Electric Cars

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Overview

- Historical Introduction
- Concept of Electric Cars
- Batteries, engine and brakes
- CO_2-savings
- Monetary savings
- Infrastructure
- Future development
- Conclusion

Historical introduction

- 1672 first automobile (steam engine, Ferdinand Verbiest)
- 1828 first electric car model, Ányos Jedlik
- Between 1832-1838 first electric carriage, R. Anderson
- 1842 first electric car with a non-rechargeable electric cell, Thomas Davenport and Robert Anderson
- 1885 the first car with four-stroke circle gasoline engine, Karl Benz
- 1891 first electric car that actually worked, A. L. Ryker and W. Morrison

Historical introduction

- 1897 first commercial application
- 1899 first world speed record of 105 km/h

Camille Jenatzy in his car Jamais Contente,
Top speed of 105.88 km/h on April 29, 1899

www.wikipedia.org

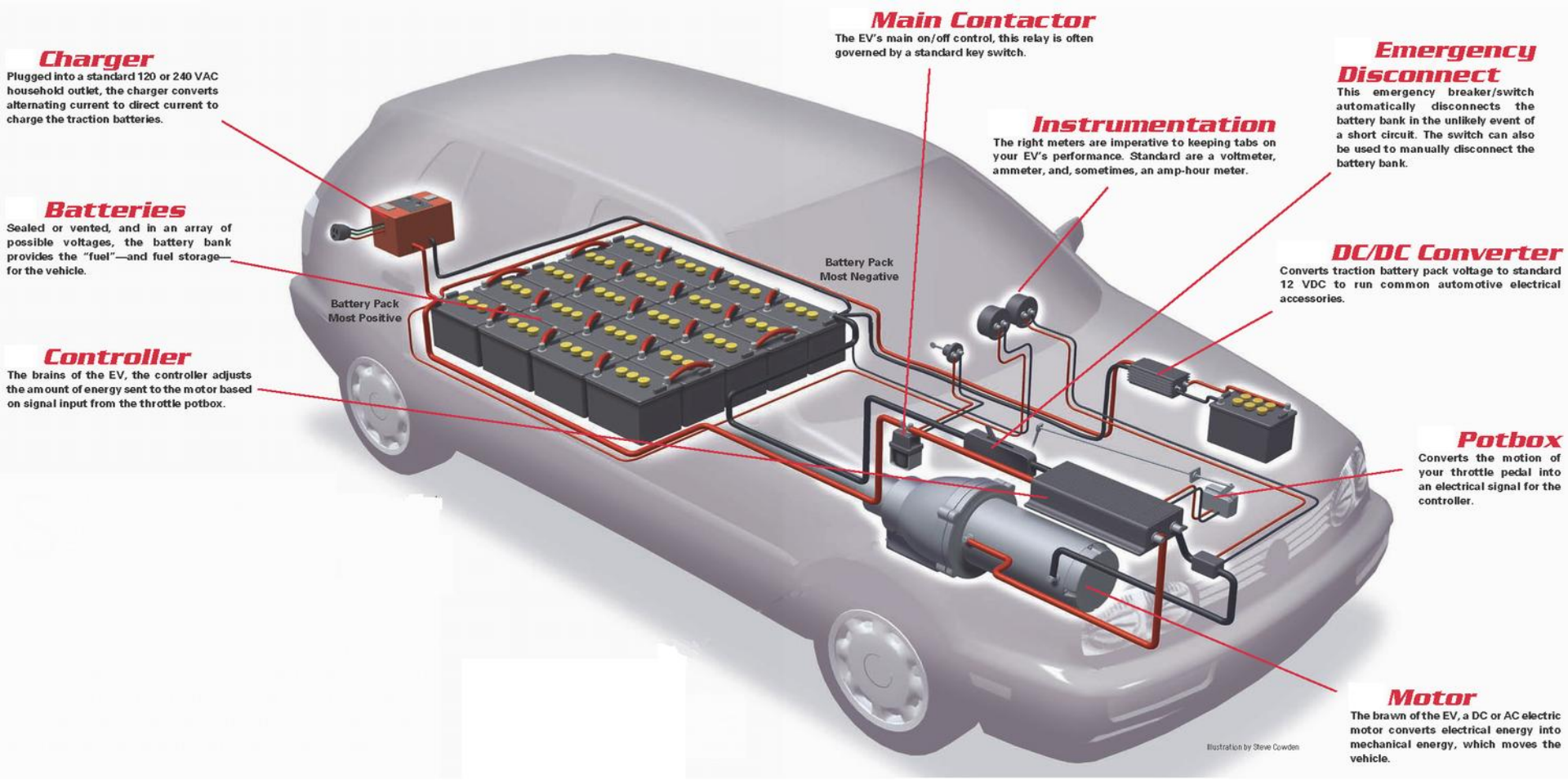
Historical introduction

- 1935 practically disappeared
- The energy crisis in the 1970's and 80's revivals the interest
- In the 90's high interest for the "emissions free vehicles":
  - New technologies in electric car industry
  - The topic of the environment pollution is still relevant

Historical introduction

Eliica vs. Porsche 911 Turbo:

Concept of electric cars



http://www.electronica.mkg

Concept of range extended electric car

www.opel.de

Batteries, engine and brakes

Battery types:

	Cost per Wh	Wh / kg	Wh / liter
Lead-acid	0.13 €	41	100
Nickel-metal	0.72 €	95	300
Lithium-ion	0.35 €	128	230

→ 24 kWh Lithium-ion Battery: 190 kg, 8400 €

Batteries, engine and brakes

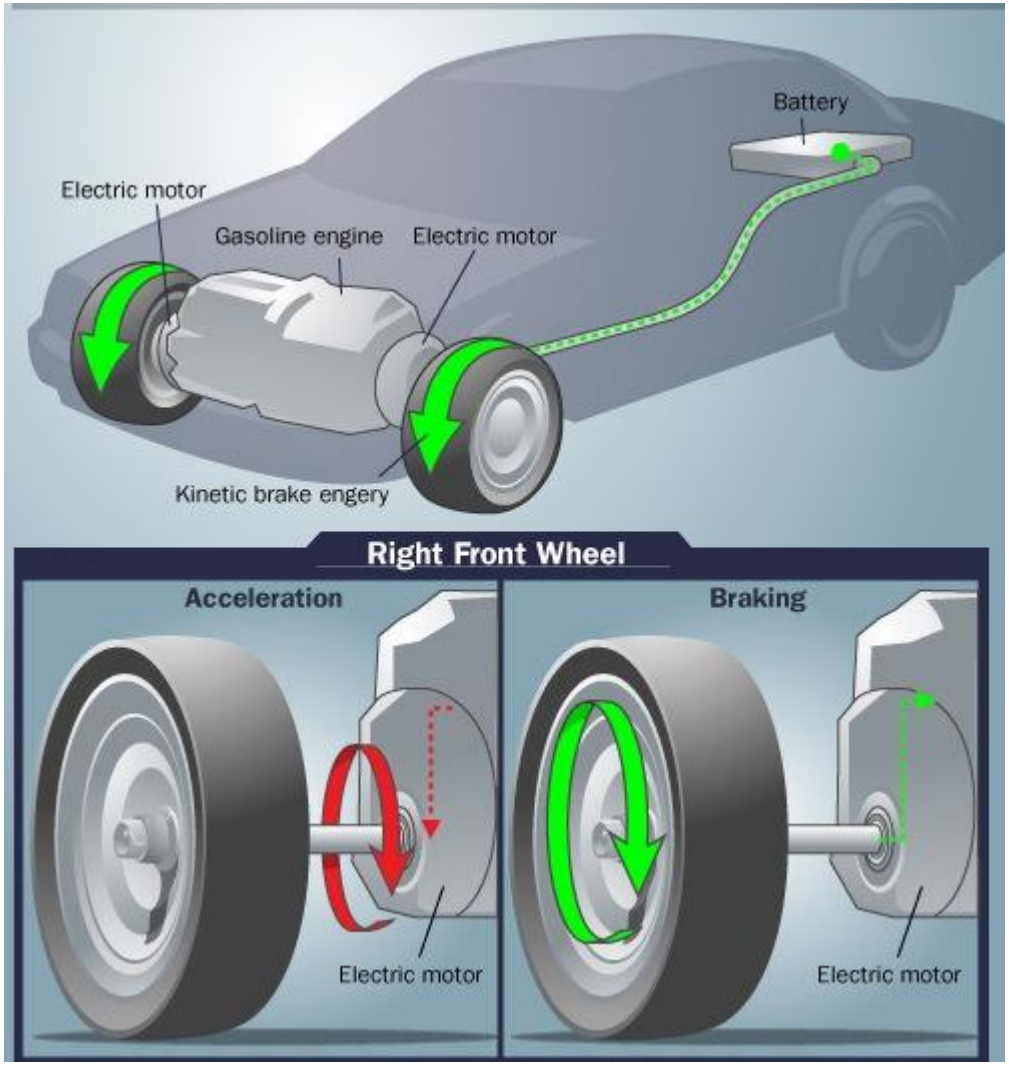
Engine types:

