive different distances unplanned, the city busses drive the planned routes continuously from point A to B, and mostly with the same busses (same manufacturer). At the end stations it could be easy to change the used battery always to loaded one, while buss waits to start the route again. Additionally as mostly the batteries are placed on the roof of the buses, it is much easier to change these than in normal cars.
- ❑ Some of the manufacturers use today Ultra Caps instead of batteries. Though, many of them are uncertain if they will use Ultra Caps also in the future or change to batteries.

Big Players (headquarters)



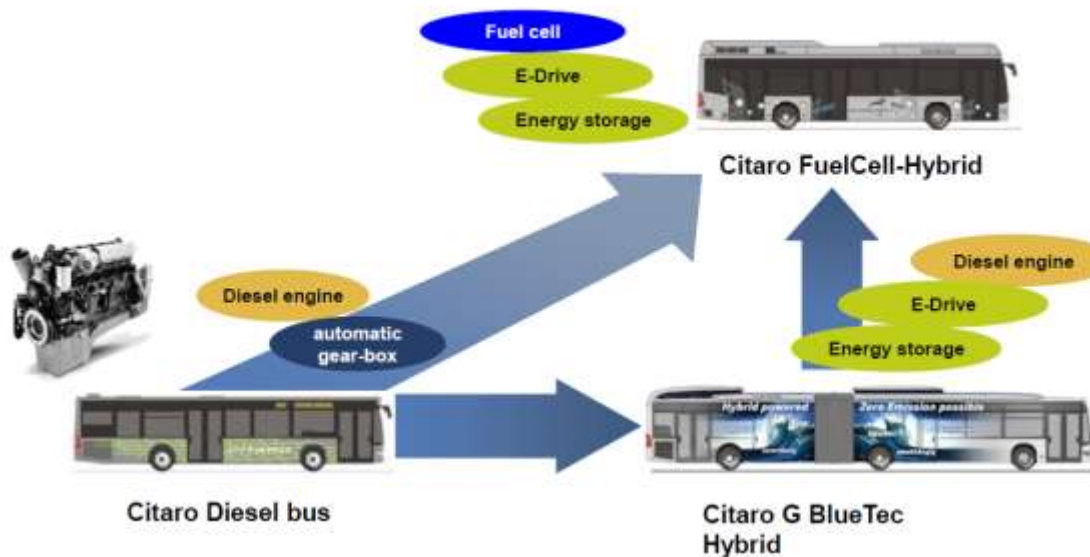
Selected **European** bus manufacturers and their pilot cities:

Company	Pilot Cities
Daimler Buses, EvoBus GmbH	Hamburg (2010-2011), Stuttgart (2010-2011), Luzern (CH 2010-2011), Rotterdam (2009-2010)
Volvo Buses	Göteborg (SWE), London (UK), Tübingen (GER), Rotterdam (NED), La Rochelle (FRA), Luxemburg, 6 buses
Scania AB	Stockholm (SWE)
MAN	Nürnberg (GER), Wien (AT)/München (GER), Berlin (GER), Munich Airport (GER), Paris (FRA)
Irisbus Iveco	Milano (minibuses)
Solaris	Dresden (GER), Leipzig (GER), Bochum (GER), Bremen (GER), Munich (GER) and Hannover (GER), Lenzburg (CH), Strasbourg (GER), Bremen (GER), Oslo (NOR), Olsztyn (PL), Warschau (PL), Düsseldorf (GER) (2010-2011), Neuss (GER) and Kaarst (GER)
Hess AG	Bellach (CH), Luxembourg 2007-2008, Munich (GER) 2008, Dresden (GER) 2008-2010, Düsseldorf (GER) Summer 2010, Zug (CH), Aachen (GER)
Van Hool NV	De Lijn Belgium (35 busses), South Holland Province (4 busses)
VDL Bus & Coach	Twente (NED), Enschede (NED)
Tecnobus	Soria (ESP), Bruxelles (BEL), Köln/Düsseldorf Airports (GER)
Temsa	n/a
Otokar	n/a
CARROCERA CASTROSUA, S.A	Madrid (Spain), Barcelona (Spain)
BredaMenaribus	n/a
Alexander Dennis Ltd.	London (UK)
Optare Group Ltd.	n/a
The Wright Group	n/a
Salvador Caetano	n/a

Selected **Asian** bus manufacturers and their pilot cities:

Company	Pilot Cities
Tata Star Buses (India)	Delhi, India Oct 2010, Commonwealth games
Ashok Leyland "HYBUS" (India)	Delhi, India Oct 2010, Commonwealth games
Hyundai Motor (South Korea)	Launched 100% electric bus "Elec-City" in June 2010
Hankuk Fiber (South Korea)	100% electric bus "e-Primus". 15 electric buses will be available in Seoul from November 2010
CT&T (South Korea)	Plans to roll out its first battery-powered buses in 2011
Daewoo Bus (South Korea)	Piloting in 6 cities including Busan and Daejeon Plans to get ready for mass production of diesel hybrid buses by 2012

- ❑ Headquartered in Stuttgart, Germany, the Daimler Buses unit, which comprises the bus business of the Daimler Group with the brands Mercedes-Benz, Setra and Orion, offers a product range including city buses, intercity buses, touring coaches, minibuses and chassis.
- ❑ Daimler Buses is currently the world market leader for buses and coaches with a gross vehicle weight of above eight tonnes and as at December 2009, employs over 17,100 staff. The American Orion city bus brand is currently the leading producer of hybrid buses worldwide.
- ❑ Hybrid and FuelCell Plans: Citaro G BlueTec Hybrid, Orion VII Hybrid
- ❑ www.evobus.de



DAIMLER

Daimler Buses

The Citaro G BlueTec Hybrid provides sustainability-benefits to the customer in addition to preserving the advantages of the standard Citaro.

