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Electric Vehicle

Demand Projection for Bengaluru and Power Demand Management

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This policy brief should be cited as: CSTEP. (2022). Electric Vehicle Demand Projection for Bengaluru and Power Demand Management. (CSTEP-PB-2022-04).

March 2022

Center for Study of Science, Technology and Policy

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Introduction

According to data from the International Energy Agency (2020) and the Ministry of Environment, Forest and Climate Change (2018), it is estimated that more than 90% of CO2 emissions from the transport sector is from road transport. The Government of India (GoI) has taken several steps to electrify the transport sector. In 2013, India expanded its decarbonisation vision by launching the National Electric Mobility Mission Plan (NEMMP) for 2020.

At the state level, Karnataka was the first state to act with the announcement of the Karnataka Electric Vehicles and Energy Storage Policy (KEVESP) in 2017. The Policy was formulated to make Bengaluru the EV capital of India. The city provides a suitable ecosystem for research and development, technological advancements, and manufacturing[1] of EVs and registers the maximum number of two-wheelers in the country. As per KEVESP 2017, the Government of Karnataka is targeting 100% EV adoption by 2030 in the private transport segment in Bengaluru. To promote EVs in the public transport segment, 1,500 EV buses will be introduced to the Bangalore Metropolitan Transport Corporation's fleet in a phased manner in the next three years. In the goods transport segment, a 100% EV target is set for three-wheelers, four-wheelers, and mini-goods vehicles by 2030. The policy also encourages e-commerce and delivery companies operating in Bengaluru to adopt electric two-wheelers/three-wheelers to their fleet by 2030.

With the current policies and the global trend of EV integration, it is necessary for stakeholders of the Bengaluru power network to assess the EV electricity demand in the coming years. The Center for Study of Science, Technology and Policy (CSTEP) analysed the impact of aggressive additions of EVs to the Bengaluru transmission and distribution network for the financial year (FY) 2026-27. Estimation was done on the quantity of EVs and the expected power demand pattern in FY 2026-27. The overall city load is expected to increase manyfold. Therefore, demand-side management strategies become crucial.

1 https://powermin.gov.in/sites/default/files/uploads/EV/Karnataka.pdf

Key insights

Until March 2021, the total number of vehicles registered in Bengaluru city was 99,57,497, out of which EVs accounted for 14,279 vehicles[2]. The category-wise estimation of EVs from the total registered vehicles is given in Figure 1.

