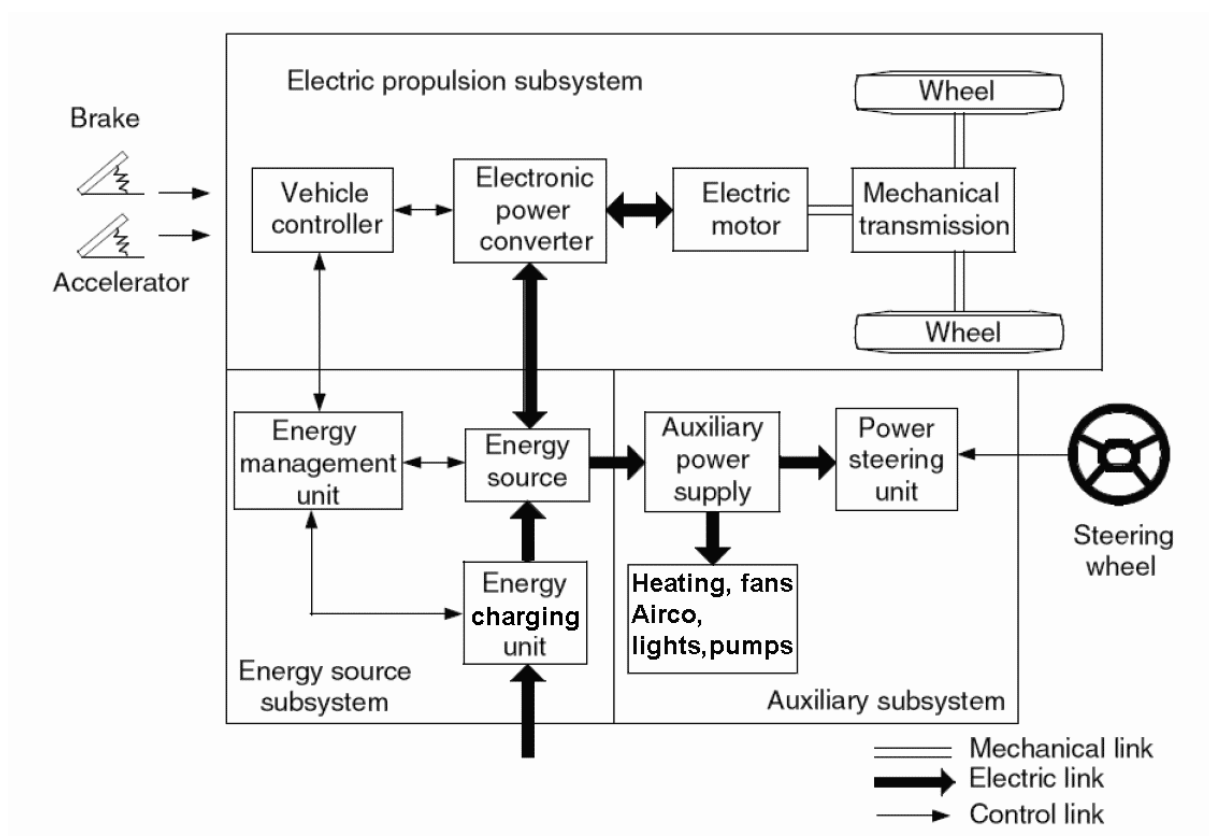


# Electric Vehicles (EV)

## 1. Power train

The powertrain of a plugin electric vehicle, has the following elements:

- electric motor
- transmission to the wheels.
- energy source: the battery pack
- battery charger (internal or external)
- inverter between battery and motor
- electronic controls
- auxiliary power supply 12 Volt



## 2. Examples of electric motorbikes

**TWIKE**

<http://www.twike.com/>

This is a lightweight cabriolet car with pedals and a NiMH or Li-ion battery. There are 4 types of Li-Ion battery, between 8 and 20 Ah, 353 Volt => max 706 kWh. Motor 3 / 5 kW, 336 Volt.



Kapazität	Akkutyp	zügige Fahrt	mittlere Fahrt	effiziente Fahrt	Gewicht	Ladezeit*	Zyklen**	Preise Vorserie
8 Ah	Lilon, 2 x 4,0 Ah	40 - 50 km	50 - 65 km	65 - 80 km	35 kg	~ 2 h	~ 1500	4.700 € SFr. 7.000
12 Ah	Lilon, 3 x 4,0 Ah	60 - 75 km	75 - 95 km	95 - 110 km	53 kg	~ 2,5 h	~ 1500	7.050 € SFr. 10.500
16 Ah	Lilon, 4 x 4,0 Ah	80 - 100 km	100 - 125 km	125 - 160 km	70 kg	~ 3 h	~ 1500	9.400 € SFr. 14.000
20 Ah	Lilon, 5 x 4,0 Ah	100 - 125 km	125 - 155 km	155 - 200 km	88 kg	~ 3,5 h	~ 1500	11.750 € SFr. 17.500

\*Ladezeit bei 16 A Ladestrom, > 95% Kapazität \*\* je nach Nutzung

## ENERTA

20 kW motor power

46 Nm torque

75km range

80km/h top speed

Battery: 6 lithium-phosphate cells

Charge time 3 h

Price 15000 USD

TOO PRICEY? The Enertia electric motorcycle goes for US \$15 000. But don't worry—you can always charge it.  
PHOTO: MIDDYVISUAL



## VECTRIX



BLDC motor  
 Ni MH battery 30Ah 125 Volt => 3,75 kWh  
 LiFePO<sub>4</sub> battery 30Ah 125 Volt => 3,75 kWh  
 Price > 10 000 EUR

### 3. Examples of electric cars

2012: Renault Twizy



Dimensions: length: 2,32 m / width: 1,19 m / height: 1,46 m  
 Total weight (including batteries 100kg): 450 kg

Battery: 7 kWh lithium-ion battery, located underneath the front seat.

