

MAINTENANCE FORUM 2018

MAINTENANCE OF ELECTRIC CITY BUSES - COST BENEFIT ANALYSIS

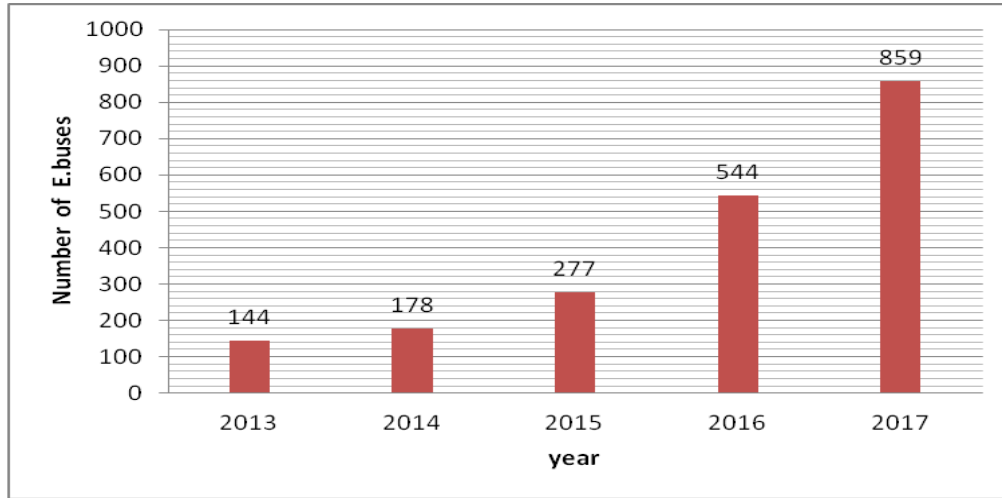
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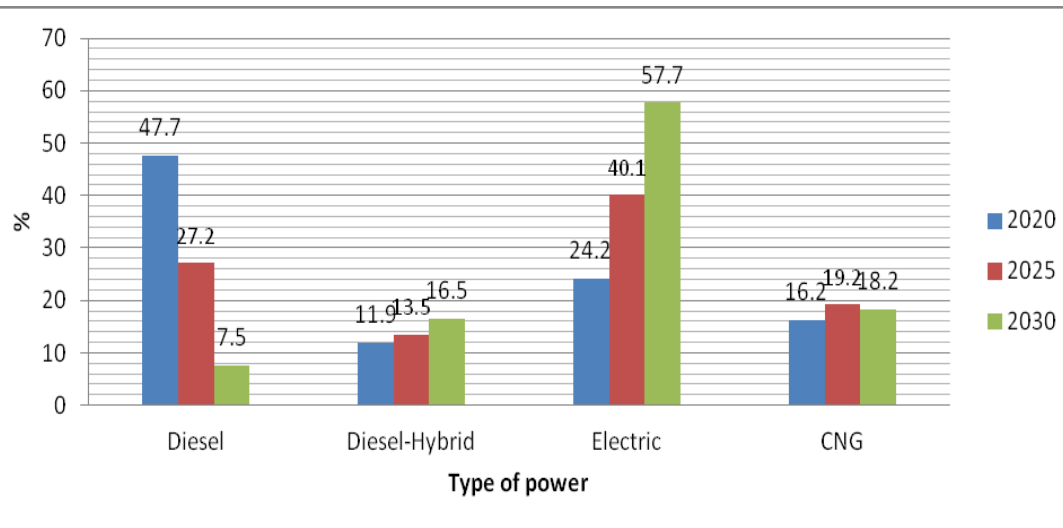
Electric buses implementation in Europe