ELECTROMOBILITY

DAIMLER

Daimler Buses

Citaro G BlueTec Hybrid
Customer

high fuel savings
high reliability because of established Citaro platform

Driver

regular Citaro cockpit/driver interface

Passenger

low noise level

Environment

high savings of CO₂
zero emission in sensitive areas
low noise level

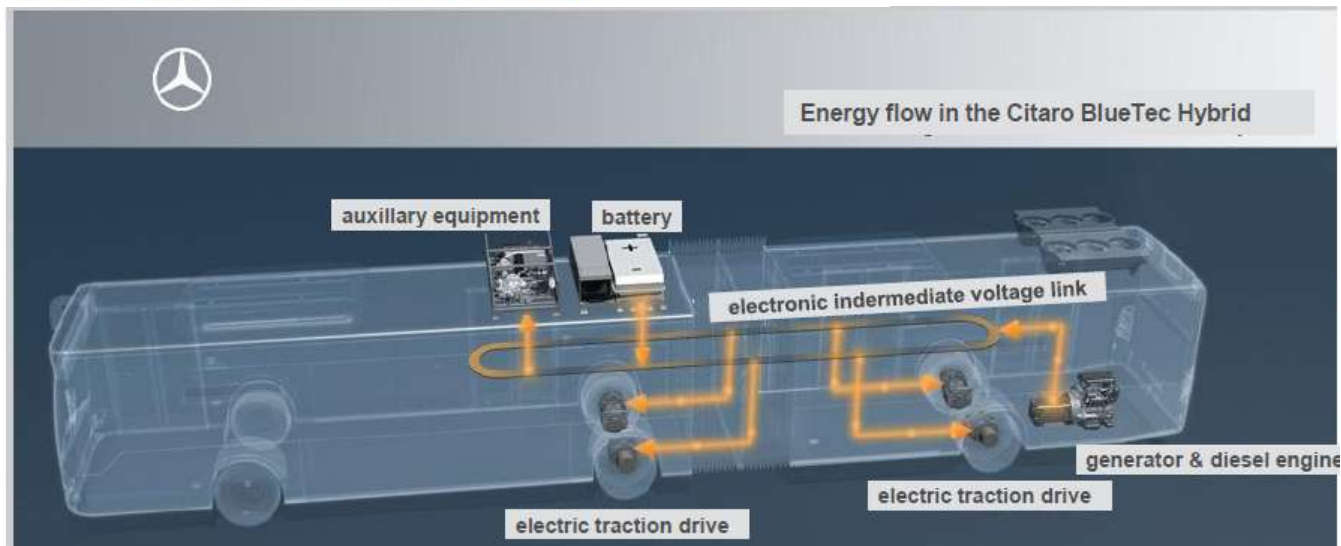
Technical Highlights

Lithium-Ion battery (330kg, 26 kWh capacity)
Electrified wheel hub motors (4x 80 kW)
Electric powered auxiliaries
Power pack (diesel engine + generator)

Design


Energy flows during the operation mode "Hybrid"

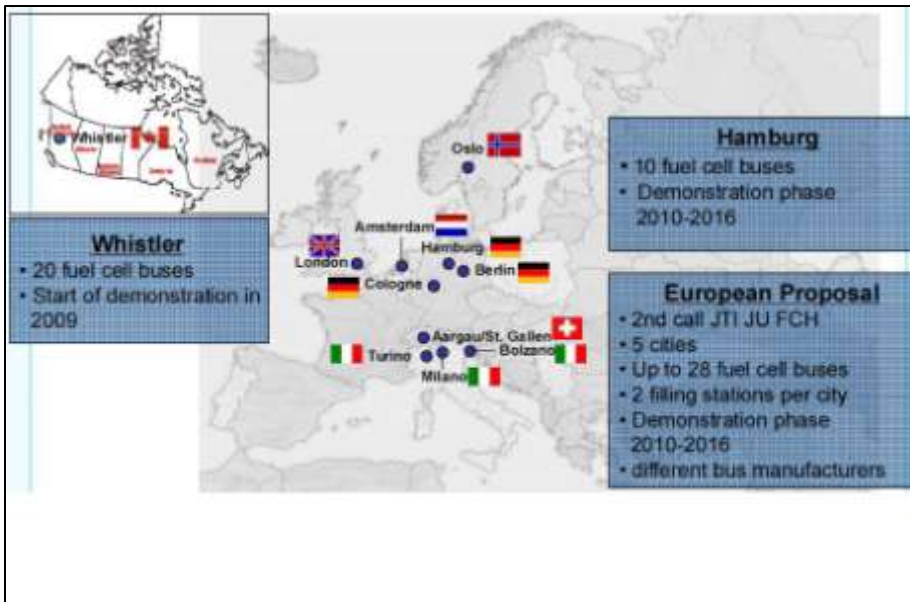
Battery and diesel engine is active



FUEL CELL technology

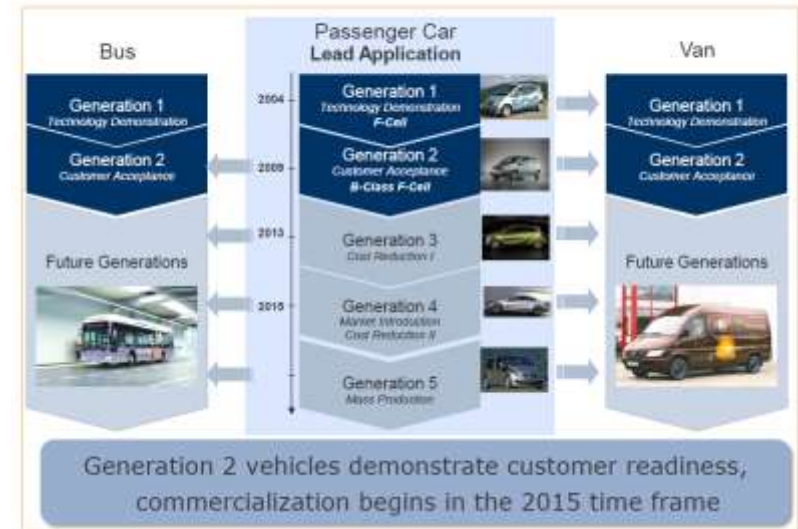
- ❑ Daimler very active in fuel cell development.
- ❑ Daimler, Linde, Shell, OMV, ENBW and Vattenfall to build hydrogen stations German wide
- ❑ Hamburg as the pilot city for Daimler's fuel cell technology

