FABRIC

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

FABRIC first results and overview

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IV european electric vehicle congress

1. FABRIC overview

Objective: To validate the dynamic charging technology (e-charging in motion) for EVs (light and heavy) and infer possible large-scale deployment scenarios. This validation includes technology development, tests and full evaluation (technical, economic, environmental, safety, regulation…). .

Project duration: From January 2014 to December 2017 with a possible extension of 6 months. .

Project partners: ICCS General Coordinator (Greece) .

Test Sites:.

- **VeDeCom test site** in Versailles, France (LVs)
- **Fiat test site in Susa** Valley, near Turin (LVs)
- **Volvo GTT ATR/cars test site** in Hällered, Sweden
- **Victoria Project, test site** in Malaga for buses.

Budget: 9 Million €
Nº. 25 partners
Countries: 9
Associated projects: Victoria, ecoFEV, Unplugged
Automakers: Renault, Peugeot, Citroen, Fiat, Volvo, Scania

FABRIC technical objectives – charging prototypes

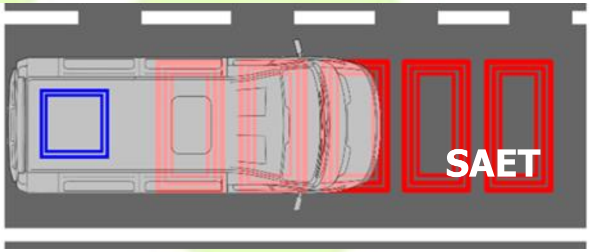
Objective: Develop three different **dynamic** charging prototype solutions to assess their efficiency and compare with existing solutions from other EU projects.

Status: Design complete, **development;** test phase

- **Vedecom/Qualcomm** solution: 85kHz, 20kW
- **Polito solution**: 20-200kHz , 20kW
- **Saet** solution: 80-100kHz, 50kW

Air gaps ~20cm

Expected delivery:
Test sites making full testing



FABRIC technical objectives – testing

1. FABRIC overview

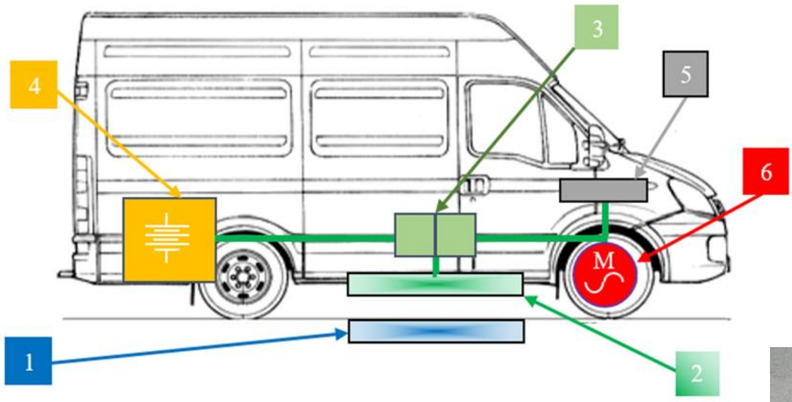
French test site:

- VeDeCoM has implemented Qualcomm IPT systems on the Satori, Versailles test track with electric vehicles provided by French car makers
- 100 meters charging lane
- VeDeCoM incorporates contributions from its members (Renault, Peugeot, Citroën, etc.)

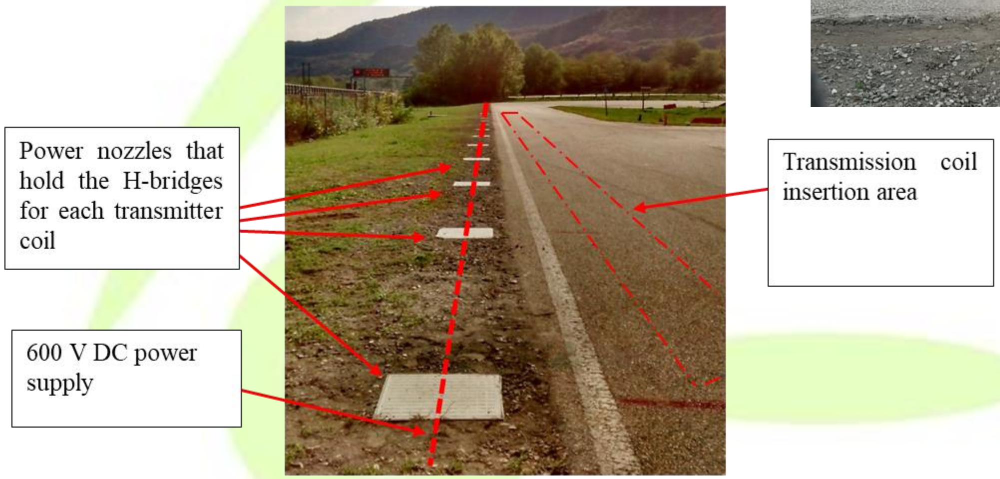
Italian test site:

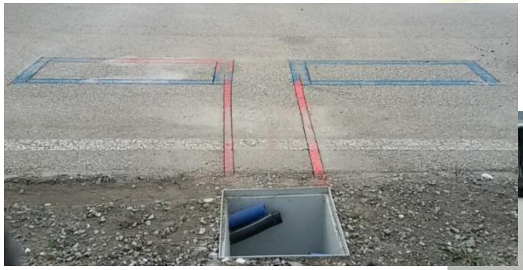
- Motor track, 700 meters long, located in Susa Municipalities
- Two paved lanes about 200m long equipped with embedded induction loops
- Can simulate toll collection system
- Smart grid interface including commercial and industrial (C&I) electricity meter
- The POLITO and SAET inductive charging solutions will be tested

FABRIC technical objectives – layout



(1) Transmitter system
(2) Receiver system + Rectifier (2)
(3) DC/DC converter
(4) Battery pack
(5) Auxilliary systems
(6) Electric Motor





FABRIC– also conductive solution is under analysis.

