FABRIC

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

D 5.3.4
Detailed LCA/LCC assessment of environment and cost impact of roads. QiE Contribution: LCC Part

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Work Structure

1. Tasks assigned to QiE
2. Definition LCC and update over previous task 531
3. Selected construction method
4. LCC Boundaries
5. Main assumptions for the LCC analysis
6. Data collection and treatment
7. Construction costs trench based method
8. LCC preliminary results

Tasks assigned to QiE

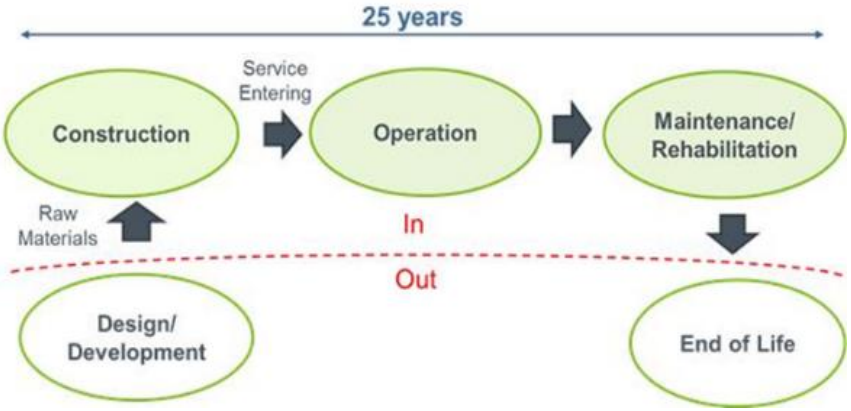
WP 53. Leader KTH (QiE contribution)

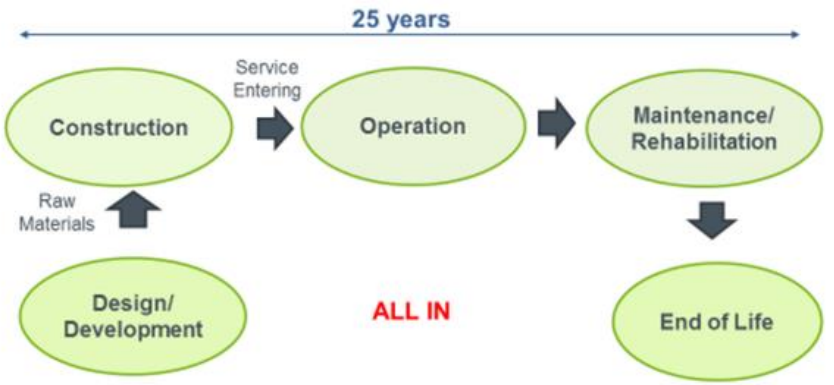
- **Task 5.3.1** Sustainable of the e-roads at system scales (LCA/LCC) components integration and development (Lead KTH, QiE, POLITO).
- Task 5.3.2. Framework for long term performance of the e-roads, including effects of environmental and mechanical loading (Lead KTH)
- Task 5.3.3 Construction of E-roads (Lead TRL)
- Task 5.3.4 Long-term E-road response predictions (Lead KTH, POLITO)
- Task 5.3.5 Monitoring, maintenance & operations of E-roads (Lead POLITO, KTH)
- **Task 5.3.6** Final assessment of E Roads using LCA and LCC (LEAD KTH, POLITO)

2 Definition LCC and update over previous task 531

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.

In the following chart we will show the modifications that took place between the draft of the LCC in D5.3.1 and the final version of the LCC in D5.3.4



