

ECONOMICAL STUDY FOR THE RETROFIT OF THE 40 SEATERS – DAR PUBLIC TRANSPORT

One Diesel bus vs Two E-Buses



New **technology** for efficient practice.

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The need for E-Buses:

A sustainable solution for urban cities

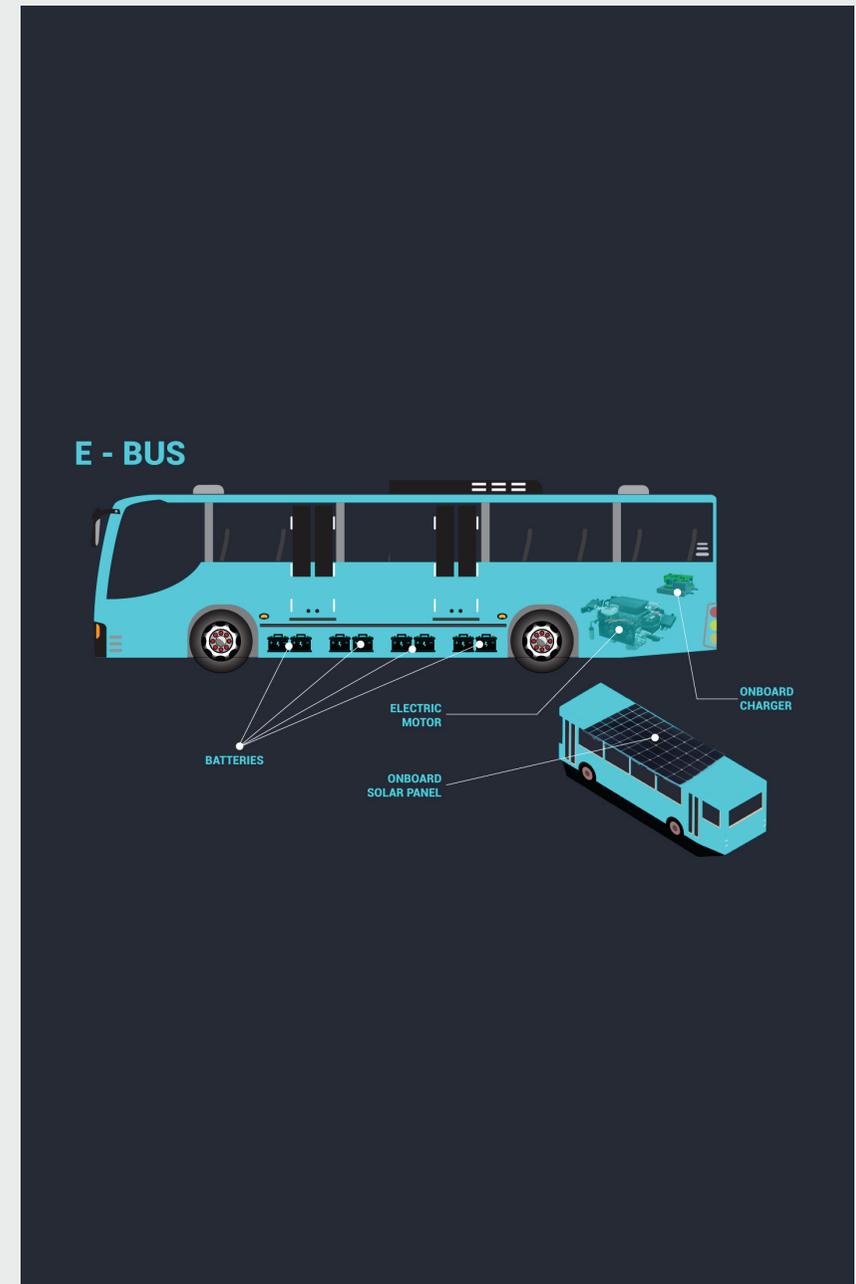
Along with contributing to the brown smog above many large cities like Dar es Salaam, urban buses account for approximately 25% of the black carbon emitted by the transportation sector, according to data from the United Nations. Fine particles, now perfectly visible to the naked eye on the main arteries of Dar es Salaam, kill 7 million people each year, primarily in developing-country large cities. *(source WHO)*

Each bus uses 26,000 liters of fuel per year. 1L transmits 3.5 kg of CO₂ in the atmosphere. Thus, each bus releases 91 tonnes of Co₂ emissions per year, making a total of 1.8 million tons per year for the public transportation system as a whole. Tanzania's total emissions are estimated to be 12 million tonnes per year, according to data from the United Nations.

