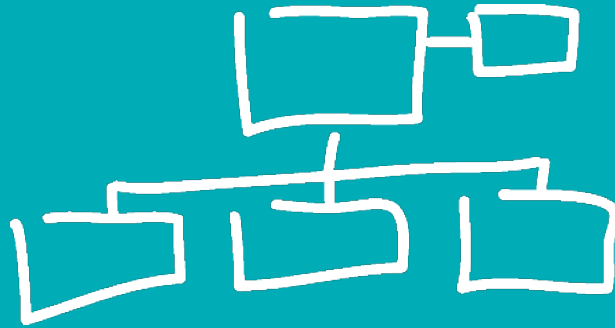




August 2015 / Anthony Froelich

EV Charging infrastructure Intelligent charging solutions

EV Charging Infrastructure product group Organisation



A global leader in power and automation technologies

Leading market positions in main businesses

~150,000
employees



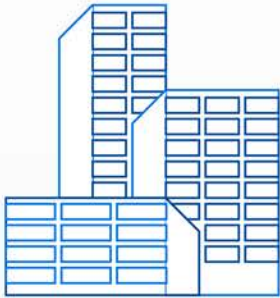
\$42 billion
In revenue
(2013)



Present
in
+100
countries



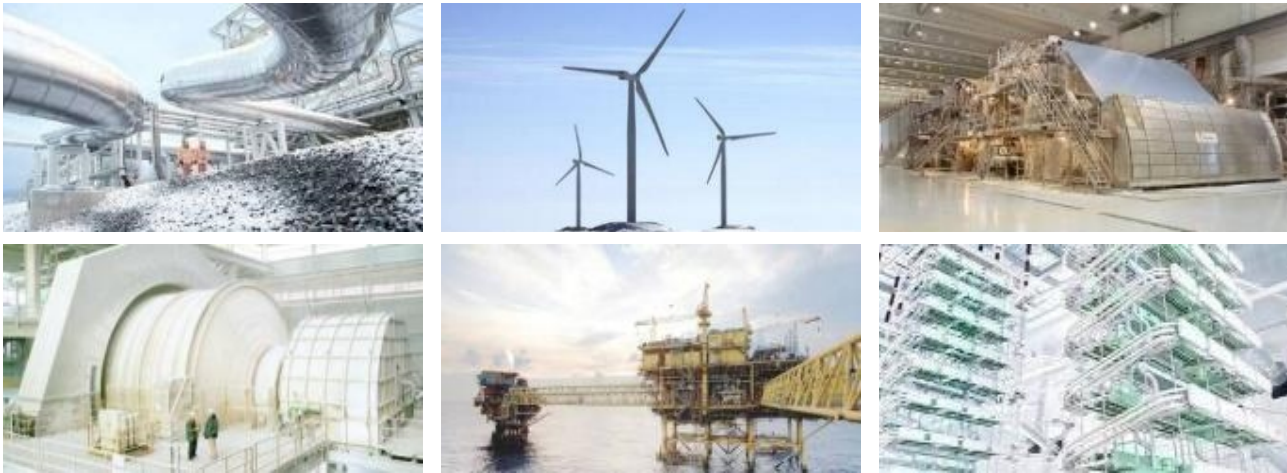
Formed
in
1988



merger of Swiss (BBC, 1891)
and Swedish (ASEA, 1883)
engineering companies

Power and productivity for a better world

ABB's vision



As one of the world's leading engineering companies, we help our customers to use electrical power efficiently, to increase industrial productivity and to lower environmental impact in a sustainable way.

