Deployment of electric buses in India

Presentation for National workshop on "introduction of electric mobility in public transport"

ELECTRIC MOBILITY ALLIANCE

21.04.2017

Confidential document for discussion only

Electric Mobility Alliance is one of its kind initiative launched in late 2016 to accelerate adoption of electric mobility in India

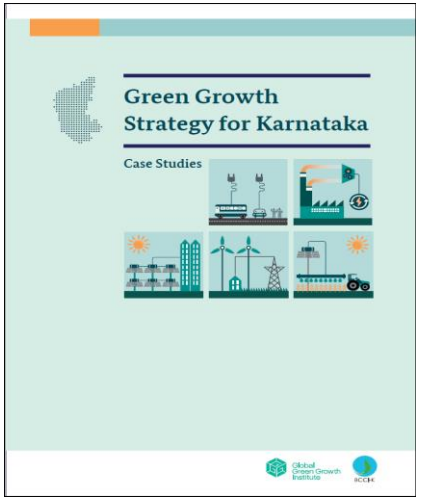
ELECTRIC MOBILITY ALLIANCE

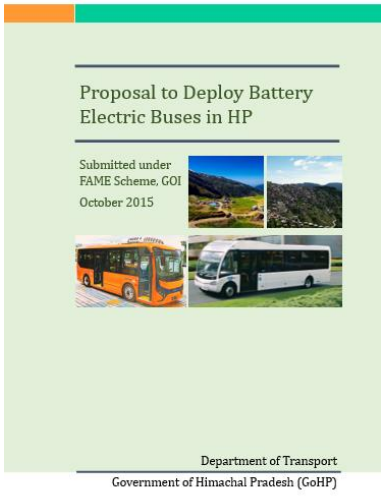
It is the thought leadership platform that brings all stakeholders together with singular objective of accelerating adoption of electric mobility in India.

Mytrah NN4Energy team is pioneering commercial introduction of electric buses in India

Midi bus successfully operated over a month on Manali – Rohtang marking the successful trial at the highest ever altitude as on date for an electric bus

Publications and thought leadership





Milestones

Leveraging our strengths in operating renewable energy projects and understanding of the power sector, **we have pioneered the introduction of electric buses in India**

- **Business case for introduction of electric buses in Bengaluru**
- **Part of consortium awarded supply of 25 electrc buses** in the state of Himachal Pradesh, a first in the country
- **Electric bus demonstration successfully conducted in October 2016 on Manali-Rohtang road** – highest altitude for an electric bus
- **Collaboration with leading electric bus manufacturers** to build ecosystem for electric bus in India

Why are electric buses not taking off in India in a big way?

ELECTRIC BUS 3-MONTH TRIAL RUN SUCCESS

Friday, 03 June 2016 | Vishav | New Delhi

After the CNG experiment that proved to be a game-changer in bringing down pollution levels in the city, battery-operated buses may be the next game-changer. Three months after the trial of the first electric bus started in the city, the Delhi Transport Corporation (DTC) officials said it is going "better than expected" and so far the results have been "quite positive".

"When the Sheila Dikshit Government had planned to bring CNG buses to Delhi, many

National Electric Mobility Mission Plan

Government of India launched the National Electric Mobility Mission Plan (NEMMP) 2020 in 2013. It aims to achieve national fuel security by promoting hybrid and electric vehicles in the country. There is an ambitious target to achieve 6-7 million sales of hybrid and electric vehicles year on year from 2020 onwards. Government aims to provide fiscal and monetary incentives to kick start this nascent technology. With the support from the Government, the cumulative sale is expected to reach 15-16 Million by 2020. It is expected to save 9500 Million Liters of crude oil equivalent to Rs. 62000 Cr. savings.

Electric buses, ropeway on NGT's Himachal Pradesh agenda

TNN | Apr 11, 2016, 01.34 AM IST

Electric buses soon on Mumbai roads; BMC grants Rs 10crore

Somit Sen| TNN | Apr 7, 2016, 10.40 AM IST

According to an Indian Institute of Science (IISc) study evaluating electric vehicles for urban transport:

"Electric buses generate 27% more revenue and 82% more profits than diesel buses per day."

