FABRIC

Feasibility analysis and development of on-road charging solutions for future electric vehicles

E-Corridors Demand and Assumptions

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Technology to Market

Work Structure

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1 Complexity of the e-corridors demand calculation

The estimations on the **future e-corridors demand is not simple**, as many factors could change in the next years, affecting the final deployment process. The Consortium´s approach is based on a number of assumptions to be validated.

E-corridors demand is absolutely linked to the EV deployment. Without a sufficient "critical" mass of EVs on the roads, no e-corridor will be sustainable as the investment costs are relatively high.

Not all BEVs and PHEVs (from here onwards EVs) will be equipped for wireless or conductive dynamic charging. Thus, an **estimation on how many of these vehicles will be suited for this technology is another input parameter.**

Finally, there are many potential deployment scenarios, but from them we must determine the **most likely scenario as first entry points** and identify the speed of introduction in determined market niches.

2 Demand calculation. Affecting factors

POLITICAL DECISIONS

- Political support , incentives
- Regulation, Environmental and energy targets
- EVs Charging Infrastructure deployment (super chargers, statics)
- Employment Generation and industrial growth

BUSINESS OPPORTUNITY .

- Private companies investment
- Business opportunity, Project Finance
- Political support, incentives in early stages

END USERS .

- End users environmental awareness
- End users cost benefit analysis
- Environmental impact e-corridors LCA
- Employment Generation and industrial growth

Roadmap EVs (light and HDV) deployment (Demand)

GREENING MOTORWAYS
INCREASE SALES EVs

CRITICAL MASS EVs

Roadmap for E-corridors deployment (Demand e-corridors)

COSTS

- Cost of EVs and components
- Oil price
- Electricity price
- Cost of batteries

INNOVATION

- Technical advances
- Battery autonomy range
- Evolution of competing technologies, gasoline, car sharing…
- Evolution of competing technologies, supercharger, swap, range extender
- Full introduction of static charging and autonomous driving
- Cost of e-corridor, LCC

3 Demand calculation. First entry points e-corridors

10 scenarios were described in deliverable 5.2.1.

Nr	Name
1	Metropolitan deployment for heavy freight vehicles
2	Metropolitan deployment for busses
3	Metropolitan deployment for general light vehicles
4	Metropolitan deployment for service vehicles / taxi's
5	International freight corridors
6	Long-haul national freight corridors
7	Short-haul freight corridors
8	National deployment for general light vehicles
9	International deployment for general light vehicles
10	International deployment for all vehicles classes

Dynamic charging of light vehicles inside the city was discarded as **charging of light vehicles will be mainly at home or at the office (probably static).**

From them and after a PESTEL analysis, it was concluded that most promising scenarios are:

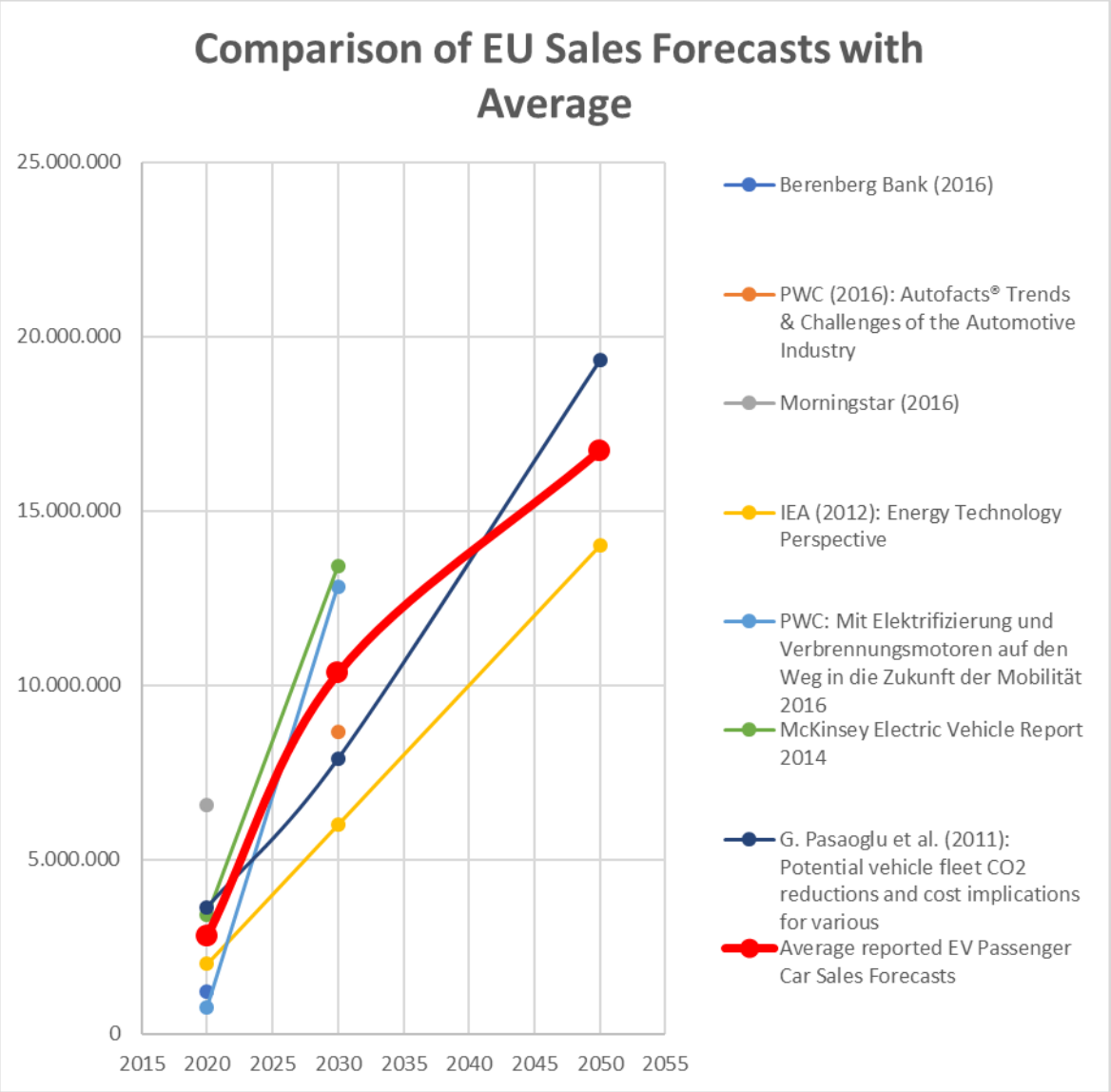
In HDV and buses:

- Urban buses (2030)
- HDV or medium trucks short distance from surroundings to city centers. (2040)
- Interurban buses (short distances, between 200-300 km). (2040)

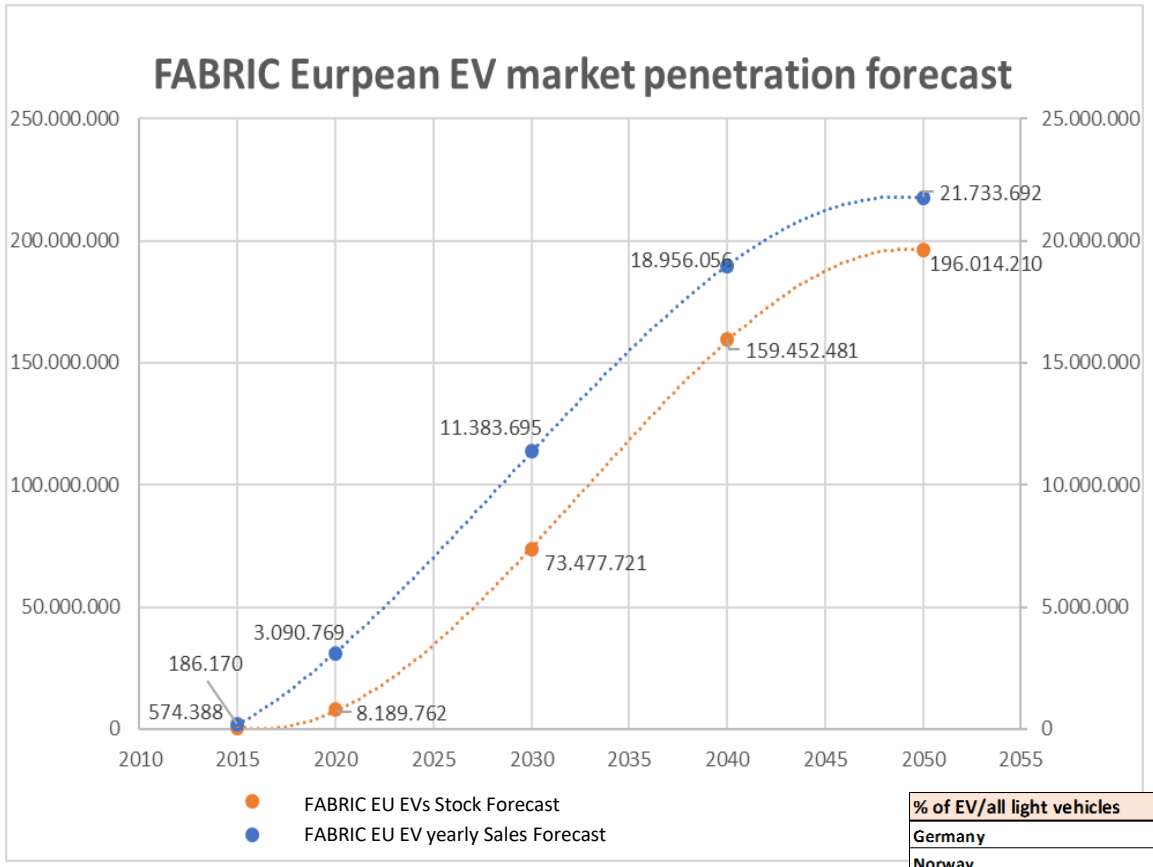
For light vehicles (including duty)