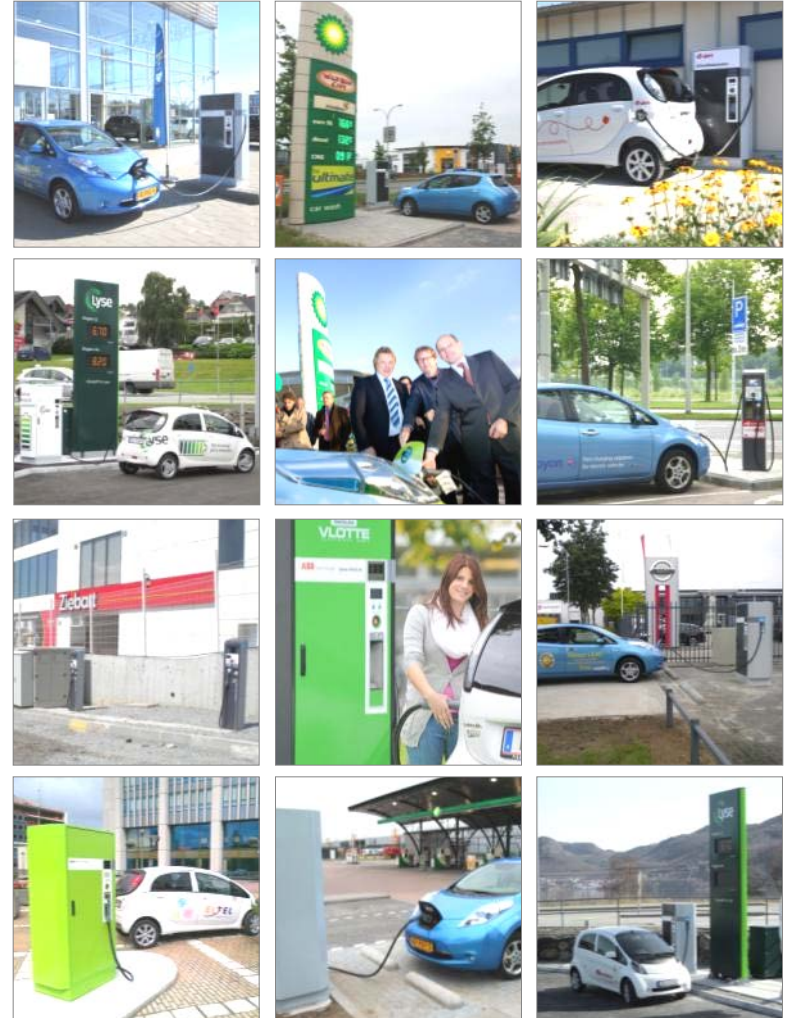
ABB DC fast charge installations

Proven technology in the field since May 2010

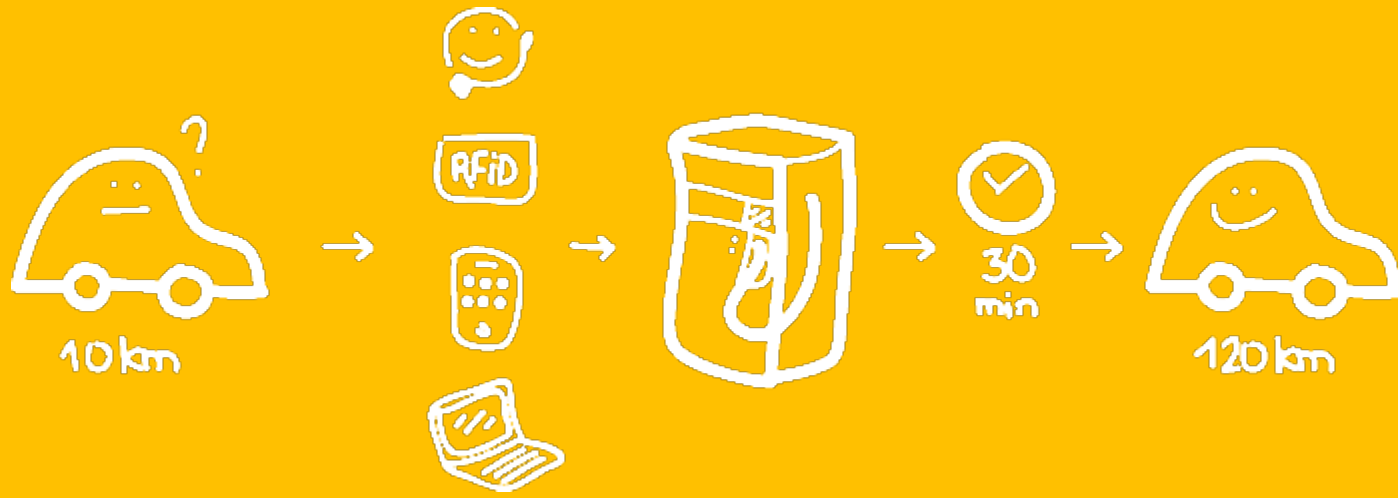
- **Actual:**

Australia, Austria, Belgium, Canada, China, Chile, Colombia, Croatia, Czech, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Ireland, Italy, Japan, Liechtenstein, Lithuania, Malaysia, Mexico, Monaco, The Netherlands, Norway, Poland, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, USA.

- **Total over 2.200 sold.**



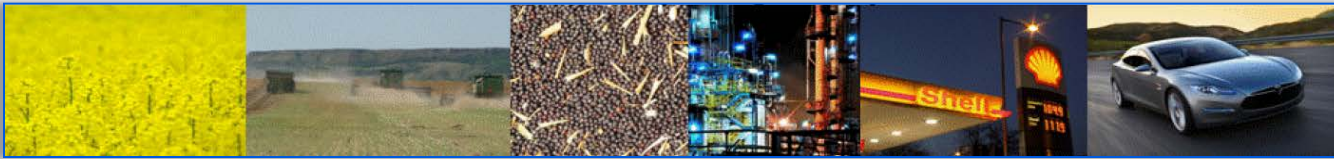
Why is e-Mobility becoming successful now ?



Well-to-wheel efficiency of alternative fuels

Range per year per m² of land

Biofuel: **7km**



Most efficient energy crops (palm oil, sugar cane) deliver **0.5L/m²** including sowing, fertilizing, harvesting, refinement and distribution.

A vehicle drives 15km/L, so 0.5L gives **7km range**.

Hydrogen: **160km**



A solar panel delivers **105 kWh/m²**.

After electrolysis, compression and distribution **63kWh** goes into the tank.

The fuel cell generates **31.5kWh** of electricity. The vehicle drives 5km/kWh, so 31.5kWh gives **160km range**.

Electric: **380km**



A solar panel delivers **105 kWh/m²**.

After distribution, charging and storage in the battery, **77kWh** is available to the motor.

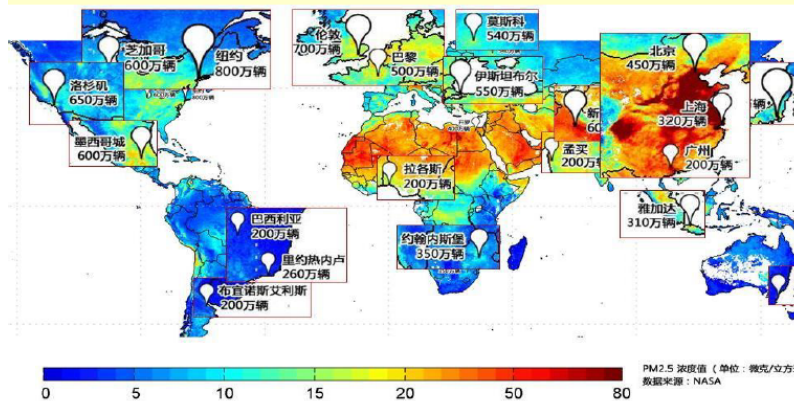
An EV drives 5km/kWh, so 77kWh gives **380km range**.

