

Research Paper

Impact-Based Energy Consumption Mitigation by Changing the Light Electric Vehicle Weight on the Drive Cycle

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Abstract

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Given the energy challenges facing the world, particularly regarding fossil fuels, therefore, recent years, the demand for electric vehicles has increased. Electric vehicles are one of the innovations that have become environmentally friendly, as it decreases fuel consumption and reduce pollution. As LEVs play an increasingly important role in sustainable urban transport, optimizing their energy efficiency is essential. This study investigates the impact of vehicle weight variation on energy consumption in Light Electric Vehicles form change Weight 800 kg to 1400 kg (LEVs) across one of the drive cycles. Through simulation and modelling, we evaluate the impact of incremental changes in vehicle mass on energy demand during standard driving scenarios, including urban, suburban, and highway profiles. The model research was developed in MATLAB/Simulink. The analysis highlights that vehicle weight significantly affects energy consumption, particularly in stop-and-go urban environments where acceleration demands are higher. Results indicate that reducing LEV weight leads to measurable improvements in energy efficiency, thereby extending range and reducing battery strain. These findings support light-weighting strategies as a practical and impactful method for enhancing LEV performance and sustainability in real-world conditions, and change the energy consumption from 0.011 kWh to 0.017 kWh. These values highlight how increasing vehicle weight leads to higher energy consumption, even under the same driving cycle 500 sec.

Keywords: Drive cycle; Light Electric Vehicle (LEV); State of Charge (SOC); Fuel Cell Electric Vehicles

1. Introduction

Due to the ongoing depletion of fossil fuels and rising geopolitical tensions, automakers are increasingly turning their attention to electric vehicles (EVs). Vehicles using electric propulsion systems are referred to as EVs. Fuel cell electric vehicles (FCEVs), hybrid electric vehicles (HEVs), and battery electric vehicles (BEVs) fall under this general category. EV development is a complex, multi-disciplinary field, but it is fundamentally built around three core technologies: chassis and body systems, propulsion mechanisms, and energy

sources. Currently, BEVs, HEVs, and FCEVs are progressing at different rates, each facing its own set of challenges. The main limitation for BEVs is the battery, which restricts them mostly to small, short-range, and low-speed uses due to their limited battery capacity. HEVs can meet the general demands of consumers, but their high production cost remains a key obstacle. FCEVs have significant long-term potential to become mainstream vehicles; however, they are still in the early stages of development, with high costs and inadequate hydrogen refueling infrastructure being major issues.



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Electric vehicles are equipped with a motor-generator (M/G) unit that enables regenerative braking, allowing energy recovery during deceleration. In HEVs, the M/G is typically placed directly behind the engine. For instance, in Honda's hybrid systems, the M/G is directly connected to the engine, followed by the transmission. This configuration features two torque-producing sources: the gasoline engine and the M/G operating in motor mode (M-mode). The battery and the M/G are linked electrically, enabling the flow of power between them and supporting regenerative braking. **Figure 1** shows the major components of the electric vehicle.

Due to their constrained battery capacity, electric vehicles exhibit a restricted driving range; consequently, enhancing energy efficiency becomes paramount. The conventional strategies for diminishing energy consumption include light weighting and moderating acceleration and deceleration. In contrast to the friction braking employed by traditional automobiles, regenerative braking represents the mechanism through which electric vehicles recapture energy. Therefore, it is essential to understand the influence of factors such as vehicle weight, acceleration, and road gradient on the energy utilization of electric vehicles. To quantitatively assess energy consumption at both the wheel and battery levels, simulations were employed to investigate various acceleration profiles and road gradients. The results indicated that wheel energy consumption escalated by 4–9% for each 15% increment in vehicle weight. This study offers significant insights for enhancing the energy efficiency of electric vehicles, along with practical recommendations for the advancement of electric vehicle technology. The analysis of energy consumption is grounded in specific driving cycles [1].

The study's objective was to examine how different acceleration and speed values affected an electric vehicle's energy usage. By using the torque characteristics of the test object's electric motor, the basic and additional resistance values were calculated using the vehicle's technical parameters, including its width, height, type of drive system, wheel sizes, useful battery capacity, and total vehicle curb weight plus the mass of passengers and cargo. Lastly, the amount of energy used for every driving cycle was calculated

[2], can make it easier to design vehicles and assess how well new automotive technologies work.