Ready to sanction funds for electric buses in HP:Centre to NGT

Press Trust of India | New Delhi
January 13, 2016 Last Updated at 18:42 IST

Home › Cities › Bangalore › BMTC urges extension of electric bus trial period

BMTC urges extension of electric bus trial period

The electric bus is said to have received positive reviews from commuters over its comfort, non-polluting features and ambience.

Delhi govt will buy electric buses to counter pollution

Faizan Haidar, Hindustan Times, New Delhi | Updated: May 09, 2016 22:03 IST

FAME launched to offer sops on hybrid, e-vehicles

Apr 09, 2015 at 10:37 | Source: PTI

FAME India - Faster Adoption and Manufacturing of Hybrid and Electric vehicles in India - is a part of the National Electric Mobility Mission Plan. The scheme envisages Rs 795 crore support in the first two fiscals starting with the current year.

PM asks auto industry to adopt electric technology fast

Jan 09, 2013 at 21:30 | Source: PTI

Prime Minister Manmohan Singh today asked vehicle manufacturers to adopt electric technologies fast in order to reduce dependence on imported oil and supplement efforts for a greener transport system.

IISc to BMTC: Choose electric buses, save earth, earn more

DECCAN CHRONICLE. | SANGEETA BORA

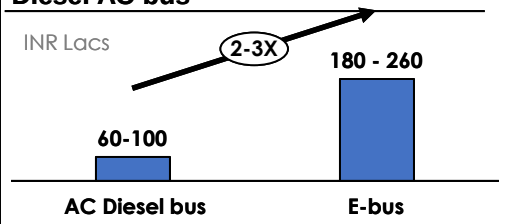
Published Apr 5, 2016, 3:44 am IST **Updated** Apr 5, 2016, 3:44 am IST

Voice of customer

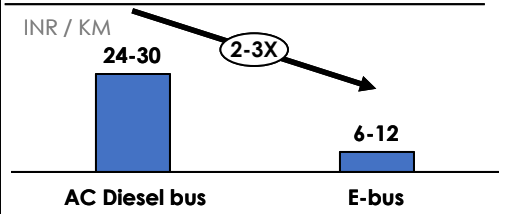
- Electric bus are expensive. Why should we do it?
- Can technology support my operational duty cycles?
- How will my organization mange this new technology?
- What is policy of Government of India for promoting adoption of electric buses?

Are electric buses expensive?

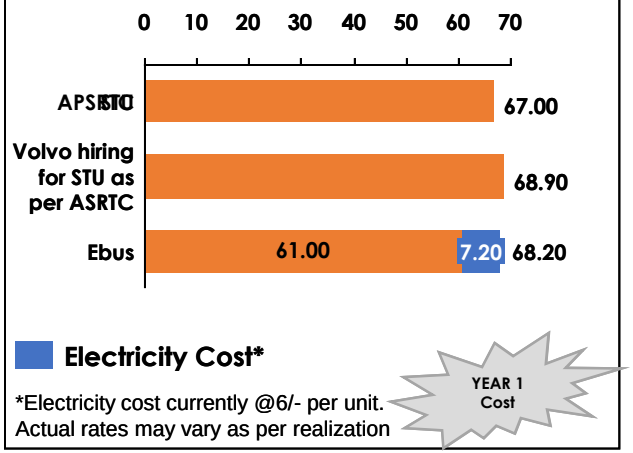
Capital cost of E-bus is 2-3 times of Diesel AC bus