Volvo Testing site

- Volvo GTT ATR/cars test site in Hällered
- Test track for conductive electrical road tests (DC 750V)
- Test track is 435m long, electrified part of the track is 275m.
- Technology evaluation results
- Demo of the track and system
- EM emissions measurements
- Conductive charging technology benchmarking

E-road in Volvo testing site

Volvo truck with pantograph

FABRIC technical objectives – grid infrastructure

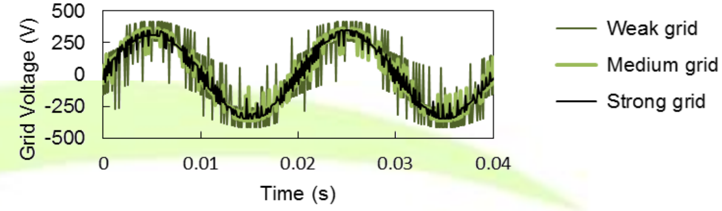
1. FABRIC overview

Objective: Perform impact studies on the grid, adapt test sites‘ micro-grid to support the tests

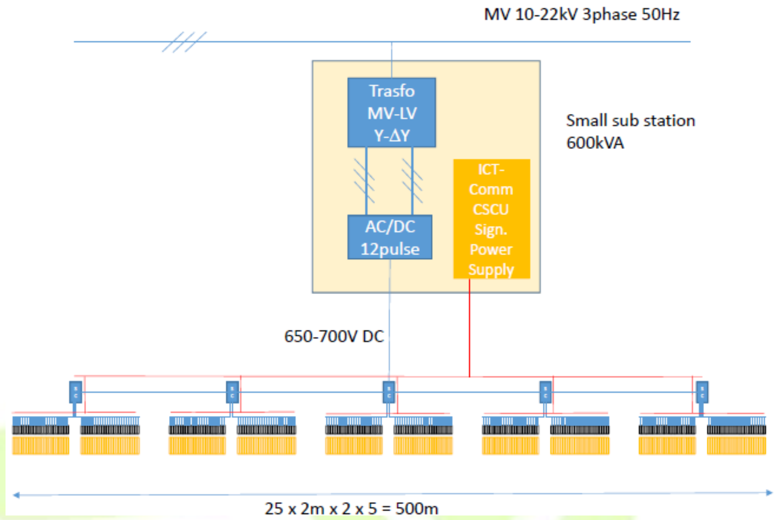
Status: Impact study complete

- Power demand simulations for various traffic models (demand fluctuates from 2-8 MW in some milliseconds)
- Harmonics and power flow analysis at the test sites (max power Satori: 100 kW, Polito: 45 kW, minimal adaptations needed, so as to simultaneously charge 2 vehicles)
- Integration of RES and Energy Storage study (ESS: larger energy storage capacity reduces daily demand peaks but is expensive)

Harmonics analysis

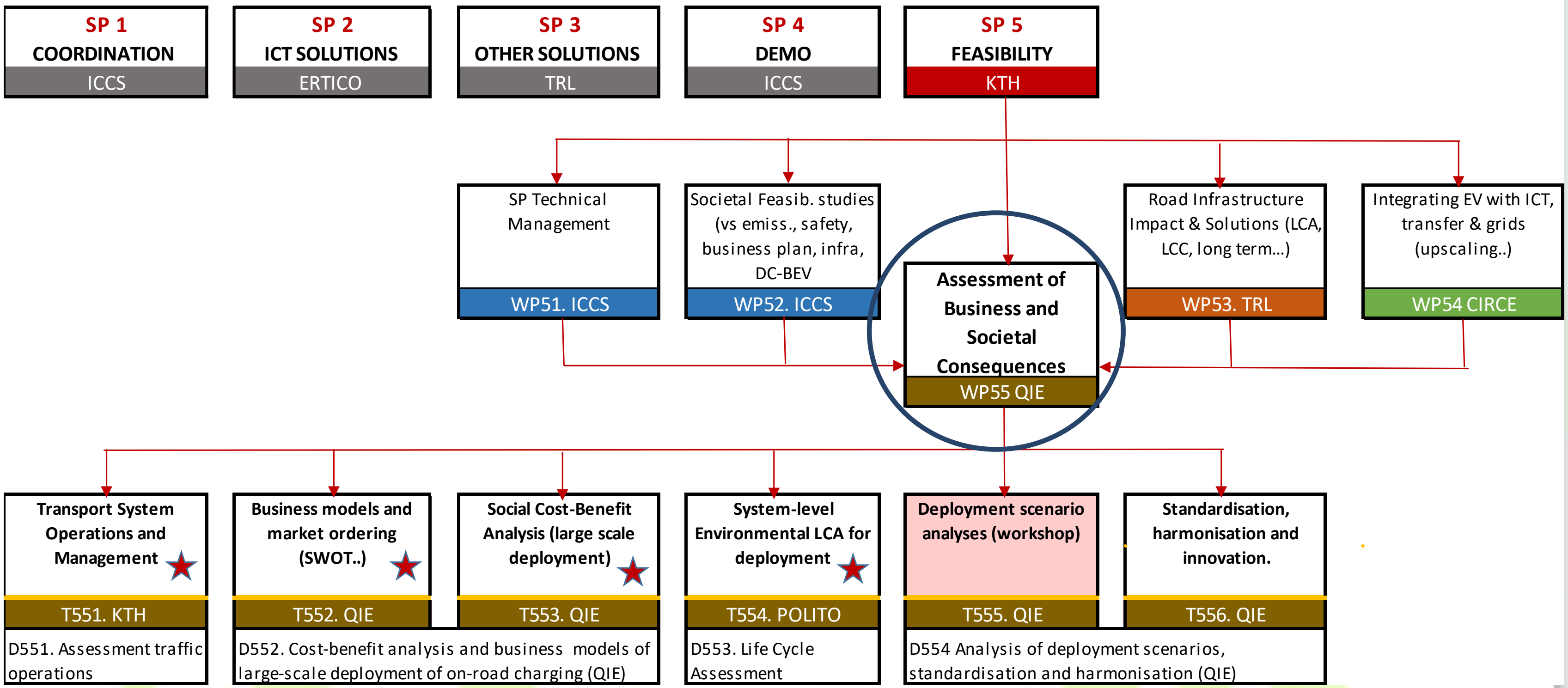


Example infrastructure layout



Expected delivery: Study almost complete

2. Feasibility Analysis First Results



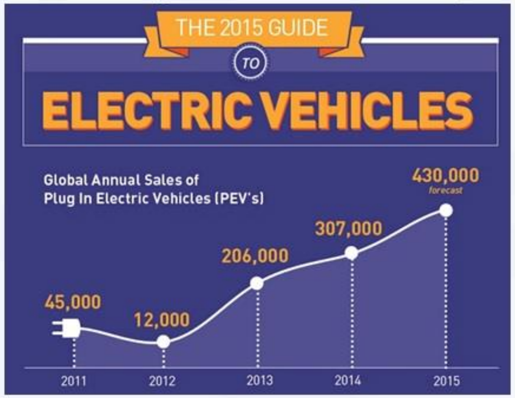
Electromobility trends (I)

