Sustainable Transport for a Better World

BATTERY ELECTRIC VEHICLES (BEV) WHAT DOES IT SOLVE?

'EXPLORING THE APPLICABILITY OF BEV IN AFRICA AND THE MIDDLE EAST IN THE AID AND DEVELOPMENT SECTOR'

PROJECT LEARNINGS & FINDINGS REVIEW 2022-2024

Fleet Forum

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LIST OF ACRONYMS

GHG: Green House Gases

BEV: Electric Vehicle

ICEV: Internal Combustion Engine Vehicle

PHEV: Plug-In Electric Vehicle

HEV: Hybrid Electric Vehicle

kWh: kilowatt-hour (unit of energy)

CO2: Carbon Dioxide

CO2 equivalent: (CO2 eq.) metric measure used to compare emissions from various greenhouse gases on the basis of their global-warming potential, by converting amounts of other gases to the equivalent amount of CO2

EVSE: Electric Vehicle Supply Equipment (charger)

TCO: Total cost of operation

LTA: Long term Agreement

LCA: Life cycle Assessment

OEM: Original Equipment Manufacturers

EMR: Extended Manufacturer's Responsibilities

FMS: Fleet Management Systems

FTS: Fleet Tracking Systems

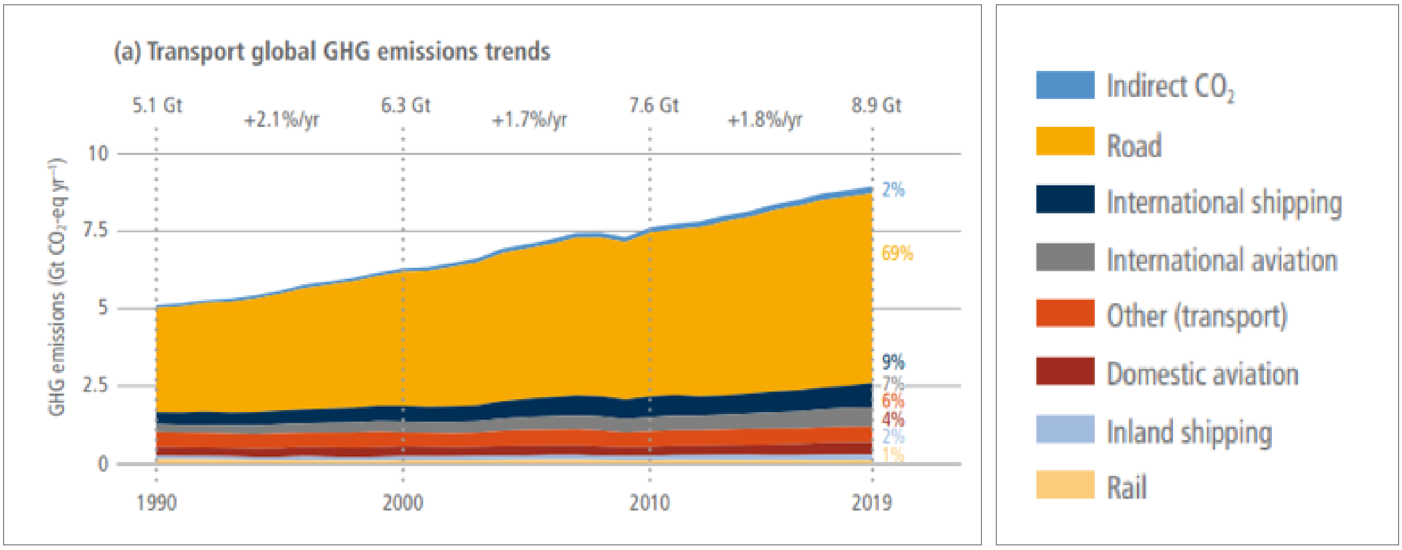
1899 - 'La jamais contente' from engineer Camille Jenatzy

1907 - 'Bailey Electric Phaeton' from Thomas Edison and Bailey&Company

HOW IS ROAD TRANSPORT CONTRIBUTING TO THE ENVIRONMENTAL EMERGENCY[1]?

Transport accounts for 15% of global GHG emissions on the planet. Transport emissions are continuously on the rise, despite global engagement to reduce them. The consequences are multiple on climate, air quality, resources scarcity, congestion, public health…

The largest source of transport emissions is the road transport of passengers and freight which represents 69% of the transport sector's total and is growing 1,7% per year (2010-2019).



Passenger cars, two- and three-wheelers, and mini buses contribute about 75% of passenger transport-related CO2 emissions, while collective transport services (bus and railways) generate about 7% of the passenger transport-related CO2 emissions despite covering a fifth of passenger transport globally[2].

While alternative lighter powertrains have great potential for mitigating GHG emissions from cars, the trend has been towards increasing vehicle size and engine power within all vehicle size classes, driven by consumer preferences towards larger sport utility vehicles (SUVs).

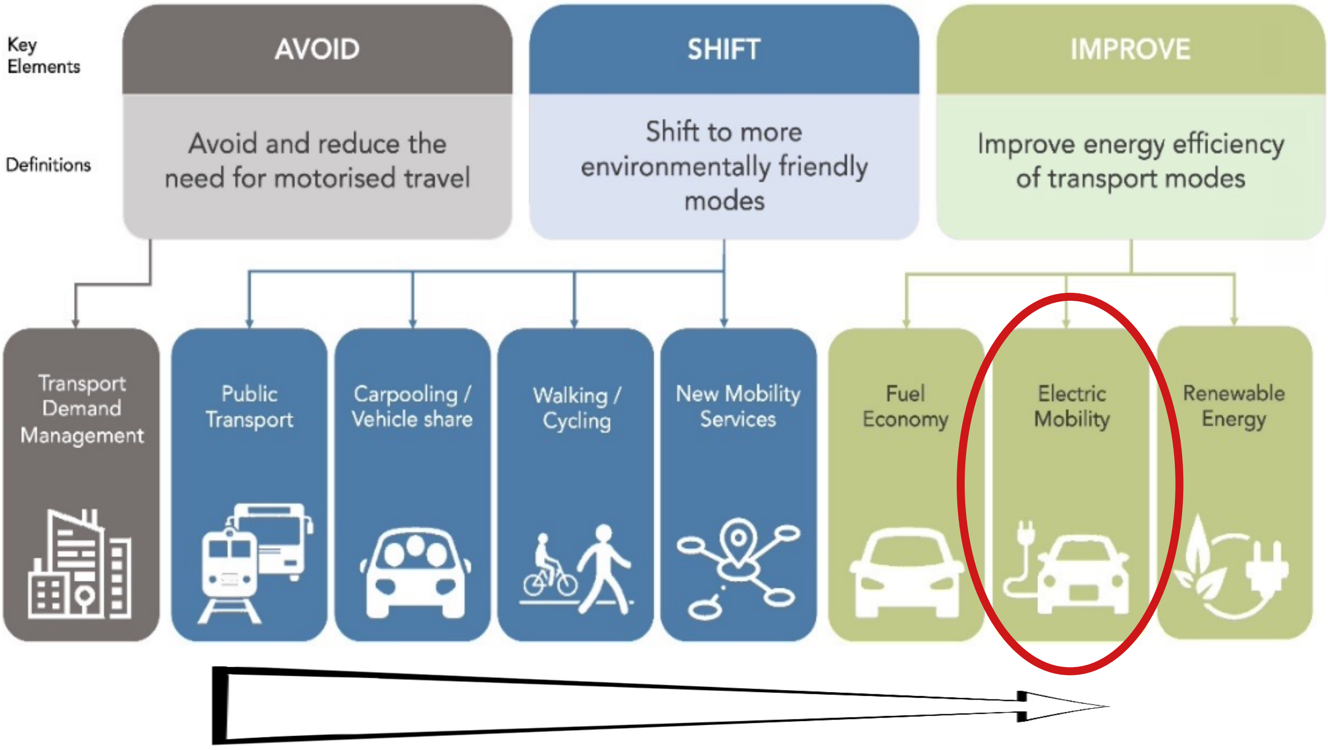
On a global scale, SUV sales have been constantly growing in the last decade, with 40% of the vehicles sold in 2019 being SUVs[3].

Based on the situation depicted above, the IPCC states with 'high confidence' that 'meeting climate mitigation goals requires transformative changes' in the transport sector. Meeting such objectives involves a double challenge of scale (halving emissions) and time (doing so before 2030).

1. IPCC_AR6_WGIII_Chapter10.pdf
2. Rodrigue 2017; Halim et al. 2018; Sheng et al. 2018; SLoCaT 2018a; Gota et al. 2019
3. (IEA 2020a) (Section 10.4, Box 10.3)

WHAT ARE THE ROAD TRANSPORT AND MOBILITY EMISSION REDUCTION STRATEGIES?

Avoid, Shift, Improve:
The typology captures and classifies the lever to emissions reductions in transport by order of potential. It's a pyramidal approach that recognizes that Avoid action have more impact than Shift actions which themselves have more impact than the Improve actions.



Reducing transport emissions is before all about reducing the need for mobility, and the share of trips done with motorized vehicles.

'Avoid' strategies reduce total vehicle travel.
They include policies and actions that minimise travel distances, size of fleet. For each mobility need, it interrogates what is the most relevant transport mode available in a given context, in order to move away from the sole 'motorized vehicle' system.

'Shift' strategies shift travel from higher-emitting to lower-emitting modes.
These strategies include more multimodal planning that improves active and collective transport modes, complete streets roadway design, high occupant vehicle priority strategies that favour shared modes…

'Improve' strategies reduce per-kilometre emission rates.
These strategies include hybrid and electric vehicle incentives, lower-carbon and cleaner fuels, high-emitting vehicle scrappage programmes, or efficient driving and anti-idling campaigns[4.]

Avoid, Shift, Improve should be the strategy to follow in any organisation that is seriously willing to reduce its transport environmental emissions.

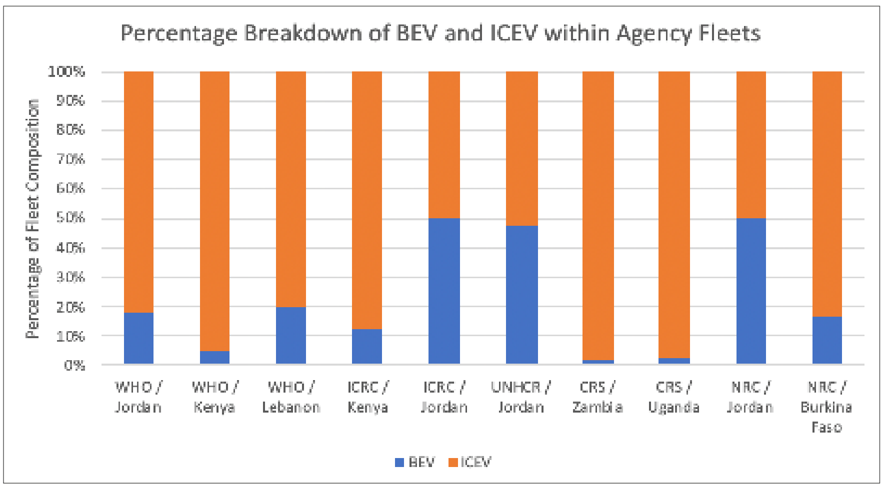
4. Lutsey and Sperling 2012; Gota et al. 2015