Traditional driving cycles, however, may not be appropriate for assessing and enhancing the development of battery electric vehicles, as they have been influenced by the operational attributes of traditional vehicles; however, the driving characteristics inherent to battery electric vehicles may exhibit considerable divergence. To facilitate the advancement of the new energy automotive sector, it is imperative to establish a novel driving cycle that aligns with the authentic operational scenarios of battery electric vehicles. The Markov chain approach and statistics are used to build the driving cycle. The study that follows demonstrates that the newly created driving cycle accurately simulates real-world driving, providing a strong basis for precise performance assessment of battery electric vehicles [3]. What impact does load weight have on a light commercial electric vehicle's energy efficiency? To exclude any outside influences that can skew individual measurements and their findings, the scientists made the decision to investigate the effects of weight and the characteristics of a driving cycle in a lab setting. The effect of load weight on the vehicle's range is minimal and falls short of the vehicle's theoretical maximum range in urban logistics applications when simulating driving cycles in the context of an electrically powered light commercial vehicle. Operating electrically driven vehicles on mountainous terrain with steeper slopes and comparatively longer gradients results in higher electricity consumption and, thus, a shorter range [4]. Weight is one of the factors that can influence an electric vehicle's dynamic and range characteristics. When converting an internal combustion engine car to an electric vehicle, the batteries and their location can be changed. Addi-

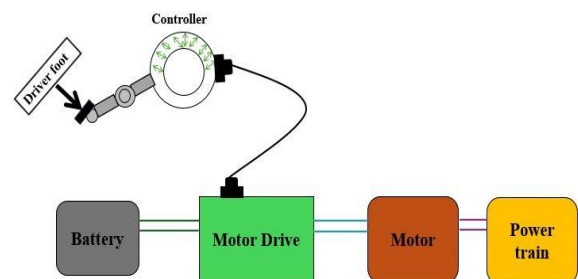


Figure 1. The major components of the electric vehicle

tionally, batteries of different capacities can be selected for serial electric vehicles, such as the Tesla Model S. The quantity of batteries and the overall weight of the electric vehicle determine not only its price but also its performance attributes, such as dynamics and range between charges [5].

Most existing studies concentrate on large-scale project evaluations, estimating the energy use of EV control algorithms, or conducting simplified well-to-wheels analyses. To address this limitation, the present work introduces a basic EV energy model that uses second-by-second data on vehicle speed, acceleration, and road grade to calculate instantaneous energy consumption, while also capturing regenerative braking energy recovery.

The proposed framework can be integrated into in-vehicle applications, smartphone-based eco-driving tools, eco-routing systems, and transport simulation platforms aimed at estimating fleet-level EV energy demand. One of the main advantages of EVs is regenerative braking, which enables energy recovery during deceleration. However, most existing energy consumption models rely on average regenerative braking efficiency values or factors tied to a vehicle's average speed.

In contrast, the suggested model uses real-time vehicle operation data to calculate regenerative braking efficiency, improving accuracy in energy-use estimation. Compared to empirical measurements, the model shows an average error of only 5.9%, indicating strong reliability. Results also suggest that EVs can recover more braking energy than typically assumed [6].

Additionally, the study investigates the design of a fuel cell (FC) hybrid powertrain and evaluates it under two power management algorithms (PMAs) for a defined driving profile. The mathematical model represents parameters of a small vehicle [7], while accounting for assumptions such as driving range, required top speed, and aggressive driving cycles. Findings reveal that battery electric vehicles (BEVs) are most suitable for short ranges, whereas fuel cell systems perform better for longer ranges where battery weight becomes restrictive [8].

The model-building procedure for electric vehicle (EV) energy consumption is presented in this work, allowing for the quick development of findings and the production of energy maps.

Artificial intelligence, more especially neural networks, demonstrated the strongest validation indicators. Based on real driving cycles, two predicted models for EV energy consumption were created for winter and summer situations within this framework [9]. A crucial last step for all these techniques is to calibrate a representative cycle to meet the driven wheels' equitable propulsion requirements over a cycle. A general methodology that may be used to address a variety of drive cycle transformation challenges has been established for this purpose. Its foundation is an equivalent concept for driving cycles that, in general, means being comparable but not identical. Considering this, a collection of algorithms is created to change either into a cycle with a specified equivalency measure or into an equivalent driving cycle. The changes are managed efficiently as a nonlinear program that is resolved by the application of general-purpose optimization methods [10].

For the vehicle designer to make the best choice, the difficulties that the bus makers encountered before the development phase can be reopened. To accomplish that, researchers and industrial development engineers must assess options and make decisions about a variety of options while considering investment returns. Therefore, this article focuses on a set of important criteria that have a bigger influence on an electric city bus's range, such as vehicle weight, rolling resistance, and auxiliary load of a hypothetical electric bus automotive industry throughout several driving cycles. Because of the considerable variability of RESs, the results indicate that a mix with a significant contribution from RESs does not always translate into reduced GHG emissions for EVs. An analysis of the driving profile under various conditions also revealed that an aggressive style can result in a 47% increase in energy consumption [11]. The issues of driving range anxiety and lengthy battery charging times continue to hinder consumer acceptance of electric vehicles, despite significant advancements in energy storage technologies and charging infrastructure being anticipated. Most of these issues can be resolved through the construction of infrastructure, the optimal sizing and design of vehicle components, and in-depth research on the vehicle's dynamics under various real-time driving conditions. To forecast the vehicle

performance metrics, such as driving range, efficiency, power demand, and energy characteristics under various driving situations [12].