China has no choice, e-Mobility is Do-or-Die Mega-Cities are turning into smog-centers



国家科技部

Auto Industry & Pollution



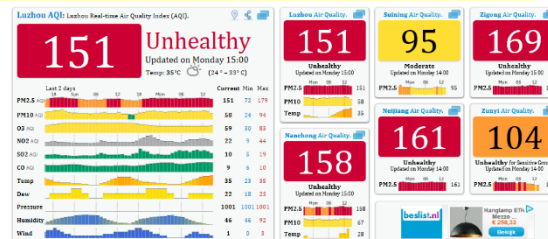
机动车保有量200万辆以上城市PM2.5 浓度值分布图



Growth of cars leads to air pollution and traffic congestion, severe challenge of air pollution in urban areas.

Frequent hazy weather in Beijing-Tianjin-Hebei region over the past few years, and PM2.5 pollution threat grows.

See also the site: <http://aqicn.org/>



Paris / Smog

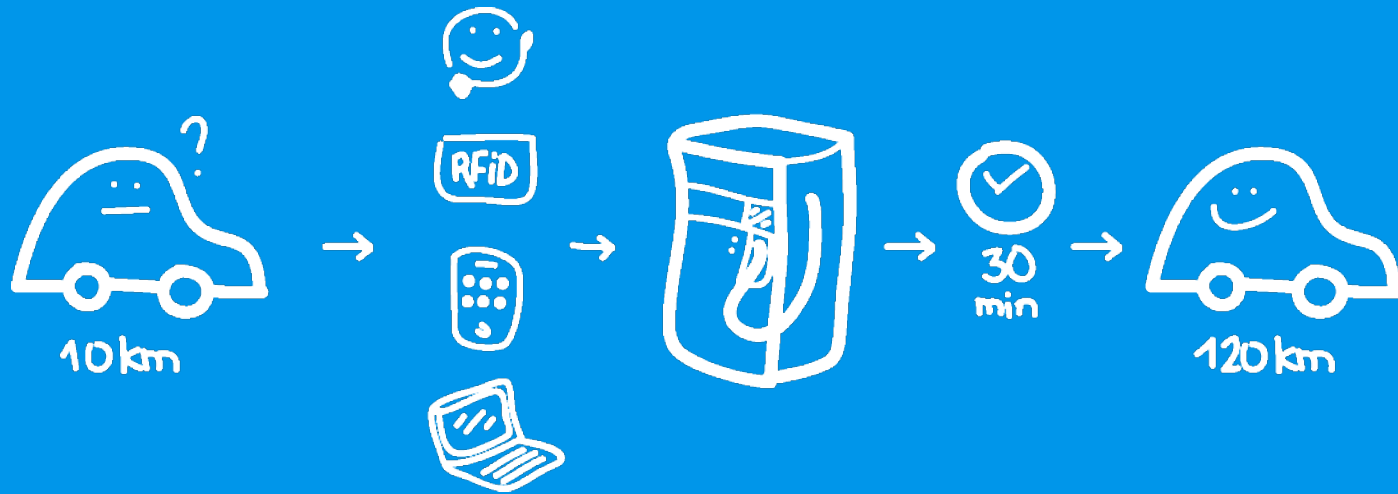
Los Angeles Times – March 17th, 2014

- PARIS -- With the City of Light buried under a thick blanket of smog for a week now, authorities in the French capital took drastic steps Monday to cut the number of cars on the road and to encourage commuters to find more environmentally friendly ways of getting to work.
- Only cars with license plates ending in an odd number were allowed on to Paris streets during the day. Drivers with plates ending in an even number were ordered to leave their vehicles at home and use public transport, which officials have made free of charge since Friday to try to reduce pollution -- at a cost of \$5.6 million a day.
- <http://www.latimes.com/world/worldnow/la-fg-wn-paris-smog-cars-ban-20140317,0,5700535.story#ixzz2waiB1wh8>