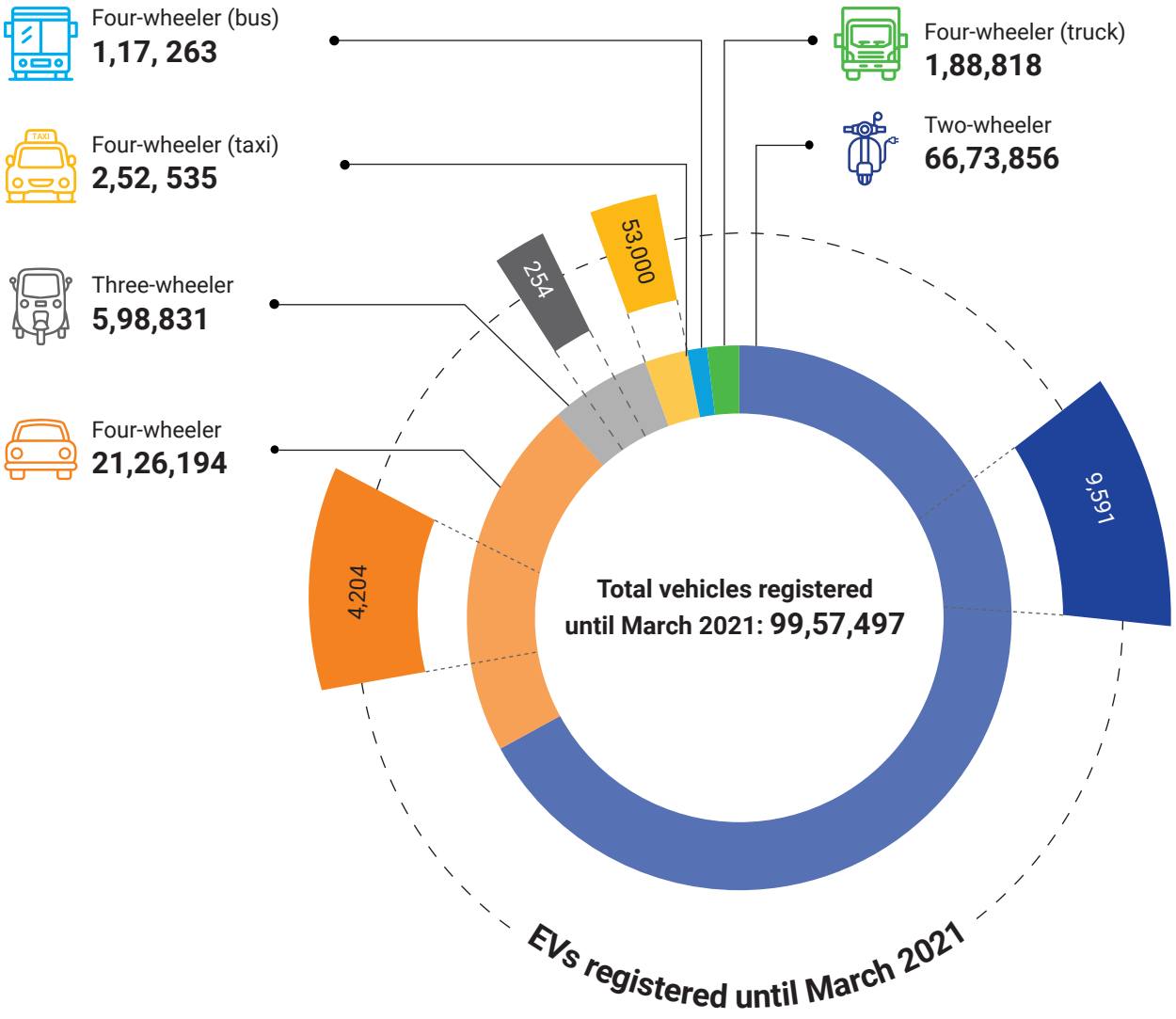


Figure 1: Electric vehicles registered in Bengaluru

Based on past trends of the number of vehicles registered and KEVESP's 2030 EV targets, a huge increase in the number of electric vehicles is anticipated in FY 2026-27. It is estimated that by FY 2026-27, there will be 1,57,78,226 vehicle registrations in Bengaluru, and among these, 42,73,637 will be EVs.

2 https://timesofindia.indiatimes.com/city/bengaluru/with-4882-east-bengaluru-on-top-in-electric-vehicle-registrations/articleshow/80780433.cms

The load curve for the projected EVs was developed for FY 2026-27 based on the past and existing charging patterns, charging time, and weighted average battery size (kWh) of each EV category. Figure 2 shows the expected load pattern from the EV load (2,000 MW) and the city load (3,815 MW) in FY 2026-27 based on CSTEP's calculations.

It can be observed that the profiles complement each other. During the daytime, when the city load (non-EV) is at its peak, the EV load is minimal, and at night-time, when the EV load is at its highest, the city load (non-EV) is at its lowest. This complementary load pattern would help in smoothing the load curve, which can be catered to by the electric utilities without much ramping and switching of generators. These load projections show that EVs are around 52% of the city load during the EV peak load instant. Figure 3 shows the load curve expected in FY 2026-27, considering the city and EV load.

If the EV load remains as expected, it will complement the city load, and we may have a reasonably flat curve, which would lead to fewer ramping requirements from fossil fuel–based generators.

However, if this huge load shifts and coincides with the city peak, then the overall demand increases from 5,000 MW to approximately 5,800 MW—an increase of 13%. This would lead to a huge difference in load peak and valley and require many ramping units online. The transmission and distribution infrastructure across Bengaluru city limits must also be strengthened to serve the coincident demand. It, therefore, becomes important to bring in policies that can be used to restrict demand so that the load curve is flat.