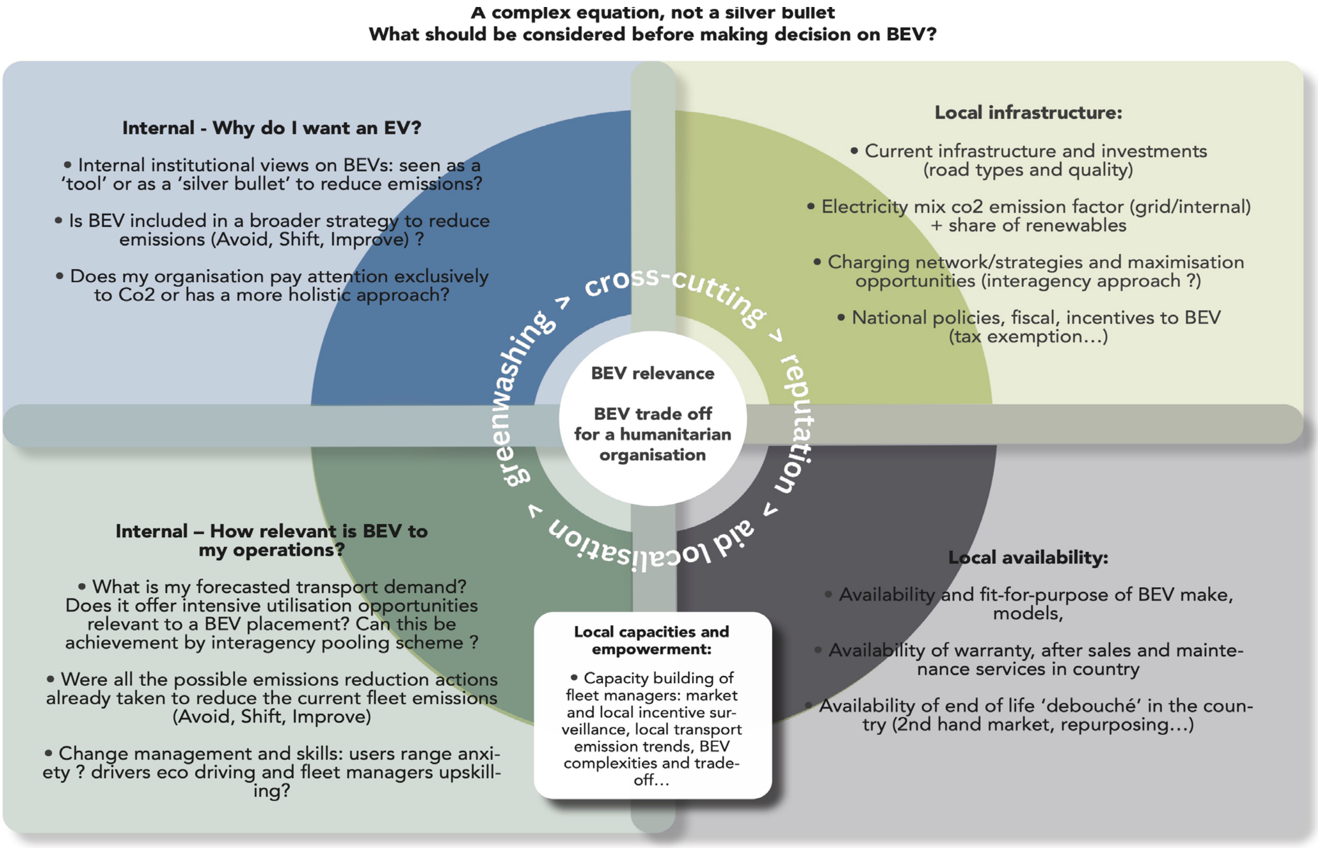
PROJECT BACKGROUND AND OBJECTIVES

Project start date: January 2022
Project end date (phase 1): January 2024
Scope: Battery EV in the Middle East and in Africa

General objectives:
- A willingness to collect facts, not opinions regarding the use and applicability of BEV in humanitarian field of operations
- A willingness to fill a gap of studies, literature availability, return on experience, for BEV usage in low- and middle-income countries of the Middle East and Africa.
- Capture and share learnings of humanitarian organizations early adopters of BEV in order to mitigate risks of such investment and capitalizing on experiences for a sector growingly interested in this technology.

Participating agencies:
The project was implemented with the joint participation and respective contributions of the below agencies:
- institutions coming from different DNAs (Red crescent red cross movement, UN agencies, international NGOs and university)
- that illustrates the willingness of a sector to work more closely together on common goals, and brings variety of positive inputs





1 - BEV 'ADOPTION PHASE' FINDINGS

Participating agencies' approach to BEV:

<u>Early adopter, early explorer: risky but necessary</u>

Humanitarian organisations participating to the project have in common being early adopter of the BEV technology and early explorer of their use in the 'low- and middle-income countries' where they operate, namely in the Middle-East and in Africa.

Such decision was taken assuming several risks:

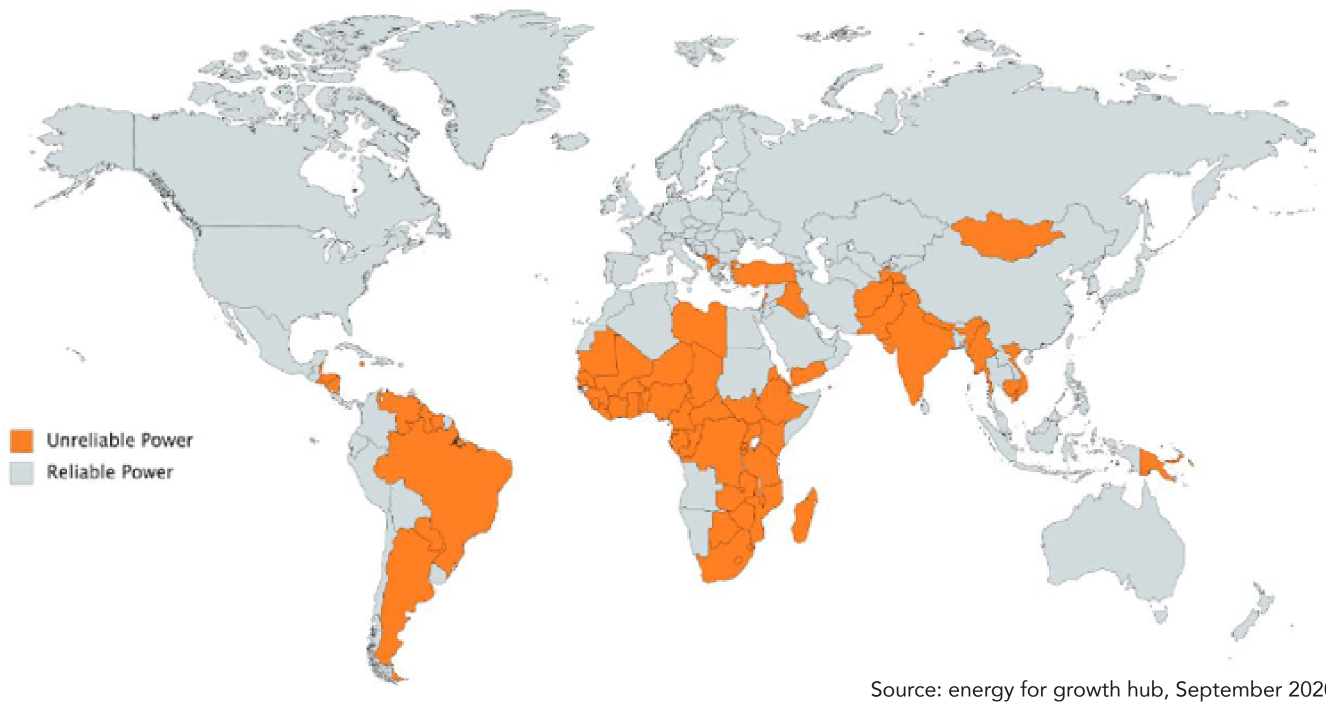
- Limited availability of literature, research, cases studies and demonstrations of BEV viability/relevance in such contexts (those being mainly focusing on high-income countries).
- Limited availability of BEV models and makes in those markets, which involved in several cases assuming import of vehicles in areas of operations, loss of guarantee coverage by OEM, set up of own self-repair and maintenance solutions.
- Absence of BEV models developed for those specific markets (Africa and Middle east), as majority of models available on the planet are developed for high-end high-income countries.

Such decision was taken assuming several risks (continued:)

- Unknown residual value of the BEV after its use phase, as the price per kWh of batteries is decreasing, meaning a risk that residual value of "older" BEVs will reduce

- A structural unreliability of national power grid in those countries, although participating agencies have the necessary means to ensure a continuity of service in electricity provision with back-up modalities (generators, solar panels…)

FIGURE 1: Map of Countries with Reliable and Unreliable Electricity Services



Source: energy for growth hub, September 2020

<u>BEV adoption: a 'political' or an 'informed' decision?</u>
The choice to engage as an organisation in BEV seem to be driven either by a political will (in the good sense of the term) understood here as a willingness to explore and learn from the yet sole alternative to ICEV, and make the bet on the promises of BEV to deliver emissions reductions.

Some participating organisations have supported this will with prospective evidences, As an illustration, in order to inform its decision making, UNHCR, supported by academic researchers has run a data-driven review of its fleet emissions coupled, identified its most emissive countries of operations, and assessed their current and future infrastructures capacities to support transition to electric vehicles. Based on assumptions they simulated the emission reductions expected by this transition and were able to estimate the timeline and costs necessary to transition the fleet in the given countries.

BEV adoption: Central vs local decision

Although some recent local policy shifts aimed at increasing the share of renewables in the electricity grid or accelerating electrification of transport like in Kenya[5], Jordan[6] or Ethiopia[7] have been factored in the decision making , choices to engage into BEV has mainly been driven by central/global level of participating agencies (fleet management units, supply chain and logistics management unit).

A variety of integration level in fleet management systems

The level of integration of electrification in the emissions reductions strategies varies from one organisation to the other:

Several agencies place electrification as a mean/tool to achieve emission reduction objectives,
as an example, NRC integrates the technology in its model to meet environmental goal but acknowledges that this lever alone is not enough:

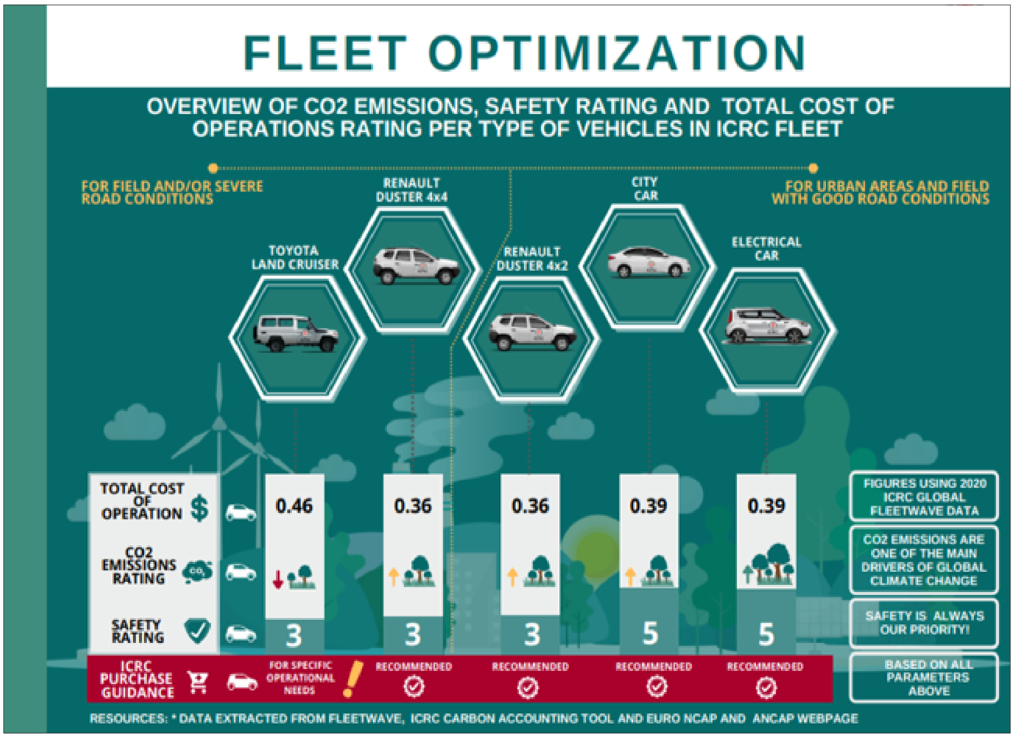
Source: NRC

[5] https://koassociates.co.ke/insight/state-of-kenya-transition-to-e-mobility/
[6] https://www.memr.gov.jo/EBV4.0/Root_Storage/EN/EB_Info_Page/StrategyEN2020.pdf
[7] https://cleantechnica.com/2023/10/24/ev-flood-gates-open-in-ethiopia-after-govt-exempted-all-evs-from-vat-surtax-excise-tax-last-year/

For UNDP, the moonshot target (50% reduction of emissions by 2030) concerns the top 3 emission source, including vehicles and materialises in an E-mobility vision.

Some agencies operationalised their electrification strategies by making BEV standard assets available within their procurement catalogues (ICRC, UN FLEET) or established market watch & market studies mechanisms (UNDP). Learning about BEV life cycle within the organisation are systematic.

Source: ICRC



The incorporation of BEV to fleet management reference documents or the development of specific guidelines existing guidance's and policies also illustrates the growing integration of that technology to fleet management modalities: WHO produced in 2020 a 'Guideline on hybrid and electric vehicles selection' and UNHCR is in the process of doing so in 2024.

Among the main challenges faced by agencies in integrating BEV in fleet management systems:
-The sourcing and procurement approach are different than for a ICEV (scarcity of models, ever evolving market, need to procure the vehicle and the charger aside…)
-The placement of the BEV on the appropriate transport segment is not as straightforward as for ICEV (range, charging infrastructure…)
-The tracking of data and its integration to current fleet management and tracking systems is complexified (need to track a new energy value (kWh), tools and software not ready…)

A communication, reputational (and greenwashing?) tool

On the public relation point of view, a clear (although not systematic) trend is observed: the procurement and use of BEV is often utilised for communication purposes, that goes from editing special logos and modifying the visual identify of the institution to be displayed on the vehicles, to setup a policy to procure BEV/HYBRID as default vehicles for representational vehicles (UNDP).

