Challenges of Electric Vehicle Adoption in Palestine: Barriers and Pathways for Market Penetration

Zeedan Taha, Kadir Aydın, Tamer Atrash

Abstract— **This study investigates the multifaceted dynamics shaping electric vehicle adoption in Palestine by examining infrastructural, economic, technological, and regulatory factors. A mixed-methods approach combines analysis of quantitative data from the Ministries of Transportation and Energy with qualitative insights from government officials, industry practitioners, and academic experts. Results demonstrate a 27-fold increase in EV registrations between 2020 and 2024 alongside significant gaps: only 50 public fast-charging stations serve over 1,500 EVs, creating an EV-to-charger ratio of 31.02, well above international norms. Financial analysis reveals that preferential import duties lower upfront EV costs, but customs and VAT rates still constrain market growth. The regulatory framework provides clarity but introduces administrative delays that slow infrastructure deployment. Skills shortages in EV maintenance, energy import dependencies under occupation, and grid reliability issues further hinder progress. Opportunities include reduced fuel expenses, solar-powered charging, job creation, and improved air quality. To address these challenges, we propose phased incentives for EVs and hybrids, time-based charging rebates, institutional charging partnerships, financial support for green enterprises and public parking operators, coordinated education campaigns, vocational training programs, and international cooperation. Implementing these strategies can reduce greenhouse gas emissions, enhance economic diversification, and strengthen energy resilience, positioning Palestine as a model for sustainable transportation in complex geopolitical settings.**

I. Introduction

The rapid deployment of electric vehicles is crucial for mitigating climate change, as broad electric vehicle (EV) adoption has been shown to directly reduce air pollution and deliver significant public health benefits in urban areas by lowering particulate matter and other harmful emissions. When powered by renewable energy sources, EVs further enhance greenhouse gas emission reductions by coupling zero tailpipe emissions with clean electricity generation [1]. The adoption of electric vehicles faces several significant challenges that hinder their widespread acceptance and integration into the market. These challenges encompass infrastructure limitations, economic factors, technological barriers, and regulatory issues, which collectively impede the transition to sustainable transportation. Many Palestinians remain hesitant to embrace electric vehicles because charging stations are still too scarce and the fear of running out of battery mid-trip looms large [2–4]. On top of that, an EV's upfront price tag (usually higher than a comparable gasoline car) combined with only modest financial incentives makes it difficult for many to see the value [5]. Technological difficulties add to the uncertainty: batteries can struggle in extreme temperatures, and there simply aren't enough trained technicians who know how to service these cars, which only reinforces doubts about reliability [2,6]. Meanwhile, shifting regulations and slow permit approvals leave both manufacturers and buyers unsure of what comes next [5]. Overcoming these intertwined obstacles will require the government, automakers, charging-network operators, and local communities to work together, crafting clear policies and building the infrastructure needed to instill confidence in electric mobility.

Switching from gasoline cars to electric vehicles can make a real impact on climate change because EVs produce far fewer greenhouse gases and help clear up city air. Going electric also brings other benefits: drivers spend less on maintenance, power companies can balance the grid more effectively, and the push toward EVs often sparks new technologies and strengthens energy independence [7]. Expanding the EV market also means creating jobs and improving how efficiently we get around [9]. Still, several obstacles remain (EVs are still more expensive to manufacture, charging stations are sparse, and batteries can underperform in extreme weather) which can make people think twice before making the switch [7]. Sustainable sourcing of materials, economic impacts on industries and labor markets, resource scarcity, and the need for robust regulatory frameworks further complicate the shift to electric mobility [8,9]. Addressing these challenges requires advancements in battery technology, expansion of charging infrastructure, and integration with renewable energy sources to realize the full potential of EVs.

The adoption of electric vehicles in Palestine offers a pathway to sustainable transport and improved energy resilience, leveraging abundant solar resources to power charging stations and alleviate frequent electricity shortages. However, the heavy reliance on imports (approximately 92% of electrical energy is sourced from Israel) alongside occupation-related restrictions, grid constraints, and permit delays for infrastructure deployment significantly impede progress [10]. Investments in grid-connected photovoltaic systems aim to reduce dependency and improve supply reliability, though challenges such as high system failure rates and structural policy barriers remain [11]. Moreover, Palestine's renewable energy potential (particularly solar irradiance averaging between 5.4 and 6.0 kWh/m²·day over roughly 3,000 annual sunlight hours) remains substantially underutilized at only 8% capacity, with optimal sites in Gaza

Zeedan Taha is with the Mechanical Engineering Department, Faculty of Engineering, Çukurova University, 01330 Adana, Türkiye. Email: tahazidane@ppu.edu

Kadir Aydın is with Mechanical Engineering Department, Faculty of Engineering, Ostim Technical University, 06374 Ankara, Türkiye.