Operating cost of E-bus is 65% lower than that of Diesel AC bus

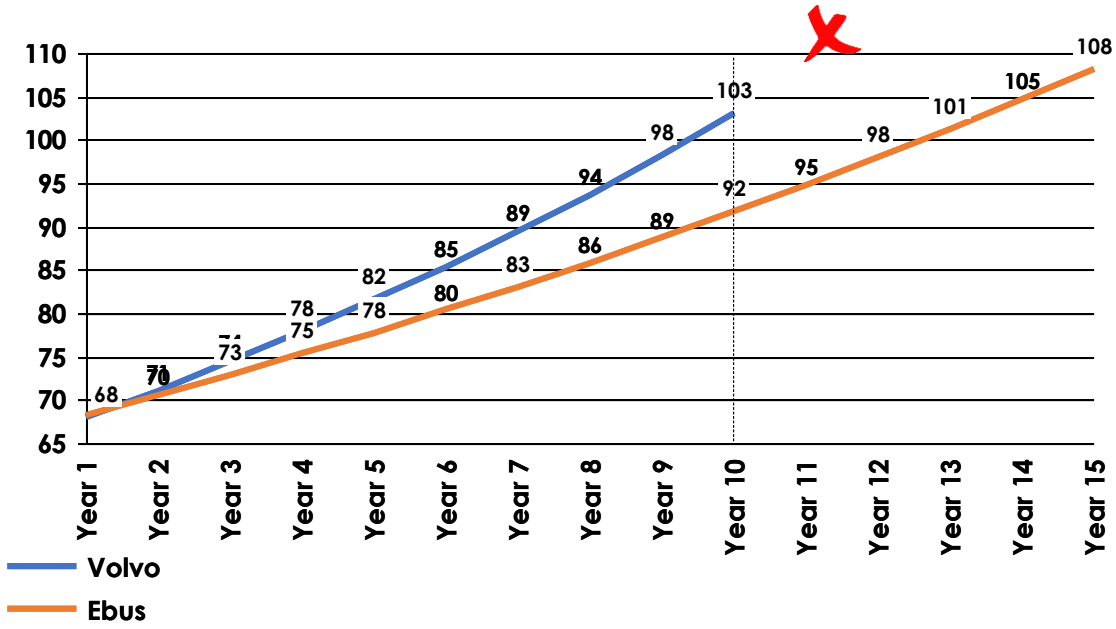


Bus Hiring Rate Comparison – STU v/s Volvo hire v/s Ebus



*Electricity cost currently @6/- per unit.
Actual rates may vary as per realization

We aim to match Year 1 rates for Electric bus at par with that of Volvo but with time, E-bus rates will be lower than the cost of running Volvo bus factoring in more stringent environmental norms & increasing fuel cost



*Hiring Cost of Volvo – Rs 39.5/-
Operating cost of Volvo – Rs 24.6/-
Current Diesel Price – Rs 59/-
MVT – Rs 3.9/-