The strong communication from organisations can have a positive impact in the adoption of BEVs in countries: showing that BEVs are feasible, increasing awareness and debate in public opinion, they can attract more interest from non-humanitarian vehicle users by expanding and reinforcing the market (increase of demand leading to increased availability of makes and models, after sales services….). Identically, the strategic decisions made by organisations to procure BEVs and place them in their fleet has been instrumental in allowing exploration of their use by fleet management department.

Photo credits: UNDP, WHO Jordan, CRS Uganda

You want to push the reflection about fleet electrification further?
Focus on the risk of Greenwashing

It is understandable that agencies communicate actively or passively about the placement of BEVs in their fleet as they are exploring those vehicles emissions reductions potential: they represent important investment, they emphasize the place given to innovation in the organisation, and sector's vehicles (cars or planes) have historically been made visible for access, acceptance and accountability purposes.

It is however riskier that they communicate before having demonstrated tangible impact results, or in a manner that suggests so.

Emitting the message that the sole placement of the BEV is guaranteeing a better environmental performance, is leaning on the 'promise' or 'gambling' that BEV are delivering emission reductions per se.

This simplification of a complex matter, by the opacity it generates, can be subject of greenwashing accusations and delay the popularization among specialised and general public of the electrification complexities and trade off.

'By misleading the public to believe that a company or other entity is doing more to protect the environment than it is, greenwashing promotes false solutions to the climate crisis that distract from and delay concrete and credible action. Greenwashing presents a significant obstacle to tackling climate change'[8].

Greenwashing tactics include:

- Applying intentionally misleading labels such as "green" or "eco-friendly," which do not have standard definitions and can be easily misinterpreted.
- Claiming to be on track to reduce a company's polluting emissions to net zero when no credible plan is actually in place.
- Being purposely vague or non-specific about a company's operations or materials used.
- Implying that a minor improvement has a major impact or promoting a product that meets the minimum regulatory requirements as if it is significantly better than the standard.
- Emphasizing a single environmental attribute while ignoring other impacts.
- Claiming to avoid illegal or non-standard practices that are irrelevant to a product.
- Communicating the sustainability attributes of a product in isolation of brand activities (and vice versa) – e.g. a garment made from recycled materials that is produced in a high-emitting factory that pollutes the air and nearby waterways.

Based on the above, it would be recommendable to adopt more balanced communications tactics and refer for example as 'test vehicle' instead of 'green or zero emissions vehicles'.

8. https://www.un.org/en/climatechange/science/climate-issues/greenwashing

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What does BEV solve?

Today's challenges for transport	What BEV solves	What BEV improves	What BEV doesn't solve
Too many KM driven			The most sustainable kilometre is the one not driven Support the most emissions reduction tactics (avoid, shift)
Too many vehicles on the road			Need to reduce quantity of motorized vehicles Risk that electrification adds vehicles instead of substituting Traffic/ congestion/ Safety Low passenger occupancy rates
Infrastructure / space			Need for road network and infrastructures (soil artificialisation…) and investments Parking spaces / traffic Charging network and electricity network infrastructure and investments
Energy efficiency / Energy Unit consumption [9]		14-24kWh/100km for a BEV (vs 49-85kWh/100km for ICEV (petrol/ diesel)	BEV is 20% heavier than its ICEV equivalent
Global warming / CO2 eq. emissions		Use-phase tailpipe CO2 emissions are eliminated (but transferred to the electricity generation used to fuel the BEV)	Production and end of life CO2 emissions (equivalent to large ICEV) Use phase still generate emissions through production of electricity Supposed 'Zero emission' (promises)
Other air quality emission (PM10, PM2,5, NOx)		PM tailpipe emissions are eliminated compared to ICEV PM non-tailpipe emissions are only slightly less than for BEV	Non tailpipes emission accounts for almost 50% of emissions regardless BEV/ICEV (re-suspension, road wear, brake, weight…)
Noise		Noise reduction at low speed (from engine noise)	Noise is not disappearing at higher speeds (aerodynamic, tyres…)

9. This figure displays the amount of energy (expressed in kWh) necessary to run 100km in a given vehicle. Source: https://theshiftproject.org/panorama-offre-vehicules-impact-carbone-technologie/

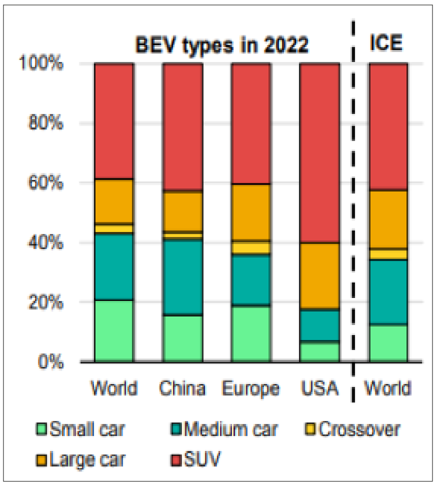
Today's challenges for transport	What BEV solves	What BEV improves	What BEV doesn't solve
Public Health: Lack of physical activity, sedentary behaviours			Lack of physical activity, sedentary behaviours
Equity			Benefits higher incomes areas Equity and coherence (against beneficiaries, colonialism)
Resources scarcity/depletion		Increases energetic dependence, reduces country of operation's fossil fuel dependency (oil import)	High critical mineral dependency (lithium, cobalt, nickel) which extraction requires fossil fuel and generates environmental and social impact, and which scarcity induces prices volatility
Waste generation and management		Reduces maintenance needs and costs (BEV constituted of less mechanical components)	Battery end of life and recycling is not dominated. Replacement of ICEV induce that they are scrapped (and not converted)
Costs		Running costs reduced	Purchasing costs are high and High critical mineral prices is delaying the cost parity with equivalent ICEV BEV developed for high incomes purchasers
Road safety			Accidents-safety Vehicles on the road

BEV MARKET TRENDS IN THE MIDDLE EAST AND AFRICA:

Let's take a step back in the following section look at what are the market global trends.

<u>> OEM priorities… are not in Africa and the Middle East</u>

Electrification of fleets is witnessing a clear and steady acceleration over the past years (both in terms of sales, technological evolutions of BEV, incentives, policies…), that trend is global but the 3 main markets for BEV sales remain **China, Europe and the United states.**



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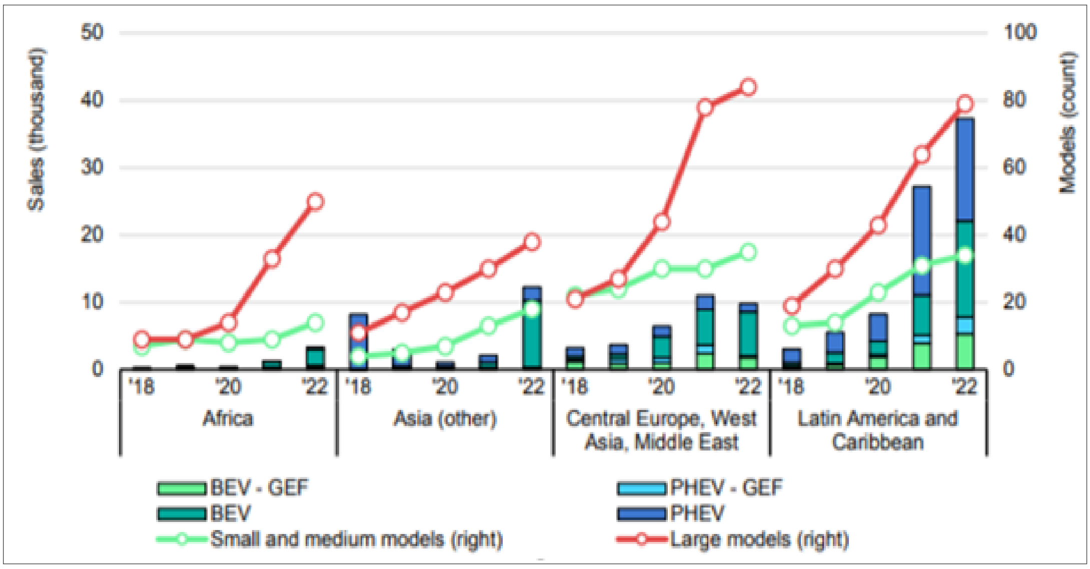
Given the resources scarcity at global level [10] low-and medium-income countries don't seem to be priorities for OEM, that favour filling **high income countries** demand with **high end products like SUV**, that are also the most margin rewarding. Some signal of interest for Africa however exists as some local start-ups or international OEM initiated assembly on the continent or plan on doing so, for example in Ethiopia, Nigeria [11] or Morocco [12].

> Availability of BEV models in Africa and Middle East

- In Africa, 2 and 3 wheelers are currently the most electrified vehicles, as for the 4 wheelers, best sellers are crossover and SUV, and it seem this trend will remain and increase.



Source: IEA global EV outlook 2023[13] - Electric car sales by powertrains (columns) and available models by car sizes (lines) in selected regions 2018-2022

- Costs: given the trend of sales in those regions, we can expect that the models available remain high-end product with quite significant costs.

> Leading importers of foreign used ICEV

Government incentives for investing in BEV charging infrastructure may be further dampened by the influx of foreign used cars (Africa was the leading importer of light used vehicles between 2015-2018, with over 40% of the global market share) . However, there are several policies already in place in some African countries to restrict used vehicle import. About 25 countries in Africa place maximum age limits on used vehicles, 4 countries have completely ban used vehicle import and 10 countries ban the import of vehicles more than 5 years old[15].

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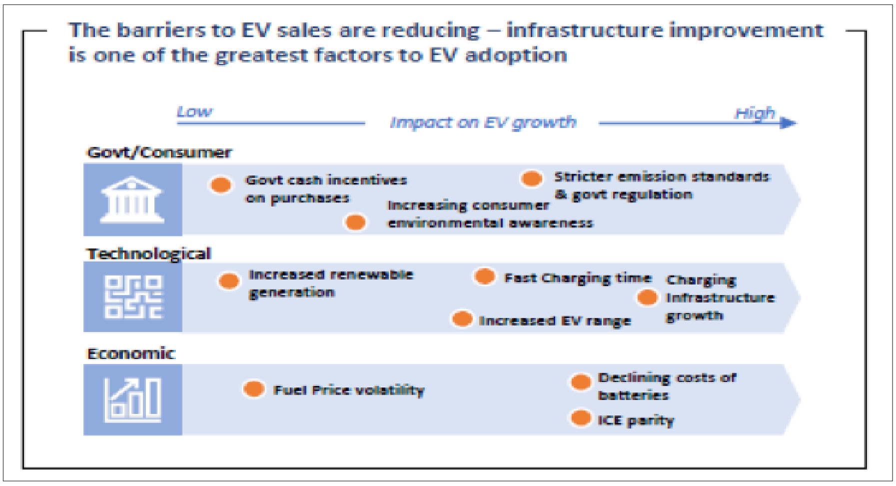
10. https://www.businessinsider.com/electric-vehicle-battery-crunch-new-chip-shortage-2023-7
11. https://businessday.ng/energy/article/electric-vehicle-assembly-to-start-in-nigeria-in-january-2024/
12. https://www.ft.com/content/8549619c-9c23-4a00-88ab-dfdac92a22ca
13. https://www.iea.org/reports/global-ev-outlook-2023/trends-in-electric-light-duty-vehicles#abstract
14. Global Trade in Used Vehicles Report | UNEP - UN Environment Programme
15. https://www.sciencedirect.com/science/article/pii/S2590198221000919#b0045



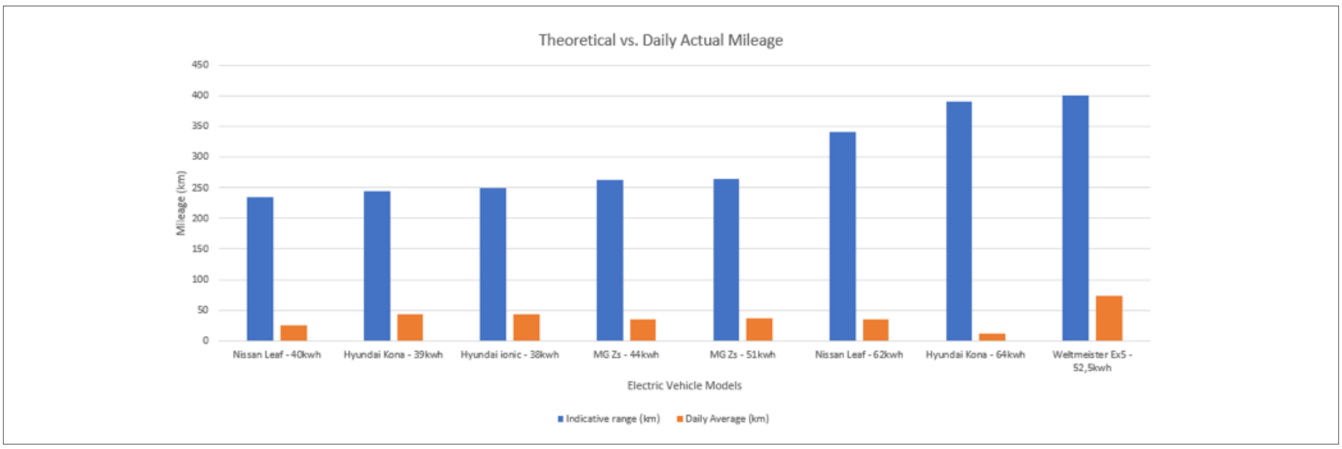
Source: UNHCR

NEEDS SIZING AND RIGHT PROFILING: THEORY VS PRACTICE

> As any other asset, the profiling of a BEV should theoretically be made following both:
- A sound prospective mobility/transport needs analysis[16] by the humanitarian organization,
- A country specific review of external factors (road infrastructure, charger network…)

> In practice, we have made the following observations:
- Some BEV have been placed within fleet mainly constituted of heavy-duty 4x4, therefore raising the question of a fleet right-sizing right-profiling anomaly prior to a mid-sized BEV placement.
- Despite having implemented a sound need sizing exercise, the BEV makes and models procured are in the end rather dependant on their availabilities on the local market.
- A trend to seek for the best ICEV replacement (by sourcing BEV with the highest battery capacity (power and range), without sufficiently identifying the best use-cases for BEV within a specific context of operation

This observation is corroborated by the review of the BEV procured that are overall rather under-utilised.