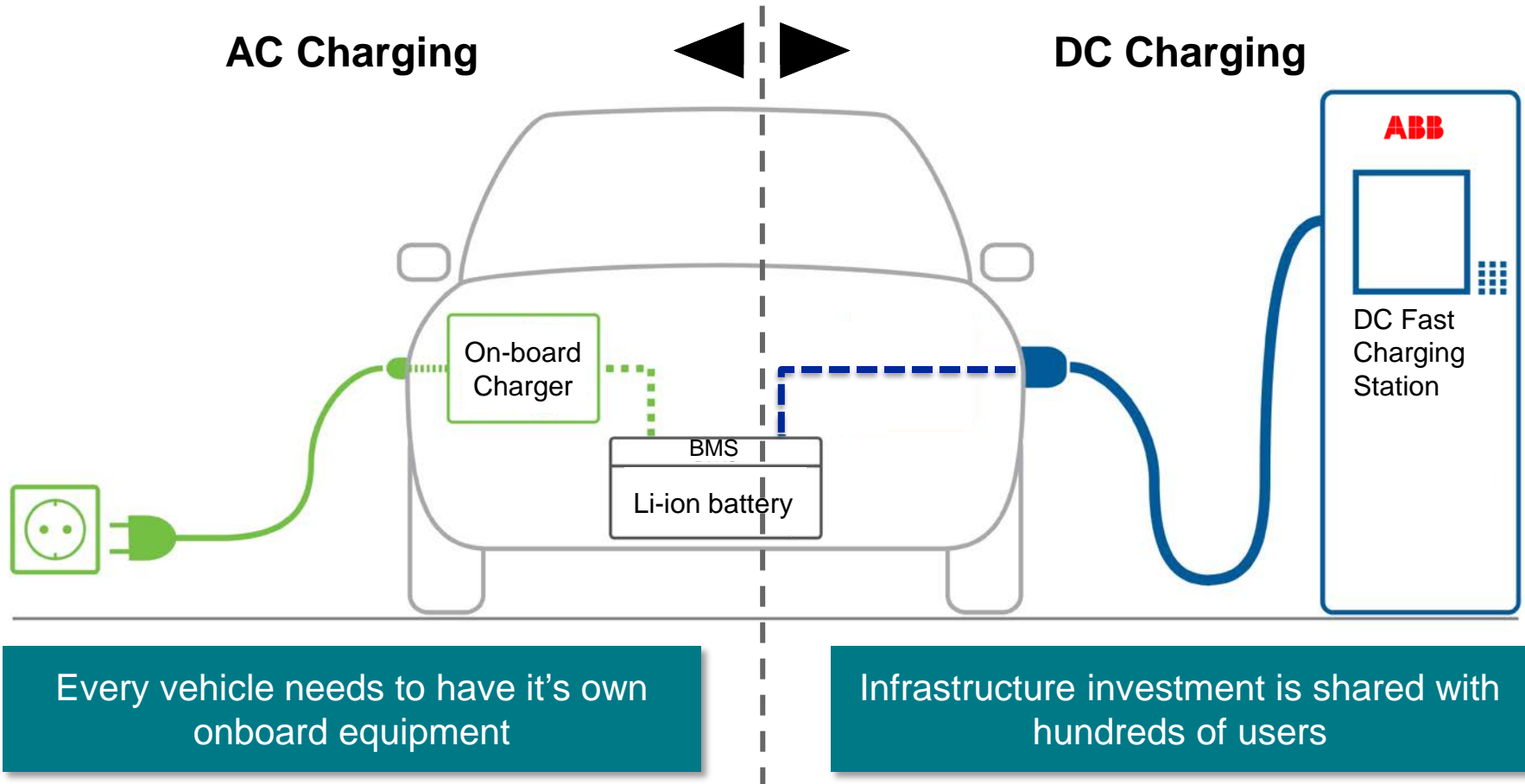
EV Charging Infrastructure product group

Market (cars & standards)



DC charging versus AC charging

On-board versus Off-board equipment



DC charging extends the range

The major part of charging will be Slow Charging



EV Slow Charging

- 16 hours
- 100 km



Slow Charging and
Ultra Fast Charging

- 15 hours
- 300 km



EV Ultra Fast Charging

- 22,5 hours
- 300 km

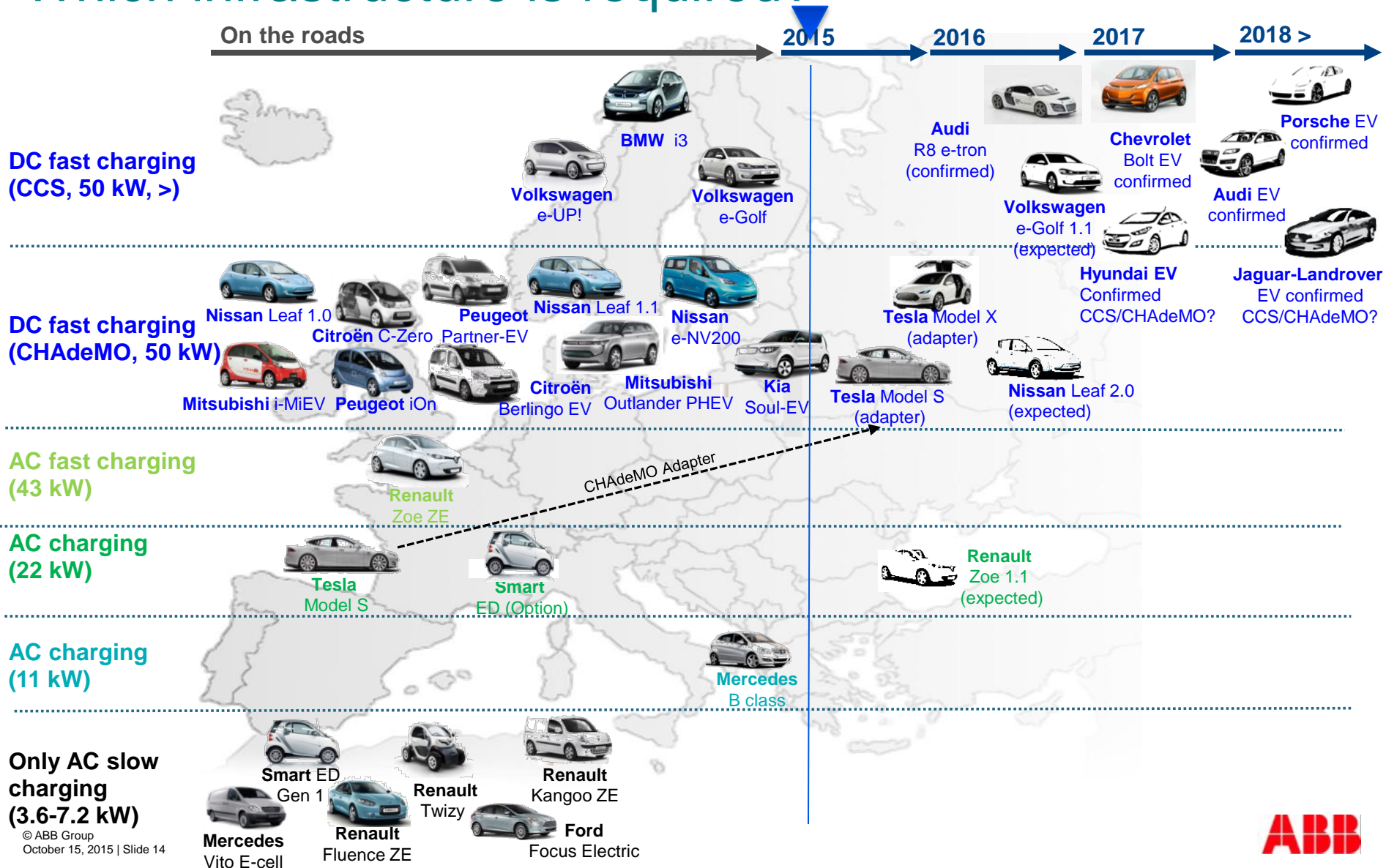
ABB is following the OEM Fast Charging standards