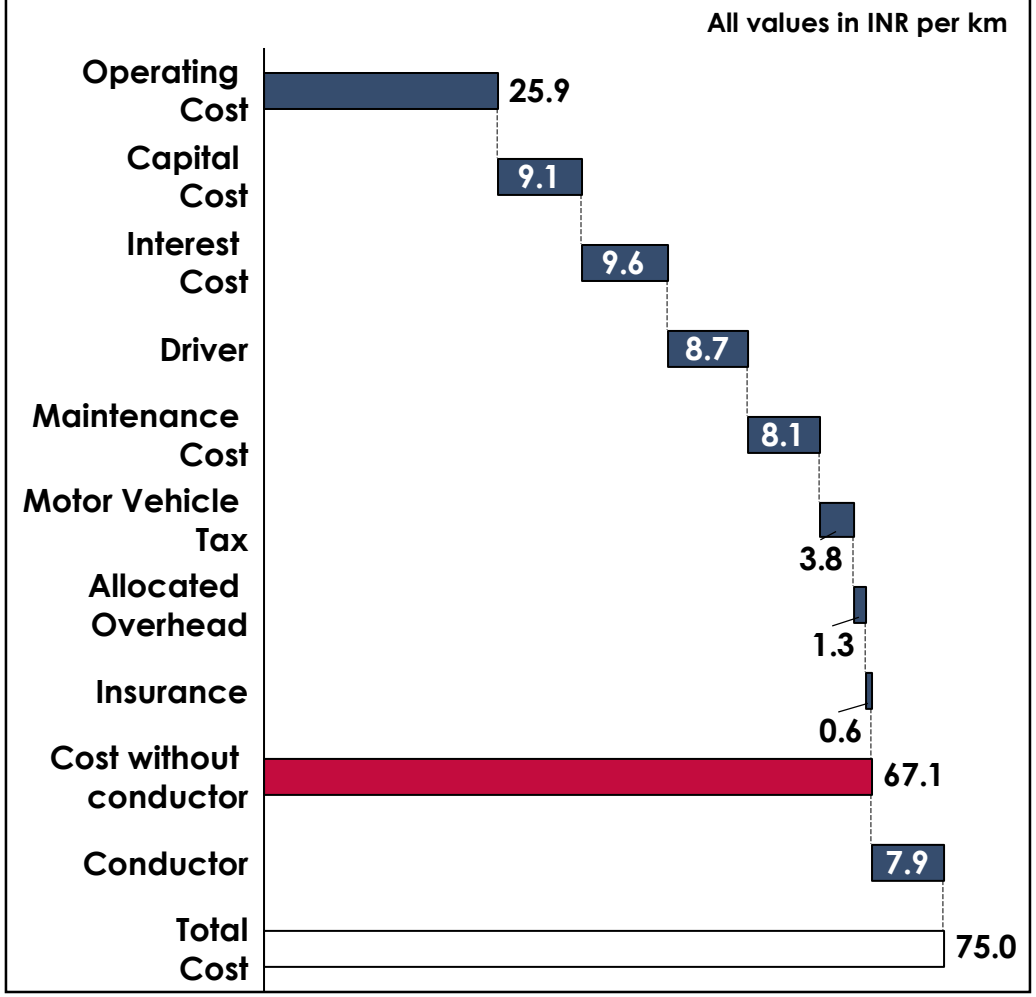
Let's think INR / km

instead of INR / bus

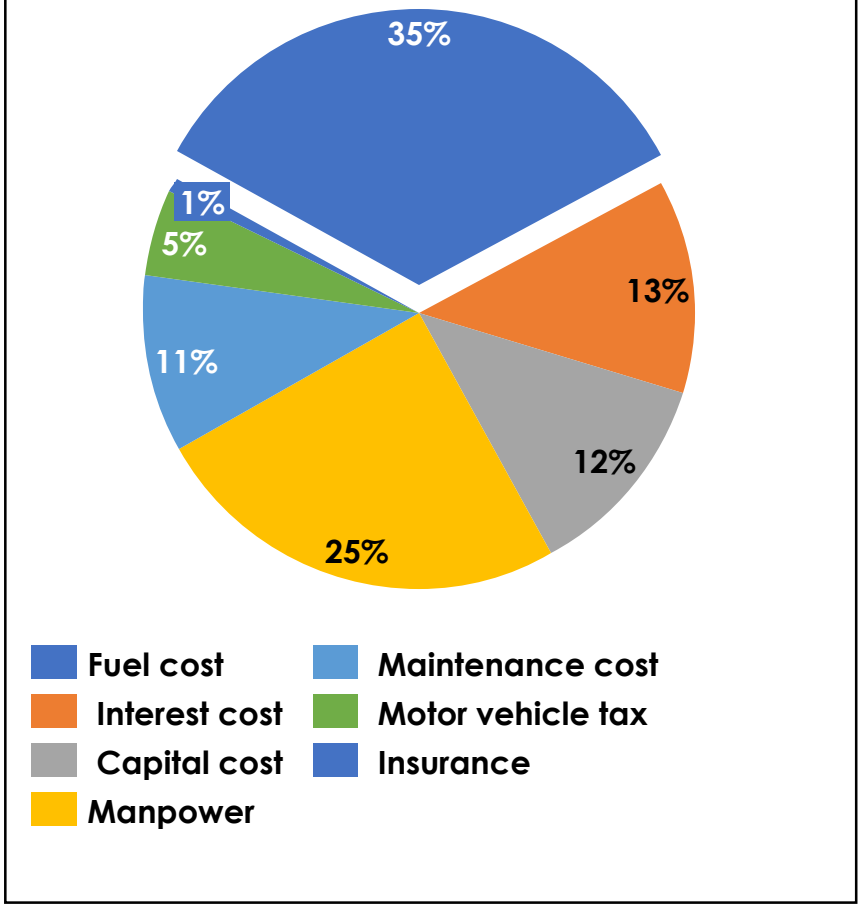
Voice of customer: Can technology support my operational duty cycles?