Electric Vehicles

Range increases due to battery breakthroughs

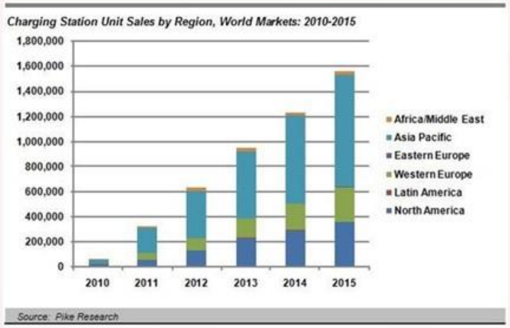
New models

Global adoption increases steadily



Infrastructure

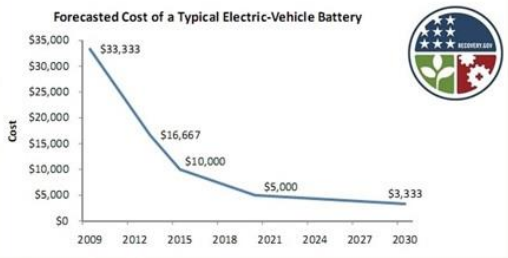
Static charging infrastructure is deployed fast



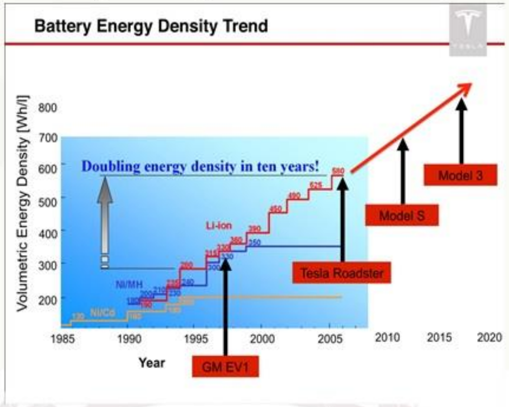
Very fast supercharger deployment (>250km range in 20 minutes)

Batteries

EV batteries' price dropping

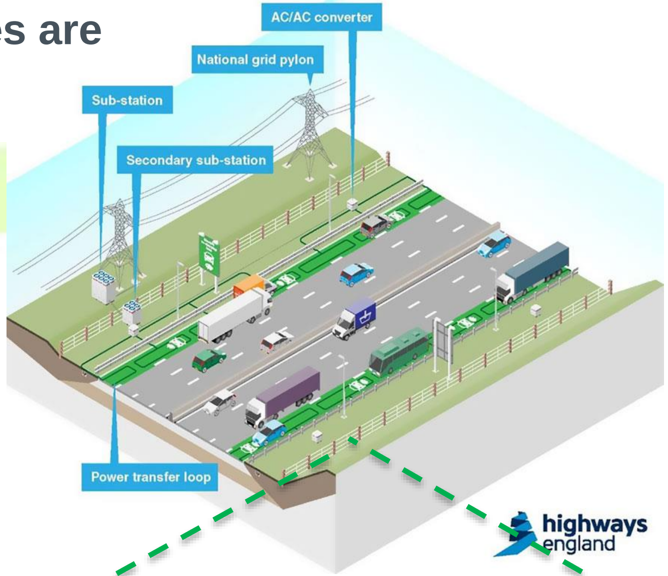


Battery density increases linearly



Electromobility trends (II)

Investments on dynamic charging technologies are growing



- UK government £500 million investment over the next five years for the creation and testing of electric highways.

- EU R&D project funding focused on dynamic charging
  - ❑ FABRIC
  - ❑ FASTINCHARGE
  - ❑ VICTORIA…

An LCC and LCA was prepared for the infrastructure

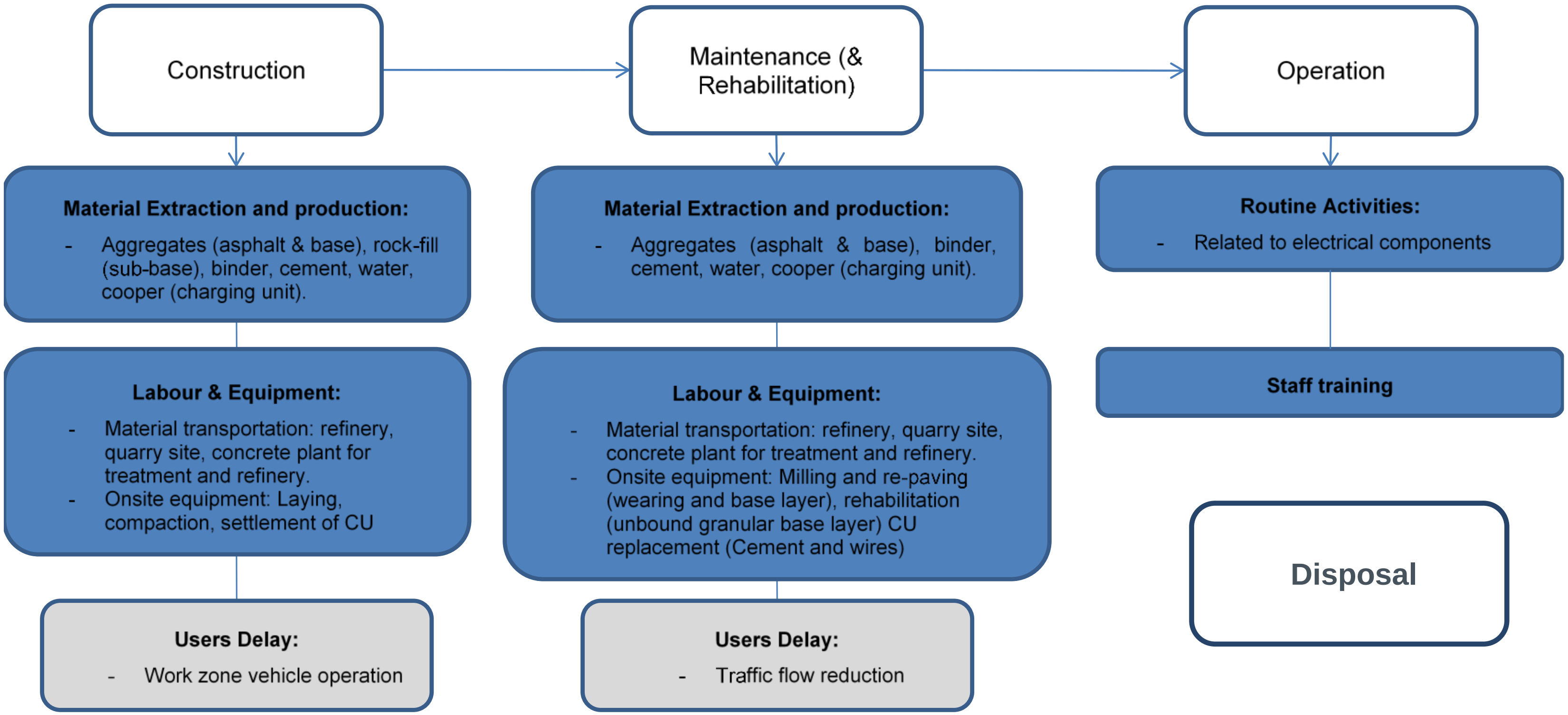
The **life cycle costing of the e-corridor** are the costs of acquiring it (including consultancy, design and construction costs, and equipment), the costs of operating it and the costs of maintaining it over its whole life through to its disposal. These costs include internal resources and departmental overheads, where relevant.

