Discussion Paper

Scaling Up BEV Charging and Battery Capacity in Saudi Arabia

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Executive Summary

This study estimates the investment requirements for passenger battery electric vehicle (BEV) battery manufacturing and charging infrastructure in Saudi Arabia from 2026 to 2060 under two adoption scenarios: Ambition and Ambition_plus. Scenario-based modeling is used to project BEV stock growth, incorporating climate-adjusted battery degradation rates and technology cost reductions derived from learning curves.

The methodological framework comprises two main components: (1) estimation of total battery capacity demand and the associated domestic manufacturing investment, and (2) assessment of charging infrastructure deployment and the capital required for 50 kW direct current fast charging (DCFC) networks.

For 50 kW DCFC infrastructure, cumulative net present value (NPV) investment needs are estimated at approximately ﷼14-18 billion (SAR) under Ambition and ﷼38-49 billion under Ambition_plus. When averaged over the study period, this equates to ﷼0.4-0.52 billion per year for Ambition and ﷼1.08-1.4 billion per year for Ambition_plus.

For domestic lithium-ion battery manufacturing, cumulative NPV requirements range from ﷼18 billion (50% domestic production) to ﷼36 billion (100% domestic production) under Ambition, and from ﷼46 billion to ﷼91 billion under Ambition_plus. Corresponding annualized investments are ﷼0.6-1.15 billion for Ambition and ﷼1.5-3 billion for Ambition_plus.

The findings highlight that sustained, well-coordinated investment is essential to match infrastructure rollout with EV uptake, mitigate risks of underutilization or congestion, and build domestic manufacturing capabilities. These benchmarks provide a practical foundation for budget planning, the development of public-private partnerships, and industrial localization strategies – directly supporting Saudi Arabia's clean transportation transition and economic diversification goals.

Metric	Ambition	Ambition_plus
BEVs on road, 2060	~4 million	~10 million
Cumulative battery demand	334 GWh	853 GWh
DCFC points required	~300,000	~820,000
Charging infrastructure investment	﷼ ~0.4-0.52 billion per year	﷼ ~1.08-1.4 billion per year
Battery-plant CAPEX (50 % local / 100 % local)	﷼ ~0.6-1.15 billion per year	﷼ ~1.5-3 billion per year

Keywords: Electric Vehicles, EV Charging Infrastructure, Investment Opportunity, Battery Manufacturing

List of Abbreviations

BEV	Battery electric vehicle
CAFE	Corporate Average Fuel Economy
CAPEX	Capital expenditure
CCE	Circular Carbon Economy
CCS	Carbon capture and storage
DCFC	Direct current fast charging
EPR	Energy price reforms
EVIQ	Electric Vehicle Infrastructure Company
EOL	End of life
FCEV	Fuel cell electric vehicle
GHG	Greenhouse gas
GCC	Gulf Cooperation Council
GCAM-KSA	Global Change Assessment Model tailored for Saudi Arabia
HDV	Heavy-duty vehicle
ICE	Internal combustion engine
KAEC	King Abdullah Economic City
LDV	Light-duty vehicle
NPV	Net present value
PCS	Public charging station
PIF	Public Investment Fund
SEC	Saudi Electricity Company
SUV	Sport utility vehicle

Introduction

01

Saudi Arabia's land transport sector is both an economic backbone and a major contributor to energy consumption and greenhouse gas (GHG) emissions. As the Kingdom advances its Vision 2030 agenda – focused on economic diversification, environmental sustainability, and improved quality of life – road transport is expected to undergo a transformative shift. A central pillar of this transition is the adoption of electric mobility, aimed at lowering domestic oil use, reducing air pollution, and decarbonizing end-use energy systems (Bhatt et al. 2024; Kamboj et al. 2024).

Launched in 2016, Vision 2030 set ambitious goals to reduce reliance on oil and improve energy efficiency, positioning sustainable transport as a critical reform area (Kingdom of Saudi Arabia 2016). The subsequent Circular Carbon Economy (CCE) framework, introduced during the Kingdom's G20 presidency, underscored the role of low-emission technologies such as battery electric vehicles (BEVs) in national development (Luomi et al. 2021). These ambitions were reinforced at the Saudi Green Initiative Forum in 2021, where the government pledged net-zero emissions by 2060. The roadmap includes generating 50% of electricity from renewables by 2030, implementing large-scale carbon capture and storage (CCS), expanding energy efficiency across all sectors, and planting 10 billion trees (Kingdom of Saudi Arabia 2021).

Policy instruments complement these strategies. Corporate Average Fuel Economy (CAFE) standards for light-duty vehicles align Saudi regulations with global benchmarks (Saudi Standards, Metrology and Quality Organization 2023). Domestic energy price reforms (EPR) under the Fiscal Balance Program encourage efficient consumption (Dubyan and Gasim 2019).

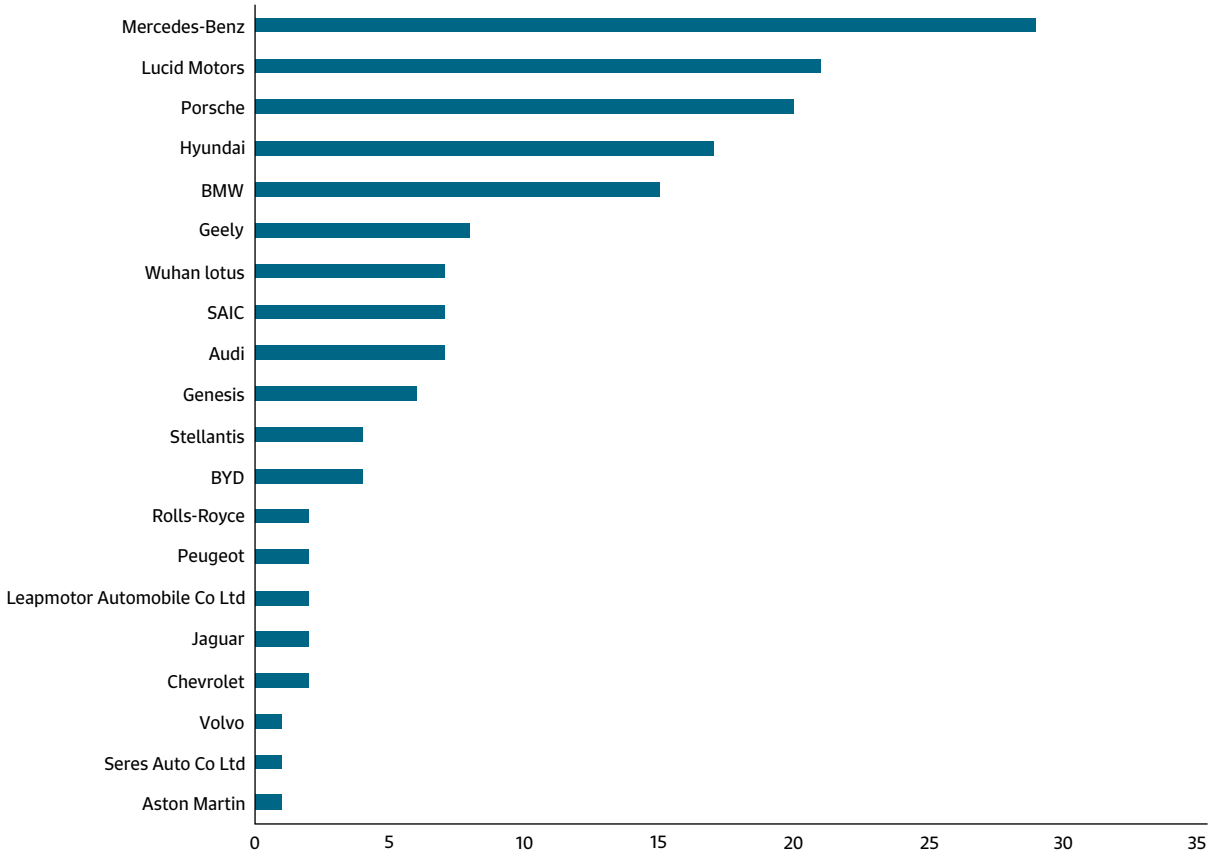
At the local level, initiatives such as the Royal Commission for Riyadh City's target for 30% of vehicles in the capital to be electric by 2030 highlight the integration of transport sustainability into urban planning (Royal Commission for Riyadh City 2021). These coordinated efforts reflect Saudi Arabia's commitment to creating a sustainable, low-emission future aligned with global climate action goals.

Market dynamics underscore the urgency of this transition. Saudi Arabia is one of the world's largest consumers of motor gasoline: despite ranking 41st in population, it is the 10th-largest global consumer and the fourth-highest in per capita use, behind the United States, Canada, and Kuwait (Sheldon and Dua 2019). Rising population, urbanization, and income levels have driven a sharp increase in car ownership and transport demand (Aldalbahi and Walker 2016). Between 2021 and 2023, vehicle registrations increased by 9%, with private cars rising by 11%, motorbikes by 39%, and public transport vehicles by 21%. Road transport alone accounts for about 95% of transport-related CO_2 emissions, which represent nearly 23% of national emissions (Kingdom of Saudi Arabia 2024).

To address this, Saudi Arabia is fostering BEV deployment through public and private investment initiatives. The Electric Vehicle Infrastructure Company (EVIQ), a joint venture between the Public Investment Fund (PIF) and Saudi Electricity Company (SEC), aims to install more than 5,000 fast chargers nationwide by 2030 (EVIQ 2024). On the manufacturing side, PIF has partnered with Foxconn and BMW to launch Ceer, targeting the production of electric sedans and SUVs for domestic and regional markets (PIF 2022). Simultaneously, PIF's investment in Lucid Motors has led to the construction of a BEV plant in King Abdullah Economic City, with an eventual capacity of 155,000 vehicles annually (PIF 2023).