Manpower cost and fuel cost account for more than 60-85% of the total cost of STU depending on the bus model

Estimated Cost build-up of premium AC low floor 12m for daily fleet run of ~270 kms



Cost breakup for premium AC low floor 12m Bus



Volvo price assumed at INR. 90 lac
Annual run of ~1 lac kms for ~350 days operations
Diesel assumed @INR. 57 per liter, Mileage @2.2 KMPL

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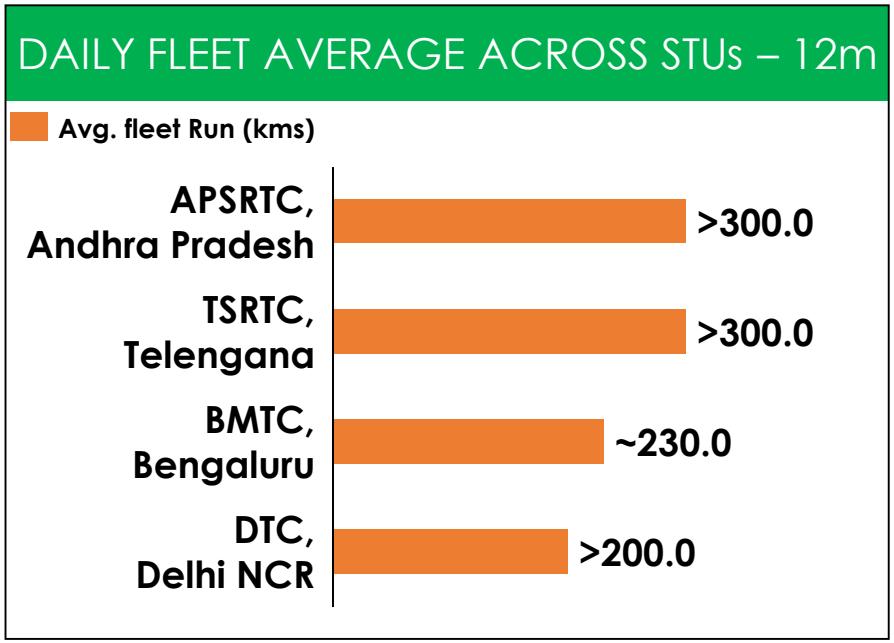
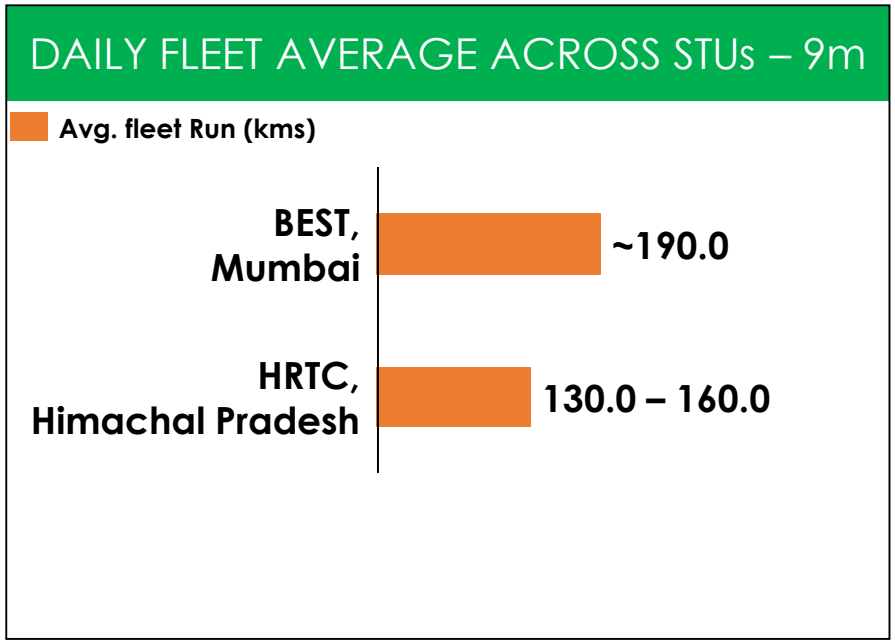
Electric buses should offer similar duty cycles as diesel buses for STU to have flexible operations and no additional cost