- Distances 20% above the autonomy of batteries in 2050 (400-600 km on average as battery autonomy through motorways)

4 Revision of existing Roadmaps for EVs deployment



FABRIC EVs roadmap estimation for EU



We consider a most optimistic scenario than previous forecasts, due to added factors and recent events

EVs penetration will be:

- Disruptive (fast)
- Access to motorways will need specific conditions

% of EV/all light vehicles	2015	2030	2040	2050
Germany	0,11%	13,95%	58,78%	86,33%
Norway	2,83%	64,00%	81,60%	96,00%
United Kingdom	0,17%	55,61%	63,99%	82,23%
France	0,17%	39,55%	80,06%	92,39%
Netherlands	1,09%	14,56%	29,79%	55,55%
Europe (23)	0,13%	27,84%	60,41%	74,27%
Europe (23) (% WPT-EV)		60,00%	75,00%	100,00%

E-corridors Demand estimation procedure

EVs Demand calc.

E-corridors Calc.

	STRATEGY TO CALCULATE E-CORRIDORS FORECAST
1	Analysis of historic EV sales & stock data in Europe and rest of the world
2	Benchmark external roadmaps for EVs (BEV + PHEV) penetration till 2050
3	Identification of major key factors affecting the EV sales
4	Identification of new key factors unknown in previous reports
6	Forecast EV stocks from literature (EV + PHEV) till 2050 (deregistration after 10 years)
7	Identification of more active EU countries in promoting EV cars
8	FABRIC EV deployment Scenario
9	Definition of business models; Light EV in trips among cities and HV in trips short distance
10	Location of widest and congested motorways between cities at distance 400-600 km
11	Location of widest and congested motorways in neighbourhood traffic at distance 200-300 km
12	Revision of TEN-T plans to enlarge some congested motorways adding a green corridor
13	Matching active countries supporting EV and widest congested motorways for 2 business models
14	The effects of the e-corridors in the EV market
14	Other aspects affecting the demand.

Business Case Strategy. Range extender or battery reduction

1. Keep the battery size and use the e-corridors as a range extender increasing the overall autonomy (20%). Ideal power transfer 50 kW.

Used for light EVs

2. Reduce the battery size and use the e-corridor to keep the same autonomy with less battery volume.

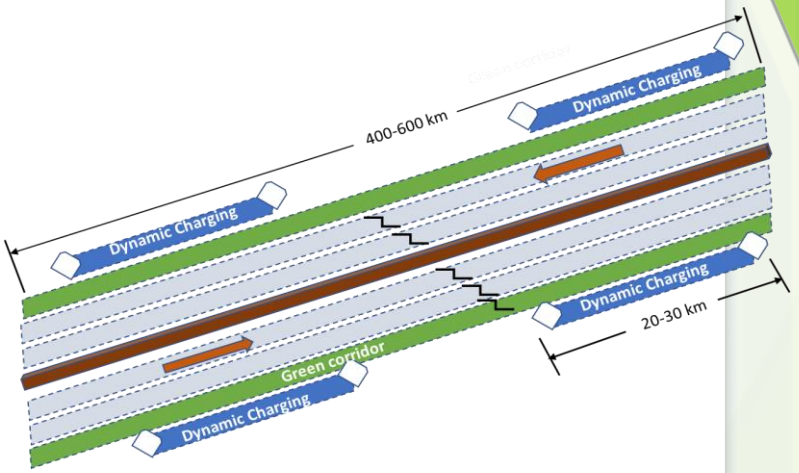
Used for e-bus and e-truck

Business Case Strategy. Greening the motorways

1. **Motorways.** Dedicate a specific lane (green corridor) for electric-vehicles in the most crowded motorways (gaining travel time) to run distances between 400-600 km with a extender range of 20%, using the TEN-T infrastructure (larger motorways with 3 to 4 lanes per direction)