Europe - the trend of introduction and buses on electric drive



Europe - 2017 cities with e.buses

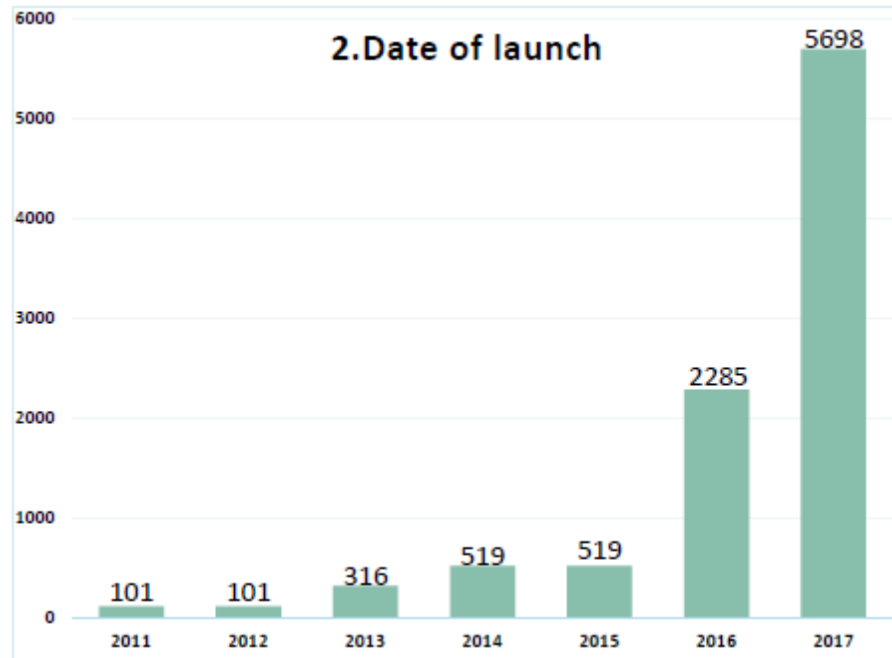


EU- forecast representation buses for public transport

Electric buses implementation in China

The largest number of buses in the world is present in China. Only three cities in China have over 10600 e-buses in operation: Shenzhen (5698), Beijing (2500), Shanghai (2200)... with a constant trend of increase.

The picture shows the trend of growth in E-buses by years in the city of Shenzhen



Advantages of electric buses

Besides the effect of climate change and greenhouse gas emissions, electric buses is the most promising for the urban transit due to the space occupied by the cars and bicycles to transport the same number of passengers.

CPF
cycling promotion fund

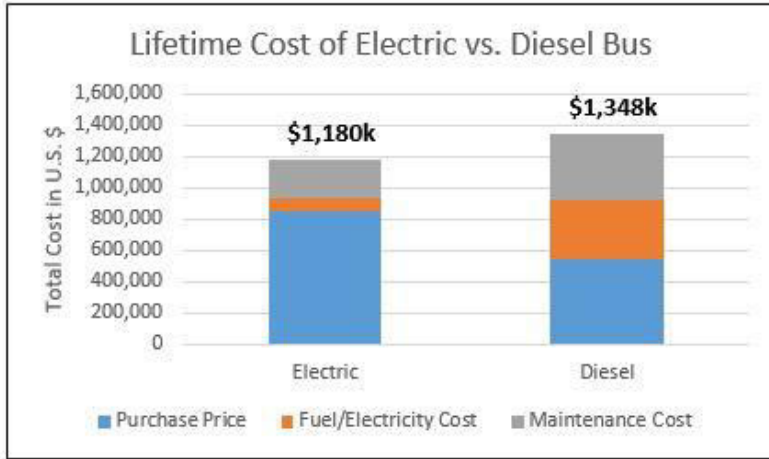


Dots

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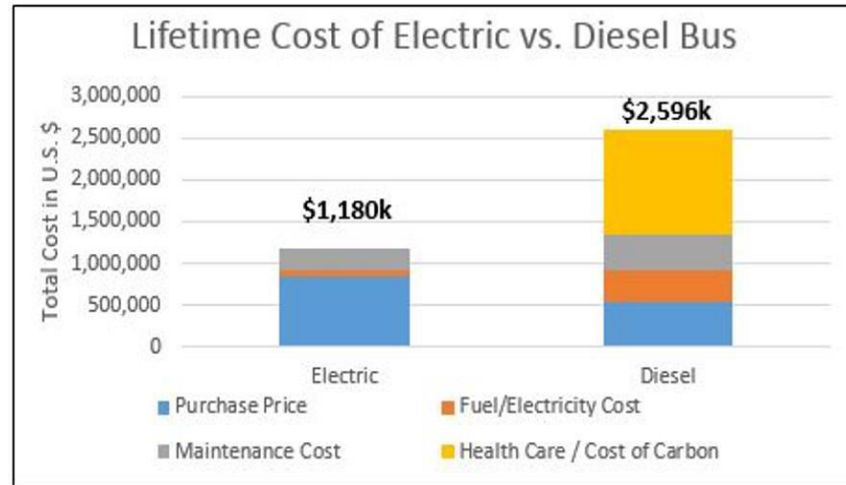
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Advantages of electric buses