Daimler's HyFLEET:CUTE project in Europe and the US



Fuel cell electric vehicle roadmap

DAIMLER 



Source: UITP, Supplier Business report

- A subsidiary of the Volvo Group, Volvo Buses is the world's second largest bus manufacturer, with a product program comprising city buses, intercity buses and tourist coaches, as well as chassis combined with a comprehensive range of services such as financing, servicing, vehicle diagnostics and traffic information systems. The company sells approximately 10,000 buses and chassis each year. Headquartered in Gothenburg, Sweden, Volvo Buses has approximately 7,900 employees worldwide, with sales operations in 85 countries and production activities in Europe, North and South America, Asia and Africa.
- Hybrid Plans: 7700 hybrid (serial production from April 2010), Volvo B5L Double-Decker Hybrid

□ Product range:

CITY						
	Volvo 7700	Volvo 7700 Articulated	Volvo 7700 Hybrid	Volvo 8500 Low Entry	Volvo 8700 Low Entry	Volvo city bus chassis
INTERCITY						
	Volvo 8500	Volvo 8500 Low Entry	Volvo 8700	Volvo 8700 Low Entry	Volvo intercity bus chassis	
COACH						
	Volvo 9700	Volvo 9900	Volvo coach chassis			

Source: UITP, Supplier Business report

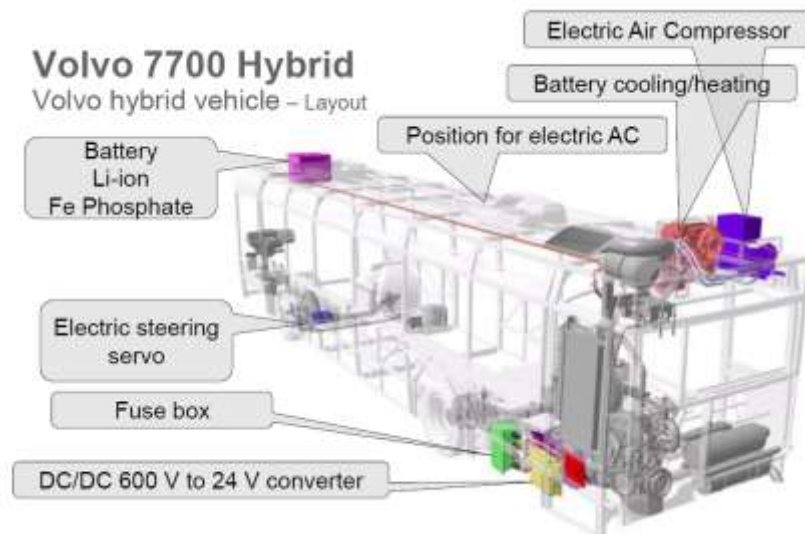


In-House parallel design

- 30% Lower fuel consumption
- 50% less NOx and PM
- 5 more passengers
- Silent start and -3 dB less noise
- 120 kW Electrical machine
- Electric AC, Compressor, Doors, Steering Servo
- Lowest life time cost*
- Very High reliability
- *Including environmental cost

Volvo 7700 Hybrid

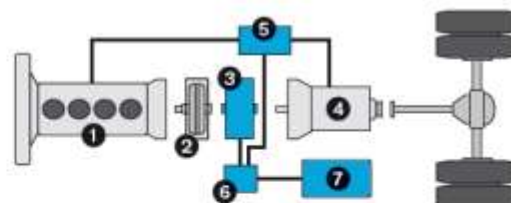
Volvo hybrid vehicle – Layout



SPECIFICATIONS

VOLVO 7700 HYBRID BUS

Length:	12.0 m
Height:	3.2 m
Width:	2.55 m
Wheelbase:	5.95 m
Gross vehicle weight:	18,900 kg
Suspension:	Air suspension
Brakes:	EBS disc brakes
Number of doors:	3
Lowest boarding height:	25, 27, 27 cm
Maximum number of passengers:	95
Hybrid system:	Parallel hybrid Volvo I-SAM
Diesel engine:	Volvo D5, 210 hp, 800 Nm
Electric motor:	160 hp, 800 Nm
Transmission:	I-Shift, automatic gearshifting system, 12-speed splitter/range gearbox



The hybrid bus's main components

1. Diesel engine
2. Clutch
3. Electric motor/generator
4. Transmission
5. Electronic control unit
6. Energy converter DC/AC
7. Batteries

Scania Aktiebolag (AB), commonly referred to as Scania, is a global automotive industry manufacturer offering a wide range of buses and coaches from chassis to fully built buses, although the majority of bus production is chassis production with a subsequent outsourcing of final assembly through independent bus bodybuilders. The group is the world's fourth-largest bus manufacturer in the heavy bus segment behind Daimler, Volvo and Germany-based MAN AG.

Scania also manufactures diesel engines for motive power of heavy vehicles, marine, and general industrial applications.