- AC-Induction
- DC-Brushes

Both types can be:

- Wheel-hub-engine
- Direct-drive-engine

Batteries, engine and brakes



Brakes:

- Regenerative brake
- Can extend range up to 30%
- Useful for stop&go

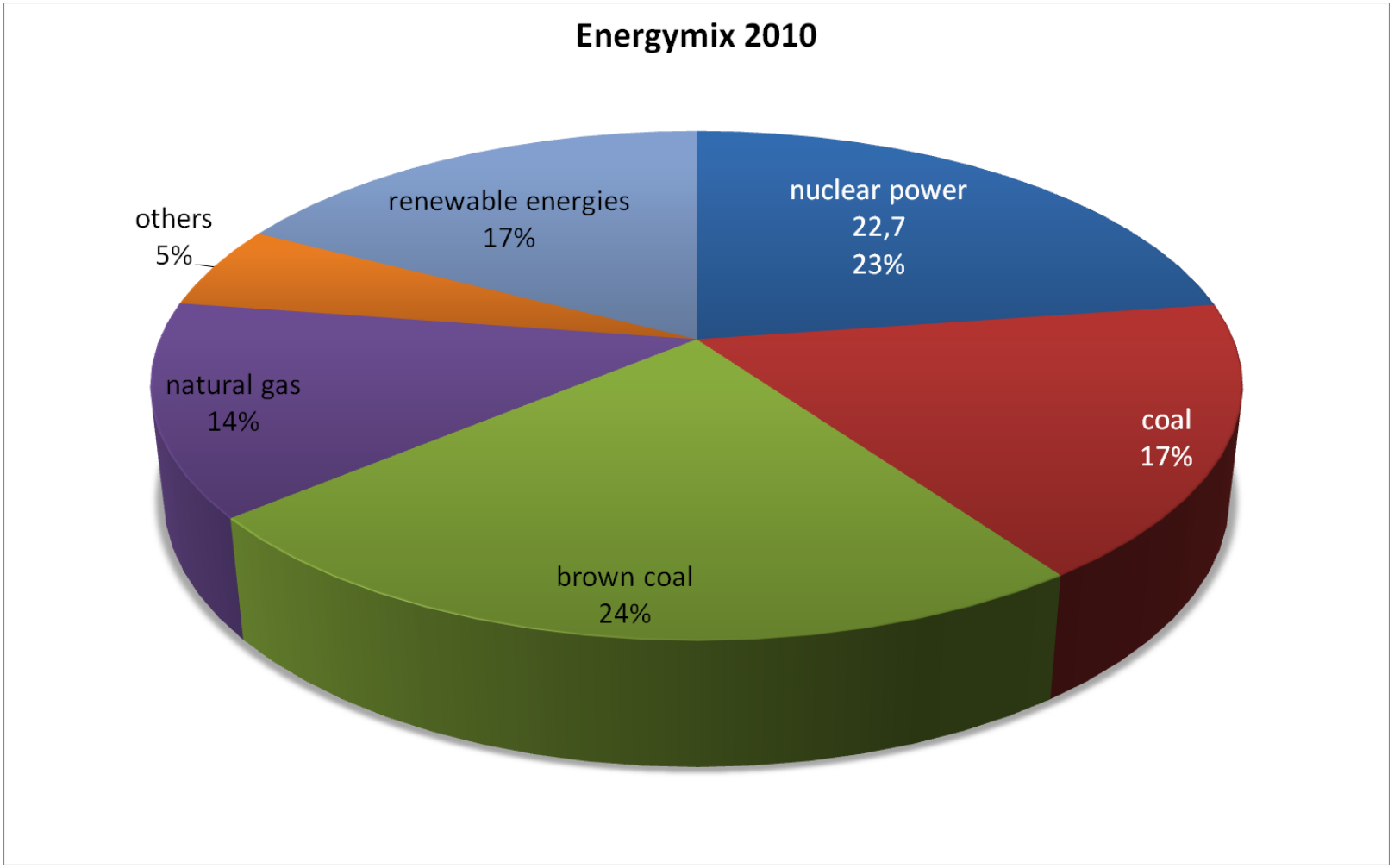
www.electric-car-abc.com

CO_2-savings

- CO_2-emission of fossile-energy powered vehicle: about **160 g/km** (average mid-class car)
- What causes the emission of an electric car?

  →The production of energy used to charge the electric car
- Where does this energy come from?

CO_2-savings



→ 563 g/kWh CO2-Emission

CO_2-savings

How much energy does a electric vehicle need?

Nissan Leaf:

range: 175.5 km

engine power: 80 kW

max. speed: 140 km/h

battery capacity: 24 kWh

charging efficiency: 85%

→ 0.161 kWh/km

→ 90.58 g/km

http://www.car-addicts.com

CO_2-savings

Comparison to other latest electric vehicles:

	Ford Focus Electric	Chevrolet Chevy Volt*	Mitsubishi i-MIEV	Smart ED
release date	2012	2011	2010	2009
engine power	92 kW	111 kW	49 kW	30 kW
max. speed	135 km/h	161 km/h	130 km/h	100 km/h
battery capacity	23 kWh	16 kWh	16 kWh	16.5 kWh
range	160 km	80 km	150 km	135 km
CO_2 / km	95 g/km	132 g/km	71 g/km	81 g/km

Monetary savings

Nissan Leaf vs. Nissan Micra:

	Leaf	**Micra**
engine power	80 kW	72 kW
max. speed	140 km/h	180 km/h
consumption	0.161 kWh/km	0.05 l/km