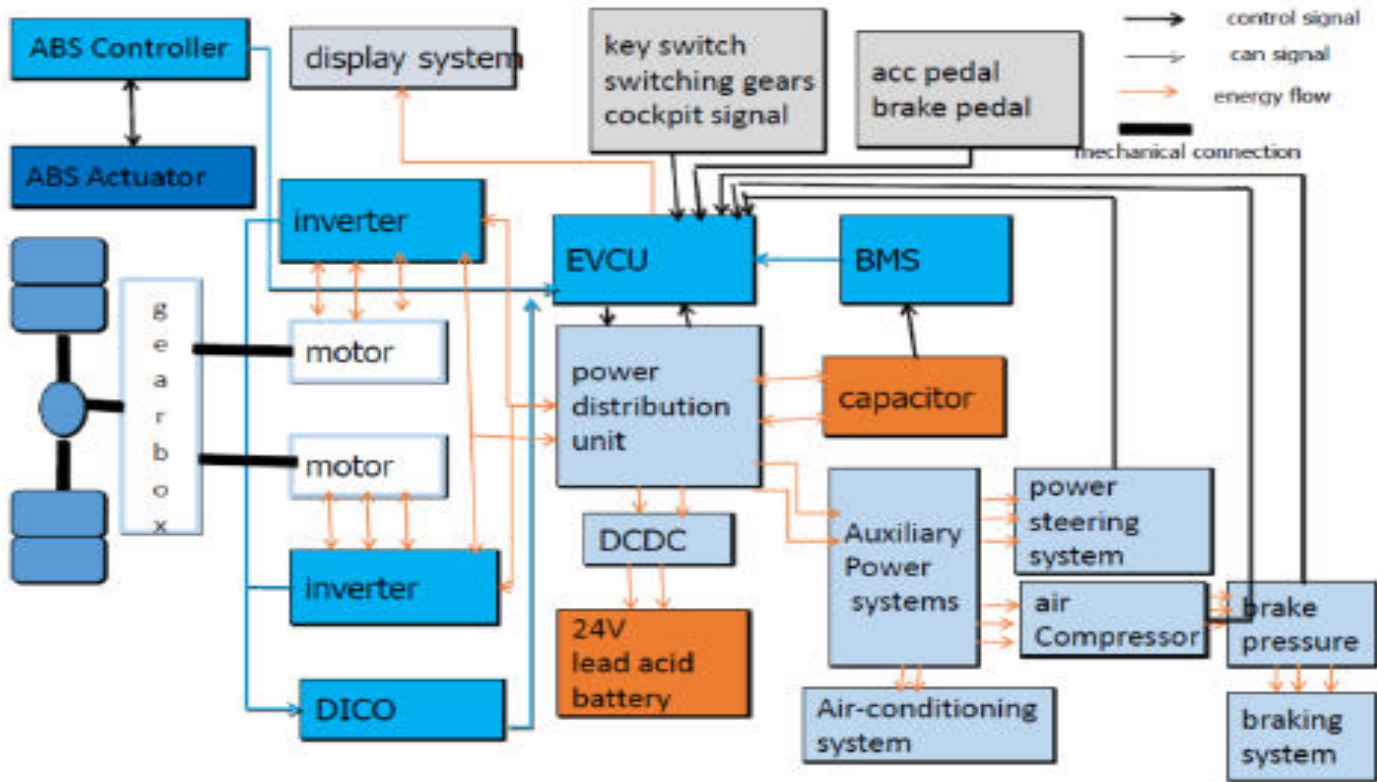


Lifetime Cost of Electric and Diesel bus without cost of Health Care

Lifetime Cost of Electric and Diesel bus with cost of Health Care



Components diagram



Electric bus Vs Diesel bus

Bus component	Diesel bus	Electric bus
Internal combustion engine	YES	No
Engine lube system	YES	No
Engine oil	YES	No
Oil filter	YES	No
Air filter	YES	No
Strap	YES	No
Engine cooler	YES	No
Antifreeze	YES	No
Intercooler	YES	No
Starter	YES	No
Turbocompressor	YES	No
Fuel injection system	YES	No
Fuel tank	YES	No
Fuel filter	YES	No
Exhaust system	YES	No
SCRT system	YES	No
AD-blue,	YES	No
Gear box	YES	No

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Electric bus Vs Other transport units

	E-bus /Euro/	Diesel/Euro/
Annual cost of maintenance of electrical charger, grid	5.000	0
Annual cost of vehicle maintenance	3.700	11.100
	CNG	Trolleybus
Annual cost of maintenance of electrical grid	0	326.340