Scania has been extremely successful in extending its modular concept to buses and coaches, and has achieved up to 85% integration between trucks and buses. The integration of bus chassis production into the truck operations and the restructuring of bus bodybuilding operations have contributed to Scania's successful turnaround of its bus operations.

ounded in 1891 in Södertälje, Sweden, the company's head office is still in the city. Today, Scania has ten production facilities in Argentina, Brazil, France, the Netherlands, Poland, Russia and Sweden. In addition, there are assembly plants in ten countries in Africa, Asia and Europe. Scania's sales and service organisation and finance companies are worldwide.

Source: UITP, Supplier Business report

www.scania.com

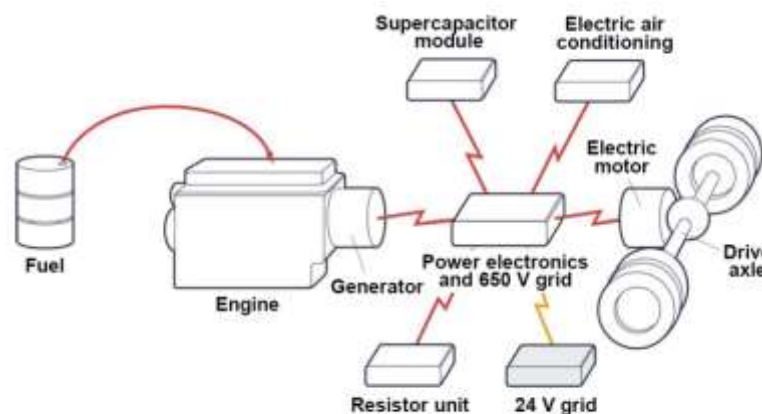


The company has a vision that CO₂ emissions per tonne transported can be reduced by 50% between 2000 and 2020, and this ethos is extended through the bus and coach industry.

The company's hybrid drive concept is being developed as a robust technology that is adaptable for different alternative fuels to deliver 25% savings in consumption. During 2008 and 2009 Scania conducted large scale trials.

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



Scania series hybrid powertrain

- ❑ Global deliveries 2009: 6.200 units
- ❑ Product type/range: complete busses (coach, city), chassis, engine
- ❑ Production locations: GER, POL, TÜR
- ❑ Hybrid plans: MAN Lion's City Hybrid
- ❑ www.man-mn.com/en/en.jsp

MAN DE-Hybrid-Stadtbus IDEAS 1

Schematischer Aufbau des Antriebsystems



MAN Lion's City Hybrid Technical data

Hybrid system	Serial full-hybrid system with MAN's own intelligent Energy Management and start-stop function
Length	11.980 mm
Width	2.500 mm
Height	3.300 mm
Wheelbase	5.875 mm
Unladen weight	12.640 kg
Permissible gross vehicle weight	18.000 kg
Seats	28 + 1
Standing room	49
Diesel engine	MAN D0836 LOH CR MAN PURE DIESEL® EEV
Output	184/250 kW/PS bei 2.300 U/min
Capacity	6.871 cm³
Maximum torque	1.050 Nm bei 1.200 - 1.750 U/min
Drive motors	2 x asynchronous electric motors, 75 kW rated power each
Traction energy storage	High-power capacitors ("ultracaps"); six roof-mounted, air-cooled modules
Tyres	Twin 275/70 22.5" tyres <ul style="list-style-type: none"> · ABS – anti-blocking system · EBS – electronic braking system · ASR – anti-slip regulation
Safety equipment	Insulated high-voltage vehicle system with permanent monitoring of insulation <ul style="list-style-type: none"> · All high-voltage lines and systems are installed outside of the passenger compartment · Emergency cut-off switch for on-board and high-voltage systems

Fuel cell development

□ Today MAN has over 550,000 kilometres of service with hydrogen buses linked with the H2-Argemuc project in Munich. Parallel to this MAN Nutzfahrzeuge AG is also developing and assessing the use of hydrogen with a fuel-cell drive. Both the fuel-cell bus with a hybrid fuel-cell drive and a further bus with a combustion engine will be deployed in service for the public transport company operating around Munich airport. The H2 fleet trials in Berlin are putting the experience gained to widespread use and this will serve as a basis for future service.

The hydrogen combustion engine which is already available is a naturally aspirated 6-cylinder inline engine installed horizontally which operates on the four-stroke Otto principle.

MAN and Neoplan store gaseous hydrogen in pressurised tanks at a pressure of 350 bar, in a similar way to the storage in natural-gas buses. On the roof of city buses there is enough room for a storage system to give them an adequate operating range. Depending on duty cycle and the type of storage an operating range of over 200 km can be assured.