50kW CHAdeMO / 22-43 kW AC / 50kW CCS 2



Follow the car through Europe: Which car, when?

Which infrastructure is required?



Today

Mass market fully electric cars – 1st generation

Driving range: ~120-140 km

Normal charge: 4-8 hours

DC Fast charge: +- 100 km in 20 min

Price range : Nissan ~ \$40k, BMW ~ \$65k



Nissan Leaf



BMW i3



VW e-golf

Why? battery = ~24 kWh

Tesla Model S

The next generation car but available today

Driving range: > 400 km

Normal charge: 4-8 hours

DC Fast charge: > 300 km in 30 min

Price range : \$100k +



Why? battery = 85 kWh

Daimler-BYD cooperation: the Denza car in China

The start of the mass market practical car

Driving range: 300 km

Normal charge: 4-8 hours

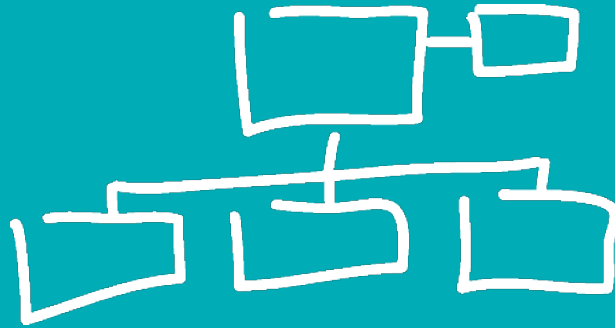
DC Fast charge: > 200 km in 30 min



Why? battery = 48 kWh

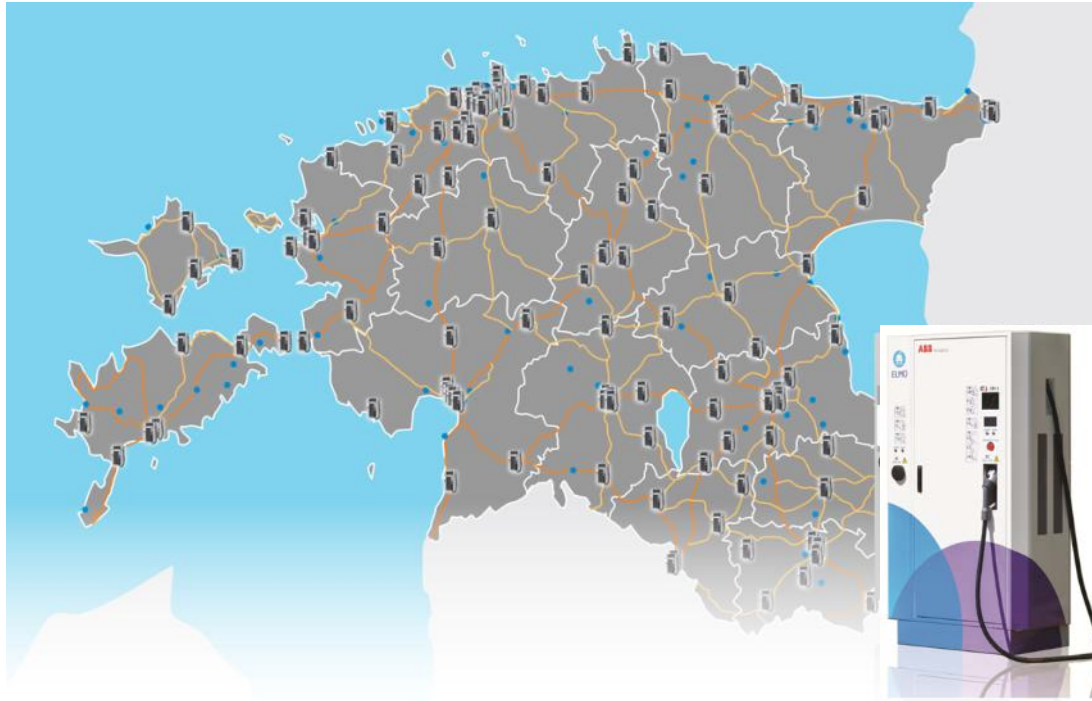
EV Charging Infrastructure product group