Annual cost of vehicle maintenance	13.000	9.275

Case study – GSP Line EKO 1



Line EKO 1		Number E.bus in operation (4)			
Total length (km) (Direction1+Direction 2)	Charging time (min)	Turnaround time (min)	interval (min)	freq (bus/h)	Q (pass/h)
15,8	16 (9+7)	62-68	<u>20</u>	3	240

Case study – GSP Line EKO 1

	E-BUS	DiSel Bus Eypo 5
Driven mileage [km]	80000	80000
El. Power consumption [kWh/100 км]	115	
Diesel consumption[l/100 км]		44
El. Power cost [Euro/KWh]	0.07	
Diesel cost [Euro/l]		1.17
Total energy cost [Euro]	6440	41184

energy costs

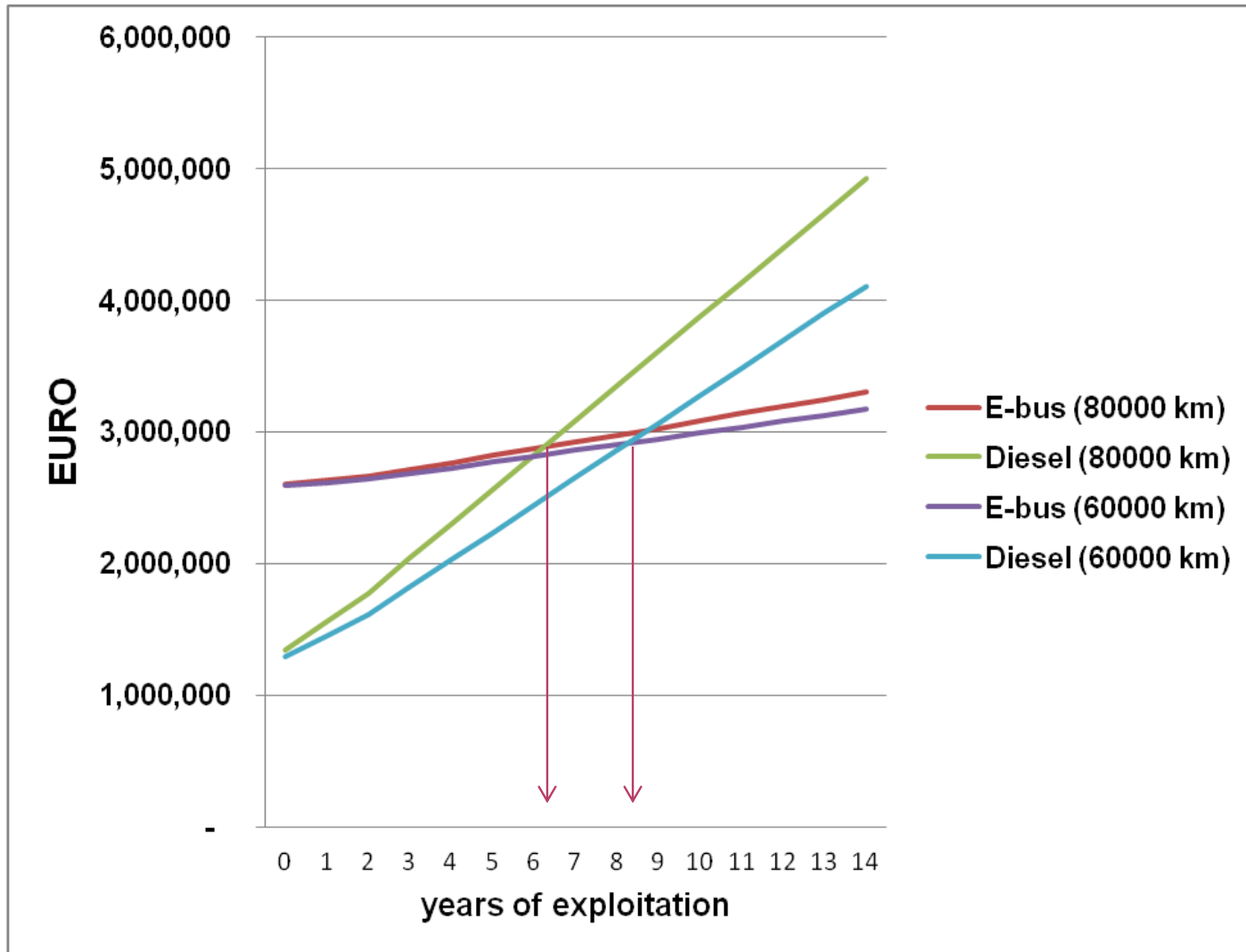
Pollutants	Cost of air pollution	Emission of diesel bus (Euro 5) 80 000 km	Total cost air pollution
	[Euro/g]	[g/годишње]	[Euro]
CO	0.000035	196160	6.8656
CxHy	0.001	32720	32.72
NOx	0.0044	261600	1151.04
PM ₁₀	0.087	2640	229.68
Delta CO ₂ /Dizel-E.bus/	0.000035	23,120,000	809.2
Total			2229.5