The proposed model estimated the forces acting on the vehicle and the duration of driving cycles, accounting for electric motor efficiency when calculating resistance forces, which ultimately determined EV energy consumption. The driving cycle analysis was carried out using this model, and the resulting simulations formed the basis for a mathematical evaluation of battery life. An electric vehicle was simulated in the MATLAB Simulink environment, and a power reserve analysis of the developed EV was completed [13].

Further studies examined how system power and vehicle weight influence fuel consumption. Findings reveal that the fuel-saving benefits of hybrid-electric vehicles (HEVs) are often diminished in larger, more powerful models. Nevertheless, compared to conventional internal combustion engine vehicles, HEVs incur a much smaller fuel-use penalty from added weight [14].

In the design of traction motors for light electric vehicles (LEVs), material properties are optimized to minimize energy consumption. Vehicle simulations were conducted during the design stage, incorporating mathematical models of both the traction motor and the battery, two critical LEV components. These simulations, tested over different drive cycles and motor stack length variations, identified the optimal power density that minimizes energy consumption [15].

To achieve more accurate energy consumption estimates, model feedback to the generator allows recalculation of reference values under electric drive limitations. This approach was applied to analyze various driving conditions, showing that while maximum acceleration has minimal effect on energy use, maximum velocity significantly impacts consumption [16]. A number of hybrid architectures and a fully battery-electric vehicle are evaluated and contrasted with a traditional car with an internal combustion engine in a study by Martin Redelbach *et al.* Using a vehicle simulation tool, a wide range of parameter modifications were carried out to assess the impact of lightweight on fuel efficiency. To examine the effects on cost efficiency from the standpoint of the user, the simulation results were included into

a total cost of ownership model. The analysis demonstrates that as electrification increases, the possibility to lower energy use through lightweight declines. As a result, compared to ICEs, EVs have lower operating cost reductions in EUR/km per kilogram saved [17]. Giulia Sandrini *et al.*, have provided research on goal is to examine the vehicle characteristics that affect light weighting results on an actual driving cycle that is typical of northern Italy's home-to-work commute. Specifically, an earlier study conducted on regular driving cycles is replicated to see if the same findings about the variability in the light weighting result can be reached. Two opposing vehicle models a small automobile and a N1 vehicle were used in this investigation. They were simulated using a reputable vehicle simulation program for estimating energy usage. In order to assess energy consumption across a real-world driving cycle, several simulations with varying vehicle mass and other vehicle parameters, such as aerodynamics and rolling resistance, were run [18].

2. Equations with Model the BEV

The vehicle dynamics considers the impact of all the forces and torques that are applied to the vehicle. The total of the aerodynamic drag force (F_d), the force from rolling resistance (F_r), the gradient force (F_g), and the acceleration force (F_{acc}) is the longitudinal tractive force (F_x) needed at the wheel during driving [19], [20], [21], [22]. The parameters of vehicle model as shown in Table 1.

2.1. Dynamics Design for Vehicles

2.1.1. The aerodynamic drag force

The resistive force known as aerodynamic drag force opposes the velocity of an item passing through a fluid, like air. It has a major impact on the efficiency, performance, and stability of vehicles and other moving objects, making it a crucial component in the study of aerodynamics. The interaction of the air molecules with the object's surface causes drag, which is energy loss that needs to be compensated for by thrust or propulsion. The shape of the object, surface roughness, velocity, and air density are some of the variables that affect the amount of aerodynamic drag. In domains like automotive design, speed and energy efficiency, and aerospace engineering, it is critical to comprehend and reduce drag.

Table 1. The parameters of vehicle model

Parameter	Description
E bat	Battery energy (Wh or kWh)
P motor	Power required by the motor (W)
v(t)	Vehicle speed at time t (m/s or km/h)
η drivetrain	The drivetrain efficiency (dimensionless, typically ranging from 0 to 1)
R	The coefficient of rolling resistance (N·m)
ρ	Density of the air (kg/m ³)
Af	The vehicle's frontal area (m ²)
Cd	Dimensionless drag coefficient
μ	The friction coefficient
m	Vehicle mass (kg)
V	Velocity of the vehicle (m/s)
α	The inclination angle in (degrees)
SOC	State of charge (dimensionless, between 0 and 1)
ISC	Initial state of charge
E consumption(t)	Energy consumption at time t (Wh or kWh)

The aerodynamic drag force refers to Eq. (1), F_d (N) which is defined.

$$F_d = \frac{1}{2} C_d A \rho v^2 \quad (1)$$

2.1.2. Rolling resistance force

Rolling resistance force is the resistive force that prevents a rolling item, like a tire or wheel, from moving across a surface. It is mostly brought on by the wheel's and the surface it rolls on deforming, as well as energy losses from internal friction in the materials. Rolling resistance, which is typically smaller than sliding friction, is important in applications like as transportation systems, cycling, and vehicle dynamics.