The LCC and LCA was based in the trench based construction procedure

CONSTRUCTION METHODS	DESCRIPTION	FEATURES
Trench based construction	Creating a trench in the existing highway, installation of the system (whether in situ or pre-cast), backfilling and laying an asphalt surfacing layer	Quickest and cheapest option, potential reflective cracking at the surface and transverse joints. Need to customise a machine for specific width and depth requirements
Full lane reconstruction	Removing the full depth of bound layers from lane, and either constructing in-situ or using pre-cast units, followed by construction of a concrete pavement around the units and then by asphalt surfacing	More time consuming and expensive but with the advantage of locating longitudinal construction joints at the edge of the lane. DWPT units and associated connection pipework would be delivered to the site in precast form and the pavement constructed around them.
Full lane prefabricated construction	Replace with a full lane width prefabricated section containing the entire system. This could possibly be finished with asphalt surfacing as above, or by having a porous concrete surfacing already placed on the prefabricated sections	An accelerated construction period and factory construction quality. Whilst prefabrication is likely to be the highest capital cost option, there would be significant savings in traffic management costs with the only major concern being the potential disruption caused by the transport of these systems to site

Calculations of LCC has been made considering **only trench based method** as it was the one used at the sites

LCC and LCA Boundaries



The LCC and LCA models has been prepared to incorporate users delays, during construction and operation. However first results does not consider users delay in first version..

Data collection and treatment

- **Primary data:** Direct data from the FABRIC test-sites
- **Secondary data:** Data usually taken from databases or other official sources that have calculated them on systems that can be considered equivalent to the unit process present in the product system to be analysed.
- **Tertiary data or estimated data:** generally, these data are deduced from literature works or other sources or from the primary or secondary data through estimation.

LCC calculations can be summed up in the following formula:

Life Cycle Cost = Agency costs (R&D costs+ Capital costs (investment)+ projected life-time operating costs + projected life-time maintenance costs + projected renewal costs + projected disposal costs (asset disposal-residual value) + **User Costs (in our particular case excluded in this first version).**

Main assumptions for the LCC and LCA analysis

- **Cost assumption**: three periods; 2020 (no demand, high costs, research costs), 2030 (low demand, medium costs, less research costs, 2050, high demand, lower costs, minimum research)
- **Main results are given for 2030 and to 2050** with projection of existing costs coming from three main suppliers; Polito, Saet and Vedecom-Qualcom.
- **Life time for the e-corridors of 20 years**. Depreciation time at different levels depending on the component.
- **Traffic assumptions** will be included in the next stage (user costs)
- **The energy and resources consumption by the traffic during the operation phase are not included** in this study.
- LCC **excludes** all costs that arise during **regular road construction**.
- The "**salvage value,"** usually the net value from the recycling of materials at the end of a project's life will be considered**, but the "remaining service life" (RSL),** ***won't be considered.***