ecological cost of diesel buses

Case study – GSP, line EKO 1 investments, energy, maintenance, ecology

Years of exploitation	E-bus (80000 km)	Diesel (80000 km)	E-bus (60000 km)	Diesel (60000 km)
0	2,598,150	1,342,065	2,590,100	1,287,800
1	2,630,350	1,559,130	2,614,250	1,450,600
2	2,662,550	1,776,195	2,638,400	1,613,400
3	2,714,750	2,038,260	2,682,550	1,821,200
4	2,766,950	2,300,325	2,726,700	2,029,000
5	2,819,150	2,562,390	2,770,850	2,236,800
6	2,871,350	2,824,455	2,815,000	2,444,600
7	2,923,550	3,086,520	2,859,150	2,652,400
8	2,975,750	3,348,585	2,903,300	2,860,200
9	3,027,950	3,610,650	2,947,450	3,068,000
10	3,080,150	3,872,715	2,991,600	3,275,800
11	3,143,350	4,134,780	3,035,750	3,483,600
12	3,195,550	4,396,845	3,079,900	3,691,400
13	3,247,750	4,658,910	3,124,050	3,899,200
14	3,299,950	4,920,975	3,168,200	4,107,000

Case study – GSP
Line EKO 1



total cost of the lifecycle

Case study – GSP Line 77

Daily exploitation cost of the Diesel and El. Bus on the same bus line - 77

Km per day	250		Euro/day
Fuel per day (L)	145	1.17	169,65
AD Blue per day			1,5
Tiers per day			11,1
Oil per day			2,1
Daily amortization			43
Daily maaintenance			88,9
Registration per day			1,94
Salary of 3 drivers per day			45
Local pollution per day			11
Global pollutionCO ₂ per day			6,8
Water, electric per day			1,5
Salary of maintenance employees per day			13,95
Total cost			396,44

Km-per day	250		Cost (Eupo) / day
El. Power per day(kWh)	312	0.07	21.84
Tiers per day			6.57
Daily amortization			88
Registration per day			1.94
Salary of 3 drivers per day			45
Daily maaintenance			32,88
Water, electric per day			1.5
Salary of maintenance employees per day			3,75
Total cost			201



THANK YOU FOR YOUR ATTENTION!!!

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