The typical operational requirement for STUs for intracity operations with 12m buses is around 200 – 300 kilometres. Many STUs have routes with average daily run in excess of 300 Kms





Larger battery packs

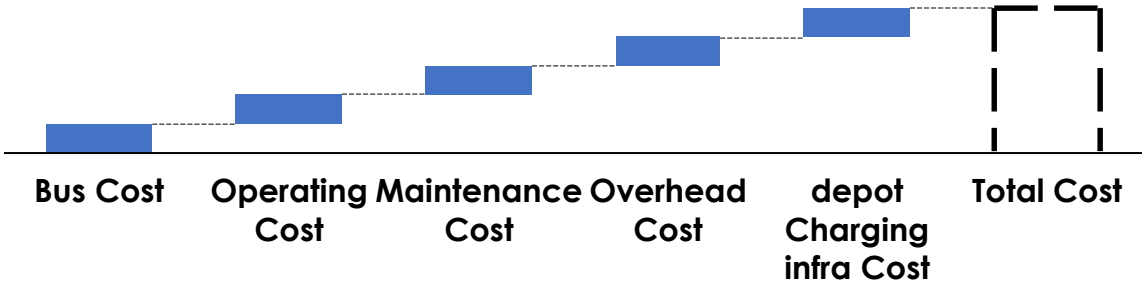
Fast charging

Opportunity charging

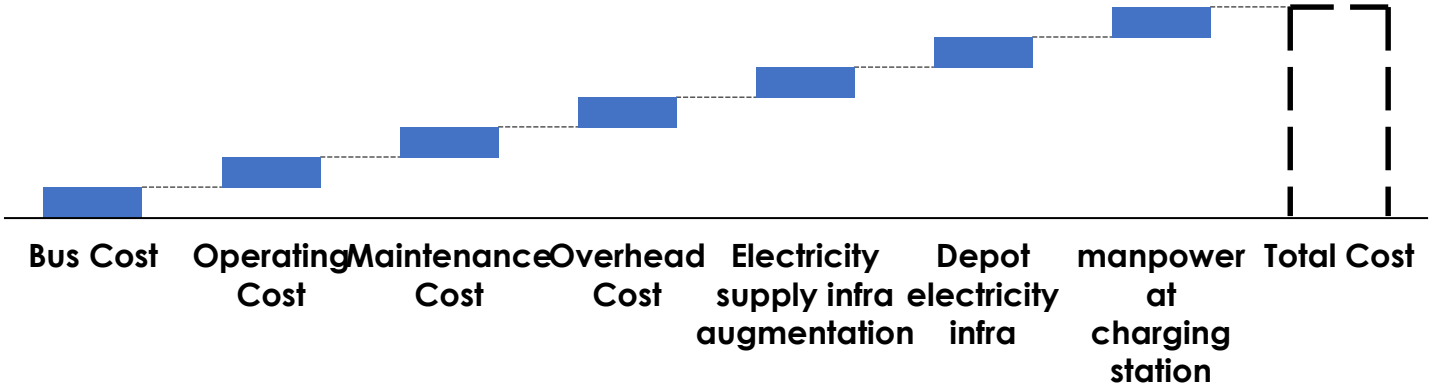
Appropriate solutions can be determined based on Total system cost and not just cost of the bus