2. **Urban**. Urban buses. Use the bus lanes or the trolley lanes with static charging and then dynamic if the number of e-buses is high and need more charging capabilities

3. **Periurban áreas**. Dynamic charging in areas with high HDVs density (from logistic centres to city or among close cities (intercity buses). Yearly contract between Duty Service companies and infrastructure owner.



E-corridors calculation in EU motorways

AADT EVs IN MOTORWAYS IN 5 SELECTED COUNTRIES	FABRIC Forecast Stock light EVs No. EVs in busiest roads (>12.000 cars/lane)			FABRIC Forecast Stock light EVs No. EVs in busiest roads with WPT		
Year	2030	2040	2050	2030	2040	2050
European Union (20 countries+France)				60%	75%	100%
Germany	1.674	7.054	10.360	1.004	5.291	10.360
Norway	7.680	9.792	11.520	4.608	7.344	11.520
United Kingdown	6.674	7.679	9.868	4.004	5.759	9.868
France	4.746	9.608	11.087	2.848	7.206	11.087
Netherlands	1.747	3.575	6.666	1.048	2.681	6.666
AVERAGE (FIVE KEY COUNTRIES)	3.341	7.250	8.912	1.336	5.437	8.912

FORECAST 5 KEY COUNTRIES Year	AADT/lane (in km) [1] > 12.000 veh	Maximum e-corridors /500 km	2030-40	2040-50	2050-60
European Union (20 countries+France)	**12.727**	**32**	**10**	**10**	**12**
Germany	3.159	6	2	2	2
Norway	89	2	0	0	2
United Kingdown	2.408	6	2	2	2
France	3.582	8	2	2	4
Netherlands	1.323	4	2	2	0
TOTAL (FIVE KEY COUNTRIES)	**10.561**	**26**	**8**	**8**	**10**
REST OF COUNTRIES	**2.166**	**6**	**2**	**2**	**2**

[1] In the case of France with no data, an estimation of the ADDT/lane has been done

[2] In the case of Norway, the length of the motorways network is reduced but one road has been identified within TEN-T

[3] Some slight adjutaments have been done to provide an even number of e-corridors

[4] The e-corridors are not acummulative

From the most active countries promoting electromobility and the TEN-T infrastructures, we extract EU motorways with more than four lanes with traffic congestion (AADT/lane over 12.000 cars) and we convert the third lane in green

E-corridors calculation in Urban areas

A draft calculation has been done for buses and e-trucks in urban and periurban areas according to the number of citizens, buses lines, logistic centres and the existence of trolleybuses

Europe SCENARIO CITY BUSES / INTERCITY BUSES / DUTY HEAVY TRAFFIC	Cities > 500K inhabitants	Nº of e-corridors	2030-40	2040-50	2050-60
Nº of e-corridors	100	600	120	180	300
% Penetration e-corridors			20%	30%	50%

Discussion on assumptions

Technology inside Evs	Technology on e-Roads	Competing Technologies	Costs	Business Scenarios
Average battery range for light electric vehicles	Same lane than conventional vehicles or dedicated e-corridor?	Competing products like superchargers	Battery price will decrease dramatically	E-roads on motorways, or inside or around cities? (different for each scenario)
Average battery range for HDV and intercity busses	Full Introduction of wireless static charging in the markets (in % of other with other solutions)	Autonomous driving needed when charging on the e-corridor?	Cost e-corridor /km: around	How many EVs will be in roads (table 41 Demand report)
	Dynamic Power Transfer for light vehicles: 20, 50, 100 kW (Polito/Qualcomm)	Will conductive dynamic charging be considered in the business model and if so to what extent. Specifically, for the HDV/Bus Scenario.	How will the oil price develop?	How many EVs will be ready for dynamic wireless charging
	Dynamic Power Transfer for heavy vehicles?		Average depreciation period for the e-corridor.	
	Average distance between consecutive Vehicles		How will the electricity price develop?	
	Length of e-corridor		Over cost of transforming a static wireless charging module mounted on a EV to a dynamic wireless charging device.	
	How much range extension should the e-corridors provide?			
	Average speed within the e-corridor			

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Thank you!

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