Recent sales trends suggest momentum is building. In Q3 2024, approximately 158 BEVs were sold, with SUVs dominating the market. These vehicles featured average battery capacities of 85 kWh and driving ranges of around 460 km (Figure 1).

Figure 1. Q3 2024 sales of BEVs in Saudi Arabia.



Source: Authors' analysis and Transport General Authority (2024).

Lucid Motors, Mercedes-Benz, and BMW currently lead Saudi Arabia's premium EV market; however, public charging infrastructure remains limited, with fewer than 110 chargers concentrated in Riyadh, Jeddah, and the Eastern Province. Firms such as Electromin and EVIQ are accelerating rollout efforts to close this gap (Abdulkareem and Ellaboudy 2025). Multiple drivers are shaping EV demand in Saudi Arabia. At the city level, Riyadh's sustainability strategy aims for 30% of vehicles to be electric by 2030, sending a clear signal to public and private fleets under the Royal Commission for Riyadh City.

On the supply side, domestic industrial policy is progressing with Ceer – the Kingdom's first EV brand – and Lucid's plant in King Abdullah Economic City (KAEC), which is expected to reach a production capacity of up to 155,000 vehicles per year. These initiatives expand local model availability and help anchor fleet procurement. Further, nationwide charging access is improving through the PIF-backed Electric Vehicle Infrastructure Company, which is deploying a fast-charging network to reduce range and convenience barriers. Against this backdrop, a rigorous assessment of investment requirements is essential to align policy, infrastructure, and manufacturing with the anticipated growth in BEV demand.

This study evaluates passenger BEV uptake under two scenarios – Ambition and Ambition_plus – through 2060, and quantifies the associated investments required for public fast-charging infrastructure and a potential domestic battery manufacturing industry. Domestic battery manufacturing captures more value than complete vehicle assembly because cells and packs dominate EV costs and can be exported across mobility and stationary markets (BloombergNEF 2024). Further, battery production is electricity-intensive, so coupling plants to a growing, renewable-rich grid improves unit economics and lowers embedded emissions, while alignment with national industrial policy and upstream metals investments shortens supply chains and diversifies offtake (BloombergNEF 2025; Degen et al. 2023).

For infrastructure, the public network sizing focuses on direct-current fast charging. Slow and medium-speed AC options are suitable for homes, workplaces, depots, and long-stay car parks; however, they do not meet the refuel-and-go needs of high-throughput traffic or time-sensitive fleets. Therefore, DC fast charging is prioritized on intercity corridors, at logistics hubs requiring rapid turnaround, and in dense districts where long dwell times are scarce. Additionally, persistent high temperatures reinforce this choice because brief, high-power sessions limit heat exposure for batteries and users. All investment and deployment estimates in the study for charging infrastructure refer solely to DC fast-charging installations.

The remainder of the paper details data sources and methods, scenario design, and model calibration for adoption, charging, and manufacturing. It then presents results on BEV uptake, charging network sizing, and investment trajectories for fast-charging and battery production.

Model Methodology and Assumptions

02

This study focuses on land-based transport and evaluates the decarbonization potential of current and planned initiatives. It employs three methodological approaches, summarized below:

1. **Service demand and EV stock projection:** This study uses GCAM-KSA to assess decarbonization pathways for Saudi Arabia's land transport sector under two scenarios. The Ambition scenario assesses current policies and near-term interventions, including incremental efficiency gains driven by CAFE standards, calibration to actual fuel prices through January 2025, adoption of clean vehicles reaching up to 30% of new sales in Riyadh, and an exogenous modal shift toward buses and rail – expected to account for 20% of total mobility by 2060. The Ambition_plus scenario represents the most proactive policy package. It includes accelerated clean-vehicle adoption; removal of infrastructural and institutional barriers for light-duty vehicles (LDVs) by 2035 and for heavy-duty vehicles (HDVs) between 2040 and 2045; a 30% public transport share by 2060; an internal combustion engine (ICE) scrappage policy starting in 2030 with a 15-year vehicle age cap; and full deregulation of transport fuel prices by 2030.

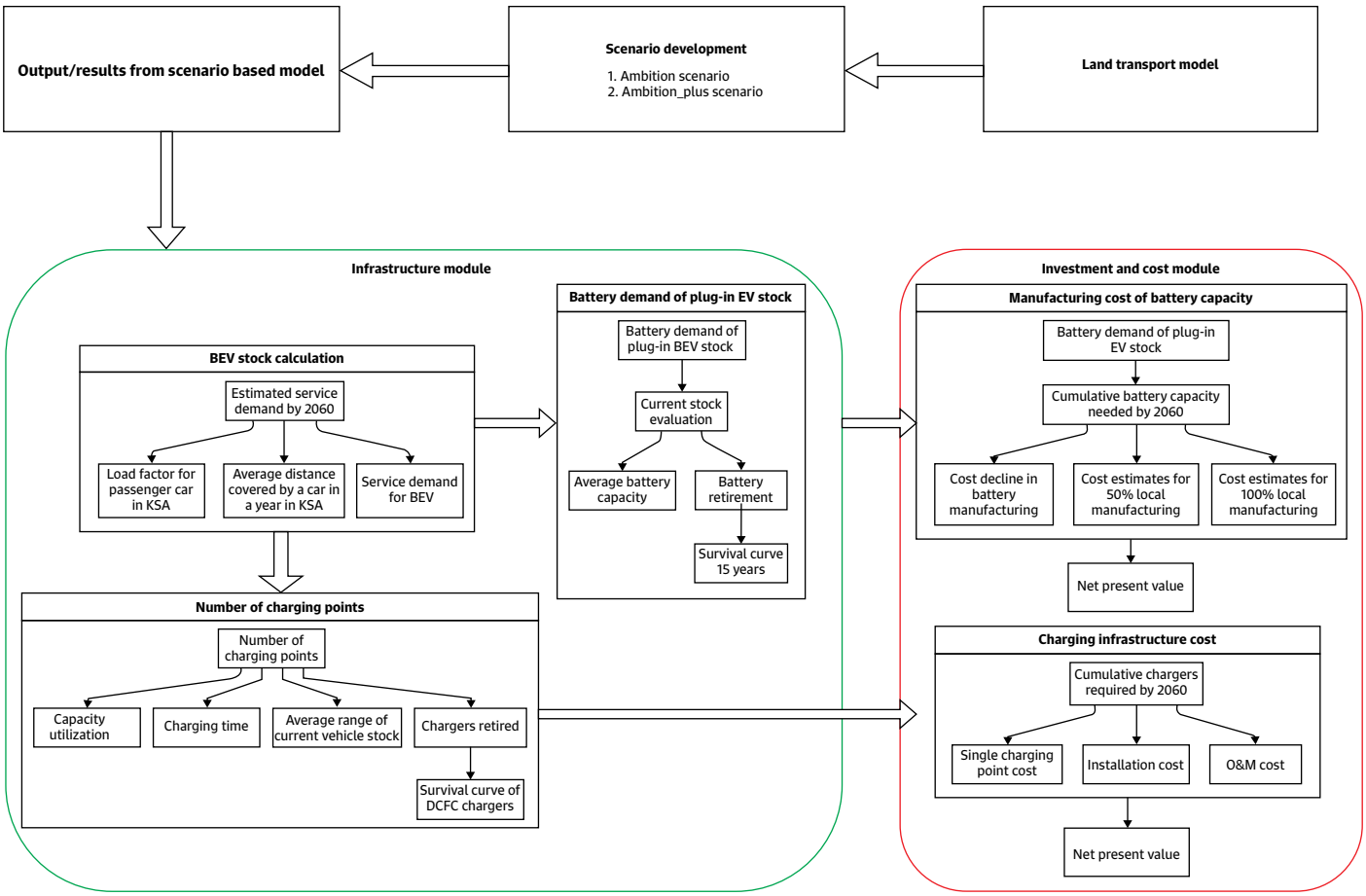
2. **Battery demand estimation and domestic production cost:** This study estimates Saudi Arabia's lithium-ion battery pack demand based on both new EV sales and replacement needs, as vehicle lifespans typically exceed battery lifespans. Average pack sizes are calculated from recent sales data. Battery degradation is explicitly modeled, with end-of-life defined at approximately 70% to 80% of initial capacity. Given Saudi Arabia's climatic conditions, a 15-year battery life is assumed. For investment planning, the analysis uses capital cost assumptions consistent with recent battery manufacturing projects in the Gulf Cooperation Council (GCC) and globally. To meet projected demand, two manufacturing pathways are evaluated: full indigenization, involving 100% domestic production, and partial localization, in which 50% of production is domestic and the remainder imported. These pathways are intended to inform industrial scaling, investment attraction, and supply chain resilience strategies.

3. **Charging infrastructure requirements and investment:** Charging infrastructure needs are determined by vehicle usage patterns and charger performance parameters, including the number of sessions per vehicle, utilization rates, session length, vehicle range, and charger retirement. A survival-curve model is used to estimate charger lifetimes and retirements due to wear, obsolescence, maintenance, and environmental conditions. This approach enables realistic projections of active stock, replacement schedules, and long-term infrastructure planning aligned with BEV adoption. Costs are divided into hardware and installation components.

Hardware is priced in 2025 SAR, based on a single DCFC unit cost that declines annually by 1.9%. Installation costs include labor, materials, and utility upgrades, drawing from recent nonresidential benchmarks in the GCC. Economies of scale are captured through upper-, medium-, and lower-cost cases.

This section presents the complete methodology, including data sources, assumptions, and analytical steps, and is accompanied by the Figure 2 flow chart. It summarizes the sequence from scenario design through model calibration, infrastructure sizing, and investment estimation. Key parameters and equations are referenced in the subsections that follow.

Figure 2. Illustration of model methodology.