Source: UITP, Supplier Business report



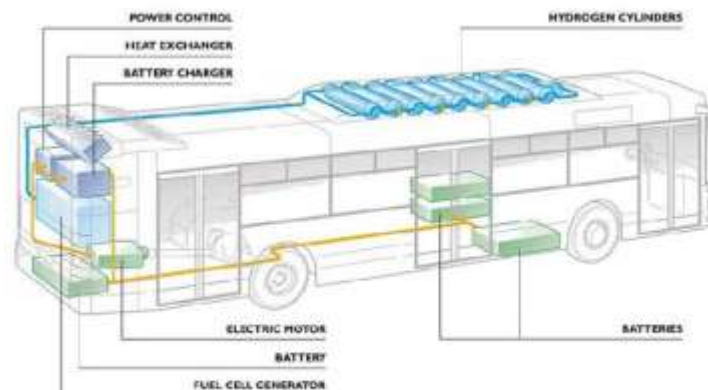
MAN's hybrid fuel cell bus

Source: MAN Nutzfahrzeuge

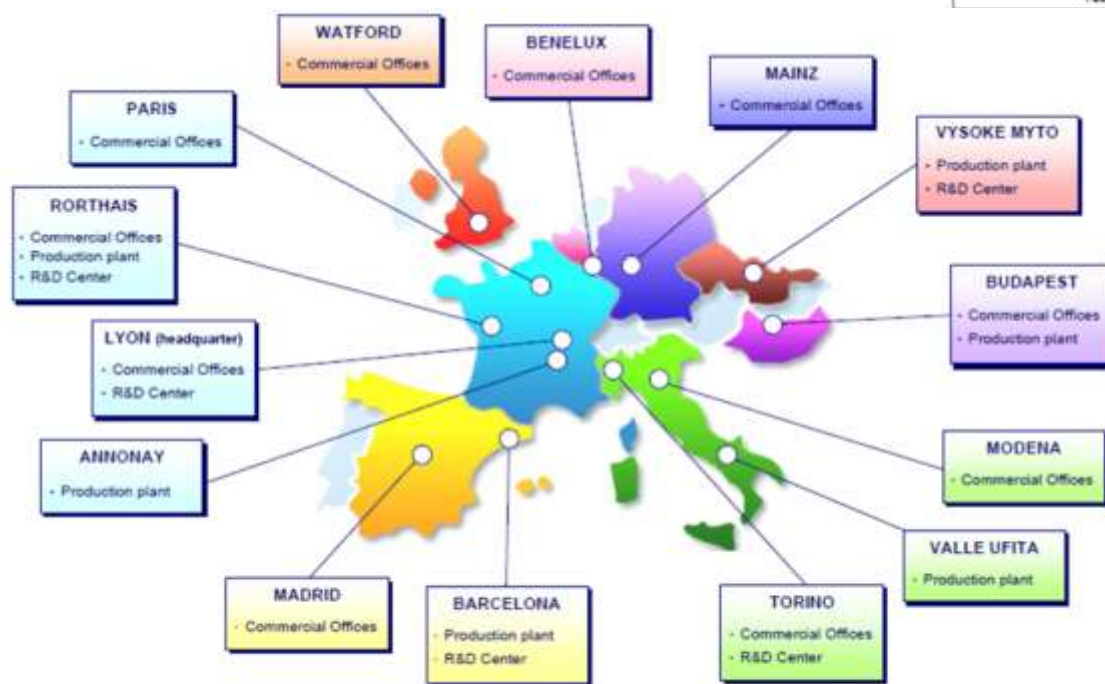
- ❑ Market share (2008): 18,9% of all busses in Europe (second biggest after Daimler)
 - Global deliveries 2008: 9.475 units (8.585 in Europe)
- ❑ Product type/range: complete busses (coach, city), chassis, engine
- ❑ Hybrid plans: Irisbus Iveco announces a new hybrid Citelis in 2010
 - in cooperation with BAE Systems
 - Li-Ion Battery from A123 (USA), 11 kWh
 - Prototype used batteries from Zebra
- ❑ Introduced in mid-2009, the Volgren-Iveco hybrid bus is the first Australian built hybrid-electric bus and, the first hybrid bus in Australasia to feature Allison's two-mode parallel hybrid technology
- ❑ Irisbus introduced, through its development and demonstration Fuel Cell Programme, its CityClass fuel cell/battery hybrid bus in Madrid, Spain, in 2003, and in Turin, Italy, between 2004 and 2006.
- ❑ www.irisbus.com