LCC preliminary results

Project Analysis Summary

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

LIFE CYCLE COSTING SUMMARY

QiEurope — Technology to Market

PROJECT DETAILS	
PROJECT TITLE	FABRIC E-CORRIDORS. LIFE CYCLE COSTING
AUTHOR	QI EUROPE
DATE	20-may.-17

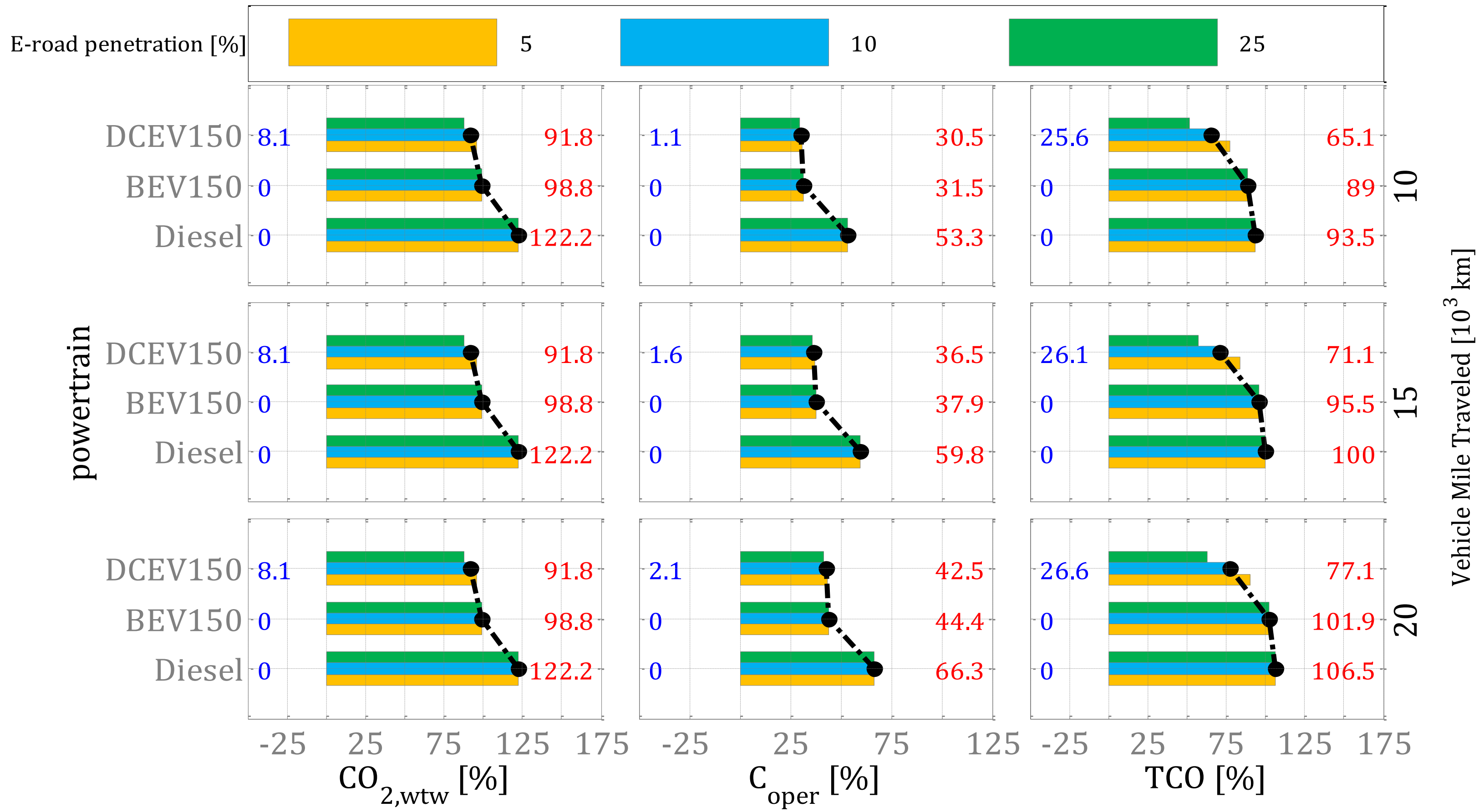
PROJECT ANALYSIS SUMMARY

OPTION No.	DESCRIPTION	LIFETIME ASSET	TOTAL COSTS	ANNUAL AVERAGE TOTAL COSTS	PRESENT VALUE TOTAL COSTS	ANNUAL AVERAGE PV TOTAL COSTS
1	POLITO (SCENARIO 1, REDUCED DEMAND 10 E-ROADS, 2030)	25	89.157.950 €	3.566.318 €	70.687.688 €	2.827.508 €
2	POLITO (SCENARIO 2, HIGH DEMAND 100 E-ROADS, 2050)	25	64.271.358 €	2.570.854 €	49.541.029 €	1.981.641 €
3	SAET (SCENARIO 1, REDUCED DEMAND 10 E-ROADS, 2030)	25	100.948.721 €	4.037.949 €	78.010.160 €	3.120.406 €
4	SAET (SCENARIO 2, HIGH DEMAND 100 E-ROADS, 2050)	25	65.241.138 €	2.609.646 €	50.351.093 €	2.014.044 €

The cost of 25 km e-corridor will be around 90 Million € in 2030 and 65 Million € in 2050. The annualized average present costs will be around 2 Million €

LCA. Summary of results

Vehicle Miles of Travel - E-road penetration



DCEV represents the most advantageous option in terms of CO_2 emissions, operation costs and Total cost of ownership compared with a BEV or a diesel car,

***normalized with respect to diesel results over NEDC**

Business models and market ordering

- The business models have been identified considering a penetration rate of the EVs in the urban, periurban and motorways and the estimation of many other assumptions

All stakeholders involved need to perceive the benefits

Trajectory one is related to WPT systems and WPT-EV manufacturers

FOR BEV USERS

(BEV Costs + Static Recharging costs + Dynamic Recharging Costs - Extra Advantages (externalities)
<=
(ITE Costs +Fuel Costs- Extra variable of range and outage anxiety)

Trajectory two is related to institutional investors and public administrations

FOR INVESTORS

(Incomes sales electricity e-road + Incomes Services e-road)
>=
(Cost of e-infrastructure)