Weight 100 kg. The car has an integrated charger

The battery is easy to charge thanks to an extendable spiral cable stored beneath a flap at the front of the vehicle. This cable is also compatible with roadside battery charging facilities. An adapter permits this cable to be plugged into any 220V 10A household electrical supply. The battery fully charges in 3,5 hours.

Twizy 45: This version doesn't require a licence (depending on country) and comes with a 4kW motor. Max speed is 45 km/h. Price 6990 EUR. Rent of battery: 45 EUR/month (for a use of max 7500 km/year)

Renault Twizy: The version requires a driver's licence. It is powered by a 15kW motor, 57 Nm torque. Max speed 90 km/h. Price: 7690 EUR for the "Urban" and 8490 EUR for the "Technic" version.

Rent of battery: 49 EUR/month (for a use of max 7500 km/year)

Range 100km (combined cycle).

Renault Twizy is an electric city car, which delivers all the fundamentals associated with a car: four wheels, a steering wheel and pedals, plus an enveloping body for two occupants sitting in tandem, one behind the other. Steering circle 3,4 meter.  
It will go on sale in Europe beginning of 2012.

2009: i-MiEV

<http://www.mitsubishi-motors.com/special/ev/4innovations/index.html>

The i-MiEV is powered by a compact 47 kW PMSM that develops 180 Nm (133 lb-ft) of torque and a 330V, 16 kWh or 20 kWh lithium-ion battery pack.

Top speed: 130 kph (81 mph)

Range of up to 130 km (81 miles) for the 16 kWh pack or 160 km (99 miles) for the 20 kWh pack.

Rear wheel drive. The motor is coupled to a reduction gear and differential to drive both rear wheels.

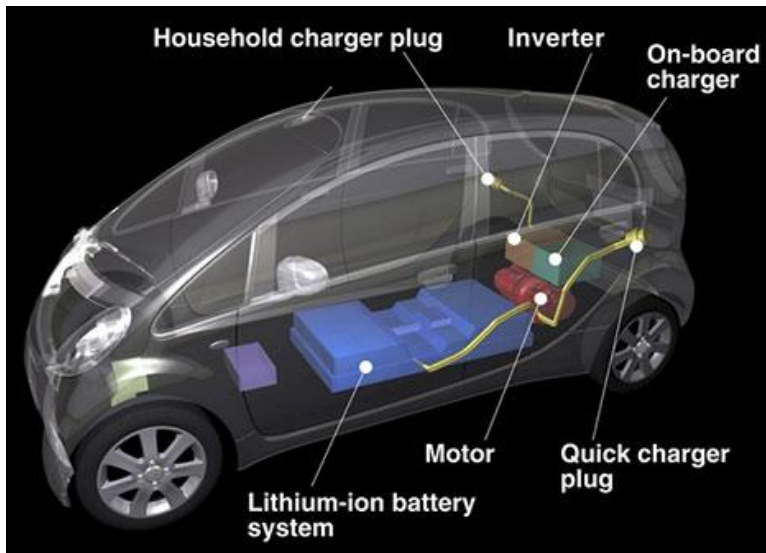
Weight 1080 kg.

Price 27000 - 33000 EUR.

The latest version has a new lithium-ion battery, a more efficient electric motor (10% lighter), a new inverter (30% smaller) and tires that rotate with less resistance.

The range has been boosted to 160 km (99 miles) with the 16 kWh battery, which is 23% better than before. This means that the car can either be sold for less with the smaller battery, or with an even longer range and the bigger one. No word on top speed, but we can probably assume it's still close to 130 kph (81 mph).





There is also a *sports version* of the i-MiEV, with 200 kg batteries. Max speed is 200 km/h. Motor power is 60 kW, max torque is 230 Nm. The range is 200 km.

There is also an older 4x4 version with in-wheel motors: Lancer Evolution MiEV:

2005: Mitsubishi MIEV

The Lancer Evolution MIEV has four high-efficiency direct-drive motors inside its 20-inch wheels, *each* producing 50 kW of power and 518 Nm torque, adding to maximum output of 200 kW.

Vehicle weight: 1590 kg.



*Wheel motor MIEV*

2008: Tesla roadster

Sportscar, family of Lotus.

Top speed 200 km/h. Accelerates in 4 seconds from 0 to 100 km/h.

Range 320 km. Weight 1220 kg.

Energy consumption 13kWh/100km

Price 100 000 EUR.

Electromotor:

- 375 Volt AC 4 pole squirrel cage motor, air-cooled.
- Weight 32 kg.
- Power 158 kW @ 6000 rpm, Torque 270 Nm.
- Efficiency: 92% average, 85% at peak power.
- Variable frequency IGBT drive.



Batteries:

- 55kWh, 6831 small Li-ion cells.
- Full charge about 3.5 hours using the Tesla Motors High Power Connector



2010: Koenigsegg Quant



The all-electric sportscar (4 seats) is powered by unspecified battery technology with new fancy acronym, “Flow Accumulator Energy Storage” (FAES), and solar energy supplied via a thin film layer photovoltaic coating over the car. The car charges to full capacity in 20 minutes. The combined solar/FAES offer a claimed range in excess of 500km. There is a four-wheel brake regeneration.

Rear-wheel drive powered by a pair of AC induction motors. Combined output power 512 hp, torque 715 Nm.

Car weight: 1780 kg.

#### Smart ForTwo Electric Drive