Reference stories from Europe



Project Estonia: Country wide network “Elmo”

ABB awarded Europe’s largest EV infrastructure project



200 DC + AC combined fast chargers
507 AC chargers at office locations
Turnkey project & network services

- ABB awarded Europe’s largest ever EV infrastructure deployment
- Nationwide network: every main road in Estonia will have a fast charger approximately every 50 km
- Opened on 20/02/2013

Payment systems

- ✓ Membership model, RFiD
- ✓ SMS payments
- ✓ Smartphone payments
- ✓ Automated acces via phone
- ✓ E-wallet payments

Project Estonia: country wide network

Operating in extreme conditions / Official opening on 20/02/2013

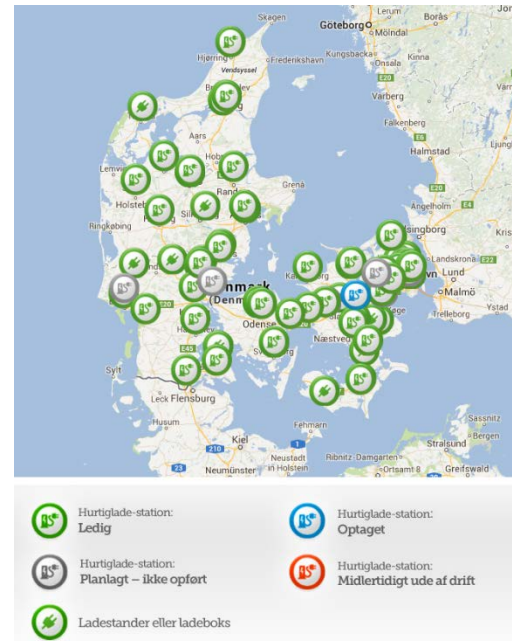


CLEVER rolls out >100 connected fast chargers

Country wide network throughout Denmark



- Clever rolled out a network of 50 Terra 51 DC fast chargers in just 3 months time
- New agreement by end 2013 with >50 CCS fast chargers, so in total > 100 DC Fast Chargers



Fastned: Nationwide fast charging network

201 fast charging stations in the Netherlands

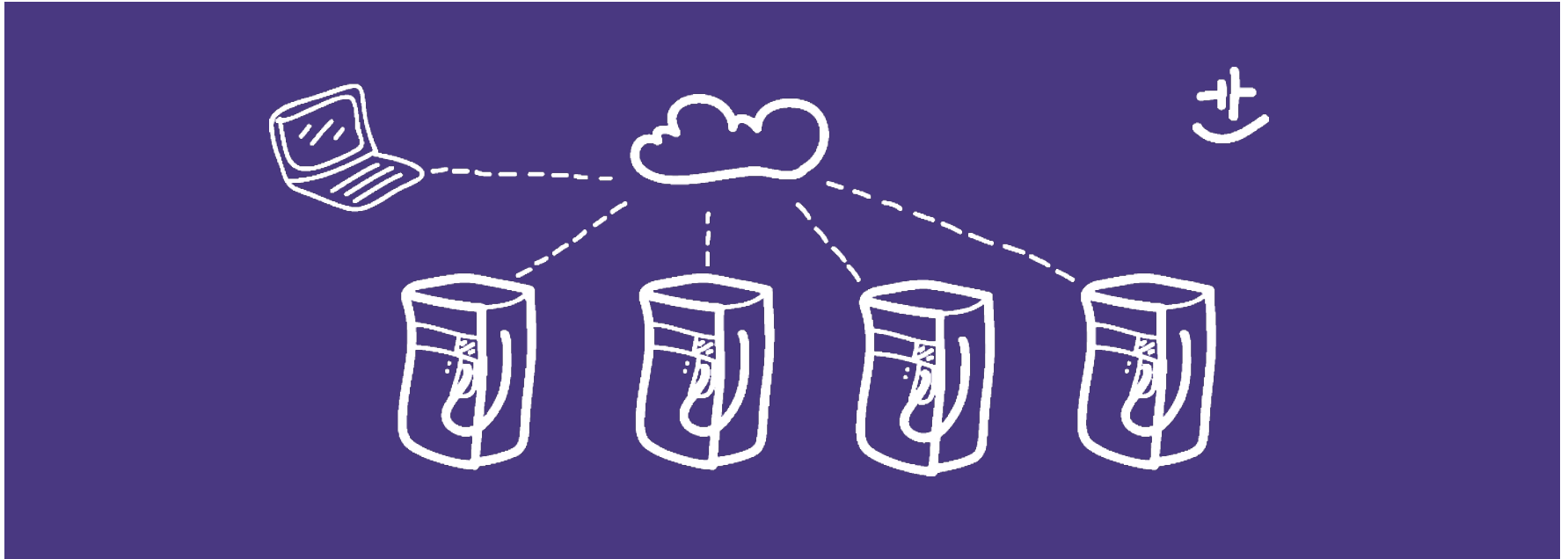


- Always a charger within 50km.
- Each station equipped with 2-4 multi-standard fast chargers and solar canopies.
- Serving EVs from all major car brands, including CCS, CHAdeMO and Type-2 standards.
- Independent company with government support.