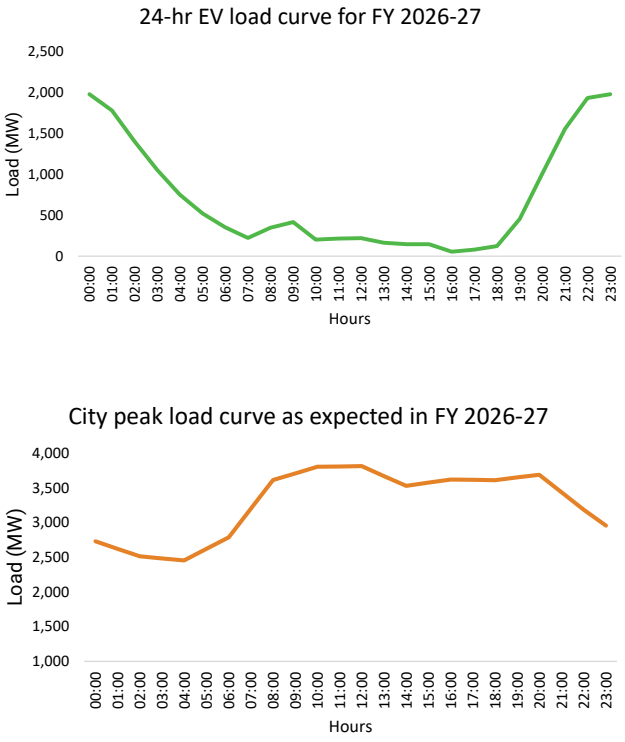


Figure 2: A typical day 24-hour synthetic EV load profile for FY 2026–27 and city load curve as on 1 May 2026

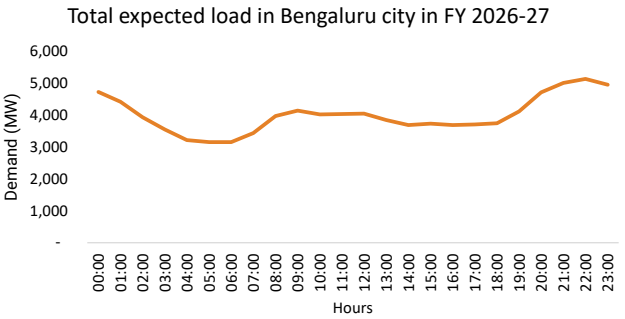


Figure 3: 24-hour total demand expected in FY 2026–27

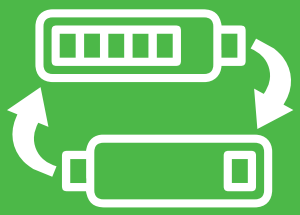
Recommendations

Time of Day Tariff

The Indian market might not be familiar with the time of day tariff concept, but it is a widely accepted practice in Western and European countries. This scheme encourages people to charge their vehicles during the city off-peak load times and discourages charging during peak load times. This is done through tariff meters by varying the cost of charging EVs on a real-time basis.

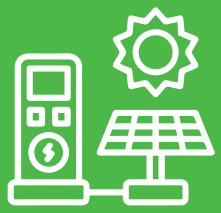
Scheduled Tariff

In the scheduled tariff system, monthly tariffs (24 hours per day) are fixed in advance, and consumers are notified. They can adjust their electricity demand according to the tariff rates to suit their daily needs. A higher price will be levied during the hours when the city observes its usual peak in demand, and a lower price will be levied for the rest of the hours.



Battery Swapping Incentives

As per the recent national budget announcement, if the government promotes private players to install battery swapping infrastructure, EV owners could go to charging stations and replace their EV batteries with pre-charged batteries—charged during the off-peak city load.



Green Charging Stations

Green charging stations would get their power from solar panels during the daytime, and the excess power generated could be sent to the grid to utilise the power generated optimally. The government could provide substantial subsidies for these stations while imposing strict guidelines on operation and safety measures.