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hybrid prototype

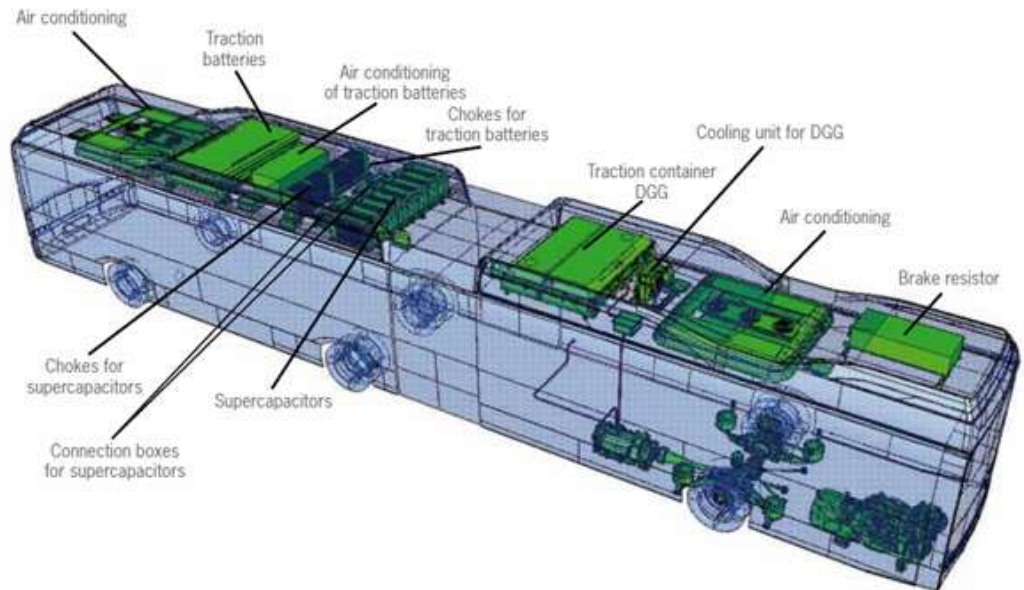


Irisbus offices and plant locations

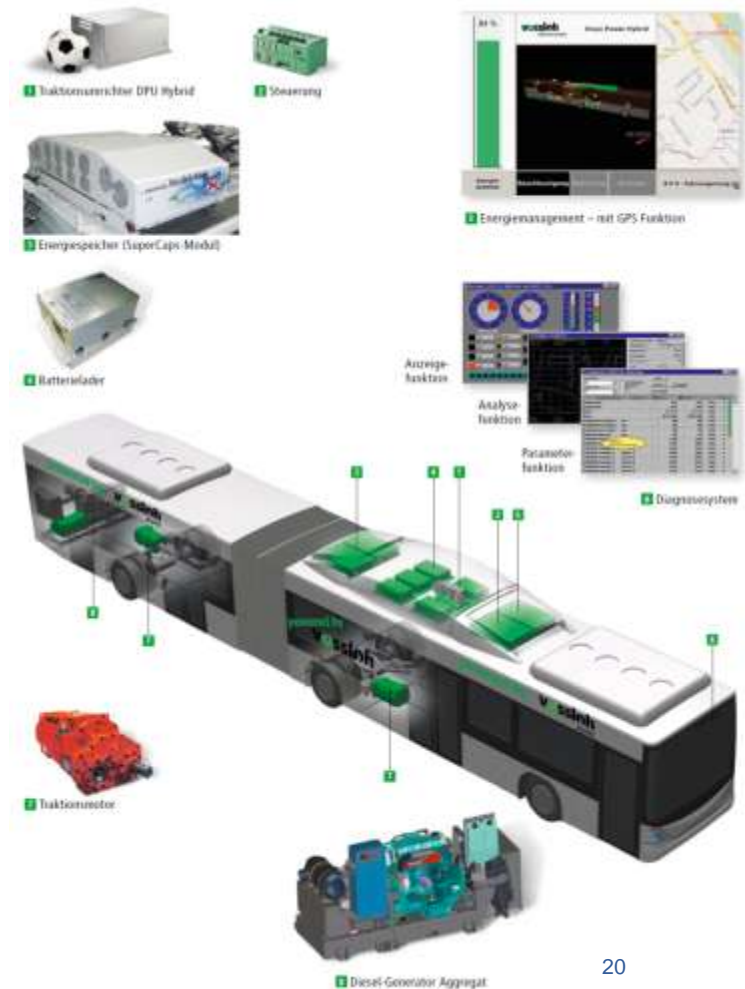
- ❑ About 700-1.000 buses produced per year
- ❑ Product type/range: city and suburban buses, trolleybuses, buses for special applications and trams
- ❑ Production locations: POL

- ❑ Hybrid plans: One of the forerunners in the hybrid business.
- ❑ Solaris Urbino Hybrid (tested also in Helsinki 2009)
- ❑ www.solarisbus.pl

Arrangement of components in the Solaris Urbino 18 Hybrid (Vossloh Kiepe)



- ❑ Swiss manufacturer, about 2.400 buses produced per year
- ❑ Product type/range: city busses and trolleys
- ❑ Hybrid plans: One of the forerunners in the Hybrid sector, as they come from trolley bus sector and therefore are experienced in electrical sector
- ❑ Europe's first double-articulated bus with a serial hybrid drive, also tested in Helsinki 2010. The energy storage with SuperCaps-Modul (von MaxWell), Energy Management System from VosslohKiepe
- ❑ www.hess-ag.ch



- ❑ **Turnover 450 Mio € (buses 2/3 out of that)**
- ❑ **About 1.700 produced units per year**
- ❑ **Product type/range: Independent coach builder; coaches, city busses, commercial vehicles**
- ❑ **Production locations: BEL**

Van Hool offers a range of environmental friendly buses, ranging from Euro IV to CNG (Compressed Natural Gas), trolleybuses and hybrid fuel cell buses. Euro IV and Euro V can be supplied with EGR (Exhaust Gas Recirculation) and SCR (Selective Catalytic Reduction) technology.

Van Hool's alternative powertrain range includes:

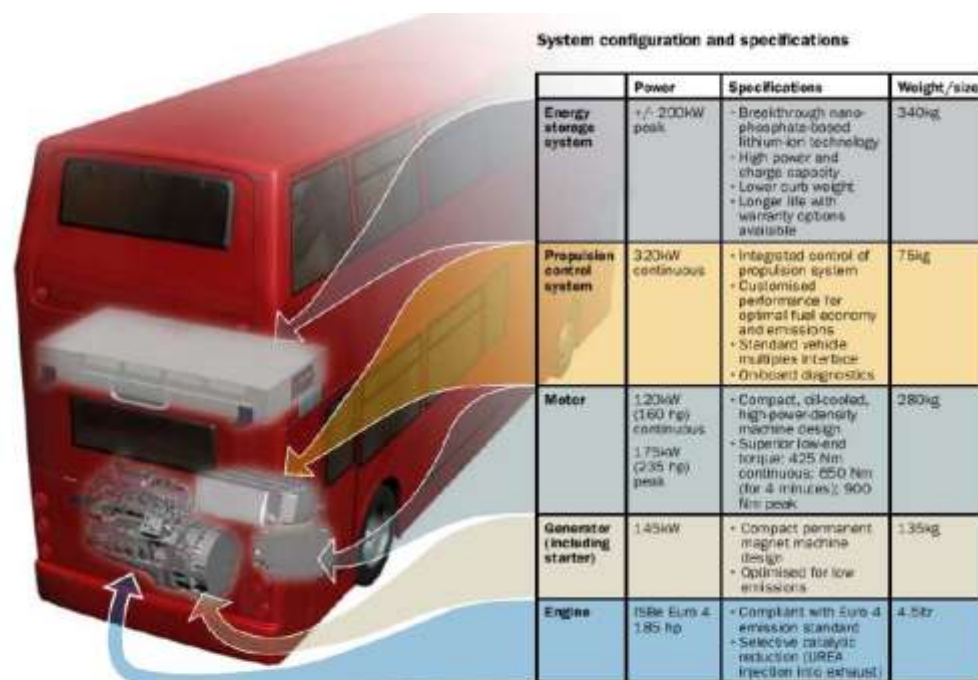
- CNG buses with EEV (Enhanced Environmentally friendly Vehicle) certification;
- Electric trolleybuses, with and without auxiliary group or in full bimode versions
- Hybrid Fuel Cell buses with the latest in propulsion technology, including battery storage and brake energy recuperation.