Tamer Atrash is with the Civil and Architectural Engineering Professions Department, College of Applied Professions, Palestine Polytechnic University, P726 Hebron, Palestine

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and the southwest West Bank for electricity generation and hot water production; legislative support and infrastructure improvements are essential to capitalize on this resource and counter political and` structural obstacles [12]. To overcome these challenges, optimized charging station placement along urban centers and main transit corridors can balance grid load, while streamlined permitting processes and community engagement initiatives enhance accessibility and public acceptance.

This study explores these challenges in-depth using quantitative data collected from the Ministry of Transportation and Ministry of Energy in Palestine, supported by qualitative insights collected from key stakeholders. By such measures and the promotion of synergistic relations between government, private sector, and local community, Palestine can lay the groundwork for a more sustainable and green transport system—bridging geopolitical and infrastructural gaps while enhancing economic growth and environmental stewardship.

II. Palestinian EV Market Overview

Section 2 presents an overview of the Palestinian electric vehicle market by examining annual registration trends, current fleet composition, and emerging charging infrastructure developments. This baseline analysis helps contextualize the drivers and barriers influencing EV adoption dynamics in Palestine.

A. Market Size and Distribution

By the end of 2024, the estimated 1,551 EVs in Palestine remain clustered in major urban centers of the West Bank, with limited presence in Gaza [13]. Most fast-charging stations have been installed by EV dealerships to serve their own customers, which remains commercially challenging given the small EV fleet relative to ICE vehicles; a higher penetration rate would be needed for charging operators to achieve sustainable revenues. A recent study predicts that replacing 10% of internal combustion vehicles with EVs by 2030 could yield energy cost savings of approximately USD 464.31 million (about 3.18% of Palestine's 2018 GDP) and reduce greenhouse gas emissions by 10.51% for methane, 10% for nitrous oxide, and 6.86% for carbon dioxide. The analysis, based on projected fuel and electricity rates and total vehicle-kilometers traveled, underscores the potential for EV energy efficiency to deliver both economic and environmental benefits in a context of high fuel prices and near-zero current EV penetration [14].

B. Charging Infrastructure

Two main operators currently manage approximately 50 fast-charging stations across the West Bank, with station power outputs ranging from 50 kW to 150 kW [15]. According to the IEA (2025), global averages in 2024 stood at 11 EVs per public charging point, with benchmarks of 1.8 Electric Vehicle to Elevtric Vehicle Supply Equipment (EV/EVSE) in Korea and 81.9 EV/EVSE in New Zealand. In Palestine, with 1,551 electric vehicles and only 50 public charging stations, the resulting ratio of 31.02 EV/EVSE indicates a significant infrastructure gap compared to best practices [16].

C. Regulatory Framework

Palestine Electricity Regulatory Council Decision No. 7/2022 establishes two station categories: commercial (requiring a two-stage permit and 5-year license) and private (home/work chargers exempt from licensing with distributor notification). Applications must include safety and municipal approvals, with permit decisions within 7 days and final licenses within 14 days. If grid capacity allows, installation incurs no extra connection fees; otherwise, standard charges apply. Tariffs are capped at commercial electricity rates, with peak-time pricing subject to approval [17].

These licensing provisions provide clarity and predictability for investors and operators, encouraging commercial station deployment. However, the administrative steps and technical requirements can delay rollout, particularly for smaller providers, and may inhibit rapid scaling of public charging infrastructure essential for consumer confidence.

Ministerial Decision No. 31/2024 of the Palestinian Ministry of Transport further restricts the importation of electric and hybrid vehicles to official agents only, effective 2 January 2025 [18]. By centralizing imports through authorized dealerships, this decision aims to ensure quality control and after-sales support. However, it may also constrain market supply, limit price competition, and slow the entry of lower-cost or niche models, thereby potentially delaying broader EV uptake in Palestine.