What is the most logical path to take? Electric buses are expected to remain the lowest-carbon option in every part of the world, even on current electricity grids.

Data shows that when comparing lifetime costs over five years, E-Buses can be more efficient and require less maintenance than diesel buses.

Furthermore, our electric buses contribute to a sustainable solution for public transport and so ensure clean and quiet cities.



Operation Comparison:

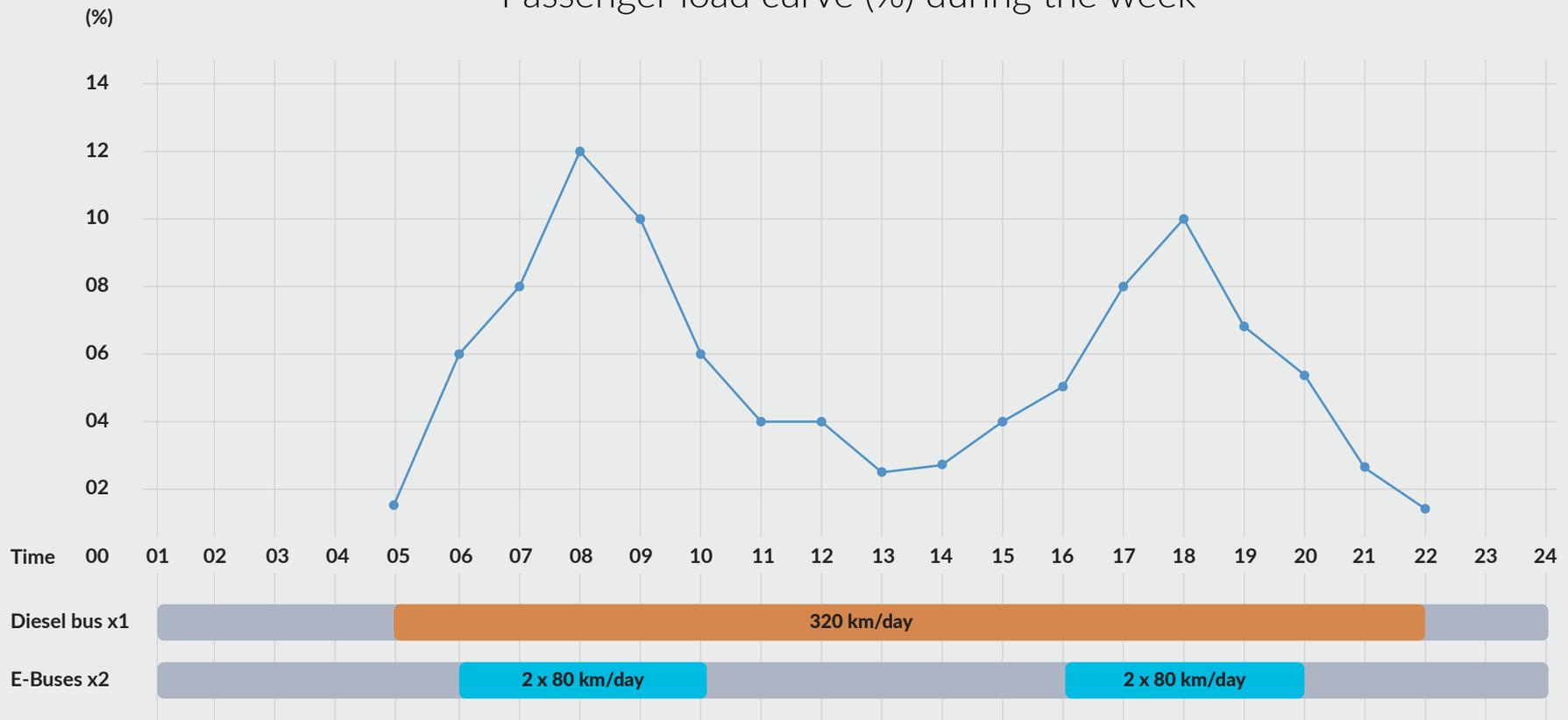
ONE Diesel bus and TWO E-Buses

THE 2 E-BUSES WILL NOT OPERATE THE SAME WAY AS A SINGLE DIESEL BUS

The Diesel bus Operates from 05.00 AM to 22.00 PM

The E-Buses Will operate from 06.00 AM to 10.00 AM and from 16.00 PM to 20.00 PM

Passenger load curve (%) during the week



Economical Comparison:

ONE Diesel bus and TWO E-Buses for 5 years

FIRST 5 YEARS	Tsh. (in M)	USD (in K)
One Diesel Bus		
Purchase	115	50
Fuel for 5 years [1]	300	130
Maintenance (oil + spare parts) [2]	50	22
Total	465	202
Two Electric Buses		
Purchase (old bus)	0	0
Retrofit (70kWh Battery) [3]		100
Charger 20 kW		14
TanESCO (1.5km/kWh) [4]		58
Maintenance [5]	50	22
Total		194

Notes:

- [1] The fuel consumption is based on real data, the company which covers 320 km/day is filling every day between Tsh. 150,000 and Tsh. 180,000 of diesel.
So $165.000 \times 365 \text{ days} \times 5 \text{ years} = \text{Tsh. } 301 \text{ M} \Rightarrow \text{USD } 130 \text{ K}$
- [2] This figure looks very low but given by the real operator. Most of the spare parts are jeopardized from old buses.
- [3] Retrofit of one bus with 70 kWh battery is estimated at USD 50,000. In this price we don't include the full refurbishing of the bus (to make it new).
- [4] TanESCO bill: as per our estimates, this type of vehicle will do 1.5 km per 1 kWh. The calculation is as follow:
 $(320 \text{ km} / 1.5 \text{ km}) \times 365 \text{ days} \times 5 \text{ years} = 390,000 \text{ kWh} \Rightarrow 390,000 \times 0.15 = \text{USD } 58 \text{ K}$.
- [5] Maintenance - **WAITING DATA**



DIESEL BUS X1

\$202K

Purchase

\$50K

Fuel for 5 years

\$130K

Maintenance (oil + spare parts)

\$22K



ELECTRIC BUSES X2

\$194K

Retrofit (70 kWh battery) + Charger 20 kW

\$114K

TanESCO (1.5km/kWh)

\$58K

Maintenance

\$22K

General data

USD 1 = Tsh. 2,300 (Tanzanian Shillings)

M = Million, K = Thousand

Price of a new 40-seater bus (CIF DSM) with taxes Tsh. 115 M or USD 50 K

Price of diesel in Dar-es-Salaam Tsh. 2400/liter - USD 1.04/liter

Price of the kWh (TanESCO) in DSM Tsh. 350/kWh - USD 0.15/kWh

Economical Comparison:

ONE Diesel bus and TWO E-Buses for 10 years

Comments

1. The modus operandi with 2 E-Buses on peak hours is definitely more profitable than a single bus covering the whole day.
2. More money can be saved if we extend the study to ten years, which is the estimated life of the batteries. Calculations can be found in the table on the right.
3. The retrofit costing estimated at USD 50.000 is definitely very high if we can imagine working on hundreds or thousands of units.
4. The volume of those type of buses in operation in Dar es Salaam is roughly estimated at 15,000 to 20,000 units. Dar es Salaam is very comparable with many capitals (or large cities) in Africa.

The problem of the funding is then the crucial issue, as all of the operators work on credits (with bank's loans).

So the idea of E-MOTION FINANCE is now vital to develop this product, as the key point is :
a larger investment for a better return.

NEXT 5 YEARS	Tsh. (in M)	USD (in K)
One Diesel Bus		
Purchase (a new bus is bought after 5 yrs)	115	50
Fuel for 5 years	300	130
Maintenance (oil + spare parts)	50	22
Total	465	202
Two Electric Buses		
Purchase (old bus)	0	0
Retrofit (70kWh Battery)		0
Charger 20 kW		0
TanESCO (1.5km/kWh)		58
Maintenance	50	22
Total		80



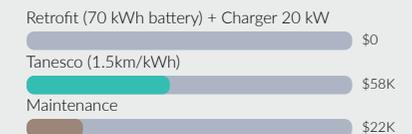
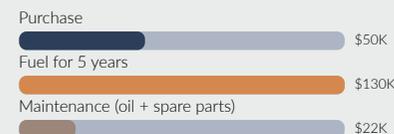
DIESEL BUS X1

\$202K



ELECTRIC BUSES X2

\$80K





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A collaboration between



ARUSHA TECHNICAL COLLEGE