Source: Authors' analysis.

2.1 Service Demand and EV Stock Projection

This study explores decarbonization scenarios for land transport in Saudi Arabia using GCAM-KSA, an integrated assessment model (Kamboj et al. 2025). GCAM-KSA's transport sector models energy demand for both passenger and freight services. Demand for each transport service is driven by regional GDP, income levels, and population. The model includes competing modes for each service type. The passenger transport structure is highly nested, with modes, vehicle types, and technologies competing at different levels through a logit choice mechanism calibrated to base-year (2015) shares.

Passenger service demand is estimated on a per capita basis and aggregated across the entire population (Appendix Table A1). Demand in passenger-kilometers (pkm) for region *(r)* and the time period *(t)* is estimated as follows:

$$D_p^{r,t} = \sigma_{t-1}^{r} \left(Y_I^{r,t}\right)^{\alpha} \left(P_I^{r,t}\right)^{\beta} \left(N^{r,t}\right)$$

where $D_p^{r,t}$ is the demand for passenger transport in the region *(r)* at the time period *(t)*, σ is the calibration parameter for the previous time-period *(t-1)*, Y_I is the per capita GDP divided by the index for income in the form of per capita GDP (defined on a purchasing power parity (PPP) basis) at time-period *(t)* in the previous time period *(t-1)*, $N^{r,t}$ is the index of price of transportation (cost to the user) aggregated across all modes and technologies and calculated as the ratio of price in time-period *(t)* to the price in the previous time period *(t-1)*, and $N^{r,t}$ is the population of the region *(r)* at the time period *(t)*. The parameters α and β represent the income and price elasticities of per capita passenger demand, respectively (Kamboj et al. 2024).

Two scenarios are modeled through 2060 to assess the long-term implications of policy measures and mitigation strategies for Saudi Arabia's energy system.

The Ambition scenario assesses the long-term effects of existing initiatives and policies, while also considering additional policy interventions scheduled for the near future. It accounts for incremental improvements in fuel efficiency attributable to the implementation of CAFE standards and associated energy efficiency measures. Importantly, it includes fuel pricing reforms by calibrating the model to the actual fuel prices up to January 2025, reflecting a more market-responsive approach to fuel pricing.

Furthermore, the scenario considers policies aimed at increasing the proportion of clean vehicles – comprising BEVs, fuel cell electric vehicles (FCEVs), and ICE hybrids – to up to 30% of new sales within Riyadh city. Additionally, this scenario acknowledges the government's ongoing efforts to develop public transportation infrastructure, assuming an exogenous modal shift toward public transit modes – such as buses and railways – projected to constitute 20% of mobility modes by 2060.

The Ambition_plus scenario represents the most proactive and stringent policy framework analyzed, incorporating aggressive measures aimed at maximizing decarbonization potential. Building upon the Ambition scenario, it envisions accelerated adoption of clean vehicles by systematically removing infrastructural and institutional barriers for LDVs by 2035 and for HDVs between 2040 and 2045. It also anticipates a substantial shift toward public transportation, targeting a 30% market share by 2060.

A central component of this scenario is the implementation of an ICE vehicle scrappage policy starting in 2030, which limits the vehicle age to 15 years to expedite fleet renewal and enhance overall efficiency. Additionally, it proposes the complete deregulation of transportation fuel prices by 2030, thereby facilitating more accurate market signals and encouraging efficient fuel consumption behaviors.

Beyond scenario analysis, the study applies an innovative methodology to estimate battery capacity demand and charging infrastructure needs for passenger BEVs, directly linking these to investment requirements for manufacturing and deployment.

2.1.1 EV Stock Calculation Using GCAM-KSA

EV stock projections are derived from the Global Change Assessment Model tailored for Saudi Arabia (GCAM-KSA). GCAM-KSA generates long-term scenarios of vehicle adoption based on socioeconomic drivers, policy frameworks, and technology cost trajectories.

Annual EV stock ($Stock_t$) is determined using:

$$Stock_t = \frac{D_t}{LF \times Annual\ VKM} \quad (1)$$

where:

- D_t = total service demand for passenger electric vehicles, expressed in million passenger-kilometers (pkm)
- *LF* = load factor for cars, representing the average occupancy in Saudi Arabia, assumed to remain constant at 1.69 (Alwosheel and Dua 2023)
- *Annual VKM* = average annual distance traveled by a passenger car in Saudi Arabia, assumed to be 25,400 kilometers annually, as estimated (Sheldon and Dua 2021)

The service demand output from the scenarios takes into account vehicle retirements. GCAM-KSA accounts for the vehicle survival rate using an S-curve approach across different modes, particularly road transport. This implementation captures the non-linear phase-out of vehicles, reflecting real-world conditions. The curve also supports estimation of new vehicle demand, including those required to replace retired stock.

2.2 Battery Demand Estimation and Domestic Production Cost

The battery demand methodology accounts for both new EV sales and replacement needs. Average battery capacities are based on national sales data, which in 2024 indicate an average of 85 kWh per vehicle – reflecting the market's strong preference for sport utility vehicles (SUVs) (Transport General Authority 2024).

2.2.1 Fleet-Level Battery Capacity Requirement in Year *t*

Fleet-level battery capacity requirement in year *t* is estimated as:

$$B_{total},t = Stock_t \times B_{cap} \quad (2)$$

where:

- B_{total},t = total battery capacity needed in year *t* (kWh)
- $Stock_t$ = number of EVs in operation in year *t*
- B_{cap} = average battery capacity per vehicle (85 kWh in 2024)

This calculation multiplies the size of the EV fleet by the average battery capacity to determine the total installed capacity.

2.2.2 Replacement Battery Demand Estimation

Replacement battery demand in year *t* is estimated using:

$$B_{replace},t = Stock_{\{t-L\}} \times B_{cap} \quad (3)$$

where:

- $B_{replace},t$ = replacement battery capacity needed in year *t* (kWh)
- $Stock_{\{t-L\}}$ = EVs sold L years earlier
- L = battery lifespan (15 years, based on Saudi climatic conditions)

This equation assumes that EV batteries are replaced after reaching end-of-life, defined as 15 years under local environmental conditions.

2.2.3 Total Annual Battery Demand

The total annual battery demand is given by:

$$B_{demand},t = (New_{Vehicles_t} \times B_{cap}) + B_{replace},t \quad (4)$$

This combines the capacity needed for new EV sales with the replacement demand, providing the overall market requirement.

2.2.4 Domestic Manufacturing Investment for Battery Capacity

The investment required to meet annual battery demand through domestic manufacturing is estimated as:

$$B_{invest}=(B_{demand},t\times C_t) \quad (5)$$

where:

B_{invest} = Investment needed for battery manufacturing

Ct = cost per GWh

The capital expenditure (CAPEX) required to establish a 1 GWh battery manufacturing facility is assumed to be ﷼ 0.3 billion (US$0.08 billion) (Benchmark Mineral Intelligence 2023; Gulf News 2024). The equation incorporates a 1.9% learning rate from 2030 to 2060, consistent with cost projections for utility-scale battery storage by the National Renewable Energy Laboratory (NREL 2025).

2.3 Charging Infrastructure Requirements and Investment

The estimate of required charging infrastructure is shaped by several key factors, including vehicle usage patterns and the operational performance of chargers. Inputs such as the average number of charging sessions per vehicle, charger utilization rates, session duration, vehicle range, and charger retirement rates all influence the final calculation.

For passenger cars, DCFCs typically provide a charging time of 30 minutes per session. Globally, DCFC utilization rates vary widely. In Europe, average utilization is relatively low at around 10% (Virta 2020). In the United States, it was approximately 16.2% in 2024 (Paren 2025). China reports an average of 11%, although utilization can be significantly higher in densely populated urban areas (Cui et al. 2024).

For this study, a 20% utilization rate is adopted, reflecting an optimistic yet reasonable benchmark based on expected growth in BEV adoption. This threshold is also commonly cited as the minimum rate at which DCFC operations become financially sustainable (Fröde, Lee, and Sahdev 2023).

The travel behavior of EV users is also captured in the model: the average daily travel distance per vehicle is 70.5 kilometers, while the typical vehicle range on a full battery is 460 kilometers (Transport General Authority 2024).

Using these figures, the model estimates that each car would require approximately 0.15 charging sessions per day – or about one session every seven to eight days. This reflects a relatively low frequency of public charging, assuming that most users supplement with home or workplace charging where possible.

To more accurately estimate the number of charging stations needed over time, this study employs a survival-curve model to account for the operational lifespan and eventual retirement of chargers installed each year. Rather than assuming that all chargers remain functional indefinitely, the survival curve provides a probabilistic view of charger longevity, incorporating real-world factors such as hardware wear, technological obsolescence, maintenance schedules, and environmental conditions.

Applying this model enables simulation of the gradual decline in the active charger stock and identification of when replacements or upgrades are needed. This approach ensures that infrastructure planning addresses both the growing demand from new BEV adoption and the natural retirement of aging charging assets. It also improves long-term investment forecasting by aligning deployment strategies with realistic equipment lifecycle expectations (NREL 2024; DOE 2012, 2015; Mastoi et al. 2022).

To estimate the costs of public charging infrastructure, expenditures are divided into hardware and installation components. Hardware costs refer to the price of the charging point itself; for DC fast charging, a single charger cost is applied uniformly across all calculations. All costs are expressed in Saudi riyals as of 2025. Hardware prices are assumed to decline at an annual rate of 1.9% over time.

Installation costs include labor, materials, and utility upgrades, based on the most detailed recent estimates for non-residential infrastructure in the GCC region. To reflect economies of scale, three cost scenarios are considered – upper bound, medium bound, and lower bound – as per-charger installation costs decrease when multiple units are deployed at a single site (Nicholas 2019).