Hybrid: Van Hool uses ultracapacitors as a second power source. Ultracapacitors have the characteristic of being able to charge and discharge very quickly. This allows the brake energy to be stored instantly and frequently and use this energy to restart the bus from stops.

Van Hool produces three types of diesel-electric hybrid buses: a midibus, a standard bus and an articulated bus. These modern buses combine a Van Hool bus manufactured bus with an electrical drive technology from Siemens.



- ❑ Alexander Dennis Limited (formerly known as TransBus International) is the largest bus builder in the United Kingdom
- ❑ Alexander Dennis has partnered with BAE Systems to develop its hybrid powertrain package (as illustrated in Figure 25, page 79) and offers the system on its Enviro200, 400 and 500 models. The company believes that its series configuration offers significant benefits in urban traffic environments. Because the engine is not directly linked to the traction motor, it is able to run at or close to peak efficiency independent of driving conditions. This significantly reduces fuel consumption and pollution.
- ❑ Product type/range: single deck, double deck buses, midi buses (mostly for UK market)
- ❑ Production locations: UK
- ❑ Hybrid plans: Enviro 400H
- ❑ www.alexander-dennis.com



Alexander Dennis's Enviro400 hybrid system configuration and specifications

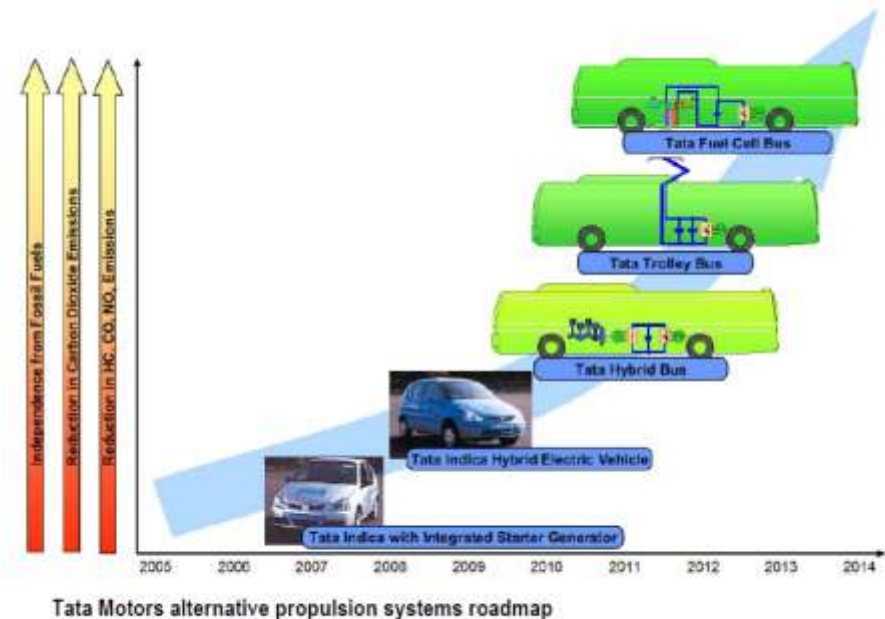
- ❑ With over 4 million Tata vehicles in use in India, the company is the country's market leader in commercial vehicles and among the top three in passenger vehicles. It is also the world's fourth largest truck manufacturer and the second largest bus manufacturer. Tata cars, buses and trucks are being marketed in several countries in Europe, Africa, the Middle East, South Asia, South East Asia and South America.
- ❑ In 2006, the company formed a joint venture with the Brazil-based Marcopolo, a leading bodybuilder for buses and coaches to manufacture fully-built buses and coaches for India and select international markets.
- ❑ Tata Motors also formed a joint venture with Fiat and gained access to Fiat's diesel engine technology. Tata Motors sells Fiat cars in India and is looking to extend its relationship with Fiat and Iveco to other segments including the bus and coach industry.
- ❑ Tata Motors emissions reduction strategy includes the following alternate propulsion systems and alternate fuels:

Alternate Propulsion Systems:

- ❑ Integrated Starter Generator
- ❑ Hybrid Bus
- ❑ Electric Trolley Bus
- ❑ Fuel Cell Bus

Source: UITP, Supplier Business report

- ❑ <http://cvglobal.tatamotors.com>



Source: Tata Motors



- Main players:
 - Hybrid and Fuel Cell Bus: Daewoo Bus and Hyundai Motor
 - Pure Electric Bus: Hyundai Motor, Hankuk Fiber, and CT&T (to launch next year)
- Hybrid and fuel cell electric buses have been developed and put in test drives in Korea. The first hybrid bus was jointly developed by Daewoo Bus Corporation and Hyundai Heavy Industries (HHI) in 2007. Core components including generator and control system were developed by HHI while the car body and the engine were developed by Daewoo.
- Eight diesel hybrid buses will be put on roads in 6 cities including Busan and Daejeon for test drives from January 2011. Korea Petroleum Association representing 4 local refineries invested 5 billion KRW in the development of these hybrid buses in line with the enactment of new laws on environment-friendly vehicles in May 2009 which applies also to clean diesel cars. Daewoo Bus will produce these diesel hybrid buses while Korea Institute of Machinery & Materials will be responsible for R&D, distribution, and operation. 50-60% of high quality diesel produced by Korean refineries are currently exported. By increasing clean diesel vehicles in the country, the huge expense for import of LPG and CNG can be significantly reduced.
- With know-how obtained through years of experience, Daewoo Bus plans to get ready for mass production of diesel hybrid buses by 2012.