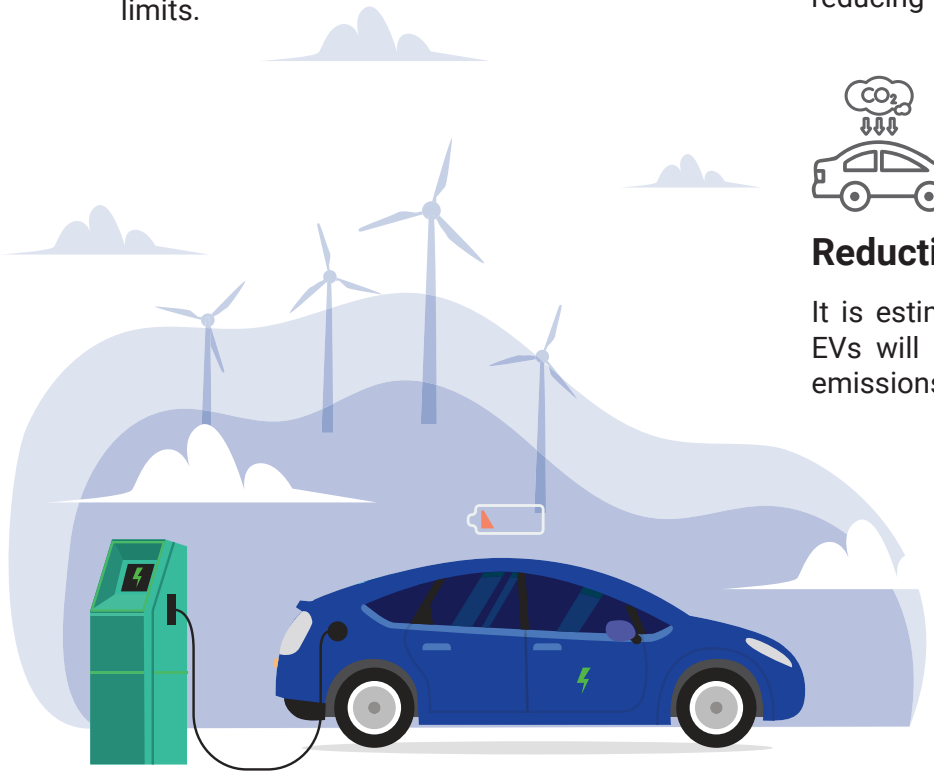
Benefits

Time of Day and Scheduled Tariff

Consumers will adapt and start to use electricity during low-price hours. The loads will be distributed across the day instead of peaking at a few instants. This could eventually increase the grid availability to integrate more EVs. It can also help in reducing consumer electricity bills.

The proposed tariff could be designed to encourage more consumers to use electricity during the high renewable energy generation time intervals. The overall power generation from conventional power (such as thermal) can be reduced as a result.

As the grid is always planned to supply peak electricity demand, when consumer demand is spread across the day based on the tariff schedule, the network peak demand will be reduced and grid strengthening requirements will be minimal even with the addition of more EVs. This will also help operators maintain grid stability within manageable limits.