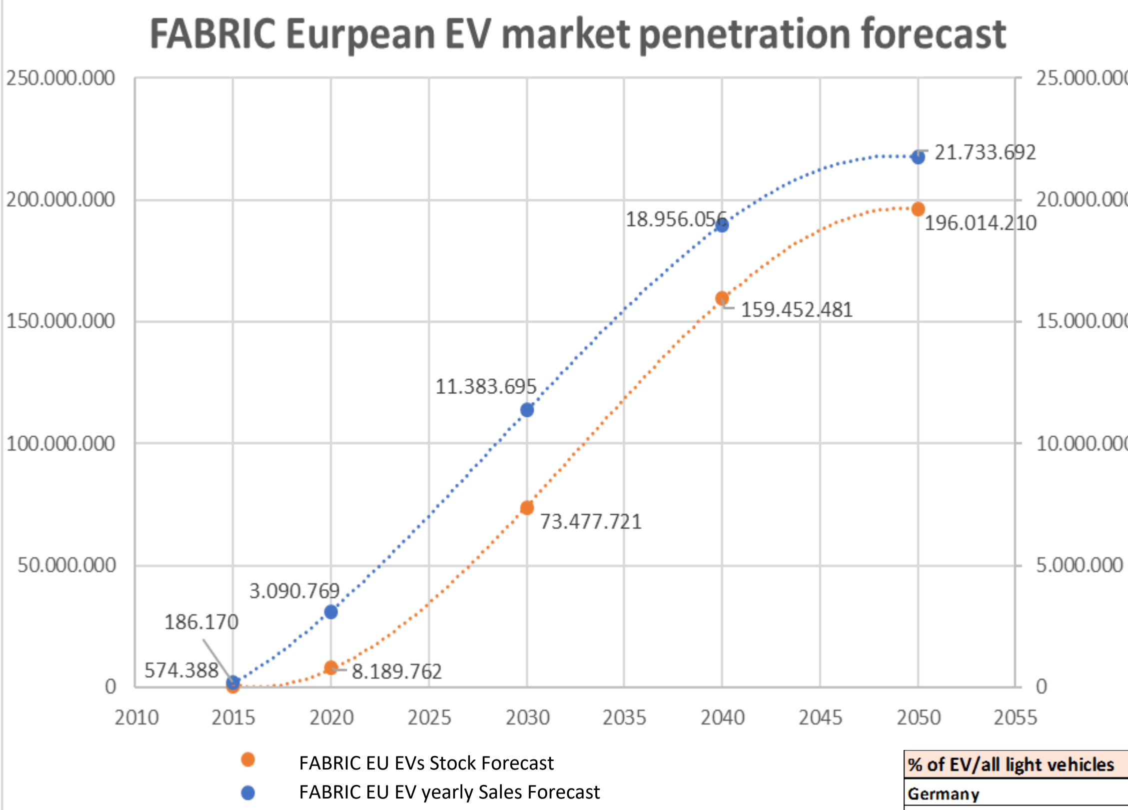
FOR ADMINISTRATIONS

(Total Energy Consumed BEV/year+Infrast e-roads/Nº years depreciation)
<=
(Total Energy Cons ICE/y+ Infraest Conv roads/years deprec+ Environmental Costs/year))

2. Feasibility Analysis First Results

EVs Demand. The first input needed for all calculations

The demand estimation was calculated for years 2020, 2030, 2040 and 2050



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

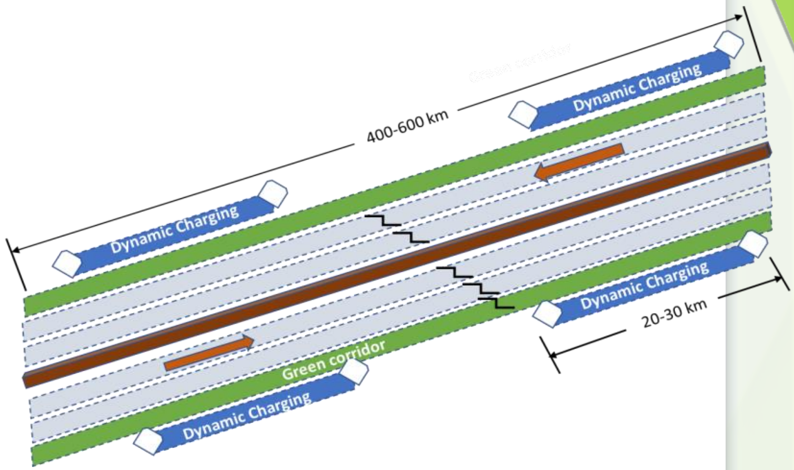
EVs penetration will be:

- 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%

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.

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

Making a Business Case. Motorways Scenario.

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

- Maximum speed within the e-corridor: 25 m/s (100 km/h)
- Minimum distance between vehicles 60 m
- Added Toll (in addition to the energy fee): 10 €/vehicle (pending confirmation)
- Average depreciation period for the e-corridor: 20 years.
- Yearly incomes: 3,650,000€
- Cost e-corridor /km: around 3,5 Million €/km (2030) or 2,4 Million € (2050)
- Annualized yearly cost at present value; 2 Million €for lifetime of 20 years
- E-Corridor length of 25 km

Making a Business Case

Motorways Scenario. Conclusions:

		FABRIC SCENARIO (with e-corridors)					
	LIGHT VEHICLES IN MOTORWAYS	**2.030**		**2.040**		**2.050**	
1	Percentage of fleet that it is electric	28	%	60	%	75	%
	Light EVs	13.306	units	28.512	units	35.640	units
2	Nº electric vehicles that use motorways	70	%	80	%	100	%
	Light EVs in motorways	9.314	units	22.810	units	35.640	units
3.	No. Of light EVs equiped with WPT (dynamic charging)	60	%	75	%	100	%
	Light EVs-WPT in motorways	5.588	units	17.107	units	35.640	units
3	Users that recharge in motorway superchargers	20	%	30	%	40	%
	Light EVs charging in supercharger in motorways	1.863	units	6.843	units	14.256	units
4	Users that recharge in motorway e-corridors	10	%	20	%	30	%
	Light Evs-WPT charging in e-corridors in motorways	931	units	4.562	units	10.692	units
	% of users charging in e-corridors/EVs equiped with WPT	17	%	27	%	30	%
	HEAVY VEHICLES IN MOTORWAYS	**2.030**		**2.040**		**2.050**	
5	Percentage of fleet that it is electric	28	%	60	%	75	%
	e-HDVs	1.814	units	3.888	units	4.860	units
6	Nº electric heavy vehicles that use motorways	30	%	60	%	100	%
	e-HDVs in motorways	544	units	2.333	units	4.860	units
7	No. Of e-HDV equiped with WPT (dynamic charging)	60	%	75	%	100	%
	e-HDVs-WPT in motorways	327	units	1.750	units	4.860	units
8	Users that recharge in motorway superchargers	20	%	30	%	40	%
	e-HDV charging in supercharger in motorways	109	units	700	units	1.944	units
9	Users that recharge in motorway e-corridors	10	%	20	%	30	%
	e-HDV charging in e-corridors in motorways	54	units	467	units	1.458	units
	% of users charging in e-corridors/EVs equiped with WPT	17	%	27	%	30	%
10	Nº of e-corridors in motorways	10	units	10	units	12	units

Number of daily EV in three lanes motorways with a daily traffic of 18.000 units/lane (88% light vehicles and 12% heavy vehicles) and number of e-corridors

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 % Penetration e-corridors	100	600	120 20%	180 30%	300 50%

Making a Business Case

Urban and Periurban Scenario. Conclusions:

The estimation done for the e-corridors deployed in urban and periurban areas in Europe, is based in the following assumptions:

- The market uptake will affect to the most crowded cities in Europe with best budgetary conditions and most environmental problems (air polluted)
- A percentage of the bus lines will be electrified and adapted to static/stationary and dynamic charging. We have considered on average a 40% of total fleet from 2030 to 2060.
- We consider that in those pioneering cities where dynamic charging will be in place in urban buses, it will easier to introduce also dynamic charging in the surroundings for intercity buses connections or HDVs short distance trips. The number of periurban e-corridors will be also adapted to the size of the city.