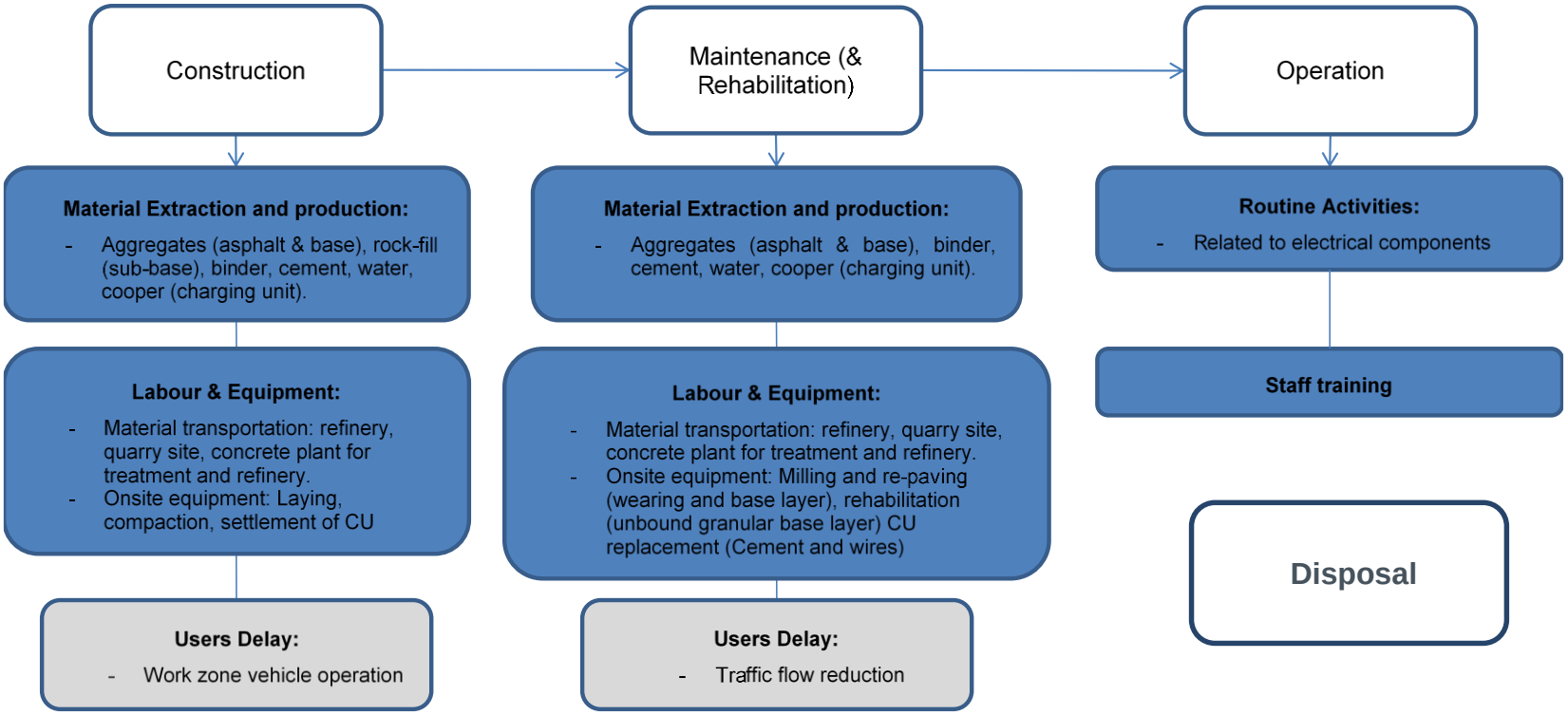


3 Selected construction method

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

4 LCC Boundaries



The LCC model has been prepared to incorporate users delays, during construction and operation , but this information is included in the first LCC version.

5 Main assumptions for the LCC analysis

- We asked the material and service suppliers about **current costs** of the different components, then the costs once the e-corridors will **start been manufactured** in 2030 with a number of units (Demand of 10 e-corridors) and finally expected costs in 2050 with **cost optimization processes** because of higher demand, automation procedure, learning curve, economy of scale (100 e-corridors).
- We prepared **two scenarios** (one for 2030 and one for 2050) with costs coming **from three main suppliers**; Polito, Saet and Vedecom-Qualcom.
- We considered a **life time for the e-corridors of 25 years**. **Depreciation time at different levels depending on the component.**
- **Traffic assumptions will be included in the next stage** "cost benefit analysis" and the "project finance", foreseen for task 552 Business models.
- **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.**

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).**

Construction costs trench based method

E-ROAD CONSTRUCTION (A. TRENCH BASED)