The rolling resistance force refer to Eq. (2), F_r (N) which is defined.

$$F_r = \mu m g \cos \alpha \quad (2)$$

2.1.3. The gradient force

Gradient force, in the context of vehicles, refers to the component of gravitational force acting along a sloped surface or incline. When driving uphill or downhill, it has a big impact on the dynamics of the vehicle. A vehicle needs more engine power or torque to ascend an incline because it must resist the gradient force that opposes its motion. On the other hand, this force aids in the vehicle's motion during descent and, if improperly controlled by braking, may result in acceleration. The rolling resistance force refers to Eq. (3), F_g (N) which is defined.

$$F_g = m g \sin \alpha \quad (3)$$

2.1.4. Vehicle acceleration force

Vehicle acceleration force refers to the net force that causes a vehicle to increase its speed. This force results from an imbalanced force acting on the vehicle's mass, usually produced by the engine or motor through the drivetrain, in accordance with Newton's Second Law of Motion. To create forward motion, acceleration force must overcome a number of resistive forces, including rolling resistance, gradient force (on inclines), and aerodynamic drag. Since it affects variables like acceleration time, fuel economy, and overall drivability, an understanding of acceleration force is essential to vehicle design and performance analysis.

The vehicle acceleration force refer to Eq. (4), F_{acc} (N) is defined.

$$F_g = m a \quad (4)$$

The longitudinal tractive force refers to Eq. (5), F_x (N) is defined.

$$F_x = \frac{1}{2} C_d A \rho v^2 + \mu m g \cos \alpha + m g \sin \alpha + m a \quad (5)$$

Where C_d is the drag coefficient, ρ is air density (kg/m³), A is the frontal area (m²), v the velocity of the vehicle (m/s), μ is the friction coefficient, m mass of the vehicle (kg), α the inclination angle in (degrees), a the vehicle acceleration (m/s²), g the gravitational acceleration (m/s²).

2.2. The Permanent Magnet DC Motor Model

Electric vehicle (EV) propulsion system simulation and analysis heavily rely on the

Permanent Magnet DC Motor (PMDM) model. Because of their great efficiency, small size, ease of control, and dependable operation, PMDMs are frequently seen in EVs. The motor's mechanical and electrical dynamics refer to Eq. (6) and Eq. (7), such as torque production, armature current, back electromotive force (EMF), and rotor speed, are represented by a PMDM model. The development of motor control techniques, the prediction of motor behavior under various load and voltage situations, and the optimization of overall vehicle performance are all made possible by accurate PMDM modeling. Designing energy-efficient drive systems and incorporating the motor into a comprehensive vehicle simulation framework need the use of this model.

$$V_a = L_a \frac{di_a}{dt} + E_b + i_a R_a \quad (6)$$

$$T_m = J \frac{dw}{dt} + B w + T_L \quad (7)$$

Where V_a is the armature voltage (V), i_a is the armature current (A), R_a is the armature resistance (Ω), L_a is the armature inductance (H), E_b is the back EMF (V), T_m is the motor torque (Nm), J is the moment of inertia ($\text{kg}\cdot\text{m}^2$), B is the damping coefficient ($\text{N}\cdot\text{m}\cdot\text{s}/\text{rad}$), w is the angular speed (rad/s), T_L is the load torque (Nm).

2.3. The Battery Model

A battery model is a mathematical or computational depiction of a battery's performance and behavior under different operating circumstances. These models are crucial for managing thermal performance, predicting state of charge (SOC), estimating longevity, and comprehending how batteries store and transfer energy. Different battery models have different levels of depth, ranging from basic empirical formulas to intricate electrochemical models.

2.3.1. Energy consumption rate

The rate of energy consumption, referred to as Eq. (8) can be modeled as:

$$E_{consumption}(t) = \frac{\eta_{drivetrain} P_{motor}(t)}{P_{motor}(t)} \quad (8)$$

Where $\eta_{drivetrain}$ is the efficiency of the motor and drivetrain.

2.3.2. Battery discharge

The battery discharges refer to Eq. (9) according to energy consumption over time:

$$\frac{dE_{bat}}{dt} = -E_{consumption}(t) \quad (9)$$

2.3.3. State of Charge (SOC)

The state of charge, referred to as Eq. (10) at any time, is related to the battery capacity and energy consumption:

$$SOC(t) = ISC - \frac{E_{consumption}(t) \cdot t}{E_{bat, capacity}} \quad (10)$$

Where $E_{bat, capacity}$ is the total energy capacity of the battery. Example of Modeling Over a Drive Cycle:

2.4. Final Model

Thus, the final model for the BEV over a drive cycle is essentially a system of differential equations that describes the energy consumption, battery discharge, and state of charge, as shown in Eq. (11) and Eq. (12).

$$\frac{dE_{bat}}{dt} = -\frac{P_{motor}(t)}{\eta_{drivetrain}} \quad (11)$$

$$SOC(t) = SOC(t_0) - \frac{1}{E_{bat, capacity}} \int_{t_0}^T \frac{P_{motor}(t)}{\eta_{drivetrain}} dt \quad (12)$$

This model can be solved numerically to estimate the vehicle's range, energy consumption, and other performance parameters under different driving conditions.