Additionally, an NPV approach is used to evaluate the long-term investment requirements and cost implications of charging infrastructure deployment under these scenarios.

2.3.1 Number of Chargers Required in Year *t*

The number of public DC fast chargers needed in year *t* is calculated as:

$$\text{Chargers}_{\text{Needed}_t} = \left(\frac{\text{Stock}_t \times S_d \times T_s}{H_{eff}} \right) - \text{Existing}_{\text{Chargers}_{\{t-1\}}} + \text{Chargers}_{\text{Retired}_t} \quad (6)$$

where:

- Stock_t = EV stock in year *t*
- S_d = average charging sessions per vehicle per day
- T_s = average charging time per session (hours)
- H_{eff} = effective charger hours per day
- $\text{Existing}_{\text{Chargers}_{\{t-1\}}}$ = chargers operational in the previous year
- $\text{Chargers}_{\text{Retired}_t}$ = chargers retired in year *t* (Appendix Figure A1)

For DCFCs, T_s is assumed at 30 minutes per session and H_{eff} at 4.8 hours/day (20% utilization).

2.3.2 Capital Expenditure on New Chargers

The capital expenditure on newly deployed chargers in year *t* is calculated as:

$$\text{Initial}_{\text{Cost}_t} = \text{New}_{\text{Chargers}_t} \times C_{\text{unit}} \quad (7)$$

where C_{unit} is the cost per charger, including equipment, installation, and grid connection.

2.3.3 Annual Operational and Maintenance Costs

The annual operational and maintenance (O&M) costs for public chargers in year *t* are calculated as:

$$\text{O\&M}_{\text{Cost}_t} = (\text{Cumulative}_{\text{Chargers}_t} \times \text{C_unit} \times \text{r_O\&M}) \quad (8)$$

where r_O&M = 0.01 (1% of capital cost).

The net present value (NPV) of total infrastructure costs is calculated as:

$$\text{NPV} = \sum_{t=\,start\,year}^{t_0=\,end\,year} \left(\frac{(\text{Initial}_{\text{Cost}_t} + \text{O\&M}_{\text{Cost}_t})}{(1+r)^{t-t_0}} \right) \quad (9)$$

where r = 0.03 (3%). This formulation accounts for the time value of money in infrastructure planning (Elgqvist and Pohl 2019; Chang et al. 2012).

2.4 Data and Assumptions

Table 1. Data and assumptions used in the methodology.

Passenger BEVs		
Battery demand requirement	**Assumptions**	**Source**
Average battery capacity	85 KWh	Calculated through Q3 EV sales data in Saudi Arabia (Transport General Authority 2024)
Average cost of manufacturing 1 GWh of battery capacity	﷼ 0.3 billion (US$~0.08 billion)	Benchmark Mineral Intelligence (2023), Reuters (2022), Gulf News (2024)
Battery life	15 years	Geotab (2025), KAUST (2025)
Charger type	50 kW, DCFC chargers	Electromin (2025a)
Charging time	30 minutes	DOE (2012)
Charger utilization	20%	Virta (2020)
Vehicles served per day	9.6 hours per day	Calculated through charging time and charger utilization
Daily travel (kilometers)	70.5 kilometers	Calculated through average yearly travel (Sheldon and Dua 2021)
Average vehicle range (kilometers)	460 kilometers	Calculated through Q3 EV sales data in Saudi Arabia (Transport General Authority 2024)
Cost per charging point	﷼ 93,088 (US$~24,823)	Electromin (2025b)
Installation cost_lower bound	﷼ 37,485 (US$~10,000)	Quikr (2024)
Installation cost_median bound	﷼ 56,227 (US$~15,000)	Quikr (2024)
Installation cost_upper bound	﷼ 74,970 (US$~ 20,000)	Quikr (2024)
Operational and maintenance costs	1% of capital cost	DOE (2012), Nicholas (2019)

03

Results: Electric Vehicle Adoption and Infrastructure Investment in Saudi Arabia

Electric vehicle adoption in Saudi Arabia is gaining momentum as the Kingdom advances its Vision 2030 objectives related to sustainability, energy diversification, and emissions reduction. Although current penetration remains modest compared with global leaders, recent policy developments, regulatory support, and infrastructure investment are accelerating the transition.

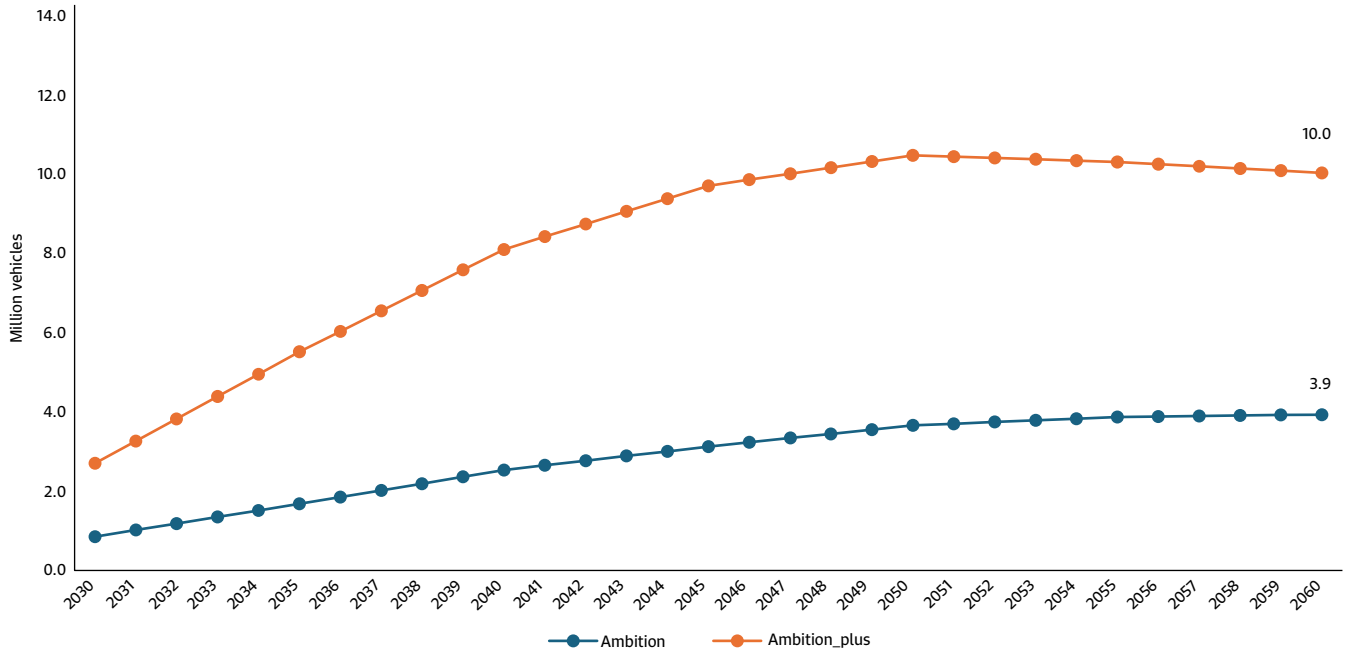
Government targets include converting 30% of Riyadh's vehicles to electric by 2030. Strategic partnerships with global manufacturers, local assembly initiatives, and the expansion of public and private charging networks are facilitating this progress. The launch of Ceer and the growing presence of Lucid signal expanding industrial capacity and market readiness.

Results are presented in two parts: charging and battery infrastructure and the associated investment requirements for BEV charging and battery manufacturing.

3.1 Charging and Battery Infrastructure

3.1.1 BEV Adoption Trends in Different Scenarios

Figure 3. Total BEV stock projection.



Source: Authors' analysis.

Between 2030 and 2060, two scenarios outline distinct adoption paths. In the Ambition scenario, cumulative BEV stock reaches about 0.8 million units by 2030, increasing steadily to around 3.9 million by 2060. The Ambition_plus scenario starts from a higher base of approximately 2.7 million BEVs in 2030 and accelerates to nearly 10 million by 2060. These divergent trajectories reflect varying levels of policy ambition, charging infrastructure deployment, total cost of ownership dynamics, and consumer adoption rates.

The model, as described above, integrates various policy mechanisms into comprehensive scenario packages, rather than isolating individual policies. This holistic approach enables multiple adoption pathways that can adapt to technological advancements, market dynamics, and evolving consumer behavior. Such adaptability ensures that the transport sector remains aligned with decarbonization objectives, even as new solutions and innovations continue to emerge.

3.1.2 Battery Pack Requirements

Battery packs – which account for 35%-50% of total component costs – represent the most significant share of overall vehicle cost across all categories of electric vehicles in Saudi Arabia (Fröde, Lee, and Sahdev 2023). Other major contributors include electric motors and power electronics. At present, Saudi Arabia's manufacturing capacity is not yet scaled to meet the demand for these critical BEV components, meaning the transition to electric mobility will likely depend heavily on imports.