- Average price of 1 liter fuel: 1.52 €
- Average price of 1 kWh: 0.17 €

costs per 100 km	2.74 €	7.60 €
price	37 000 €	13 000 €

- Batteries need to be exchanged after some time

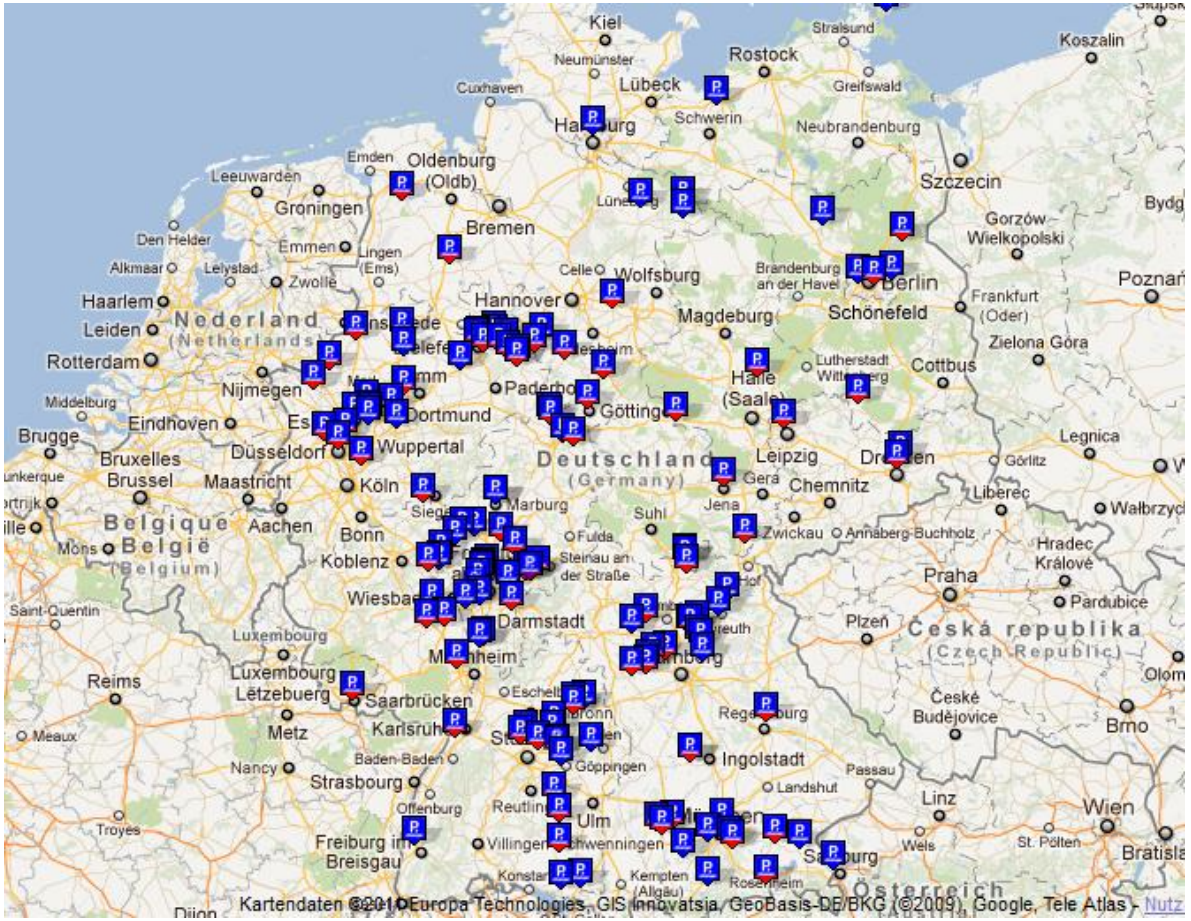
Infrastructure

- Are there enough charging stations?
- Can the existing energy production and energy grid cover the arising demand?
- What can one do if running out of energy on a trip?

Infrastructure

Charging stations:

- All vehicles can be charged at home
- More than 2200 charging stations all over Germany



www.lemnet.org

Infrastructure

- Let us assume a homogenous density of charging stations
- Area of Germany: ~ 360 000 km²

→1 charging station / 167 km²

- Divide Germany in square areas of 167 km² with a charging station at the center

→**13 km from charging station to charging station**

This result is ok with the range of electric cars!

- But there are no more than 6 charging slots per charging station at the moment

Infrastructure

Is the grid ready for electric cars?

- In the smart grid the batteries will play an important role
- Today most power plants throttle energy production at night
- Renewable energies are not reliable

Breakdown service:

- Provided by manufacturer only at the moment
- Breakdown service people need special technical education

Future development

- Solar supported vehicles
- More efficient engines
- Faster charging
- Batteries with higher capacity

Future development

Refillable Batteries:

http://www.greenmotorsblog.de

Conclusion I

- Qualified for the city (short distances)
  - Less loud
  - Does not have any exhaust gas (it still adds to CO2-emissions to the environment)
- Monetary savings
- Less emissions

Conclusion II

- Less loud -> it is dangerous for walkers
- Only for short distances
- Long recharge time
- Not enough electricity
- Better insulation for the electric car (for outdoor temperature)
- High-voltage source
- No breakdown-service
- Expensive: cars as well as batteries and its service

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