16. https://knowledge.fleetforum.org/knowledge-base/article/calculating-the-right-fleet-size

See for reference Annex 1 – Pre-Procurement check list

AGENCIES PROCUREMENT STRATEGIES: MORE LOCAL THAN GLOBAL

While some participating agencies are trying to standardize their BEV procurement approach by setting up global Long Term Agreement (LTA), in an attempt to replicate current procurement strategies for ICEVS and other assets, it is observed that local procurement is currently dominating the BEV supply strategies.

As an illustration, out of 17 BEV procured around the world by UNHCR in 2023, 13 were from local supplier while 4 (23,53%) were from Global Fleet Management. Out of 24 BEV procured by UNDP in 2022 in the framework of their Moonshot project, 37.5% (9 units) were procured using the organisation's long-term agreement, while 16 units were so through open local procurement processes.

Here is why we have witnessed these trends:

- The BEV market is still embryonic and booming, therefore it evolves at different paces all over the world more particularly in the low- and medium-income countries.

- New manufacturers, make, models and battery technologies are regularly appearing, their availabilities in stock are fluctuating depending on OEM strategies and countries of final use.

- In-country BEV related infrastructures, OEM distribution networks, warranty coverage and aftersales services availability are also variating from one location to the other.

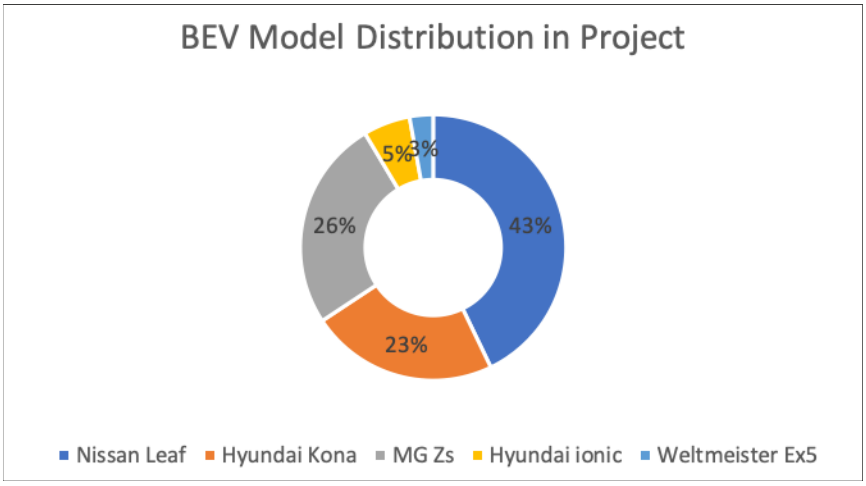
The profile of the LTA themselves reflect the lack of OEM presence in the final use-markets, as an example some participating agencies set-up one-off or longer term agreements with Kjaer and Kjaer a resale agent intending to fill the gap between the humanitarian organisations demand and the lack of presence of OEM in the Middle East and African markets.

That solution, problem-solving as allowing to operate BEV despite absence of local distributors, naturally comes with constraints: capacity to supply BEV to a certain country involves modified warranty coverages and outlook (up to 1 year warranty only in some cases) and/or induces warranty extra costs, setup of local adhoc agreement for after sales and maintenance or the development of reexport tactics…

A fully globalised, centralised and standardized approach to BEV procurement (understood here as a pure replication a the current common ICEV procurement strategy: model specifics, multi-years, multi-countries agreements with manufacturers and/or distributors) doesn't seem neither possible nor relevant yet. It's observed that participating agencies rely on the assessment of local markets to procure the vehicles, by for example using 'local after sales services availability' as a selection criteria in the procurement process.

See below the make and models tracked in the framework of the project:

A rather limited number of manufacturers offer BEV at the moment, but situation is evolving very quickly, new manufacturers and models are appearing on the market.



> Local market assessments trends:
In the framework of BEV introduction in their fleet, participating organisations have been observing the local policy and regulations evolutions regarding transport electrification, as well as establishing surveillance mechanisms of the local BEV suppliers market (establishment of OEM assembly factories in the region, development of BEV mechanics training centers, availability of make and models). In multiple cases, they have also led local open tender.

In the framework of its e-mobility vision, UNDP has been leading an extensive market research of BEV and EVSE (Electric Vehicles Supply Equipment) suppliers in 54 countries of operation. In 25 of those countries they have proceeded to the procurement of BEV/EVSE.

> After sales and warranty
As highlighted above, agencies participating to the project have in most cases conditioned the procurement of a BEV to the availability of after sales and warranty guarantees in the country of operation. That has been systematized after learning from the 1st importation process of vehicles outside of the warranty scheme that has involved in some cases concretely assuming the risk of not being able to fix their issues in country (need to export the vehicle back or to assume fully the costs and management of repair and maintenance including import of spare parts (ICRC).

Except for some specific cases like the one mentioned above, and given the low repair and maintenance required by BEV compared to ICEV as well as the coverage of those under the warranty period, participating agencies have not declared facing issues with the provision of local after sales repair and maintenance services.

As a very indicative illustration (this type of information outdates very quickly) of how the warranty coverage varies from make, models and from country to country, and includes specific distinction in the battery coverage, see the below table:

	Kenya \ Model C	Jordan / Model A	Jordan / Model B	Kenya / Model C	Jordan / Model A
General Warranty	None	5 years 100 000km	5 years 100 000km	5 years 300 000km	6 years 200 000km
Battery Warranty	None	Same as general warranty	8 years 160 000km	8 years 160 000km	8 years
Comment	Imported by organisation				

You want to push the reflection about fleet electrification further?
Focus on decolonisation of aid and sectors commitment to localisation

We have seen that decision making around operating a BEV on the ground is mainly driven by local factors, as placement decision have mainly been taken at central level. While both aid localisation and aid decolonialisation debates are gaining more and more space in the sector, that observation is a good opportunity to take a step-back and think critically:

The localisation of aid is identified as one of the main levers to reduce its environmental footprint . Several commitments to accelerate this transfer of responsibilities, not only funding but as well decision making, from the 'global north' to the 'global south' have been made by the humanitarian and aid sectors in the past years.

The Grand Bargain launched during the World Humanitarian Summit in Istanbul in May 2016, and signed by the participating agencies, has as core objective to 'improve efficiency and effectiveness of the aid': it is a unique agreement between some of the largest donors and humanitarian organisations who have committed to get more means into the hands of people in need and to improve the effectiveness and efficiency of the humanitarian action.

While global fleet management unit have been the main drive to introduce those vehicles, in a laudable endeavour to look for innovative solutions, and in many cases fundraised/assumed risk of introducing them in the countries of operations, they are also exposing themselves to the accusations of neo colonialism by duplicating as it is, and intend to universalise, a very recent and localised global north trend of electrification into global south countries without situating the mobility challenges among local needs and trends .

17. https://www.thenewhumanitarian.org/feature/2022/08/12/Decolonising-aid-a-reading-and-resource-list
18. https://www.urd.org/en/project/scoping-review-on-environmental-footprint-of-humanitarian-assistance-for-dg-echo-2/
19. https://interagencystandingcommittee.org/content/grand-bargain-hosted-iasc
20. https://energyforgrowth.org/article/the-drivers-africas-electric-vehicle-future-might-be-different-than-you-think/

This risk is particularly exacerbated by the fact that the electrification boom in the global north has **not delivered impact yet**, many questions remain unanswered such as the scalability of the solution and its capacity to fill the gap of clean mobility inequalities.

Given that the trade-offs involved by BEV placement are mainly driven by local factors, it seems essential, despite a need for global-local coherence, that humanitarian organisations invest into capacitating their local collaborators on the complexities and debates around electrification topics on one side, create and secure spaces of common critical discussions around the decision making on another, in order to positively contribute to the shift of established processes of control and power and the identification of situated solutions.

> Summary of the 'adoption phase':

The participating agencies first adopted BEV in the framework of achieving the emissions reductions they have committed to. They did so with the mindset of assessing the leverage such fleet electrification would provide to achieve their objectives, by simultaneously evaluating and building evidence on the acceptance and operability of such vehicles in their context of operations and by evaluating the change it would involve in their fleet management approaches to maximise their potential. Decisions to go electric although mainly driven by the global decision makers are very much conditioned by local considerations (share of renewables in the local electricity grid, local authorities' incentives…). Early adoption by aid agencies involves assuming a series of risks (lack of evidence provided by literature and research in low- and medium-income countries…) as well as facing multiple constraints among which sourcing and procurement are at the centre (limited availability of such vehicles in the countries, necessity to manage importation, difficulties to standardise, non-systematic aftersales services and of warranty provision offered…).

2 - USE PHASE FINDINGS

First thing first: what it means for drivers

With the aim to understand better the impacts of placing BEV among users and managers, a survey was run across participating agencies, respondents were provided multiple answers to statements (Fully agree, partially agree, partially disagree, fully disagree, I don't know).

A total of 16 drivers widespread among intervention countries took part to the survey:

- Almost all the drivers found the BEV simple to learn and to operate (87.5% fully agree, 6.25% practically agree, 6.25% answered 'I don't know). They stated preferring driving a BEV than an ICEV (11 fully agree, 1 partially agree, 1 partially disagree) and consider that their driving range is greater than the average urban mileage driven in operations (81% fully agreed, 6,5% partially agree, 12,5% partially disagree), which demonstrates that the BEV are overall well received by the drivers community.

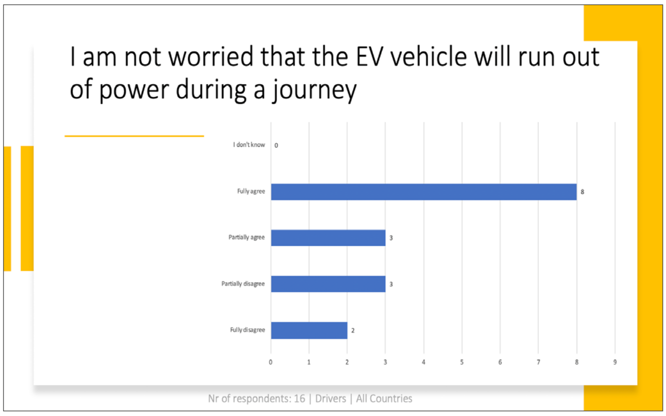
- 91.6% stated that they know how to charge a BEV (11 fully agree, 1 fully disagree) but to the statement 'I know how long it takes to charge an EV' 1 responder answered 'I don't know', 1 'I fully disagree', 2 'I partially agree' and 12 'I fully agree', highlighting that there is less confidence around this specificity of BEV. We'll get back to that in the 'charging' section below.

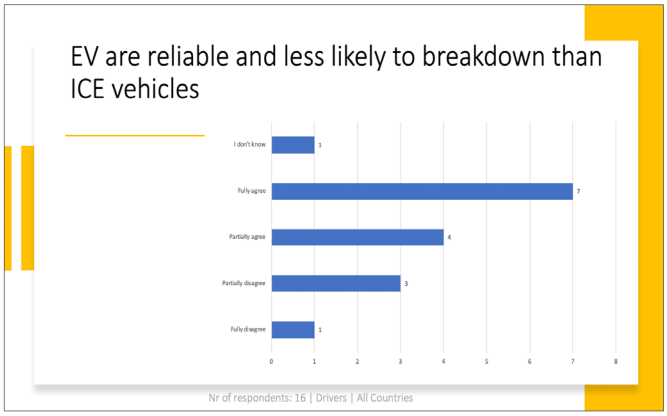
- The drivers perceptions get also more balanced when we come to specifications and features of BEVs as well as on the BEV ability to operate effectively in urban conditions:

- To the statement 'the specification and features of a BEV are equivalent to an ICEV' 62.5% answered to 'fully agree or partially agree', while 37.5% either fully or partially disagree.