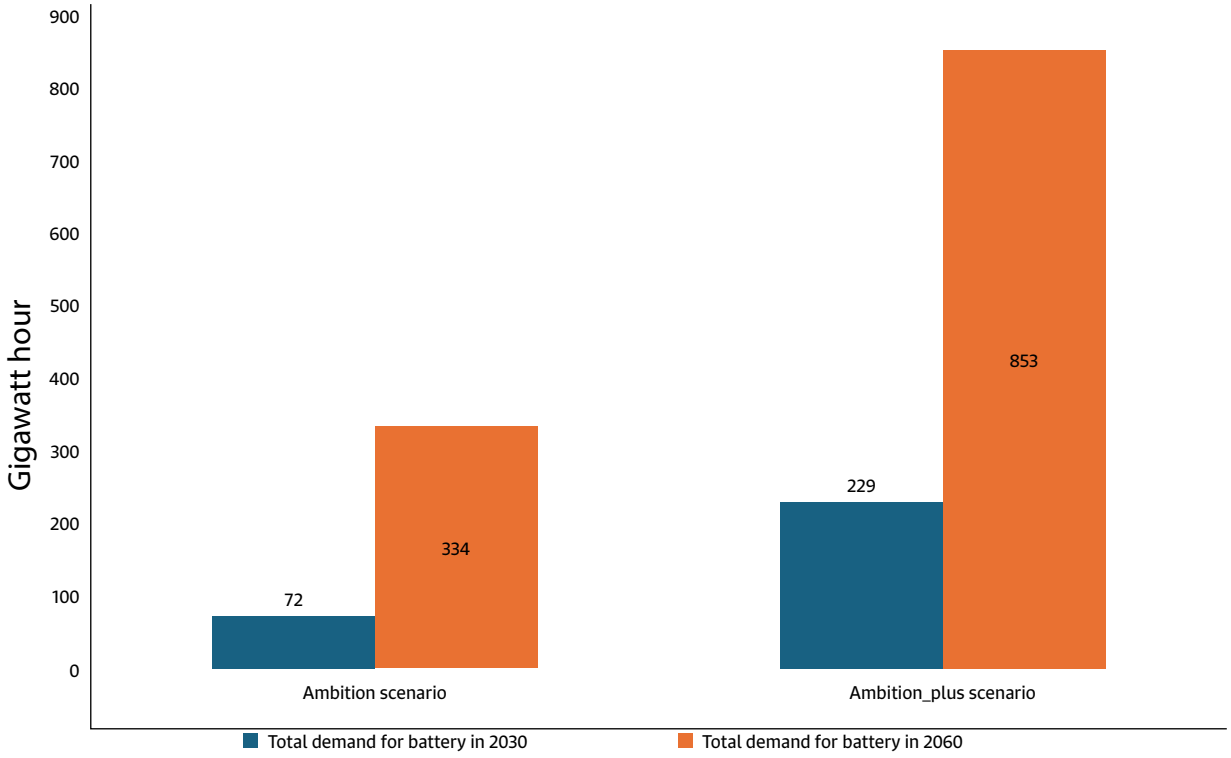
However, ongoing efforts to build self-reliance – including investments in local manufacturing and supply chains – must be guided by accurate assessments of component demand, particularly battery capacity, for both new vehicles and replacement needs as existing batteries reach end-of-life (EOL).

To estimate the demand for lithium-ion battery packs in Saudi Arabia, this study accounts for both new EV sales and the subsequent need for battery replacements, acknowledging that vehicle lifespans generally exceed battery lifespans. The analysis uses average battery pack capacities derived from recent national vehicle sales data. Notably, during the third quarter of 2024, the average battery capacity per vehicle sold reached approximately 85 kilowatt-hours (kWh), reflecting strong consumer preference for sport utility vehicles (SUVs) (Open Data Platform 2025; Transport General Authority 2024).

In assessing total battery demand, particular attention is paid to battery degradation – the gradual decline in a battery's ability to store and deliver energy over time. A battery is typically deemed to have reached EOL when its usable capacity falls to approximately 70%-80% of its original rated capacity (Etxandi-Santolaya, Casals, and Corchero 2024; Ali et al. 2024; Menye, Camara, and Dakyo 2025). Replacement battery demand is therefore calculated based on expected battery lifespan under Saudi climatic conditions.

Elevated ambient temperatures in the region are known to accelerate battery degradation, affecting both performance and longevity – particularly in BEVs (KAUST 2025). Accordingly, a 15-year battery lifespan is assumed for the Saudi context, consistent with regional performance assessments (Geotab 2025).

Figure 4. Total battery demand for BEVs in both scenarios.



Source: Authors' analysis.

Cumulative traction-battery demand in Saudi Arabia is projected to grow sharply from 2030 to 2060. Under the Ambition scenario, demand increases from 72 GWh in 2030 to approximately 334 GWh in 2060 – a fivefold increase, with a CAGR of nearly 5%. In the Ambition_plus scenario, demand rises from 229 GWh to roughly 853 GWh over the same period – about a fourfold increase at a CAGR of about 4%. These trends indicate that battery supply requirements scale nearly in proportion to vehicle uptake when average pack sizes remain stable (Figure 4).

3.1.3 Public Charging Stations for BEV Deployment

A robust public charging infrastructure will be essential to support Saudi Arabia's transition to BEVs. Much like petrol stations are central to ICE vehicles, public charging stations (PCS) will play a critical role in the EV ecosystem. PCS also represent a significant investment opportunity, particularly for private-sector players – provided that supportive policies and business models ensure viable returns.

PCS are expected to serve four primary purposes: encouraging early EV adoption, supporting commercial fleet operations, enabling fast top-ups, and facilitating long-distance or intercity travel. The demand for these stations will depend not only on EV sales, but also on factors such as charger power, operating hours, charging modes, and vehicle battery capacities.

In the early stages of EV adoption, government support for PCS infrastructure can play a particularly vital role. Such support significantly influences the pace at which individuals and businesses transition to electric mobility. These early efforts are crucial for generating the momentum needed to build a sustainable EV market.

In line with this, Saudi Arabia is actively expanding its EV charging network. The country has seen a rapid increase in charging points, including Level 2 and DC fast chargers, with providers such as EVIQ and Electromin broadening their footprint across the Kingdom. Most chargers currently installed are DC fast chargers, which enable rapid energy refills (EVIQ 2024; Electromin 2025a).

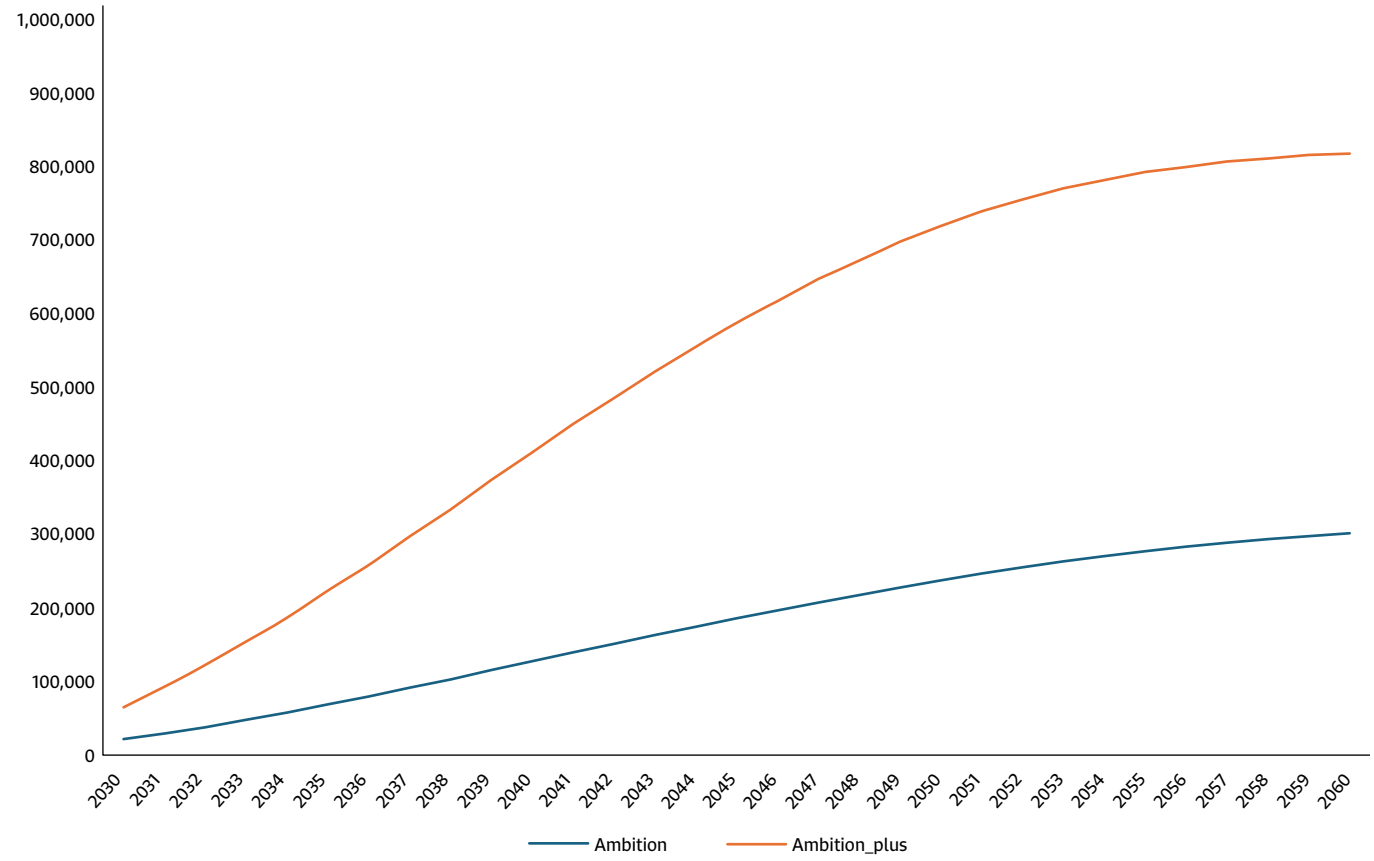
For passenger BEVs, chargers are generally grouped into three categories:

- **Level 1:** Use standard household outlets and are best suited for slow, overnight residential charging.
- **Level 2:** Common in public locations, these deliver 20-25 miles (32-40 kilometers) of range per hour and offer a faster, more practical option for most urban use cases.
- **DCFCs (direct current fast chargers):** Provide rapid recharging, typically restoring 80% of a vehicle's battery in 30 minutes or less, making them ideal for highways and long-distance travel.