Green Charging Stations

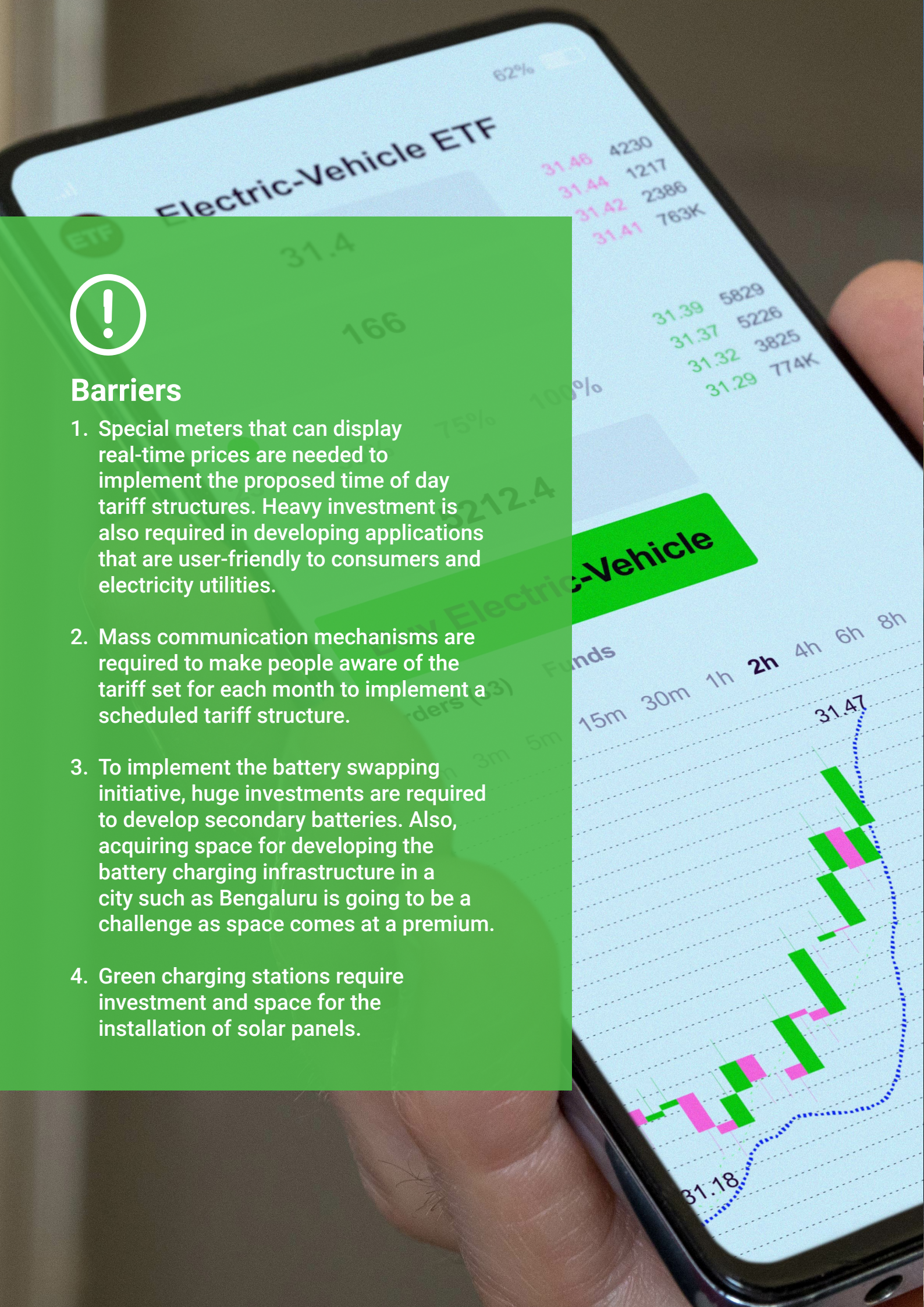
Emissions are reduced or eliminated when EVs are charged with electricity produced from renewable sources such as green charging stations. Green charging stations can be installed in commercial and government spaces, creating additional revenue sources for these establishments and promoting clean energy.

Battery Swapping Incentives

The battery swapping mechanism will help reduce the consumer waiting period for charging batteries, attracting more people towards electric vehicles. Battery swapping stations can be planned where the grid is available for additional load, thereby reducing the investment on network upgradation.

Reduction of CO2 emissions

It is estimated that the deployment of 42,73,637 EVs will reduce around 2.3 million tons of CO2 emissions per year in Bengaluru alone.



Barriers

1. Special meters that can display real-time prices are needed to implement the proposed time of day tariff structures. Heavy investment is also required in developing applications that are user-friendly to consumers and electricity utilities.

2. Mass communication mechanisms are required to make people aware of the tariff set for each month to implement a scheduled tariff structure.

3. To implement the battery swapping initiative, huge investments are required to develop secondary batteries. Also, acquiring space for developing the battery charging infrastructure in a city such as Bengaluru is going to be a challenge as space comes at a premium.

4. Green charging stations require investment and space for the installation of solar panels.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