Figure 2 shows the EV model. MATLAB Simu-

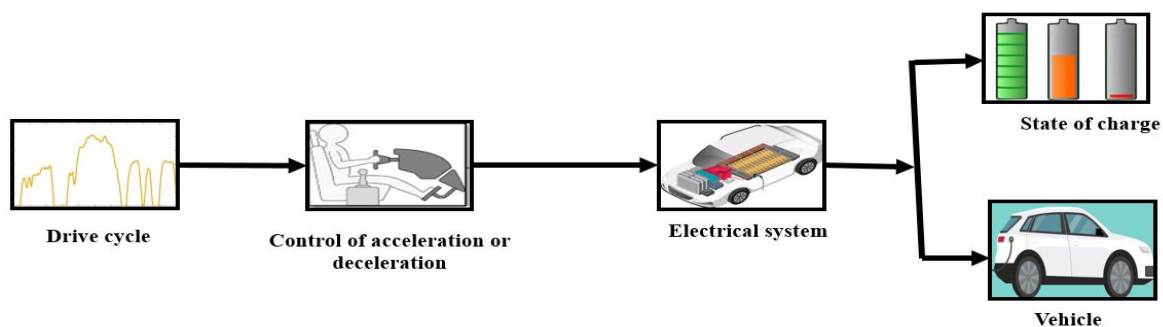


Figure 2. The electric vehicle model

link environment has been used to construct this model. The vehicle model consists of five blocks: drive cycle, control of acceleration and deceleration, electric system, state of charge, and vehicle. **Figure 3** shows the drive cycle with control of acceleration and deceleration, and the state of charge and vehicle, respectively. Technical parameters of the reference vehicle as shown **Table 2**, and dependent and independent variables used as shown in **Table 3**.

3. Results and Discussion

Using an electric vehicle (EV) model, the performance of the vehicle was evaluated based on the State of Charge (SOC) and battery characteristics across the minimum drive cycle, which consumes the least energy of the four driving cycles used [23]. This drive cycle was used to assess the dynamic behavior and energy consumption patterns under varying load and weight of the vehicle, thereby providing insight

into battery efficiency and overall vehicle performance. When testing electric cars (EVs), a standardized driving cycle is used to assess the vehicles' performance, range, and energy consumption under controlled circumstances. To provide consistent benchmarks for comparison and discussion, the effect of changing vehicle weight on the performance of the battery and the energy consumption during the same drive cycle is examined. **Figure 4** shows the driving cycle that needs minimum energy.

The way that voltage and current change over time during various driving phases, including accelerating, cruising, decelerating, and idling, is known as the voltage and current driving cycle for electric vehicles (EVs). Designing and testing EV batteries, motors, controllers, and charging systems requires this data. **Figure 5a** shows the current for electric vehicles at the selected driving cycle when the car weighs 800 kg. **Figure 5b** shows the Voltage for an electric vehicle throughout the

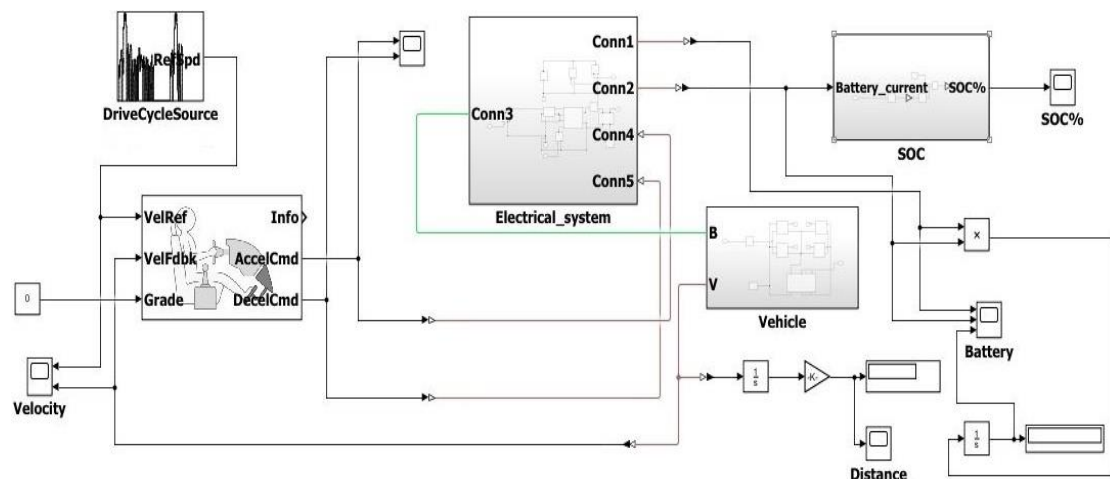


Figure 3. The cycle with control of acceleration and deceleration, and the state of charge for an electric vehicle

Table 2. The technical parameters of vehicle model

Parameter	Description
800Kg	Vehicle Wight
48 V	DC Motor
10KWatt	Battery capacity
110N.m	Torque of electrical vehicle
Fixed-ratio gearbox	Type of gearbox