This study estimates the number of DC fast chargers required in Saudi Arabia by 2060, recognizing the critical role that high-speed charging infrastructure will play in enabling widespread adoption of BEVs. The analysis considers not only the inherent advantages of DCFCs – such as significantly reduced charging times compared to Level 1 and Level 2 options – but also key influencing factors, including climatic conditions, daily vehicle usage patterns, and typical charging durations under different scenarios.

These factors are particularly relevant in the Saudi context, where extreme temperatures and long travel distances may affect both battery efficiency and user charging behavior. The study adopts a structured methodology (as presented in the preceding section) to estimate the number of required charging points specifically for passenger light-duty BEVs.

Figure 5. Cumulative number of charging points required by 2060.



Source: Authors' analysis.
Note: Includes the retired DC charging points.

Saudi Arabia's fast-changing infrastructure needs to scale sharply with the uptake of BEVs. Under a moderate Ambition pathway, the number of cumulative public DCFCs increases from about 21,500 units in 2030 to roughly 300,000 by 2060. A stronger Ambition_plus pathway accelerates the buildout from approximately 64,000 in 2030 to nearly 820,000 by 2060. The gap widens after 2040, driven by greater policy intensity, higher vehicle adoption, and increased energy demand routed through DC fast charging. These trajectories underscore the need for long-horizon investment planning, grid reinforcement, and coordinated corridor-plus-urban siting strategies to keep pace with fleet growth (Figure 5).

Widespread, reliable public charging remains a prerequisite for the mass adoption of electric vehicles. The optimal charger-to-vehicle ratio should reflect Saudi Arabia's driving patterns, urban form, and climate. International comparators vary: China operates with approximately one public charger per eight EVs, while Norway functions with about one per 20 EVs (IEA 2023). These figures show that high adoption can be supported through different combinations of home, workplace, and public charging.

Although Saudi Arabia may not require the charger density observed in China, a geographically broad and well-integrated network is essential to build user confidence, reduce range anxiety, and enable long-distance travel – thereby supporting Vision 2030's mobility and decarbonization goals.

3.2 Investment Required for BEV Charging and Battery Infrastructure

Saudi Arabia is shaping a regional EV hub by building manufacturing capacity, securing battery materials, and scaling enabling infrastructure. Ceer, launched in 2022 by the Public Investment Fund and Foxconn with BMW-licensed technology, anchors domestic branding and assembly (PIF 2022). Lucid opened its first international plant in King Abdullah Economic City in 2023 and plans to produce approximately 155,000 vehicles per year for both domestic and export markets.

Upstream, Ma'aden and Saudi Aramco are exploring commercial lithium production, targeting operations by 2027, with the potential to supply up to 500,000 EV batteries annually. Strategic zones such as NEOM and King Salman Energy Park are being developed to host an integrated ecosystem spanning assembly, battery manufacturing, and research and development – supported by partnerships with firms like Hyundai and Pirelli (Arab News 2025; Financial Times 2025).

Hence, domestic battery manufacturing complements this platform by capturing a larger share of EV value, as cells and packs dominate total costs and can be exported to both mobility and stationary storage markets. Battery production is electricity-intensive; therefore, coupling plants with a rapidly expanding, renewable-rich grid improves unit economics and reduces embedded emissions. Alignment with national industrial policy and upstream metals investments shortens supply chains and diversifies offtake. In contrast, full vehicle programs typically require deeper supplier ecosystems and more complex, costlier distribution networks that scale more slowly.

Furthermore, public charging stations will anchor the EV ecosystem – much like petrol stations serve internal combustion vehicles – by catalyzing early adoption, supporting commercial fleets, enabling rapid top-ups, and facilitating long-distance travel. Clear policies and investable business models can attract private capital to corridor and urban DC fast charging, synchronized with local battery production and vehicle rollout. Together, these elements enhance the economics for both consumers and producers, accelerate BEV adoption, and position the Kingdom as a competitive regional hub for EVs.

3.2.1 Investment Opportunity for Battery Manufacturing

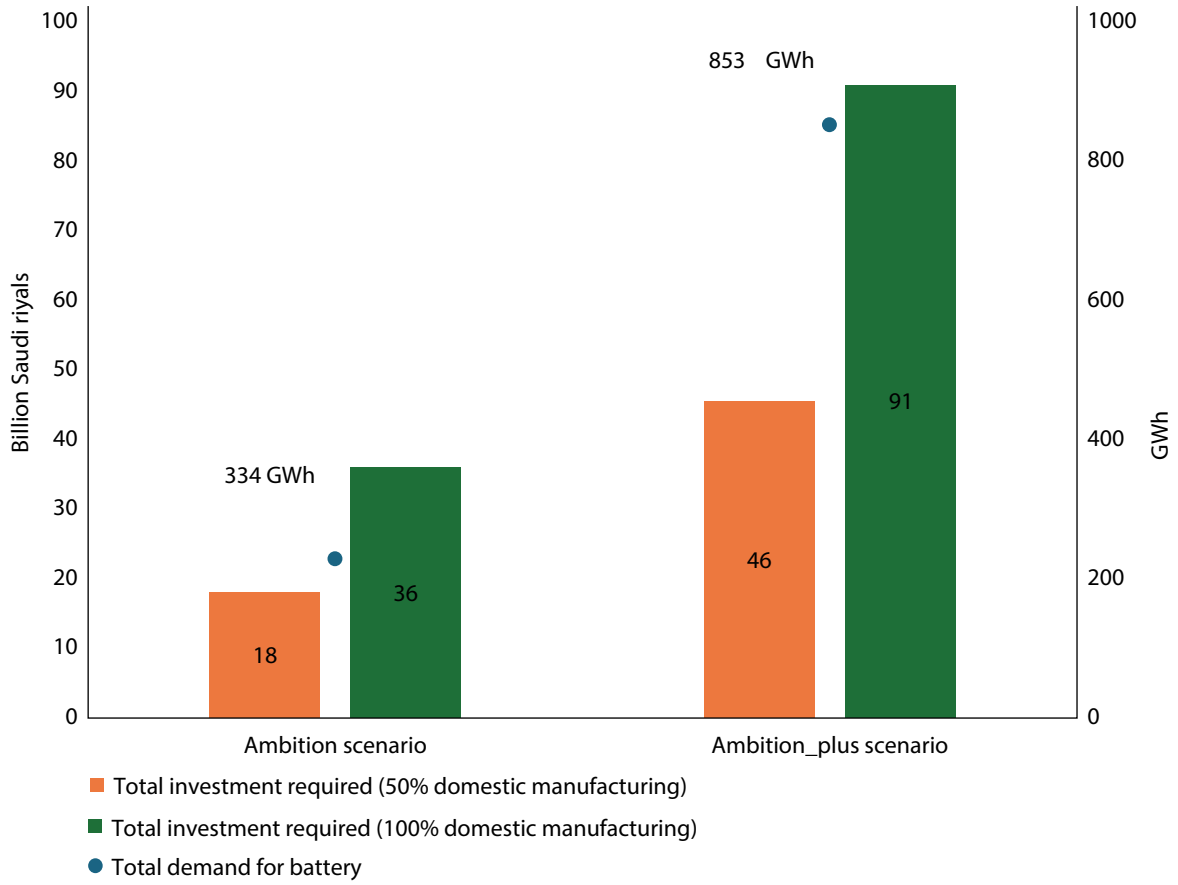
Saudi Arabia's transition to electric mobility will generate substantial battery demand from both new vehicle sales and replacements. Under the modeled pathways, annual requirements reach approximately 277 GWh in the Ambition scenario and roughly 670 GWh in Ambition_plus by 2060. This scale presents a strategic opportunity to build domestic manufacturing capacity and strengthen the Kingdom's role in regional clean mobility and energy storage markets.

For investment planning, the analysis assumes a capital cost of approximately ﷼ 0.3 billion (about $0.08 billion) per 1 GWh of manufacturing capacity. This aligns with recent global benchmarks, including the General Motors-LG Chem collaboration and Statevolt's planned 40 GWh facility in Ras Al Khaimah, estimated at approximately $3.2 billion (Reuters 2022; Gulf News 2024; Benchmark Mineral Intelligence 2023). Cost trajectories reflect a 1.9% annual learning rate from 2030 to 2060, consistent with projections for utility-scale battery systems (NREL 2025).

To meet this demand, battery producers will need to scale up both cell and pack production capacity. The associated capital requirements will be substantial and will vary in proportion to the degree of domestic indigenization.

Using the above-mentioned CAPEX for 1 GWh manufacturing facilities, the study estimates investment needs under two manufacturing pathways: full indigenization (100% domestic production) and partial localization (50% domestic manufacturing with imports). These scenarios present alternative strategies for scaling production, attracting industrial investment, and establishing a resilient supply chain – all of which are critical to achieving long-term vehicle electrification goals.

Figure 6. Domestic battery manufacturing investment requirement in Saudi Arabia by 2060.



Source: Authors' analysis.

Meeting the potential demand for battery production will require large-scale expansion of cell and pack capacity, with capital needs rising in proportion to EV adoption and the degree of domestic value addition. In the Ambition scenario, cumulative battery demand reaches about 334 GWh by 2060. This translates to an investment of roughly ﷼ 18 billion (approximately $5 billion) at 50% domestic manufacturing, or approximately ﷼ 36 billion (approximately $10 billion) at 100% domestic manufacturing. The constant annual outlay is approximately ﷼ 0.575 billion ($0.15 billion) at 50% localization and approximately ﷼ 1.15 billion ($0.31 billion) at full localization.

Under Ambition_plus, cumulative demand rises to approximately 853 GWh by 2060. The corresponding investment is around ﷼ 45.5 billion ($12 billion) at 50% domestic manufacturing and approximately ﷼ 91 billion ($24 billion) at full domestic capacity. This equates to a constant annual outlay of about ﷼ 1.5 billion ($0.4 billion) at 50% localization and approximately ﷼ 3 billion ($0.8 billion) at 100% localization (Figure 6).