ILLLUSTRATIVE

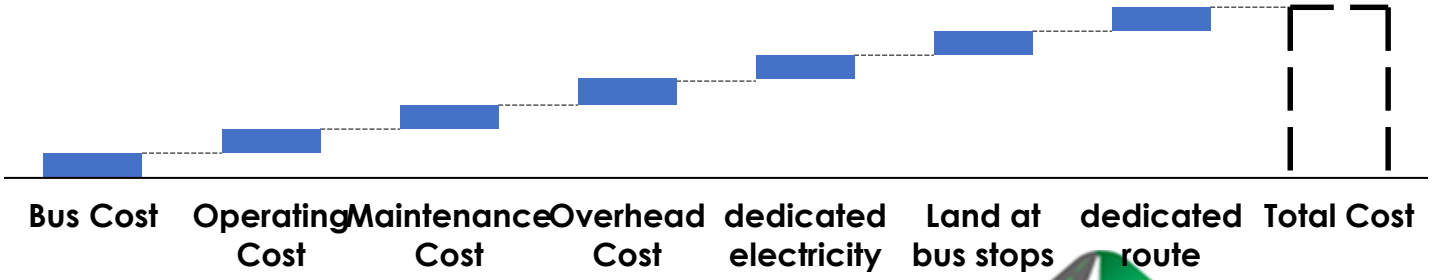
Large Battery pack (night time depot charging)



Fast charging (multiple intra day charging)



Opportunity charging (every few bus stops)

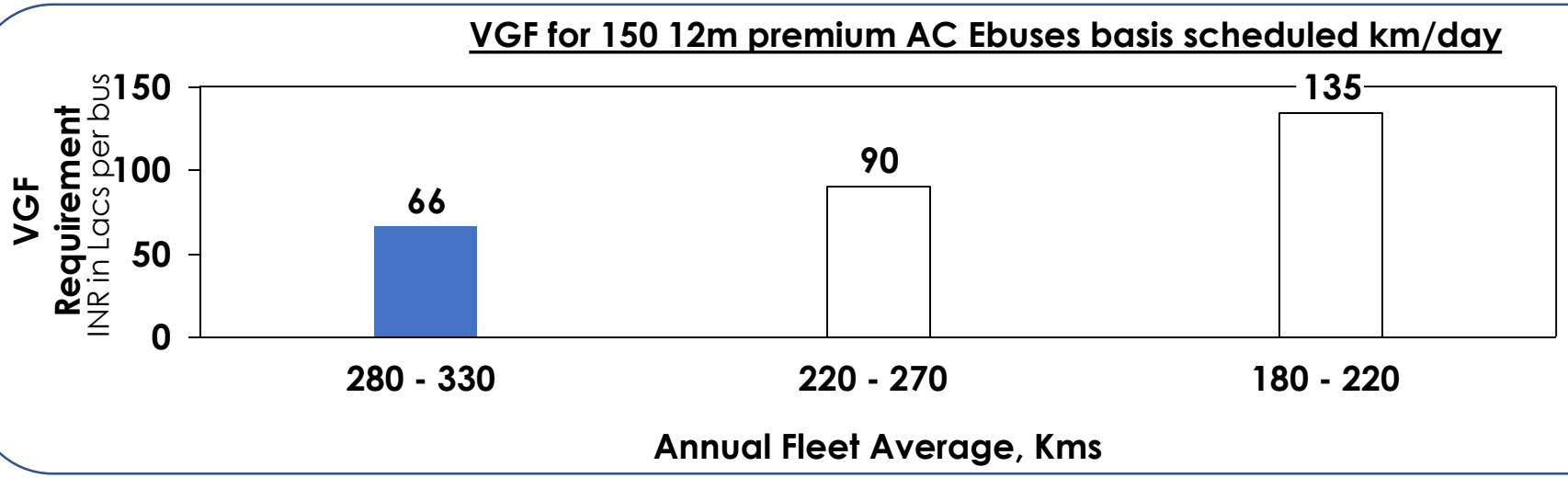


Voice of customer: How will my organization manage this new technology?