- To the statement 'BEV are able to operate effectively in our urban conditions (rain, dust, road quality) just as well as our ICEV' 79% state partial or full agreement and 21% partial or full disagreement. Main feedbacks collected by fleet managers from drivers during the course of the project has been around the ground clearance of vehicles that is slightly shorter than their ICEV equivalent – and that's mainly explained by the extra weight of the EV induced by its battery (approx. 20% heavier than their ICEV equivalent).

- But the highest level of anxiety detected in the course of that survey seems to come from the driver's perception of range of the BEVs they are operating, and about their mechanical reliability compared to an ICEV:





Those findings are matching the usual users feedback when introducing a new technology, and highlights the importance to communicate and myth-bust around the BEV technology.

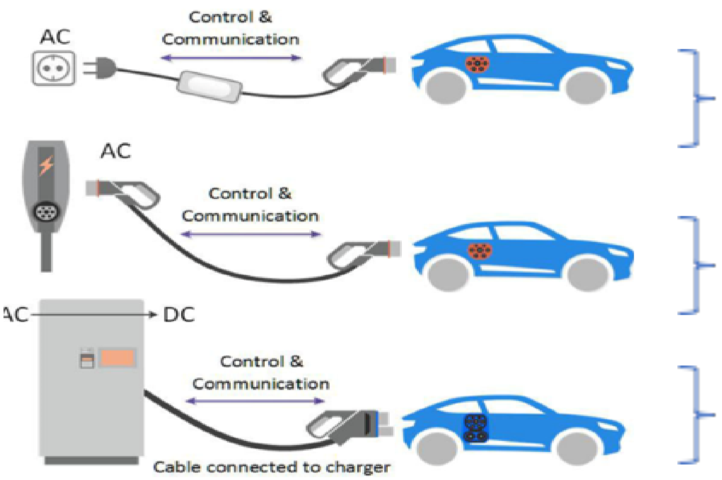
The fact that an electrified vehicle remains a vehicle induces that it doesn't require a change of skills set to be operated and managed, however, such vehicles are displaying specific features that need to be taken into consideration in order to maximise their performance (e.g. regenerative braking…). This requires an upskilling of the driver alongside a generalisation of economical driving practices among pool of vehicles operators. Drivers skills and behaviours are instrumental to the economic and environmental performances of fleets may they be electrified or not.

See in Annex 3: the upskilling needs list

> On charging and monitoring/tracking BEV consumption:
In this section we are touching probably the most important operational difference between a BEV and an ICEV: whereas ICEV operations are supported by an established (and growing) infrastructure and network of gas station in every part of the planet where one can fill its fuel tank and regain between 500 and 800km of range in a few minutes, a BEV is dependent on a charger which network availability is embryonic and that requires several hours to reload a battery.

- Its therefore essential to discuss charging tactics at the BEV feasibility study stage (see Annex 1: Pre-Procurement check list); a review of the journey and route patterns of the fleet segment should be done in order to place the charger(s) at the most relevant location, as well as a mapping of existing public and private charging points. Interagency shared charging infrastructure seems to be a very relevant approach to tackle simultaneously the investment burden of chargers installation and increasing the charger's network. For reference participating agencies at UNON compound in Nairobi are implementing that successfully.

- In terms of management and dispatch, journey allocation of BEV should take into consideration the charger's location (and the car range), as well as adjust the unavailability time of the asset to its proper charging requirements (otherwise, one would expose its self to have a BEV not sufficiently charged for a specific journey).



Level 1 – Electrical source from a regular home/office outlet. 3-8km per 1h of charging

Level 2 – Electrical source from a regular home/office hardwire, or public station. 16-32km per 1h of charging

Level 3 – Electrical source from a public station. 250-350km per 1h of charging

- Electric Vehicles Supply Equipment (EVSE) are in most cases **not supplied with the vehicle provider** (except for the level 1 charger) and need to be subject to a parallel sourcing and procurement exercise, creating de facto a challenge: separate procurement process, delivery coordination, vehicle start of operations….

- EVSE technical specifications need to match the onboard charging device of the EV (a no match would involve slower charging time for example), that can add a layer of technical complexity at the moment of sourcing a charger.

* Additionally, a large variety of EVSE is available and permanently evolving, with cascading service provision offers (simultaneous charging, smart, online tracking…), making sourcing and model selection more complex.

Smart chargers are covering a wide array of functionalities, from tracking properly a fleet of different vehicles using the same charger (RFID cards provided to drivers, ethernet, wifi…) to managing the charging of assets at times when demand and/or tariffs of electricity is lower; it also allows to set the desired minimum and maximum charge level, the charge-by time…

We've observed that participating agencies are mainly equipping themselves with level 2 chargers, and are currently exploring the use of smart chargers in order to better bridge the data collected from BEV to their current FMS/FTS, those that didn't do so had to install an electric meter upstream the charger and had to get back to a 'manual logbook' approach to track the kWh consumed by each BEV.

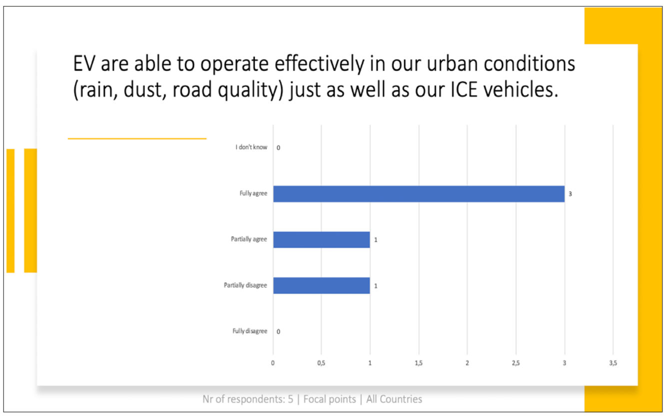
* Charger's installation and operation can therefore induce substantial electric (AC/DC, installation of electricity meters…) and **infrastructure modifications** (availability of a fixed parking lot…)

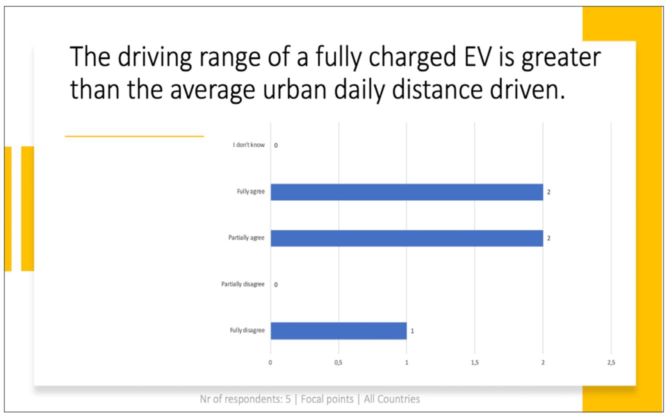
* Despite the availability of numerous (and counting) solutions on kWh tracking, the participating agencies **current FMS/FTS are not always ready** to input those data and therefore require modifications. Typical example: systems are ready to input liters of fuel but not kWh of electricity.

> On what it means for a fleet manager

Fleet managers have been at the forefront of practically integrating BEV into their fleet and evaluate their applicability to their respective contexts of operations. Beyond capturing learnings from their local experiences and tracking the vehicles data, they have also been subject to a survey, here are the findings drawn among a cohort of 5 respondents:

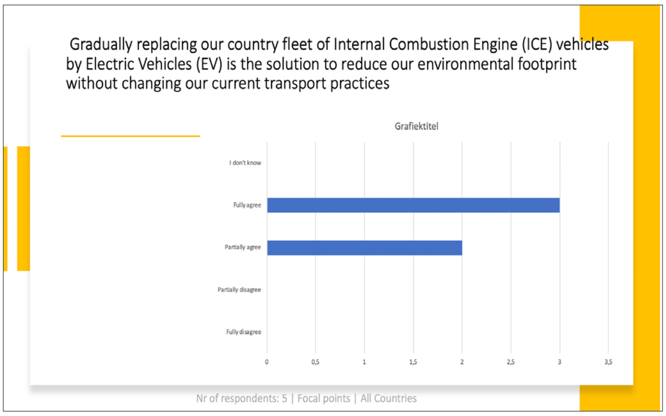
* 80% of fleet managers either fully or partially agreed to the statement that 'BEV are able to operate effectively in our urban conditions (rain, dust, road quality) just as well as our ICE vehicles' while 20% partially disagreed.

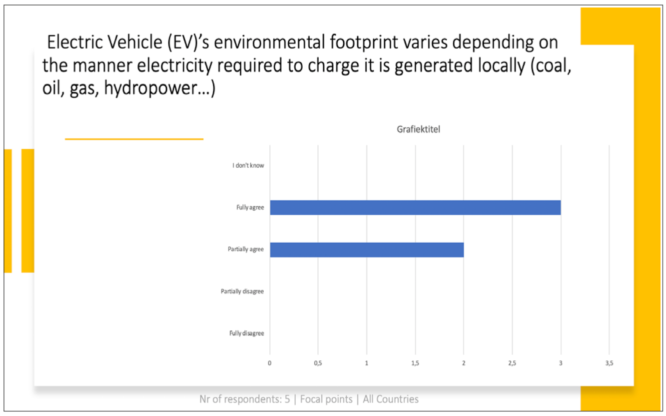




The findings are similar when responding to the statement 'the driving range of a fully charged BEV is greater than the average mileage driven in operations': 80% fully or partially agree although 20% fully disagree. Fleet managers consider the BEV mechanically reliable to meet the needs of urban transport needs (4 fully agree, 1 partially agree to that statement), we can conclude that they consider those vehicles operable in urban contexts.

- On BEV general knowledge, fleet managers are aware of how electricity generation method drives environmental performance of the BEV, however they tend to see the BEV as a silver bullet to reduce their fleet emissions (60% fully agree, 40% partially agree).





The survey didn't cover such questions and this could be the topic of future investigation but that last finding raises the question of the fleet manager acquittance with transport emission reduction strategies such as Avoid, Shift, Improve and with the stakes and complexities linked to electrification.
Similarly to the drivers survey findings, the statement that 'BEV specifications and features are equal to an ICEV' triggers 60% of partially disagree or fully disagree answers and 40% of fully agree or partially agree answers.

Coupled to the current survey results, the findings on utilisation and total cost of operation highlight a need to adjust the fleet managers skills while including BEVs to their fleet:

- charging time and constraints need to be incorporated in the journey and route planning of the fleet assets (as recharging takes time and is not available everywhere),

- particular attention need to be placed into studying routes, range of the BEV in distinct weather conditions, allocation to the most intensive segments of the transport demand.

See in Annex 2: the upskilling needs list

Fleet Forum

> On utilisation: replacing an ICEV by its BEV equivalent, a good approach?

As a BEV environmental impact is concentrated on its fabrication and disposal phases, compared to an ICEV (which use phase accounts for most of the emissions), it is use phase (number of km driven) that will determine its environmental breakeven against one ICEV. Assuming we seek for the quickest environmental breakeven, BEV utilisation should be maximal to guarantee the fastest return on investment.

It is witnessed that utilisation of BEV is rather low among participating agencies, for understandable reasons identified in the survey findings:

- Range anxiety from vehicle operators, dispatchers, passengers induced by a new technology
- Available BEV models are not designed for the markets where they have been placed by participating agencies, which also triggers anxiety on their operability, although that perception is not backed by factual findings
- Lack or low availability of charging infrastructures
- The BEV is seen as a simple replacement of ICEV, without questioning the usage actually given to the ICEV, therefore some habits from ICEV management (underutilisation, over profiling, lack of pooling…) could be transferred to the BEV.

It is essential to place the EV in context of operations where utilisation is going to be maximal, and seek for it:

- allocation to high mileage segments of transport demand
- allocation to interagency pooled approaches
- -allocation of BEV in priority at dispatching stage
- allocation to interagency ride sharing modalities

As an illustration, some participating agencies are now dispatching their assets as follow on a day-to-day basis:

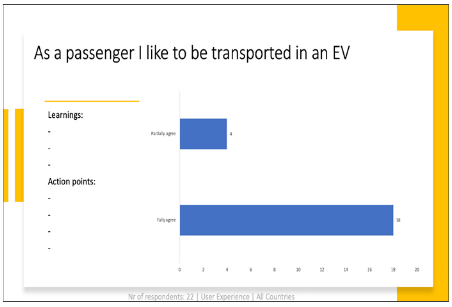
Assuming that the journey type matches the range and type of vehicle needed, dispatcher are asked to allocate vehicles following that order of priority:

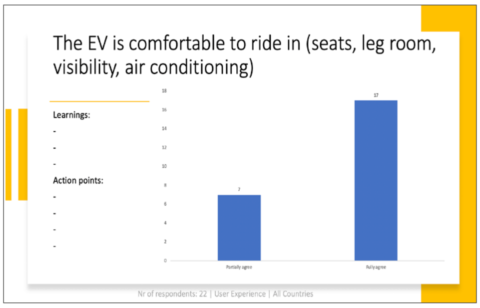
- Priority 1: BEV
- Priority 2: HEV
- Priority 3: Last resort: ICEV

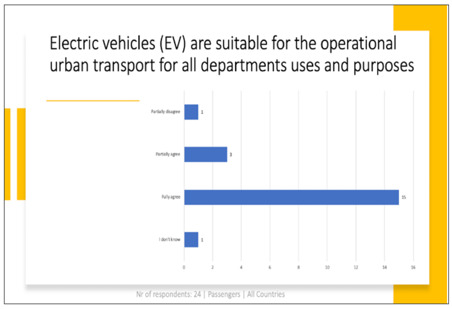
> Last but not least: What are the passenger's opinions about BEVs?