EV Charging Infrastructure product group

Business model / locations



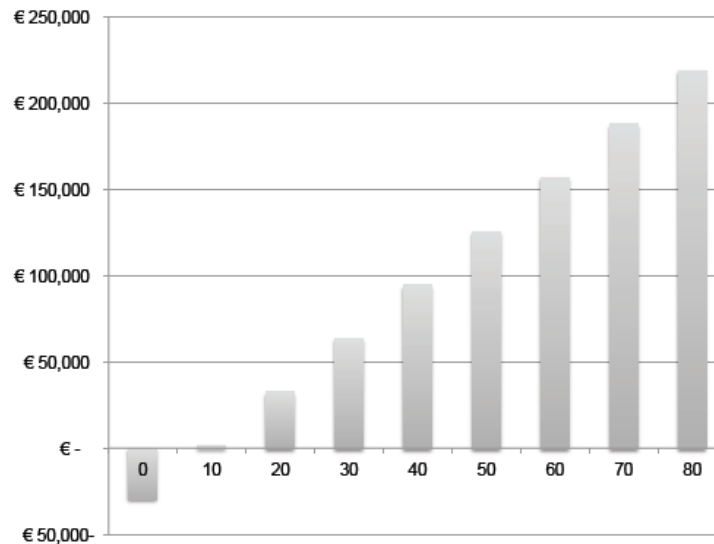
Return on investment

Plan behind the FastNed model

Assumptions

- Every EV driver will use a fast charger 1 time / week
- EV drivers will accept the average price €10 (~\$16 AUD) / session
- Average cost €1.5 (~\$2.30 AUD)/ session

At 10 charge sessions per day per station profit is > € 30k/year for every station which means break-even



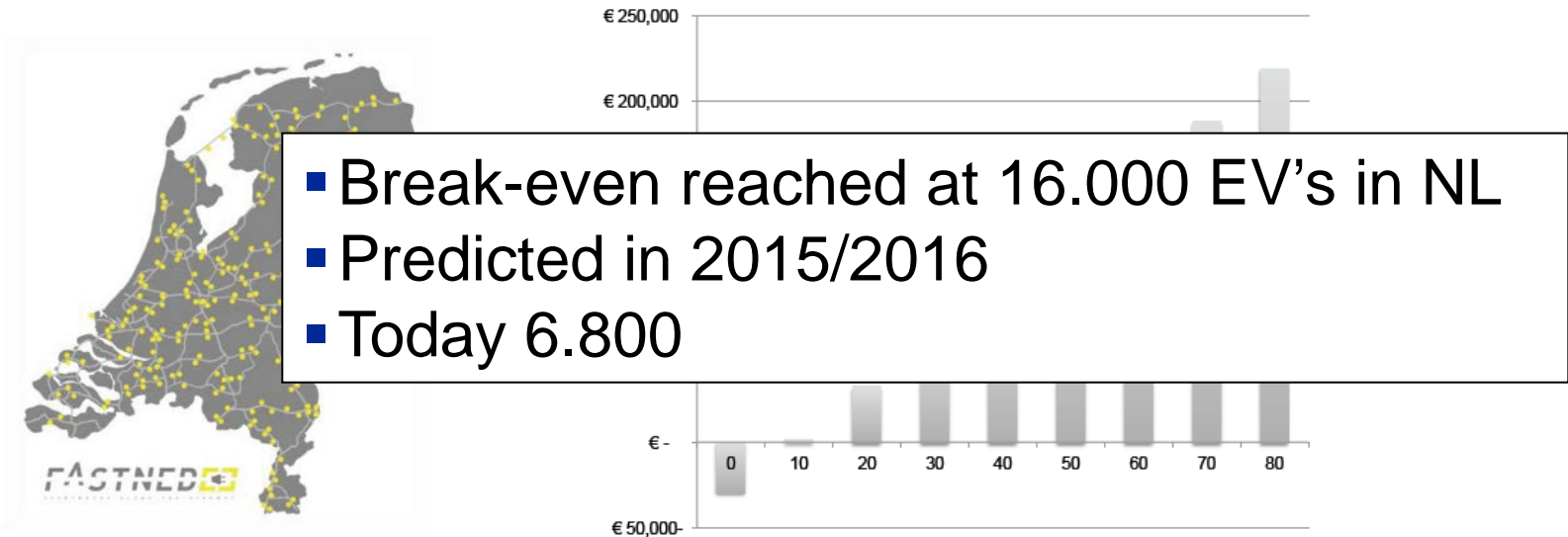
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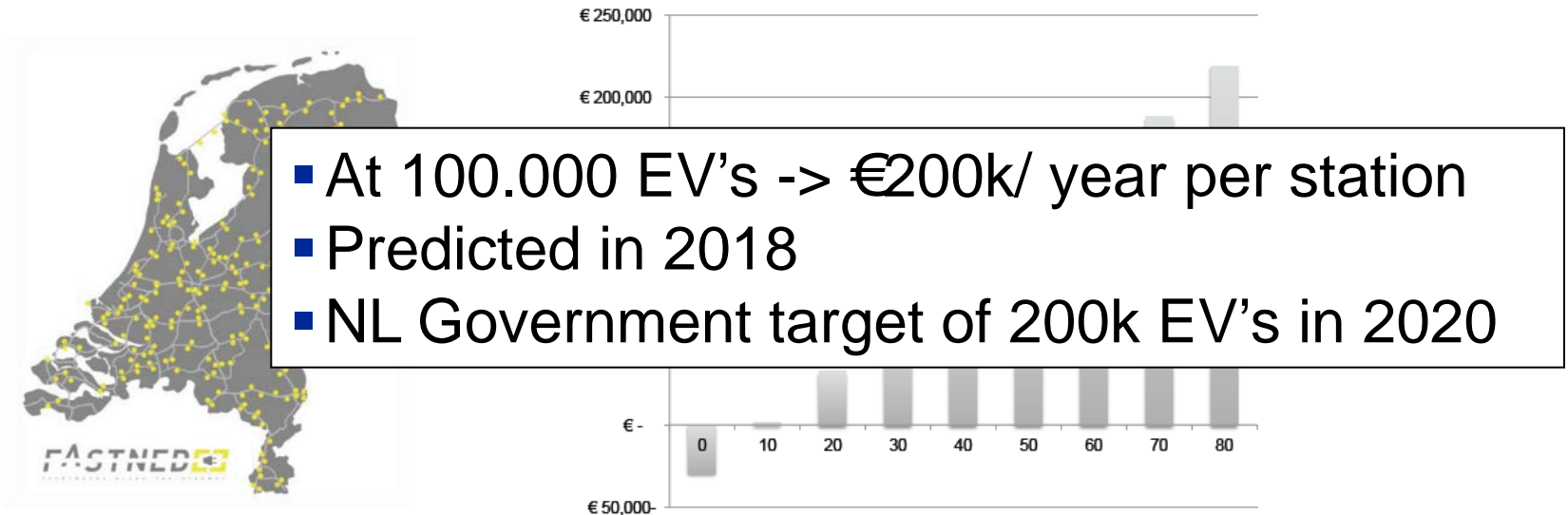
Return on investment