Gross cost contract allows STUs to deploy electric buses at scale without technology risks and need for capacity building

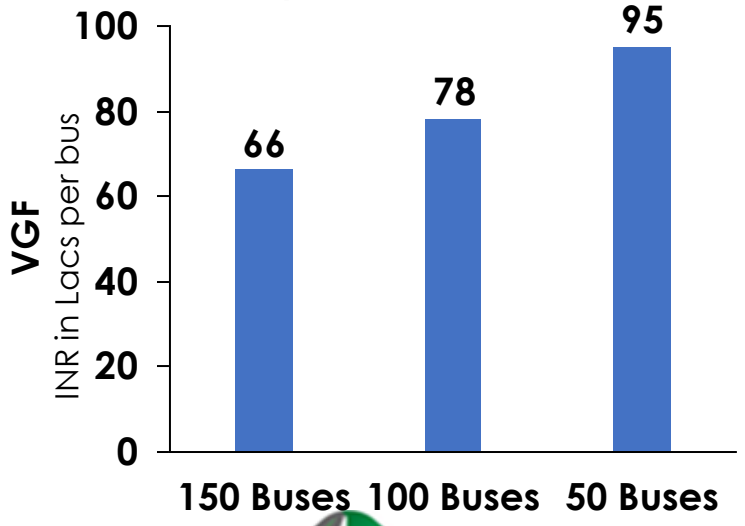
Activities to be covered for successful deployment	Operator scope	STU Scope
• Capital Investment	✓	
• Day to day Operations planning & execution	✓	
• Service & Maintenance	✓	
• Driver training & availability	✓	
• Training & Capability activities	✓	
• Charging Infrastructure sourcing & procurement	✓	
• Schedule Availability & Planning		✓
• Depot Availability		✓
• Space Charging Infrastructure		✓
• Electricity for Charging		✓
• Ticketing		✓

Focus on higher utilization and scale of deployment enable lower VGF for electric buses



Impact of economies of scale on cost

Capital cost	●
Operating cost	◔
Financing cost	◑
Maintenance cost	◑
Spare cost	◕
Training cost	◑
Overhead cost	●



● High impact

What is the policy framework for encouraging adoption of electric buses?

Policy framework for deployment of electric buses should primarily focus on outcome and not be prescriptive

Insights from solar success in India

1. Utility scale deployment with long term policy roadmap
2. Generation based incentives or performance linked VGF
3. Encourage private sector participation
4. Technology agnostic approach and outcome focus

Policy framework for electric bus

- ✓ Deployment at scale
- ✓ Long term policy support to enable investment
- ✓ Gross cost contract model
- ✓ Outcome focus: Focus on daily utilization
- ✓ Encourage competition across value chain
- ✓ Let policy evolve based on initial success
- ✓ Be technology and feature agnostic

Policy roadmap should start with focusing on quick success to catalyse ecosystem for future growth

- ✓ Deployment at scale
- ✓ Long term policy support to enable investment
- ✓ Gross cost contract model
- ✓ Outcome focus: Focus on daily utilization
- ✓ Encourage competition across value chain
- ✓ Let policy evolve based on initial success
- ✓ Be technology and feature agnostic

- Set fixed VGF (capital) amount for initial two years. VGF to be revised after two years based on success of initial set of projects
- Performance linked VGF to allow scale deployment
- Encourage STUs to go for deployment to establish performance benchmarks for further policy review
- Support STUs proposals for faster implementation and buy in
- A 2x growth every year would take deployment to 25000 buses
- Yr1: 1000; Yr2: 2000; Yr3 4000, Yr4 8000; Yr5: 16000

A refund mechanism for VGF (capital) in case of non performance of electric buses would ensure performance & hence impact

Non-performance is defined as either:

1. At least 25% of buses fleet is not able to able to run more than 200km on single charge under standard driving conditions.

2. If the fleet availability is less than 65% on an annual basis for any 1 year of operations in the first 5 years

Year of default (From date of deployment of bus on the road)	DHI's right to refund of VGF/ claim on assets (% of VGF paid)
Up to 1 year	100%
1-2 years	80%
2-3 years	60%
3-4 years	40%
4-5 years	20%
5-6 years	0%

Conclusion

- Gross cost contract model is most suitable for deployment at scale of electric buses
- Electric buses need to provide similar duty cycle for identified routes to be cost competitive for STU
- GOI policy framework should be outcome focus in terms of bus deployment and not be prescriptive to catalyse ecosystem
- There is need for some quick deployment cases to establish performance benchmark for future scale up
- A refund mechanism for VGF (Capital) would ensure accountability and performance of electric bus technology by operators

Thank you

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