Rank	City	Country	Population	Estimations					
				Aproximate Bus lines	% Fleet electrified	No. E-corr. Urban bus 25km	Nº. E-corr Periurban 25 km	Total km E-corr. URBAN	Total Km E-corr. PERIURBAN
1	LONDON	UK	12.496.800	40	40%	0,40	36	10,00	900
2	PARIS	France	11.800.687	38	40%	0,38	34	9,44	850
3	MADRID	Spain	6.529.700	21	40%	0,21	20	5,23	500
4	RUHRGEBIET	Germany	5.045.784	16	40%	0,16	20	4,04	500
5	BERLIN	Germany	5.005.216	16	40%	0,16	20	4,01	500
6	BARCELONA	Spain	4.891.249	16	40%	0,16	18	3,91	450
7	ROME	Italy	4.370.538	14	40%	0,14	16	3,50	400
8	MILANO	Italy	4.252.246	14	40%	0,14	16	3,40	400
9	NAPOLI	Italy	3.627.021	12	40%	0,12	12	2,90	300
10	HAMBURG	Germany	3.173.871	10	40%	0,10	12	2,54	300
11	WEST MIDLANDS	UK	2.909.300	9	40%	0,09	10	2,33	250
12	MANCHESTER	UK	2.815.100	9	40%	0,09	8	2,25	203
13	LISBOA	Portugal	2.810.668	9	40%	0,09	8	2,25	202
14	MÜNCHEN	Germany	2.768.488	9	40%	0,09	8	2,22	199
15	STUTTGART	Germany	2.668.439	9	40%	0,09	8	2,14	192
16	BRUSSELS	Belgium	2.607.961	8	40%	0,08	8	2,09	188
17	FRANKFURT AM MAIN	Germany	2.573.745	8	40%	0,08	8	2	200
83	OTHER EU CITIES	>500.000	<2.500.000	6	35%	4,36	332	108,94	8.300
TOTAL LENGTH E-CORRIDOR URBAN AND PERIURBAN AREAS						6,93	593	173,23	14.834
Data. Eurostars largest cities in Europe 2016						TOTAL E-corridors	600		15.008

Making a Business Case

Urban and Periurban Scenario. Conclusions:

	URBAN AND PERIURBAN LIGHT VEHICLES	2.030		2.040		2.050	
11	Percentage of fleet that it is electric	28	%	60	%	75	%
	Light EVs	13.306	units	28.512	units	35.640	units
12	Nº EVs that moves in urban and periurban areas	100	%	100	%	100	%
	Light EVs in urban and periurban areas	13.306	units	28.512	units	35.640	units
13	No. Of light EVs equiped with WPT (dynamic charging)	60	%	75	%	100	%
	Light EVs-WPT in urban and periurban areas	7.983	units	21.384	units	35.640	units
14	Users of light Evs that recharge in home chargers or urban chargers	100	%	100	%	100	%
	Light EVs charging in home chargers or urban static chargers	13.306	units	28.512	units	35.640	units
15	Users of Evs that recharge in urban e-corridors	2	%	3	%	10	%
	Light EVs-WPT charging in e-corridors in urban or periurban areas	266	units	855	units	3.564	units
	% of users charging in e-corridors/light EVs equiped with WPT	3	%	4	%	10	%

	URBAN AND PERIURBAN HEAVY VEHICLES	2.030		2.040		2.050	
16	Percentage of fleet that it is electric	28	%	60	%	75	%
	e-HDVs	1.814	units	3.888	units	4.860	units
17	Nº e-HDV that moves in urban and periurban areas	100	%	100	%	100	%
	e-HDVs in urban and periurban areas	1.814	units	3.888	units	4.860	units
18	No. Of light EVs equiped with WPT (dynamic charging)	60	%	75	%	100	%
	e-HDVs-WPT in urban and periurban areas	1.089	units	2.916	units	4.860	units
19	e-HDV Users that recharge in headquarters chargers or urban static chargers	100	%	100	%	100	%
	e-HDV charging in supercharger in headquarters or urban static	1.814	units	3.888	units	4.860	units
20	e-HDVs users that recharge in urban e-corridors	50	%	62	%	83	%
	e-HDV charging in e-corridors in urban and periurban	907	units	2.411	units	4.034	units
	% of users charging in e-corridors/e-HDV equiped with WPT	83	%	83	%	83	%
21	Nº of e-corridors in urban and periurban areas	120	units	180	units	300	units
22	TOTAL FORECAST OF E-CORRIDORS	130	units	190	units	312	units

Number of daily EVs in urban and periurban areas and number of e-corridors

Making a Business Case

Overall conclusions:

Vehicles	2.030	2.040	2.050
MOTORWAYS			
Light Vehicles	9.314	45.619	128.304
Heavy vehicles	544	4.666	17.496
	9.858	**50.285**	**145.800**
URBAN/PERIURBAN			
Light Vehicles	31.933	153.965	1.069.200
Heavy vehicles	108.864	433.901	1.210.140
	140.797	**587.866**	**2.279.340**
TOTAL VEHICLES	**150.656**	**638.150**	**2.425.140**

E-corridors	2.030	2.040	2.050
MOTORWAYS	10	10	12
URBAN/PERIURBAN	120	180	300
TOTAL	**130**	**190**	**312**

These figures are the base for the calculation of the business model at a single 25 km e-corridor. The number of DWT-EV charging at the e-corridors will be necessary to estimate the business case for each e-corridor.

The number of e-corridors and total number of DWT-EVs in Europe are also the base to estimate impacts in the supply chain.

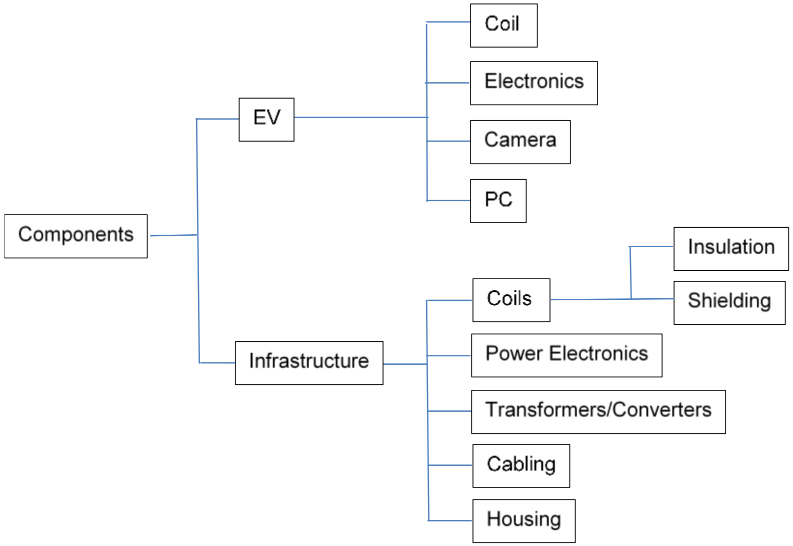
Number of daily EV-DWT vehicles charging at the European E-corridors and number of e-corridors

Supply chain conclusions.