Table 3. Dependent and independent variables used

Dependent	Independent
The coefficient of rolling resistance (N.m)	Battery energy (Wh or kWh)
Density of the air (kg/m ³)	Power required by the motor (W)
The vehicle's frontal area (m ²)	Vehicle speed at time t (m/s or km/h)
Dimensionless drag coefficient	The drivetrain efficiency
Vehicle Mass Kg	State of charge %

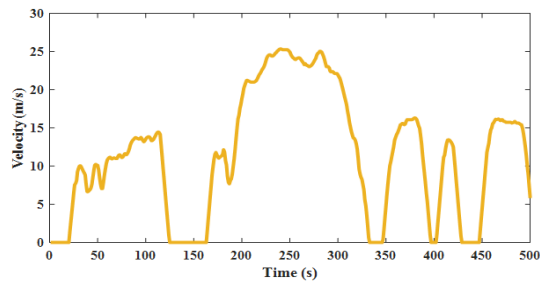


Figure 4. Drive cycle that needs minimum energy

selected driving cycle when the vehicle weighed 800 kg.

The variation of voltage and current over time during different phases of driving, such as acceleration, cruising, deceleration, and idling, is referred to as the voltage and current driving cycle for electric vehicles (EVs). This information is crucial for the development and evaluation of EV components, including batteries, motors,

controllers, and charging systems. *Figure 6a* presents the current of an electric vehicle weighing 1000 kg during a selected driving cycle, while *Figure 6b* shows the corresponding voltage for the same vehicle and cycle. With the change of weight of the vehicle, the current and voltage changed according to the value of the change in weight. *Figure 7a* presents the current of an electric vehicle weighing 1200 kg during a selected driving cycle, while *Figure 7b* shows the corresponding voltage for the same vehicle and cycle. To ensure that the current and voltage in the electric car change with the weight change, the current and voltage were measured when the weight of the vehicle increased by 1400 kg. As is clear in *Figure 8a*, which shows the current weight at a weight of 1400 kg, and *Figure 8b* which shows the voltage at the same weight and driving cycle.

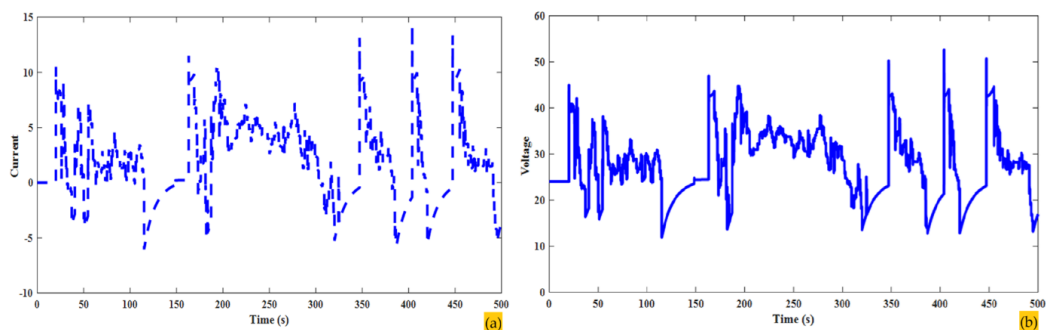


Figure 5. The electric vehicle weighed 800 kg. (a) The electric vehicle current; (b) The electric vehicle Voltage

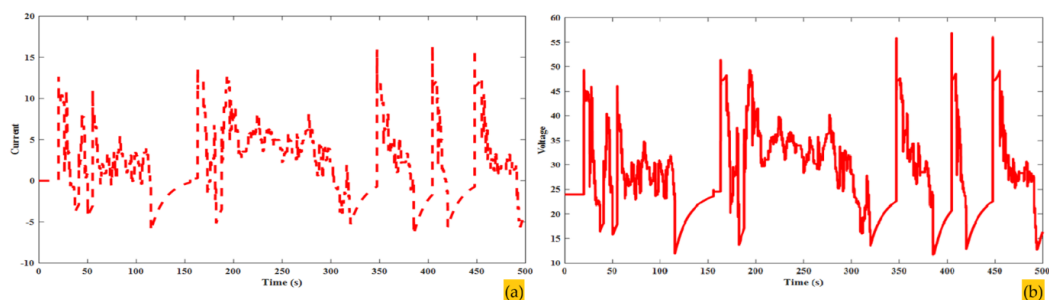


Figure 6. The electric vehicle weighed 1000 kg (a) The electric vehicle current; (b) The electric vehicle Voltage