Similarly to drivers and fleet managers as exposed above, 24 passengers from participating agencies were surveyed, regardless their function in the participating organisations.

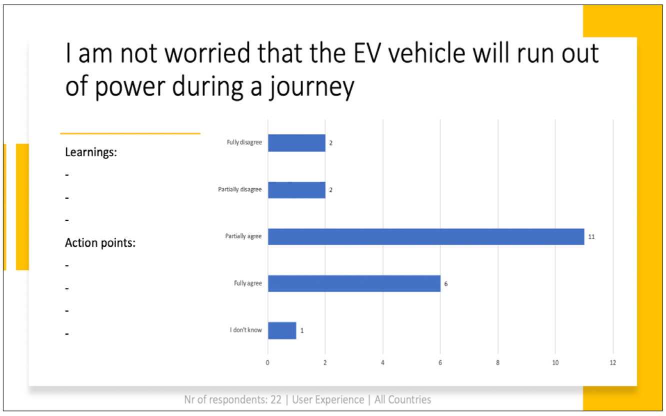
- Overall, passengers liked being transported in the BEV, found those comfortable to ride (seat, leg room…)

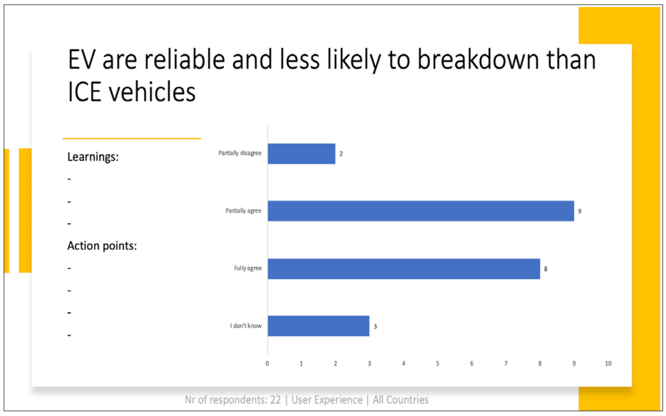






- Their feedbacks are less unanimous when it comes to range and mechanical reliability, which bring to the conclusion that engagement with users and passengers from agencies to bust myth and raise awareness about integration of such technologies in the fleet.





> Summary of the 'use phase':

The BEV are operable and applicable in the context of operations where they have been placed by the participating agencies. That operability is a determining first step to achieve BEV placement broader objectives (emissions reductions), but yet it doesn't constitute alone a guarantee to achieve them.

Challenges faced by participating agencies in this phase are both human and technical. On the human side, BEV placement involve facing user's anxiety's (passengers wonder if the range will allow to arrive at destination, drivers face vehicles specific features…) while on the technical hand BEV placement induced reviewing and adapting the established fleet management practices by giving an increased importance to the type of 'usage' best-suited for the vehicle (identifying transport demand segments more suitable to BEV placement, strategizing charger's localisation, adjust journey allocation to range, include charging constraints in fleet planning…)

3 - END-OF-LIFE PHASE FINDINGS

> On decommissioning standards

The end of utilisation phase of BEV within the participating agencies is still in the process of being determined and standardized, for obvious reasons:

- the very recent inclusion of BEV in the fleets, limiting the availability of facts/ information/ data on when to better remove them from usage.

- the absence and/or low maturity and/or unknown surrounding 2nd hand market in the country of operation (sale on public auction being one of the most used disposal methods in the sector, aiming at recovering the residual value of the vehicle). That very same observation also applies to the market of battery repurposing/recycling: there is a need to assess, search for decommissioning options (market watch).

- However, it appears clearly that the discussions around decommissioning of BEV are still rather driven by economic indicators and considerations around the use phase of the vehicle (reduce the total life cost by minimizing running costs, maximising resale costs, dispose of vehicles before warranty period ends …) and lack the inclusion of sustainability considerations (social, environmental).

That trend is fairly understandable given the common standards in place for years in the sector (5 years – 150 000km), questioning current practices requires time and facts, but it seems that things are moving as would illustrate ICRC decision to extend decommissioning criteria to 7 years and 150 000km (all assets).

Where is the BEV value? What does it imply?
The residual value of the BEV leans essentially in the battery pack and the electric motor, that is valid for both the economic and environmental values. Therefore, its right profiling (oversized batteries means oversized costs and environmental impact) as well as its optimal conditions of use (eco-driving, charging best practices…) are determinants to guarantee the asset residual value.

> On battery recycling: the uncompleted loop

Battery technologies are multiple and ever evolving, although nowadays the Lithium-Ion (LTO) is among the prevailing technologies, other technologies exist or are being developed (LFP, NCA, LMO…).

Resources depletion:

An average ICEV contains 20kg of copper and 10kg of manganese while an average electric model 55kg of copper, 15kg of manganese, 0,5kg of rare earths, 9kg of lithium, 13kg of cobalt, 40kg of nickel, 65kg graphite[21].

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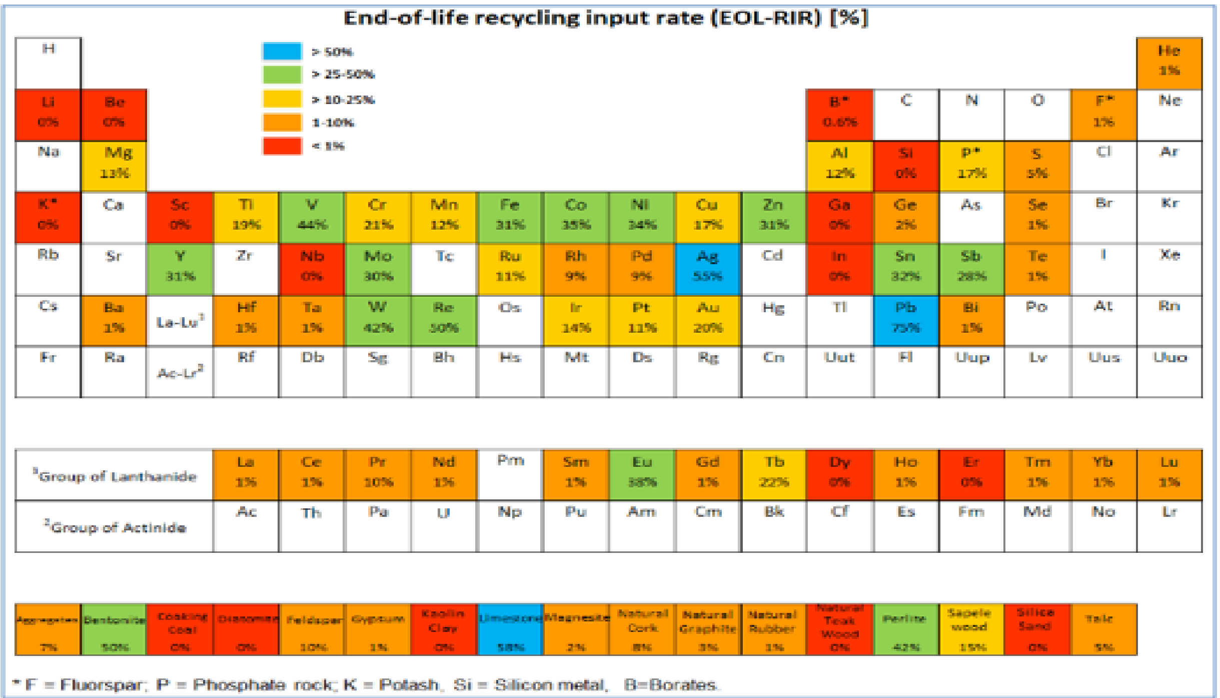
[21]. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

Battery production highly contributes to resources depletion (environmental impacts of transport are not only about the CO2 but include other negative externalities (see Annex 4 CHORD report), therefore the management of their end of life is identified as a crucial challenge to allow energy transition in the automotive sector.

Recycling rates overall remain very low

The following table captures the end of life recycling input rate of European Union as of 2017. The indicator measures, for a given raw material, how much of its input into the production system comes from the recycling of "old scrap" (or "end-of-life scrap") i.e. scrap and waste derived from the treatment of products at their end-of-life (EOL). The table indicates that in rare cases the maximum input rate is above 50% when majority varies between less than 1% and 25%.

Figure 3 End-of-life recycling input rates (EOL-RIR) for the EU-28 based on the MSA studies (when available) and used to draw the 2017 List of Critical Raw Materials for the EU.

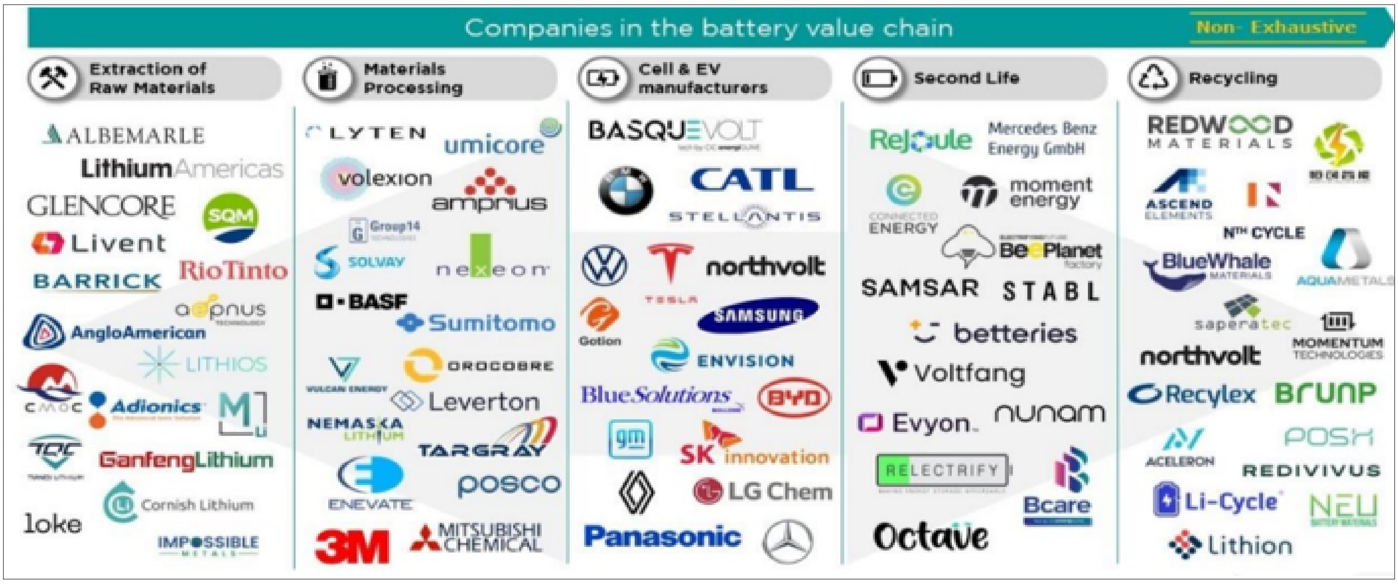


Source: End-of-Life recycling input rates (EOL-RIR) for the EU-28 based on the MSA studies (when available and used to draw the 2017 List of Critical Raw Materials for the EU

Recycling market:

Given its dependency on depleting resources, the battery pack constitutes by far the main value of the vehicle, may it be both environmental and economical and is at the center of the end of life management business model. A business model and market, that are still in a phase of definition/ constitution/ consolidation. Although still at a very early stage, the Extended Producer Responsibility (EPR) illustrates the growing attention given by OEM to the battery end of life phase to secure that business model. As a factual illustration, it is estimated that only 5% of batteries are being recycled worldwide[22].