D. Fiscal Incentives and Taxation

Palestine applies a 7% customs duty on all vehicle imports, a 16% value-added tax (VAT), and differentiated import tax rates: 10% for electric vehicles, 30% for hybrids, 50% for sub-2,000 cm^3 ICE vehicles, and 75% for larger-engine ICE vehicles. These measures have a direct impact on consumer purchasing decisions and market dynamics. The reduced duty rate for EVs lowers upfront acquisition costs relative to hybrids and conventional vehicles, enhancing price competitiveness and stimulating demand among cost-sensitive buyers. However, the overarching VAT and residual customs duties keep total ownership costs higher than in markets with deeper subsidies, limiting uptake among middle-income segments. Comparatively, the favorable EV tax rate positions Palestine ahead of some regional peers, but the absence of targeted rebates or VAT exemptions restricts broader adoption. If the government offered extra financial supportfor example by waiving VAT or providing purchase subsidies, would bring electric vehicle prices closer to those of conventional cars and likely boost EV sales.

E. Technical and Professional Training Needs

In 2020, a survey of micro, small, and medium enterprises in the West Bank found that 66% of respondents needed training in modern vehicle mechatronics, especially in mechanical maintenance and electrical systems, while 65.5% admitted they were not prepared to handle hybrid or electric vehicle systems. Because so few technicians have these skills, qualified mechanics to service EVs and hybrids are hard to find. This may lead to longer repair times, higher maintenance costs, and worries among buyers about reliability. In order to support a developed EV market, Palestine will need to

establish vocational training and certification programs that qualify mechanics how to deal with electric vehicles [19].

III. Electric Vehicles In Palestine: Opportunities and Challenges

Recent advancements in Palestine's automotive market indicate that electric vehicles are beginning to gain prominence. Electric vehicle registrations surged from a mere 31 in 2020 to 839 in 2024, attributed to advancements in battery technology and expedited charging solutions, alongside heightened public consciousness regarding environmental concerns. The gradual deployment of public charging stations, elevated acquisition costs, and persistent political obstacles constrain the pace of this trend's expansion. If Palestine implements strategic policies, increases charging stations powered by solar or other renewable sources, and conducts public awareness campaigns, it can transform this initial interest into sustainable advancement yielding environmental, economic, and energy advantages for the region.

Modeling based research indicates that sustaining existing regulations may lead to electric vehicles constituting roughly 6% of the light-duty fleet by 2035, generating over USD 287 million in cumulative fuel savings and a 4.2% decrease in transport-related CO_2 emissions [20]. A robust ambition strategy, including extensive solar charging, easing of import quotas, and requirements for public transport electrification by 2030, may elevate market share to 25% by 2035, yielding savings above USD 1.28 billion and approximately a 19% decrease in CO_2 emissions [21].

If Palestine adopts strategic policies, expands solar or other renewable energy charging stations, and executes public awareness campaigns, it can convert initial interest into sustainable progress, resulting in environmental, economic, and energy benefits for the region.

A. *Opportunities*

- Reduced Fuel Costs: Substituting imported diesel and petrol with domestically generated electricity can substantially lower both household and national energy costs, as electricity prices are significantly lower than fuel prices.
- Economic Diversification: Expansion of charging infrastructure and EV services can create new jobs in station installation, maintenance, and battery management.
- Affordable Transportation Services: As EVs' operating costs decline, public transportation and taxi services become more accessible, enhancing both urban and rural communities' mobility.
- Improved Air Quality and Public Health: Widespread EV adoption reduces tailpipe emissions, leading to better ambient air quality and associated health benefits.
- Solar Integration: Leveraging abundant solar irradiance to power EV charging provides a renewable energy advantage that is not available to internal combustion vehicles.

B. *Challenges*

- Limited Charging Infrastructure: Limited Charging Infrastructure: Potential purchasers continue to experience range anxiety due to the fact that there are only 50 public charging stations for more than 1,500 EVs.
- High Initial Costs: Despite lower taxes, electric automobiles are still more costly than many old internal combustion vehicles.
- Regulatory and Administrative Delays: Permit requirements and commercial charger licensing procedures may cause delays in the deployment of infrastructure.
- Problems with Grid Reliability: Regular power outages and grid restrictions impact charging availability and increase the likelihood of service disruptions.
- Lack of skilled technicians: Extended downtimes and increased service expenses may result from a lack of qualified specialists for EV maintenance.
- Geopolitical limitations: During occupation, dependency on energy imports, mobility limitations, and permit delays make investment and planning more difficult.
- Lower Fuel Tax Revenue: As EV adoption leads to a decline in gasoline usage, a sizeable portion of government revenue may be lost, which might have an effect on public finances and necessitate the adoption of new fiscal policies.
- Reduced Tax Revenue from Electric Vehicles: Although EVs enjoy the advantages of lower import taxes, this also leads to a decrease in the amount of taxes collected per vehicle, which reduces the amount of money the government can collect to pay for incentives and infrastructure.