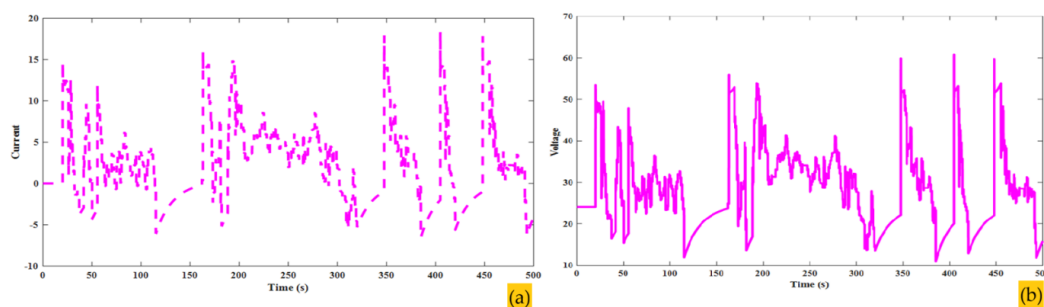


Figure 7. The electric vehicle weighed 1200 kg (a) The electric vehicle current; (b) The electric vehicle Voltage

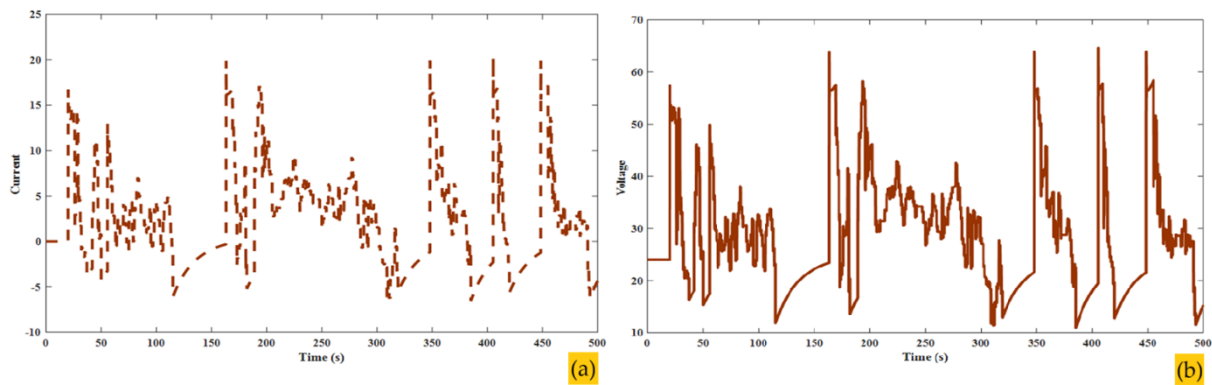


Figure 8. The electric vehicle weighed 1400 kg (a) The electric vehicle current; (b) The electric vehicle Voltage

3.1. Analysis of State of Charge Depletion and Key Battery Parameters

The State of Charge (SOC) depletion and critical battery parameters, including voltage, current, power, and temperature, were analyzed throughout the selected (constant) driving cycle to evaluate the performance of the electric vehicle (EV) under varying vehicle weights. The SOC at the end of the driving cycle for different vehicles is as follows: 800 kg: 99.68%, 1000 kg: 99.65%, 1200 kg: 99.63%, and 1400 kg: 99.59%. These results, illustrated in **Figure 9**, provide insight into how increased vehicle weight slightly affects battery depletion and overall EV efficiency.

Energy Consumption Analysis in Electric Vehicles. **Figure 10** illustrates the operation of electric vehicles (EVs), where the battery acts as the primary energy source, delivering power to the electric motor, onboard electronics, and

auxiliary systems. Understanding how energy is drawn from the battery under varying driving conditions is essential for assessing the vehicle's performance, efficiency, and driving range. Energy consumption depends on several factors, including vehicle speed, acceleration behavior, terrain, regenerative braking, and environmental conditions. To evaluate battery performance under consistent conditions, standardized driving cycles are used, representing typical real-world driving scenarios in a repeatable and controlled manner. During the selected driving cycle, the energy consumed by the EV at different vehicle weights was as follows: as shown in **Table 4**, 800 kg: 0.011 kW.h, 1000 kg: 0.013 kW.h, 1200 kg: 0.015 kW.h, and 1400 kg: 0.017 kW.h. These values highlight how increasing vehicle weight leads to higher energy consumption, even under the same driving cycle.