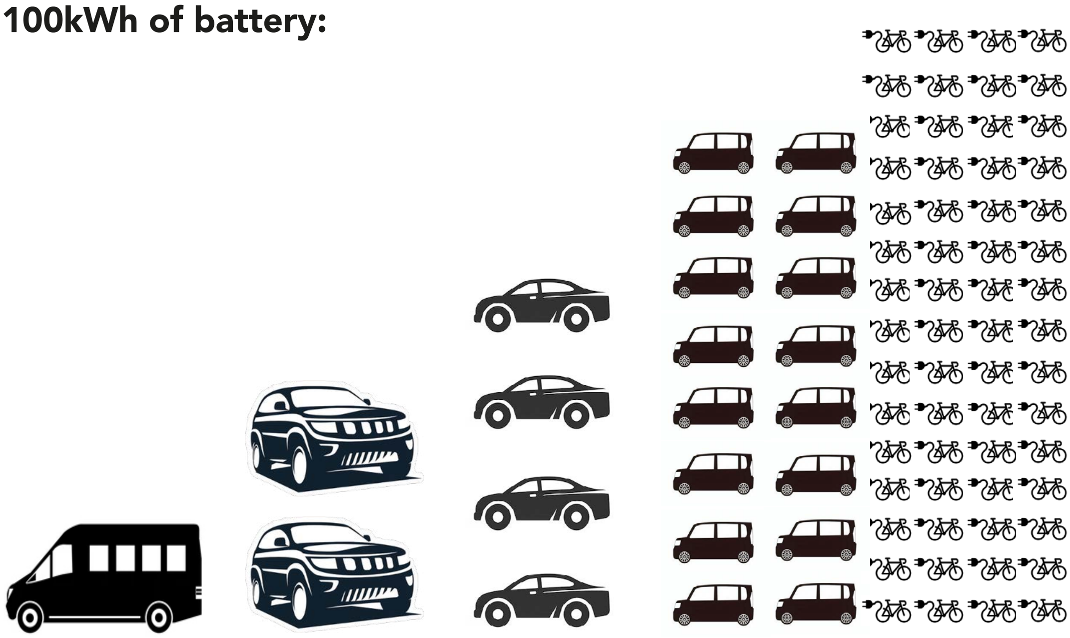
[22]. https://environmentjournal.online/headlines/just-5-of-total-battery-metal-production-comes-from-recycling/



Source: UNDP

As an illustration of the trade-off induced by battery production and its right sizing on one hand, and the level of service it delivers (number of passengers, range) on the other, see the below indicative visual: having two 50 kWh batteries, rather than a single 100 kWh battery, makes it possible to put two BEVs on the road instead of one…

Making sense of 100kWh of battery:



1 Minivan

2 SUV/Crossovers

4 City Cars

16 KeiCars

200 E-Bikes

Type	Minivan (100 kWh)	SuV (50 hWh)	City Car (25 kWh)	Keicar / Minicar (6.5 kWh)	E-Bike (0.5 kWh)
Range (km)	360	260	165	80	60
Weight (kg)	2585	1440	1000	474	25
Passenger capacity (pax)	8	5	4	2	1
Unit cost (USD)	43.000	35.000	20.000	11.000	600

> Summary of the 'end of life phase':

Participating agencies decommissioning practices, although evolving, are still very focused on the use phase of the asset and driven by economical and practical considerations (expected resale value on second hand market, extinction of the manufacturer's warranty period…). In the case of BEV the assets have been so recently placed in fleets that no conclusion yet has been drawn on what would be the optimal disposal standard. The fleet electrification seems however to contribute to an increased attention given to the end of life phase of the vehicle and to move away from the prevailing practices that 'a transfer of property is a transfer of responsibility'.

The battery pack constitutes the main value of the vehicle, and is therefore at the centre of the trade-offs induced by inclusion of BEVs in a fleet: it size determines both the economical investment and the ecological damage induced by its production and end of life.

The battery recycling loop, despite improvements, is far from being closed as recycling rates of strategical depleting raw materials are very small, and the recycling market – although clearly instrumental to the BEV business model- is in a phase of consolidation.

Instead of betting on the promise of infinite recycling, the current situation should induce prudence from BEV purchasers on both limiting the size of the battery procured (limit unnecessary resource depletion) and increasing attention to the use phase of the vehicle (placement in the most relevant transport demand segment, driving style, charging cycles).

Taking into considerations such end of life constraints in the initial decision making around BEV adoption seems instrumental.

4 - CROSS CUTTING / FULL LIFE CYCLE FINDINGS

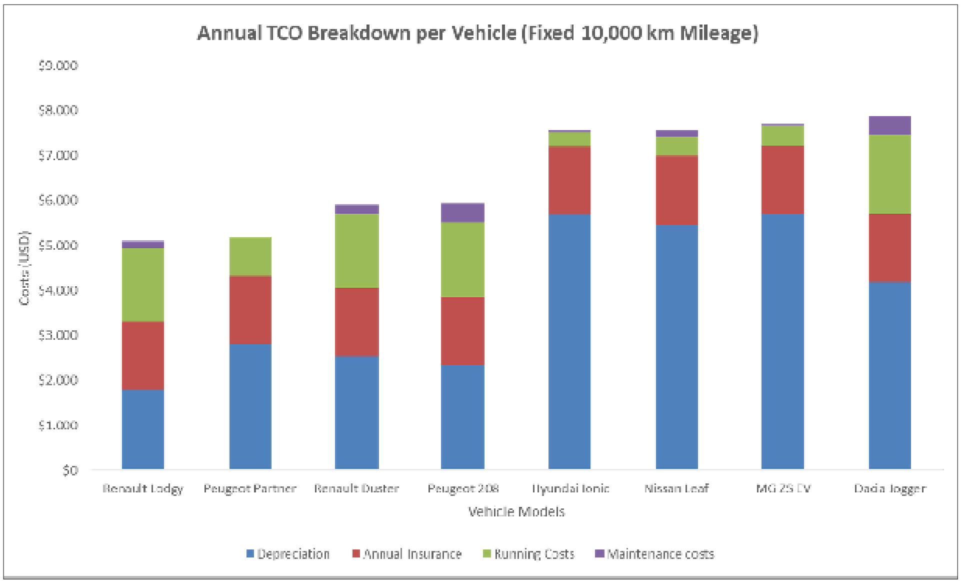
> On economic life-cycle: TCO (total cost of operation):

What is TCO?

It is the total cost of owning vehicles in your fleet over period of ownership. It is an aggregated/ combined cost amount figure that includes: the initial purchase cost of a vehicle, all running costs for fuel & maintenance; all administrative costs such as insurance and taxes relate to owning the vehicle; and then subtracting the projected market value sale income upon disposal.

We have processed the data from 34 BEV operated by the participating agencies and proceeded to calculate the TCO. See annex 5 – TCO calculations full review (all countries) results

TCO comparison BEV-ICEV:
In absence of a perfect match between a BEV model placed in fleet and it ICEV equivalent, we've chosen to look into the fleet offering the most variety of vehicles types (ICRC Jordan) and look at the TCO profiles for 10.000km.



> Purchase and depreciation costs: by far the most important cost of operating the BEV. Significantly higher than for the ICEV. NB: although worldwide the costs of procuring and BEV is getting closer to its ICEV equivalent, it is to be expected that this equalization will be delayed by the cost increase of raw materials. Limits of the findings: the TCO doesn't include the procurement and installation costs of the charger units.

> Insurance: second most important post of expense for the BEV, but rather equivalent to the ICEV costs.

> Energy/running costs: 3rd expense item of the TCO for BEV, overall cheaper than for ICEV. That cost naturally varies from one country to the other for the electricity grid costs, and from growing 'hybrid' form of energy provision (public grid, office solar panels…).

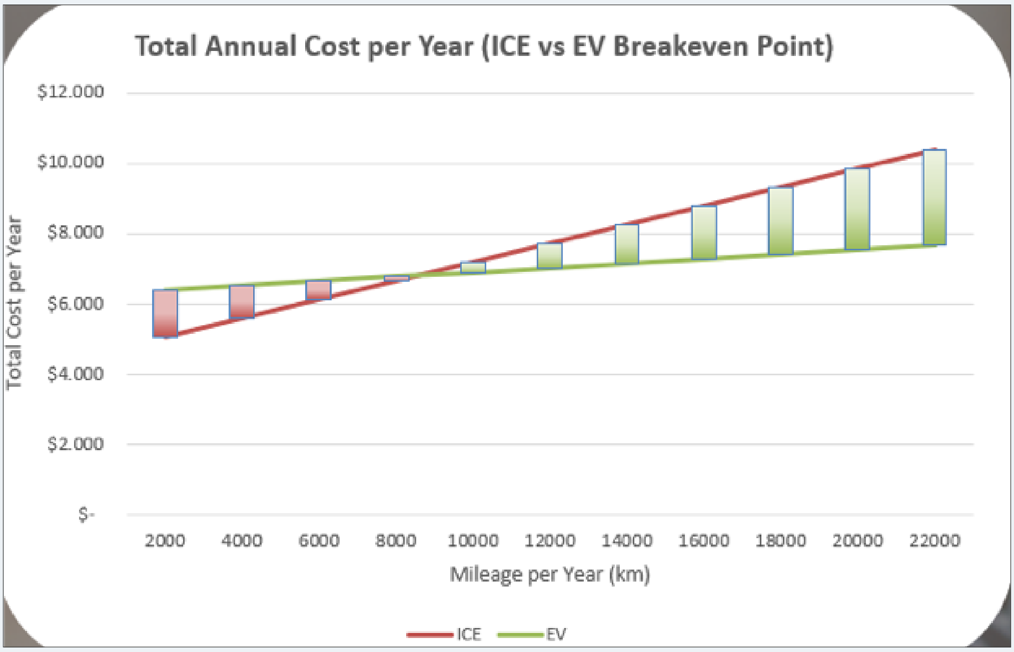
> Maintenance: definitely drastically reduced, if not eliminated, for BEV, as they are constituted of way fewer mechanical components than their ICEV equivalent. NB: the observed fleet of vehicles is very recently purchased.

> Overall TCO: if we take into account all the expenses, the TCO for a BEV is slightly higher than for an ICEV. Ensuring a high usage of the BEV (by prioritizing its dispatching, its allocation to high demand transport segments…) is instrumental to allow quicker financial breakeven against an equivalent ICE.

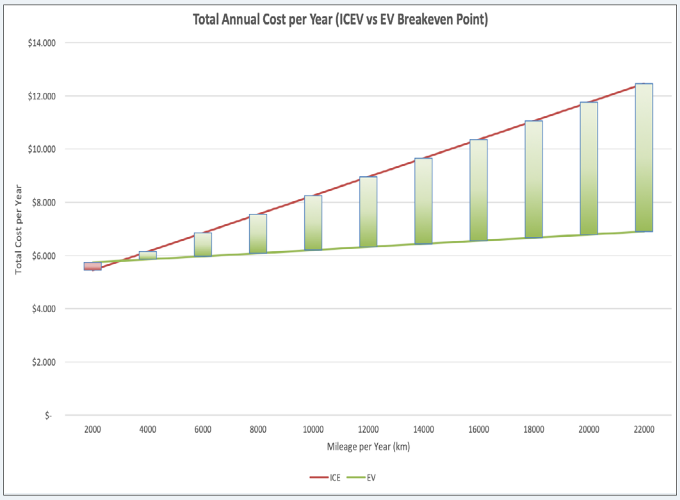
BEV vs ICEV TCO: breakeven depends on the fleet profile

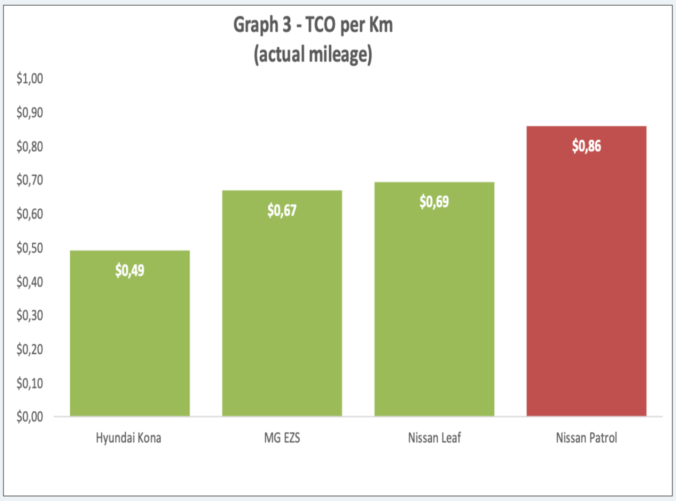
- It is observed that depending on the profile of the participating agencies fleet in the given country, their TCO breakeven varies depending on the ICEV profile of the fleet. Of course, the following findings are exposed to the critics or being comparing apple and carrots, as the BEV and ICEV compared might not be pertaining to the same car category, however they are shedding an interesting light on the actual fleet profiles in which the BEVs have been placed.