Plan behind the FastNed model

Assumptions

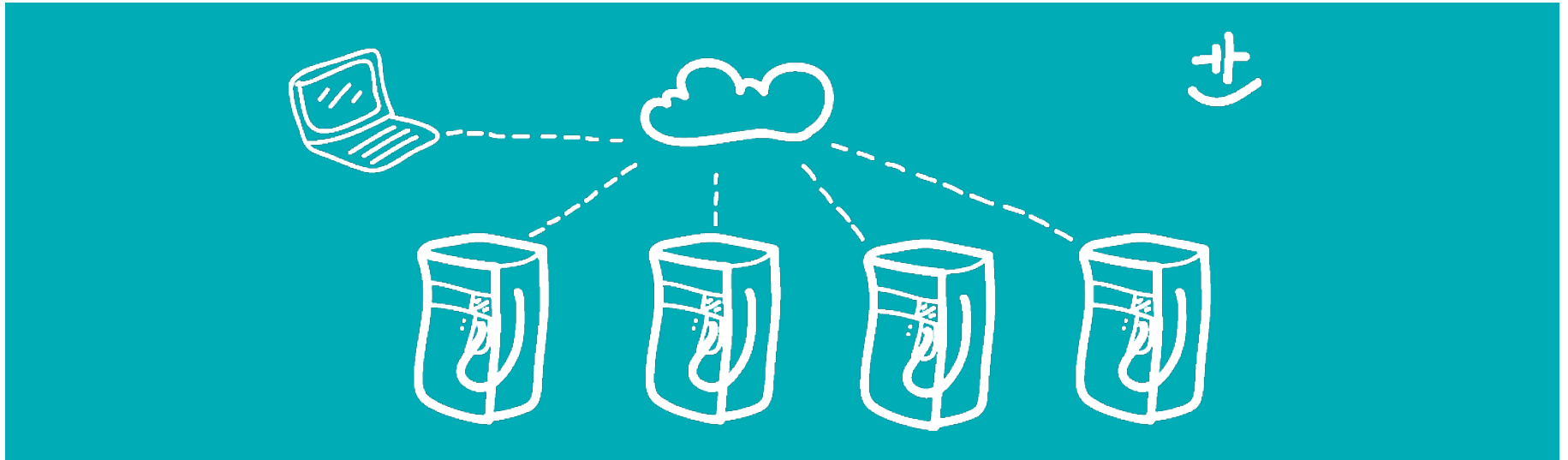
- Every EV driver will use a fast charger 1 time / week
- EV drivers will accept the average price €10 / session
- Average cost €1.5 / session

At 80 charge sessions per day profit is > € 200k/year/station



Electric Vehicle Charging

Where to?



BEV's in 3 years cheaper than combustion cars ?

Volkswagen prediction from 2014

- Electric cars will be cheaper than combustion cars within three years . This reports the German car company Volkswagen. The rapidly falling price of batteries according to the company is the main reason.
- "We expect that the cost per kilowatt of capacity of lithium-ion batteries will soon drop to a size of approximately 100 Euro (\$150 AUD). This limit will be reached in 2015 or at the latest shortly afterwards “ said Rudolf Krebs, chief of the department in Volkswagen which produces electric cars.
- The price of €100 (\$150 AUD) per kilowatt applies as the limit where electric cars become cheaper than their petrol or diesel counterpart, taking into account acquisition and use.
- At present, the price of a battery pack is at 500 Euro (\$760 AUD) per kilowatt hour. For a battery pack of 26.5 kilowatt hours, as the Volkswagen Golf Blue e-motion ,you will pay about € 13.250. At € 100 per kilowatt the price for the same package drops to € 2,650.
- The prediction of Mr. Krebs is more optimistic than previous estimates of the automotive industry. According to other groups it takes at least five years longer before the battery limit of € 100 per kilowatt will be achieved.
- Source: Produktion.de (via ZERauto en petrochem.nl)

Power and productivity
for a better world™