2. Feasibility Analysis First Results

Scarcity of Copper

- *Copper production 2017*, 25 million tons (ICSG)
- *TEN-T whole network* in EU 136,000 km with dynamic wireless charging capabilities, copper demand would be **Cu TEN-T= 1,230,528 tons.** So the whole TEN-T network represents ***5% (5.13%)*** *of* the annual global copper production.
- Considering the core TEN-T network which spans *34.401 km* the needed copper would be around ***1.3%*** of the annual global production.
- Equipping a BEV with wireless charging capability would need roughly **5-6** kg more copper so for a million BEVs the copper demand would increase by **6.000 tonnes** which is a negligible amount comparing to the global production.
- The total Cu demand for a passenger BEV with wireless charging capability is **90 kg** so **90,000 tons** per million BEVs **or 0.38%** of the current global Cu production.



Analysis of copper restrictions

- Other components analyzed
  - Transformers
  - Converters
  - Power electronic boards
  - Communications equipment
  - Cameras and ICT HW

Effects of up scaling to vehicle fleet and energy grids

Conclusions for the motorway scenario

Route type	e-road		
Safety distance (s)	2		
Driving cycle: Constant highway speed (km/h)	110		
Max. number of vehicles per km	15		
Max. number of vehicles per 25 km	375		
Time to cross 25 km (h)	0.227		
Max. hourly traffic (veh/h)	1650		
Traffic profile: Equivalent daily hours	3		
Number of vehicles per day (approx.)	5000		
Average consumption per vehicle (kWh/km)	0.15		
Dynamic and static Power transfer (kW)	20	50	100
Total POWER required for 25 km (MW)	9.4	23.4	46.9
Energy recharged over 25 km			
One vehicle (kWh)	4.5	11.4	22.7
Total on average day (MWh)	22.7	56.8	113.6
Range extender (km) assuming 0.15 kWh/km	30	76	152
Number of coils per 25 km (0.5m/coil)	50,000		
Number of LV transformers per 25 km	25		
Number of HV/MV transformers	1x 10 MVA	1x 25 MVA	1x 50 MVA

Impact on the grid of motorway e-corridors for LV

Effects of up scaling to vehicle fleet and energy grids

Conclusions for the bus scenario

Route type	Urban buses		
Number of buses	400		
Number of routes	40		
Driving cycle	SORT 1-1-2-2-3-3		
Average Daily route (km)	9		
Number of stops per route	27		
Total number of stops	1080		
Time for one route (round trip)	0.5 h (1 h)		
Service time (h) = nº of round trips	18		
Energy required (one round trip)			
Per route / bus (kWh)	36.0		
Fleet (MWh)	14.4		
Energy required per day (18 h service)			
One bus (kWh)	648		
Fleet (MWh)	259.2		
Dynamic and static Power transfer (kW)	50	100	150
Total POWER required by fleet (MW)	8	16	24
Charging mode	Continuous	25 m at stop	10 m at stop
km of e-corridor	360	27	11
Required on-board energy storage (kWh)	6	7.5	9
Required average charging time per stop (s)	48	24	16
Required charging time per bus and route (min)	21.6	10,8	7,2
Number of coils per route (2.5m/coil)	3600	270	81
Total number of coils	144,000	10,800	3,240
Number of LV transformers per route	4.5		
Total number of MV/LV transformers	180x 315 kVA	180x 630 kVA	270x 630 kVA
Total number of HV/MV transformers	1x 8 MVA	1x 16 MVA	1x 24 MVA

Impact on the grid of e-corridors for buses in urban scenario

Next steps

Task 5.5.3. Social Cost-Benefit Analysis

- The cost-benefit analysis gives an account of the total economic effects of a large-scale on-road charging deployment on all aspects of society. Health benefits from lower PM10 and NOx emissions in the urban areas will have to be taken into account as will the impact of on-road charging on the oil price and vice versa.

Task 5.5.5. Deployment scenario analysis

- A stakeholder workshops will be organized where various scenarios will be explored representing the energy and transport systems. Building on the environmental LCA and LCC analysis, this overarching systems perspective is necessary in order to estimate the total impacts (environmental, but also economic and safety issues) that could be expected from different forms and scales of "on-road charging" solutions. It is a kind of sensibility analysis for different scenarios.

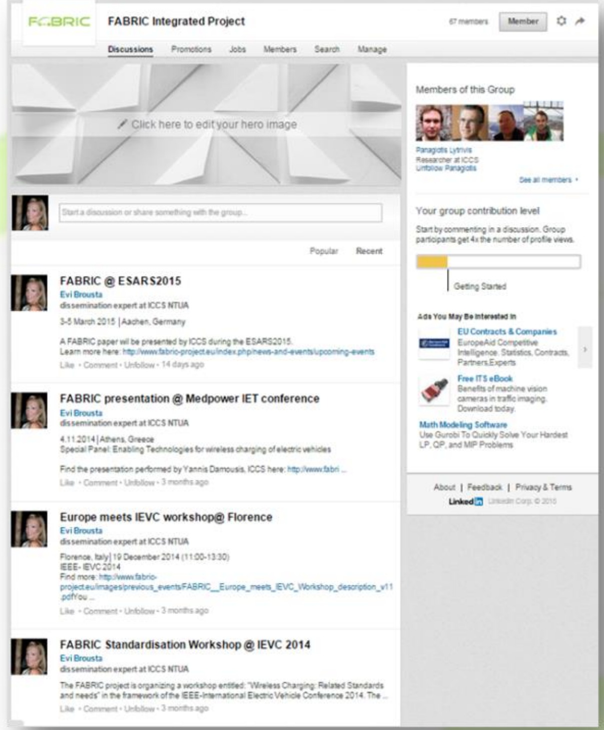
Task 5.5.6. Standardization, harmonization and innovation

- This task will produce a report on how to best handle full standardization and mandatory harmonization in this developing domain, in a way that would facilitate the deployment of on-road charging in Europe

FABRIC– how to contact

Website www.fabric-project.eu

LinkedIn group



Join the ERG

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FABRIC

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

Thank you!

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