IV. Solutions and Suggestions

The following strategies are suggested in order to address the issues noted and accelerates the adoption of EVs in Palestine:

- Gradual Rollout of EV and Hybrid Incentives: Use a phased transition plan to gradually implement infrastructure assistance and tax cuts. Since hybrid cars already have a lower environmental impact and don't require new charging infrastructure, this strategy enables the government to support them as a temporary fix while adjusting budgets and preserving revenue stability.
- Smart Charging Incentives: Time-based incentives or credits for charging during times of lower grid demand might still encourage off-peak usage even when electricity prices in Palestine are fixed

throughout the day. In comparison to dynamic pricing methods utilized in other markets, this strategy offers reduced effective charging costs by utilizing excess renewable output and smoothing demand curves, hence lowering peak load pressures.

- Investment in Charging Infrastructure: Start by establishing charging stations for employees and guests by collaborating with sizable organizations (such as colleges, cities, hospitals, and large corporations) that already have parking structures. Expand public and private charging networks concurrently by forming strategic relationships with the private sector, giving priority to major transport corridors and urban areas in order to reduce range anxiety.
- Green Enterprise and Public Parking Support: Offer grants and low-interest loans to nearby companies working on battery recycling facilities, smart charging infrastructure development, and renewable energy projects. In order to increase accessibility and lower initial investment barriers, public parking owners should also be given financial support or tax incentives to install EV chargers.
- Public Awareness Campaigns: Start extensive education programs emphasizing the advantages of EVs, the savings on the overall cost of ownership, and the best charging techniques in partnership with academic institutions and pertinent ministries (such as the Ministry of Education and the Ministry of Transportation). Utilize governmental and academic channels to hold public lectures, workshops, and community outreach initiatives in order to increase demand and foster customer confidence.
- Vocational Training and Education Support: To create a workforce with the skills to support the expanding EV market, collaborate with technical and vocational education institutions to create and implement specialized EV and hybrid vehicle maintenance curricula, certification programs, and hands-on training workshops.
- International Cooperation: Work together with regional and global EV advocates to share best practices, secure technical support, and draw in foreign capital for Palestine's EV sector.

V. Conclusion

This study examined the status of electric vehicle adoption in Palestine, discussing opportunities and barriers based on the Palestinian market. At the same time, it identified significant opportunities in reducing energy costs, integrating solar energy, economic diversification, and contributing to environmental conservation.

To translate these opportunities into sustainable growth, a comprehensive strategy is required. First, introducing gradual incentives for both electric and hybrid vehicles can mitigate financial impacts while maintaining momentum. Second, solar energy can be harnessed to charge electric vehicles, and off-peak electricity tariff reductions can be used to reduce user charging costs and reduce the impact of electric vehicles on the electricity distribution network. Third, rapid infrastructure expansion should begin with institutional partnerships before expanding to broader public-private networks to keep pace with the increase in electric vehicle numbers. Fourth, supporting green projects and public parking operators with targeted grants and tax incentives can accelerate the deployment of charging stations in urban and peri-urban areas. Fifth, strong public education initiatives carried out in partnership with governmental and academic institutions will help increase consumer trust, knowledge, and comprehension of the characteristics and needs of electric cars. Sixth, using TVET institutes to set up technical and vocational training programs would guarantee the availability of skilled technicians, cutting down on maintenance time and enhancing service quality. Last but not least, international cooperation with top markets for electric vehicles and development partners will supply technical expertise and draw in required funding.

Policymakers may overcome the operational and geopolitical obstacles to the adoption of electric vehicles and provide a clear roadmap for the growth of the electric car industry in Palestine by combining extensive subsidies, infrastructural expenditures, technical training, and educational outreach. In addition to lowering greenhouse gas emissions and improving air quality, the effective implementation of this integrated framework would encourage economic diversification, strengthen energy resilience, and establish Palestine as a regional leader in environmentally friendly transportation.

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