Focus on Jordan: breakeven and fleet compositions

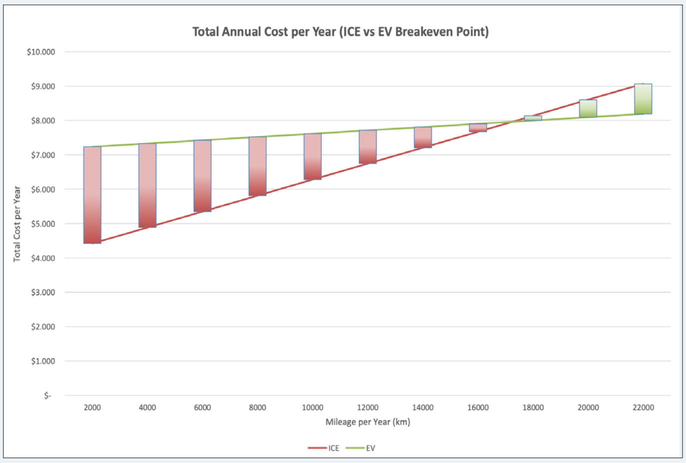


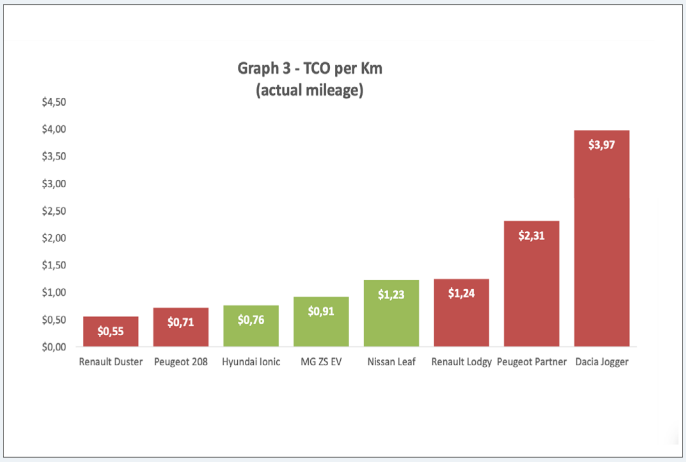
1 - On average in Jordan the breakeven of BEV vs ICEV is 9 000KM (4 agencies and 23 BEVs)



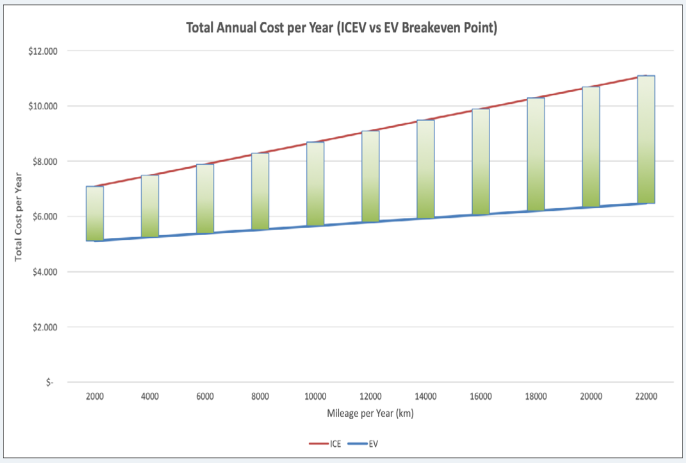


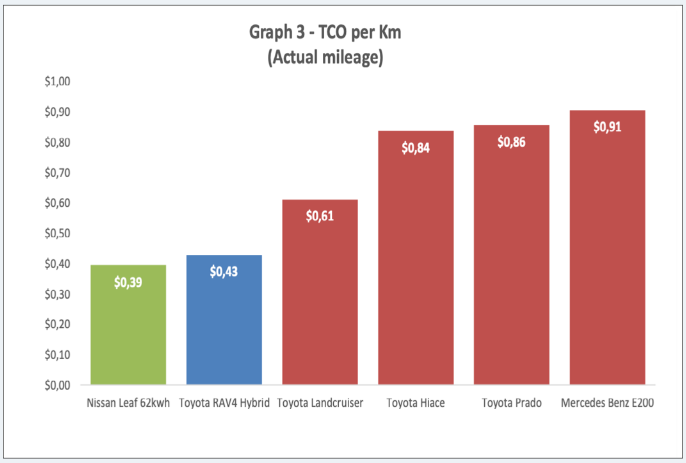
2 - UNHCR economical breakeven is achieved around 3000km, which look impressive if we were not to acknow-ledge that the totality of the fleet is constituted of heavy duty 4x4.





3 - On the other side, the BEVs need to be driven almost 16000km to be economically viable against a fleet mainly constituted of rather small ICEV like it's the case for the ICRC





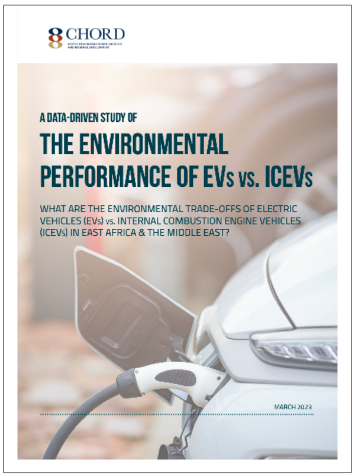
4 - Finally, in the case of WHO, the curve never breaks even and that's also due to the fleet composition

What this Jordan focus is telling us it that from a cost perspective, even before the engine technology, attention should be paid to the fleet's profile, the above examples highlight clear missed opportunities to reduce environmental footprint by reducing the weight, size and power of current fleets.

That point is extremely important as it highlights improvement necessity: fleet managers at global and local level need to unlearn and relearn their functions through new lenses: identifying that BEV have better TCO than rest of the fleet shouldn't solely trigger to rush towards BEV but before all interrogate on the current profiling of their fleet and the reasons underneath those choices. Running regular right sizing and right profiling exercises is instrumental to proper fleet management.

> On environmental life-cycle: size matters, CO2 approach is partial

The full report produced by CHORD[23] can be found in annex 04, here are the main takeaways:



- **LCA is a very complex exercise** for an item such as a vehicle, which supply chains is very complex, access to datasets is done through databases that are not always updated to all and latest makes and models, OEM are not openly sharing the LCA of their products.

  The report compares emissions from 3 types of vehicles: a large ICEV heavy duty 4x4 , a mid-size ICEV 4x3 (reflecting current fleet profile of agencies participating in the project) and a mid-size BEV 4x2. This comparison is done taking into consideration the context of 3 countries of operation: Jordan, Lebanon and Kenya.

- **Adopt the smaller vehicle to match a requirement** regardless its engine type, is instrumental to reducing emissions. Vehicles size and weight have a direct impact on their 'production' and 'disposal' processing (see table 3), on top of their better-known energy consumption and emissions during 'use' phase.

Table 3: Carbon emissions associated with the production and disposal of each vehicle (kg CO_2 eq.)

Vehicle	Production	Disposal	Production & disposal
mid-size EV	10,530	444	10,974
mid-size ICEV	6,589	287	6,876
large ICEV	11,231	320	11,551

- **It's not only about the CO2:**
  during its whole life cycle, BEV has better performance on CO2 than ICEV regardless its country of operation (see figure 11) but not systematically in other environmental impact categories (see figure 7). That's a good reminder of how the sector's current approach to environment is 'limited' to CO2, our views would require a more holistic approach to better take into account the environmental impact of our actions.

Figure 11: LCA results for global warming for production, use (200,000 km), and disposal

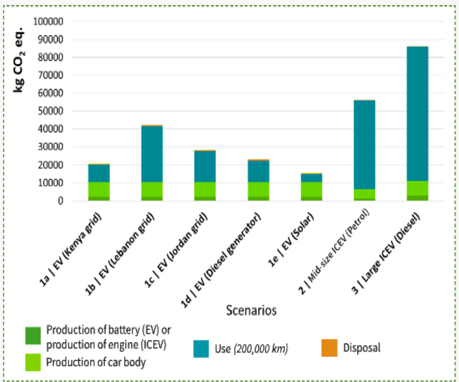
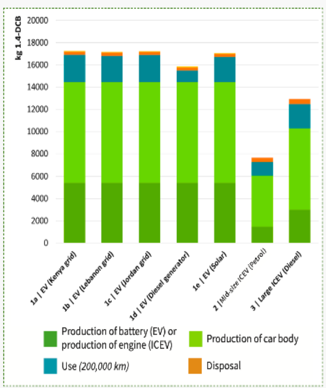


Figure 7: LCA results for freshwater and marine ecotoxicity



23. https://knowledge.fleetforum.org/knowledge-base/article/the-environmental-performance-of-evs-vs-icevs

• **From a sole CO2 eq. perspective, the BREAKEVEN** of BEV compared to ICEV varies country per country, as induced by the carbon intensity of the electric grid/ electricity source (See figure 12)

Figure 12: Break-even point for GHG emissions associated with mid-size EV vs. mid-size ICEV

At what point does the EV have lower carbon emissions than the mid-size ICEV?

The "EV Solar (1e)" refers to the scenario in which the EV has the lowest GHG (Scenario 1e), with solar power. The "EV Lebanon (1b)" refers to the scenario which the EV has the highest GHG (Scenario 1b). This illustrates that when considering the emissions associated with production, use, and disposal, the mid-size EV outperforms the mid-size ICEV after 18,305 km when electricity is produced via solar, and 45,300 km when electricity is produced according to the Lebanon grid (i.e., predominantly oil).

CONCLUSION AND OPENING

BEV are applicable, risks are identified

In view of the findings drew in the course of this project, captured in the above pages, it can be acknowledged that BEV **can be operated in the countries and context of operations** where they have been placed by the participating agencies.

This 2-year project also allowed to highlight the **risks, challenges and opportunities** of fleet electrification in aid and development sectors:

- A **learning curve** remains present, for example on how to determine the relevance of including BEV in a fleet, on which transport demand segment and for each given context.
- Guaranteeing an **increased utilisation** of BEV (to ensure their fast return on economical and environmental investment) is challenged by the current established practices (ICEV are versatile silver bullet that can be allocated to many if not all transport demand segments, therefore making the shift to a tailored usage-oriented approach more complex)
- The absence of battery **end of life / recycling solutions** in the country of intervention is a non-neglectable risk that agencies need to factor in their decision making.
- Although 'theoretically' demonstrated, no real-world evidence exist so far that fleet electrification allows to **deliver impact on the emissions reductions** commitments from the sector.

That's actually on that last point that partners to the project have agreed to engage in a **second phase**, that will focus on looking at how can BEV contribute to achieving emissions reductions objectives at a fleet level.

> Forward looking on electrification in aid and development sector:

- **RETROFIT:**

  Retrofitting is a mechanical operation where the petrol/diesel engine and fuel tank on an ICE vehicle are removed and replaced with an electric motor and battery, thereby turning into an electric vehicle.

  The solution is still embryonic, but at the image of the electric mobility sector, is quickly evolving: France allows since 2020 the retrofitting process of vehicles, some start-ups are providing retrofitting kits for specific models[24], OEM are also investing in that solution although still mainly centred on 'collection' models[25].

Renault 5 retrofitted

  Among several initiatives on the continent, 'E-motion Africa' in Tanzania partners with local tourism companies to convert internal combustion engines vehicles to electric vehicles. The application of such retrofit is also valid for motorcycles, 3-wheelers and public buses[26].

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24. https://www.lormauto.eu/

25. https://theoriginals-services.renault.com/kit-retrofit-homologue https://www.renaultgroup.com/en/news-on-air/news/retrofit-transform-a-combustion-motor-car-into-a-full-electric-car/

26. https://e-motion.africa/

The retrofit, by allowing to increase the lifespan of vehicles, combined to the fact that systematic export to middle east and Africa of ICEV vehicles from EU/USA market, and to the observation that daily mobility needs observed in the current project require 'small' batteries, raises the following question: should the aid and development sector face those local trend and realities and support, try and draw learnings from such initiatives? At what extent would that contribute to broader goals of the sector (localisation, SDGs) by generating employment locally, supporting business development and local capacities?

- **KEICARS:** intermediate BEV, low speed electric vehicles: The current BEV best sellers in the US and EU market are not representative of the make and models available in the market since years.

  The very small BEV such as the Japanese Kei-cars propose very minimal characteristics: range <120km, mass <750kg, 2-4 passengers, max speed 40-70km/h.

  Such characteristics allow to offer a limited environmental footprint (the battery size is limited but allow to match daily transport needs in an urban context, a smaller volume impacts positively traffic, parking and reduced purchase price allows popularization and reduction of inequalities to access sustainable transport.
  Such vehicles segments could play a growing role in the global goals to electrification, by ensuring a cautious and optimal allocation of scarce resources and moving away from the 'electrical tanks' as growingly stated by the automotive industry[27].

  Combined to the growing trend of aid and development operations in urban context, and to the estimate of rather low passenger's occupancy rate in the sector's vehicle, would such categories constitute an interesting segment to explore in our sector?

Renault Twizzy and Toyota C+

[27]. https://www.acea.auto/news/de-meo-a-turning-point-for-the-european-auto-industry/

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ANNEXES:

Annex 1 – Quick guide (seperate document)

Annex 2 – Pre-procurement checklist (seperate document)

Annex 3 – Upskilling needs – drivers and fleet managers (seperate document)

Annex 4 – Survey results (seperate document)

Annex 5 – TCO calculations results (seperate document)

Annex 6 – CHORD report (seperate document)