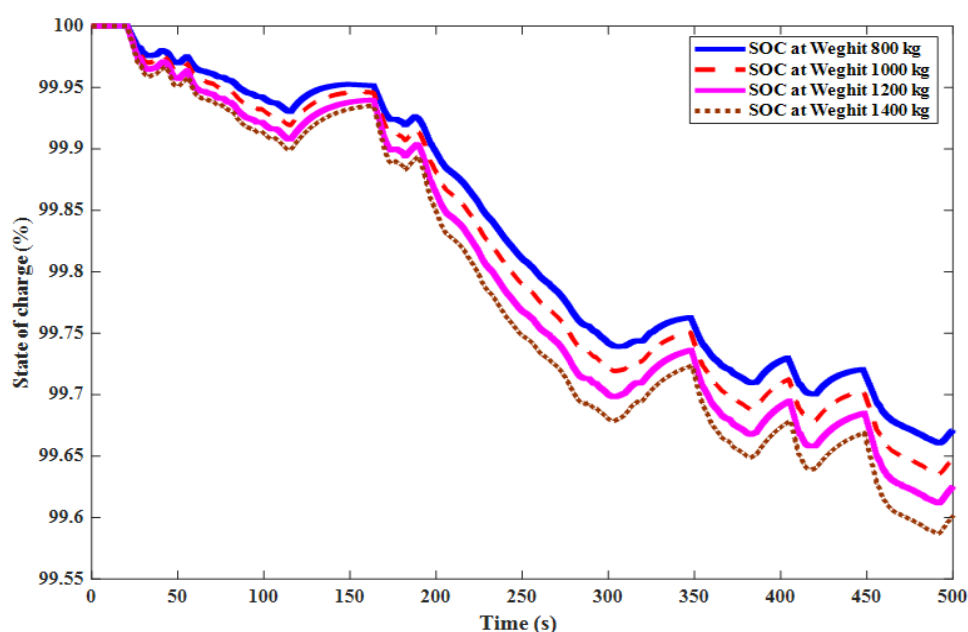


Figure 9. The state of charge at different vehicle weighs

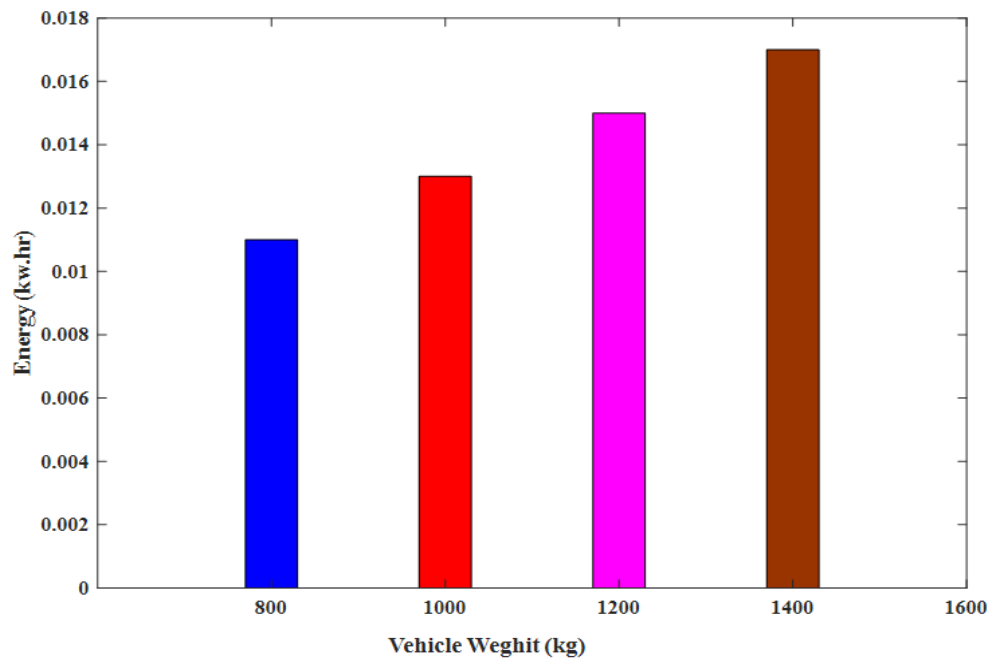


Figure 10. The energy at different vehicle weights

Table 4. Comparison between electric vehicle weights

Parameters	Drive cycle			
Electric Vehicle weights	800 kg	1000 kg	1200 kg	1400 kg
Total Energy	0.011 kw.hr	0.013 kw.hr	0.015 kw.hr	0.017 kw.hr

4. Conclusion

The decline and extinction of fossil fuels have led to a shift towards electric cars, as they reduce dependence on fossil fuels. Electric vehicles also rely entirely on batteries, and batteries vary from one type to another according to the material used to make battery plates, which affects the rate of charging and discharging the battery and consequently its lifespan. Every electric car needs a suitable battery, which varies depending on the weight of the vehicle and the battery type Nickel Manganese Cobalt battery and the capacity 10 K Watt, and determines the distance the car travels. In this research, MATLAB was used to build a module for an electric car and study the effect of car weight on battery performance and the rate of charging and discharging the battery. Battery performance was studied at five different electric vehicle weights: 800, 1000, 120,000, and 14,000 kg. At each weight, the charging and discharging rates, as well as the current and voltage consumed, were calculated. Finally, the energy consumed at each weight was measured. The results showed that as the weight increases, the current consumption rate increases, and the battery discharges faster. The energy also

increases with increasing weight. 800 kg: 0.011 kW.h, 1000 kg: 0.013 kW.h, 1200 kg: 0.015 kW.h, and 1400 kg: 0.017 kW.h. These values highlight how increasing vehicle weight leads to higher energy consumption, even under the same driving cycle. Therefore, the study recommends that researchers use modern technologies to manufacture batteries with less weight and increased capacity.

Author's Declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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Competing interests

The authors declare no competing interest.

Additional information

No additional information from the authors.

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