3.2.3 Investment in Charging Infrastructure

Developing a robust charging network is critical to Saudi Arabia's transition to electric vehicles. To accelerate EV uptake, charging stations must be deployed across all major cities and along the Kingdom's highway corridors. Public charging needs will depend not only on total EV sales, but also on the specific usage patterns and charging preferences of different vehicle classes.

This section provides a structured, data-driven framework for estimating the investment – including both capital and operational costs – required to deploy EV charging infrastructure between 2030 and 2060. It is designed to support policy planning, investment analysis, and infrastructure development tailored to the passenger BEV segment.

Under the Ambition scenario, Saudi Arabia would require roughly 300,000 DCFC points by 2060; the more aggressive Ambition_plus scenario increases this requirement to about 820,000 chargers. Taking into account the cumulative charger stock, this study estimates the investment required for deploying the necessary DCFC charging points under the stated scenarios.

Public charging costs vary widely by charger type but are expected to decline as production scales. Cost estimates include both the DCFC hardware and installation (labor and materials). Installation costs depend on charger power capacity and site-specific infrastructure requirements; DCFCs typically incur higher costs due to complex installation processes and necessary electrical upgrades.

Operational expenditures primarily cover maintenance and repair, including replacement of charge cords damaged by vandalism or misuse, repair or replacement of out-of-warranty EVSE components, technician call-outs for troubleshooting or manual software resets not covered by network fees, and routine preventive or corrective servicing (DOE 2012, 2015; Nicholas 2019).

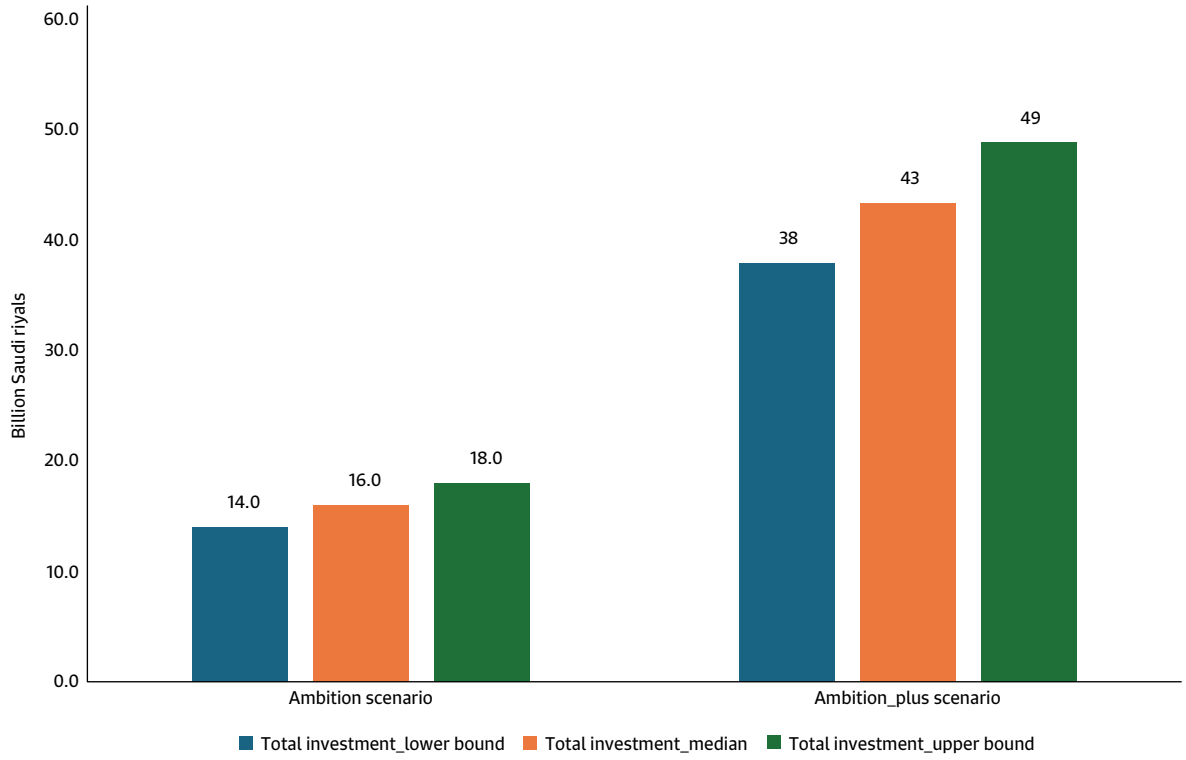
Based on the projected number of chargers required to support the EV transition, the corresponding initial investment needed to establish the charging infrastructure has been estimated. The assessment is based on inputs from multiple sources. The DCFC cost per charging point is reported to be approximately ₰ 93,000 (approximately $24,800) for a CirControl Raption 50 22 kW-50 kW fast charger (Electromin 2025b). For installation costs, this study assumes the cost of installing the same charger type in the UAE, due to a lack of information on DCFC installation costs in Saudi Arabia (Quikr 2024).

For the purposes of the study, the costs associated with the charging infrastructure have been assumed to remain constant over the period until 2060. This has been done due to a lack of information on the trends in costs associated with establishing charging stations in the Saudi Arabian context. The operation and maintenance cost is taken to be 1% of the capital cost per year (DOE 2025).

To capture the uncertainty inherent in infrastructure cost projections, this study defines three cost cases: lower-bound, median, and upper-bound. The lower-bound case reflects optimistic assumptions on hardware learning rates, economies of scale, and streamlined installation practices. The median case represents the most likely cost trajectory, based on current price benchmarks and moderate cost reductions. The upper-bound case accounts for potential price pressures from supply-chain constraints, labor-rate escalation, and slower-than-expected learning effects.

Presenting results across this spectrum enables a robust sensitivity analysis, illustrating how total investment requirements shift under plausible cost envelopes and providing policymakers with a clearer view of downside risk and upside opportunity.

Figure 7. DCFC (50 KW) investment in infrastructure costs by 2060 under two scenarios.



Source: Authors' analysis.

Meeting Saudi Arabia's prospective BEV demand requires a large, sustained build-out of public direct-current fast charging, with capital needs rising in line with vehicle uptake and the degree of domestic value addition. Under the Ambition scenario, by 2060, the cumulative investment need ranges from ﷼ 14 billion ($3.7 billion) in the lower-bound case to ﷼ 18 billion ($4.8 billion) in the upper-bound case, with a median estimate of ﷼ 16 billion ($4.3 billion). This reflects the scale of infrastructure expansion required to meet the demand for 300,000 DCFC charging points by 2060.

A stronger Ambition_plus pathway, which assumes higher BEV penetration, raises the required network to approximately 820,000 charging points by 2060 and substantially increases cumulative investment requirements. These range from ﷼ 38 billion ($10 billion) in the lower-bound case to ﷼ 49 billion ($13 billion) in the upper-bound case, with a median estimate of ﷼ 43.5 billion ($9 billion). The difference between the lower- and upper-bound projections in both scenarios reflects uncertainty in key cost drivers, including hardware prices and installation expenses.

Importantly, the reported values are expressed in NPV terms, using a 3% real discount rate to account for the time value of money over the investment horizon. The annualized real investment needs under the Ambition scenario are estimated at approximately ﷼ 0.4 billion ($0.11 billion), ﷼ 0.46 billion ($0.12 billion), and ﷼ 0.52 billion ($0.14 billion) per year for the lower-bound, median, and upper-bound cases, respectively. Under the more aggressive Ambition_plus scenario, the corresponding annualized requirements rise to around ﷼ 1.08 billion ($0.29 billion), ﷼ 1.24 billion ($0.33 billion), and ﷼ 1.4 billion ($0.37 billion) per year.

This study restricts network sizing to DCFC for Saudi Arabia's public infrastructure. Although slow and medium-speed options – such as Level 1 wall outlets and Level 2 AC chargers – offer low hardware costs and modest grid impacts at sites with long

dwell times (e.g., homes, workplaces, fleet depots, and long-stay car parks), they do not meet the refuel-and-go needs of through traffic or time-sensitive fleets. DCFC is indispensable along intercity corridors, at logistics hubs requiring rapid vehicle turnaround, and in dense urban districts where many users lack access to extended parking.

Climatic conditions provide an additional rationale. Persistent high temperatures make brief, high-power sessions preferable to prolonged Level 1 or Level 2 charging, which would expose batteries and users to extended heat. Accordingly, the investment and deployment estimates in this study include only DCFC charging station installations, each with a single charger.

3.3 Limitations

This study's main strength lies in its integrated design, which links the infrastructure and investment model with the IAM (GCAM-KSA) transport outputs. This approach consistently captures sectoral feedback and avoids double-counting overlapping policies, yielding a coherent view of how incentives, efficiency standards, electrification, and modal shifts interact across the transport system.

Nonetheless, several limitations constrain its utility for policymakers, utilities, and investors: (i) narrow cost sensitivities – charging CAPEX/OPEX vary only within approximately ±15%, which is insufficient to capture supply-chain volatility and learning-rate uncertainty; (ii) the baseline charger utilization assumption (≈20%) may be optimistic relative to observed outcomes in early public charging networks; (iii) fixed battery sizing – the assumed 85 kWh pack does not reflect future heterogeneity arising from efficiency gains or segment shifts; and (iv) power-system and market-design gaps – system-level demand and peak impacts (TWh, MW) are not quantified.

Conclusion

04

Global experience shows that electrification can transition from a niche to mainstream technology in little more than a decade. Saudi Arabia now aims to replicate – and, in some respects, leapfrog – this shift. The Kingdom is poised for growth in the electric vehicle market and the development of EV charging stations. The country is anticipated to lead the Middle East in its electric vehicle adoption. According to the United Nations, the urban population is expected to reach 44 million by 2050, up from 23 million in 2020.