ITEM DESCRIPTION				MATERIAL				MAN POWER				RENTAL/USE EQUIPMENT				
GRAPH CODE	Nº	TYPE	DESCRIPTION	QUANTITY	UNITS	UNIT.VALUE (€/Unit)	TOTAL VALUE (€)	QUANTITY	UNITS	UNIT.VALUE (€/Unit)	TOTAL VALUE (€)	QUANTITY	UNITS	UNIT.VALUE (€)	TOTAL VALUE (€)	TOTAL COSTS
1	3,1	CW	CONSTRUCTION				859 €				549 €				1.159 €	2.566 €
2	3.1.1	CW	Trench excavation				0,34 €				291 €				443 €	734 €
3	3.1.1.1	CW	Excavation 1 (3.65x0.10m)	0,08	m^3	3,7 €	0,30 €	2,0	h	72,7 €	145 €	2,0	h	221,7 €	443 €	589 €
4	3.1.1.2	CW	Excavation 2 (1.00x0.35m)	0,01	m^3	3,7 €	0,04 €	2,0	h	72,7 €	145 €		h	221,7 €	0 €	145 €
5	3.1.2	CW	Joints				4 €				36 €				66 €	107 €
6	3.1.2.1	CW	Longitudinal	2,0	units	1,0 €	2 €	0,3	h	72,7 €	18 €	0,2	h	221,7 €	33 €	53 €
7	3.1.2.2	CW	Transverse (1m width)	2,0	units	1,0 €	2 €	0,3	h	72,7 €	18 €	0,2	h	221,7 €	33 €	53 €
8	3.1.3	CW	CU Installation				184 €				40 €				196 €	420 €
9	3.1.3.1	CW	Pre-cast system installation	2,0	units	80,0 €	160 €	0,3	h	72,7 €	22 €	2,0	h	49,0 €	98 €	280 €
10	3.1.3.2	CW	Concrete (1.0x0.4 m)	75,0	kg	0,3 €	24 €	0,3	h	72,7 €	18 €	2,0	h	49,0 €	98 €	140 €
11	3.1.4	CW	Drainage				13 €				163 €				276 €	452 €
12	3.1.4.1	CW	Install pipes for water drainage	5,0	units	2,5 €	13 €	2,0	h	72,7 €	145 €	2,0	h	49,0 €	98 €	256 €
13	3.1.5	CW	Trench closure				358 €				18 €				178 €	554 €
14	3.1.5.1	CW	Asphalt layer 1 (1.00x0.35m)		kg		0 €		h		0 €		h		0 €	0 €
15	3.1.5.2	CW	Asphalt layer 2 or binder (3.65x0.10m)	100,0	kg	3,6 €	358 €	0,3	h	72,7 €	18 €	2,0	h	88,8 €	178 €	554 €
16	3.1.6	CW	Others				300 €				0 €				0 €	300 €
17	3.1.6.1	CW	Litz cable for each loops	2,0	units	150,0 €	300 €	0,0	h	0,0 €	0 €	0,0	h	0,0 €	0 €	300 €
18	3.2	CW	MAINTENANCE				2.673 €				34 €				15 €	2.721 €
19	3.2.1	CW	Surface Coarse Layer				77 €				21 €				0 €	98 €
20	3.2.1.1	CW	Periodic preventive maintenance				0 €	0,3	h	72,7 €	18 €		h		0 €	18 €
21	3.2.1.2	CW	Resurfacing	0,9	m^3	84,9 €	77 €	0,1	h	23,4 €	2 €		h		0 €	80 €
22	3.2.2	CW	CU Layer				2.566 €				0 €				0 €	2.566 €
23	3.2.2.1	CW	CU stabilisation (cement grouts)		m^3	0,0 €	0 €		h		0 €		h		0 €	0 €
24	3.2.2.2	CW	Cover repair/replacement			0,0 €	0 €		h		0 €		h		0 €	0 €
25	3.2.2.3	CW	Dowel bars		units	0,0 €	0 €		h		0 €		h		0 €	0 €
26	3.2.2.4	CW	Insulation and sealing of CU modules			0,0 €	0 €		h		0 €		h		0 €	0 €
27	3.2.2.5	CW	CU replacement	1,0	units	2.566,4 €	2.566 €		h		0 €		h		0 €	2.566 €
28	3.2.3	CW	Winter Maintenance				5 €				0 €				15 €	19 €
29	3.2.3.1	CW	Salting	0,1	m^3	31,5 €	3 €		h		0 €	0,1	h	81,0 €	8 €	11 €
30	3.2.3.2	CW	Gritting	0,1	m^3	15,9 €	2 €		h		0 €		h		0 €	2 €
31	3.2.3.3	CW	Snow removal				0 €		h		0 €	0,1	h	65,6 €	7 €	7 €
32	3.2.4	CW	Inspections				24 €				13 €				0 €	38 €
33	3.2.4.1	CW	Visual inspection of joints				0 €	0,1	h	23,4 €	2 €		h		0 €	2 €
34	3.2.4.2	CW	Inspection of roadside equipment				0 €	0,1	h	23,4 €	2 €		h		0 €	2 €
35	3.2.4.3	CW	Visual assessment of carriageway				0 €	0,1	h	23,4 €	2 €		h		0 €	2 €
36	3.2.4.4	CW	Insulation and sealing of CU modules	2,0	units	12,2 €	24 €	0,3	h	25,9 €	6 €		h		0 €	31 €
37	3.2.5	CW	Others				0 €				0 €				0 €	0 €
38	3.2.5.1	CW	Others				0 €				0 €				0 €	0 €
39	3.3	CW	OPERATION				148 €				0 €				0 €	148 €
40	3.3.1	CW	Staff training				148 €		h		0 €		h		0 €	148 €
41	3.3.1.1	CW	Staff training	2,0	day	74,0 €	148 €				0 €				0 €	148 €
42	3.3.2	CW	Others				0 €				0 €				0 €	0 €
43	3.3.2.1	CW	Others				0 €				0 €				0 €	0 €

LCC preliminary results

Project Analysis Summary

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LIFE CYCLE COSTING SUMMARY

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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 €

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Thank you!

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