- **Hyundai Motor** launched the nation's first 100% electric bus "Elec-City" in June 2010 and started test drives. Elec-City can transport up to 51 passengers with three 100kW electric. It has a maximum speed of 100km/h and can drive up to 120km per charge. The cost of operating Elec-City is only 29% of the cost of operating a CNG bus.
- **Hankuk Fiber** also developed pure electric bus "e-Primus" in cooperation with HHI and it is currently under performance certification test. e-Primus runs 120km with a 20-minute-long speedy charging and the maximum speed is 100km/h. lithium-ion polymer batteries are used. The 15 electric buses will be available in Seoul from November 2010.
- **CT&T** plans to roll out its first battery-powered buses next year. Two 20-seat models with a maximum speed of 80km/h, driving ranges of 80-120km/charge, and a six-hour recharge time. The estimated cost is 80 million KRW (\$66,528). It is powered by a 120-kilowatt motor from Higen Motors and uses batteries from SK Energy and LG Chem. It features a power control unit from LS Industrial Systems. The lightweight materials from Hanwha L&C and POSCO and a special chassis jointly developed with the Korea Automotive Technology Institute.
- Seoul Metropolitan City will provide electric buses more actively from 2011 and plans to change the half of present buses to electric versions by 2020. Charging facilities and smart chargers for electric vehicles will be installed in local offices and parking lots in large marts.

Hankuk Fiber



Hyundai Motor



CT&T



- ❑ In April 2008 Hyundai announced the company's development of a cost and fuel-efficient city bus that uses a mild hybrid system based entirely on Hyundai's proprietary technology. The mild hybrid system uses an 8KW AC motor and generator to automatically shut off the engine when the vehicle stops and to rapidly re-start when the driver releases the brake pedal. It also transforms wasted kinetic energy—during braking of the vehicle—into electrical energy, which powers the engine's cooling fan motor.
- ❑ Hyundai's second-generation hydrogen fuel cell bus launched at the 2009 Seoul Motor Show
- ❑ Technological Specification:
 - Fuel Cell Stack 200kW 450V Horizontal Array, Proprietary Hyundai
 - Technology
 - Supercapacitor 450V, 100kW, 42.8F (max. 400kW)
 - Motor PMSM 100kW x 3
 - Max. Speed 100km/ hr
 - Fuel Storage 6 Cylinders, 3.5kg H₂ @ 350 bar (5,000psi)
 - Max. Range 360km (City Mode)
 - Acceleration (0-50km/hr) 8.4 sec
 - Occupancy 26 seats





Selected pilot projects with fuel cell busses:

Project	Year	Location	Program	Bus Manuf/ Model	Fuel Cell Mfr.	Engine type	Fuel Cell Size/ Type	Range	Max. Speed	Fuel Type
EXPO ZARAGOZA	3 midi-buses, summer of 2008 present	ExpoAqua Zarazoga, Spain	International Exposition 2008	Tecnobus Gulliver, 18-ft, 22 passenger	Hydrogenics	Fuel cell/battery hybrid	12 kW PEM	124 ml/200 km	21 mph/33 km/h	Compress. hydrogen @ 200 bar
Fuel Cell Czech Hydrogen Bus Project (FCZ H2-BUS)	2009	The bus will be deployed in Prague, Czech Republic	FCZ H2-BUS	Skoda Electric Pilsen trolley bus	Proton Motor	Triple hybrid: fuel cell/Battery/ultracapacitors	N/a	N/a	N/a	N/a
Hamburg Fuel Cell Bus fleet	10 Buses to be deployed in 2010	Hamburg, Germany	HySolutions	Daimler Citaro Fuel Cell Bus	Daimler	Fuel cell/battery hybrid	N/a	N/a	N/a	Hydrogen
Hyundai FCB II	Unveiled 2009	Seoul Motor Show	N/a	Hyundai Low Floor Aero City Bus platform	Hyundai Motor Co.	Fuel cell	200 kW	225 ml/360 km	62 mph / 100 km/h	Compress. hydrogen @ 350 bar
Iveco – Fuel Cell Bus	Planned	Fleet trials planned in Milan and Mantova, Italy	ISEM Project	Iveco Europolis bus	Nuvera	Fuel cell/battery hybrid	60 kW PEM	N/a	37 mph / 60 km/h	Compress. hydrogen @ 250 bar
Lightweight Fuel Cell Bus Project	Planned in 2011	1 bus will be deployed in New York state, Project with GE Research	FTA National FC Bus Program	N/a	Hydrogenics	Fuel cell/battery hybrid	50 kW	N/a	N/a	N/a
London Hydrogen Partnership – Fuel Cell Buses	2010	5 Fuel cell buses will be deployed in transit service in London, UK	N/a	N/a	N/a	Fuel cell	75 kW PEM	N/a	N/a	N/a
North Rhine Westphalia fuel cell city bus	2010	Cologne, Germany	Pamer-German Minister of Economic Affairs	60-ft bus	Nedstack	Fuel cell hybrid	N/a	N/a	N/a	N/a
Rampini – Hydrogenics fuel cell bus	2009	Two buses purchase by transit operator Vestische Strassenbahnen GmbH in Gladbeck, Germany	Rampini fuel cell bus project	Rampini ZEV bus	Hydrogenics	Fuel cell	N/a	N/a	N/a	N/a
SunLine Transit – Advanced Fuel Cell Bus Demonstration	2009 – 2011+	1 bus will be placed in regular transit service in the Coachella Valley, California	CARB ZEB/DOE Technology Validation	Thor/ El Dorado National EZ Rider low floor bus	Ballard	Fuel cell/battery hybrid	75 kW PEM	N/a	N/a	Compress. hydrogen

Source: Hyundai (2010), Supplier Business (2010)