The relatively younger, digitally savvy population – with a greater emphasis on sustainability and an increased affinity for cars among Saudis – is anticipated to boost EV sales in the country (Riyadh Valley Company 2023). This study provides the first integrated estimate of the capital required to support these ambitions through 2060, combining a national energy system model with bottom-up cost curves for batteries and DCFC.

Under the Ambition scenario, the on-road fleet grows from near zero to just over 3.9 million cars by 2060; a stronger policy push under Ambition_plus peaks at nearly 10 million. To realize these figures, a 50 kW DCFC infrastructure requires total cumulative NPV investment between 2026 and 2060 of ﷼ 14-18 billion under Ambition and ﷼ 38-49 billion under Ambition_plus. Expressed as constant annualized real expenditures, this equates to approximately ﷼ 0.4-0.52 billion per year under Ambition and ﷼1.08-1.4 billion per year under Ambition_plus.

These figures represent the steady-state capital outlays required to maintain a deployment trajectory aligned with projected EV adoption, while avoiding under- or over-investment in charging capacity.

In terms of domestic battery manufacturing capacity, cumulative NPV investment cost requirements range from ﷼ 18 billion (50% domestic production) to ﷼ 36 billion (100% domestic production) under Ambition, with total cumulative battery demand reaching 334 GWh. For Ambition_plus, cumulative NPV investment cost requirements rise to ﷼ 46 billion (50% domestic production) and ﷼ 91 billion (100% domestic production), with battery demand increasing to 853 GWh. When annualized over the study period, these values correspond to approximately ﷼ 0.6-1.15 billion per year for Ambition and ﷼ 1.5-3 billion per year for Ambition_plus.

The analysis underscores that achieving high EV penetration will require sustained and well-coordinated investments in both infrastructure and battery production capacity. The integration of climate-specific battery degradation rates, consideration of technological learning curves, and realistic deployment timelines ensures that the financial estimates are grounded in the Kingdom's operational context.

Taken together, a comprehensive Saudi BEV ecosystem – encompassing vehicles, batteries, and a nationwide DCFC

backbone – can be delivered, depending on the adoption rate and localization ambitions. Early, well-designed policy commitments are vital: they unlock economies of scale in gigafactories, justify high-utilization charging corridors, and attract private finance through predictable revenue streams. Equally important is phasing investment – accelerating in the 2030s, moderating in the 2040s, and shifting to renewal after 2050 – to avoid overbuilding while keeping pace with demand.

These results provide quantitative guideposts for policymakers, regulators, and investors in the Kingdom, as well as for international partners seeking to establish a foothold in Saudi Arabia's supply chain when assessing the benefits of gigafactories and charging networks. Future research should incorporate explicit grid-capacity analysis, battery chemistry diversification, and vehicle-to-grid services. However, the present study already demonstrates that large-scale electrification of Saudi Arabia's passenger transport sector is both economically viable and operationally feasible.

Moreover, the investment roadmap quantified in this study directly supports Vision 2030's objective of increasing the non-oil share of GDP by catalyzing new, technology-driven value chains. Export-oriented battery or component manufacturing can further position the Kingdom as a regional supply hub for the broader Middle East and North Africa. In addition, the public-charging network analyzed here constitutes digital and energy infrastructure that can be leveraged for ancillary services, including vehicle-to-grid integration, data analytics, and smart-city applications.

In aggregate, the study's findings demonstrate that strategic investment in electric mobility is not solely an environmental measure – it is a practical, capital-efficient pathway to expanding Saudi Arabia's non-oil GDP.

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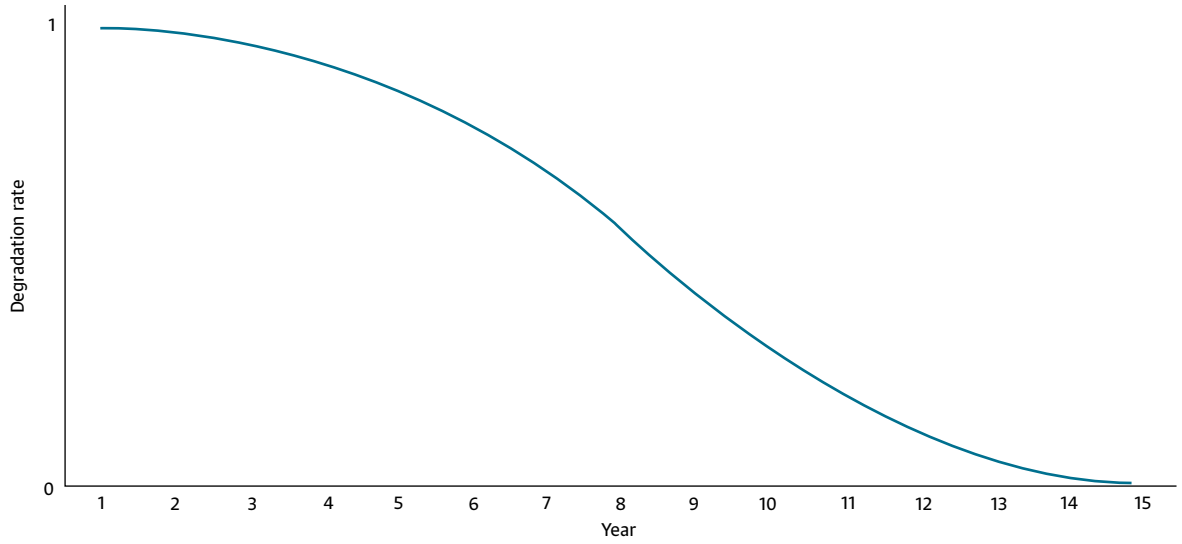
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Appendix

Table A1. Modeled passenger transport service demand in Saudi Arabia.

Scenario	2030	2035	2040	2045	2050	2055	2060
Ambition	58,405	114,182	169,981	207,847	240,539	252,297	255,104
Ambition_plus	126,865	266,916	401,203	489,877	534,116	529,265	516,219

Figure A1. Degradation curve for newly installed DCFC charging points.



Source: Pierce and Slowik (2024), Bhadury (2023), and Danlec Electrical Solutions (2024).

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Yagyavalk Bhatt is a Fellow in the Transportation and Infrastructure Department. His expertise includes energy policy, energy economics, transport modeling, the impact analysis of transport policies, emerging economies' energy transitions, renewable energy, and cost-benefit analyses in the transport and electricity sectors. He has authored and contributed to numerous research papers and studies related to these fields. Yagyavalk also leads "The Role of Clean Energy Policies: Trends in India's Transport Sector", a project aimed at estimating India's transport energy demand and assessing its potential impact on the crude oil supply chain.



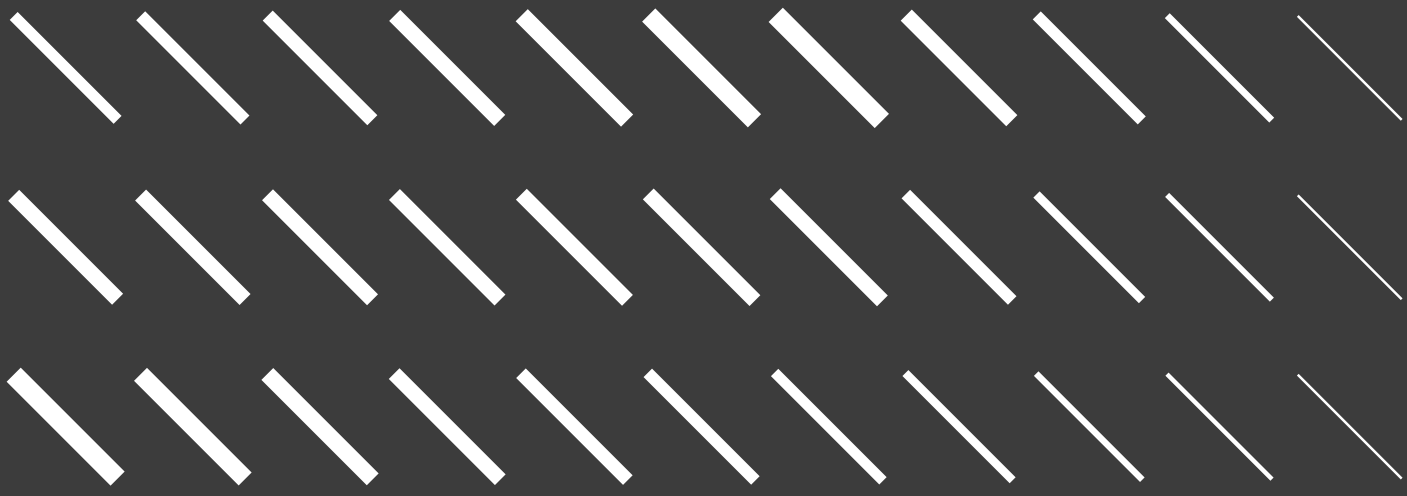
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About the Project

The “Decarbonizing Road Transportation in Saudi Arabia” project aims to address long-term emissions reduction needs in Saudi Arabia’s road transport sector – the second-largest source of carbon dioxide (CO_2) emissions in the Kingdom. The project seeks to establish a benchmark for analyzing the sector’s energy consumption and greenhouse gas (GHG) emissions, and to inform national decision-makers about potential decarbonization pathways. Using an integrated assessment modeling framework, the project strives to maximize synergies between the transport sector and other parts of the Saudi economy while evaluating a range of decarbonization strategies in a holistic manner. It explores energy efficiency improvements, modal shifts, electrification, and other policy initiatives that support Saudi Arabia’s transition toward a net-zero future.





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