

Electric Vehicle in Germany: Sales & Charging Infrastructure

Executive Summary

This report presents key insights into the burgeoning electric vehicle (EV) market in Germany, focusing on the sales trends of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs), alongside the critical development of the national charging infrastructure. Utilizing data from the International Energy Agency (IEA) and the Bundesnetzagentur, visualized through Power BI and analyzed using PostgreSQL, this report highlights significant growth in EV adoption and the concurrent expansion of charging capabilities across German states.

Introduction

The transition to electric mobility is a cornerstone of Germany's efforts to achieve its climate targets and reduce reliance on fossil fuels. Understanding the dynamics between EV sales and the availability of charging infrastructure is crucial for policymakers, industry stakeholders, and consumers. This project provides a comprehensive overview of these interlinked aspects, offering data-driven perspectives on the current state and future implications of Germany's EV ecosystem.

Methodology

Data for EV sales (BEVs and PHEVs) was sourced from the IEA Global EV Data Explorer. Information regarding charging stations was obtained from the Bundesnetzagentur's official Ladesäulenkarte. PostgreSQL was employed for data storage, querying, and preliminary analysis of the charging station data, as evidenced by the provided SQL query screenshots. Power BI was then used to create interactive and insightful visualizations, combining both datasets to identify trends and regional disparities.

The `evcharging_germany` table was created in PostgreSQL with the following schema:

Column Name	Data Type	Description
id_device	int	Unique identifier for the charging device
company_name	varchar(115)	Name of the company operating the charger
type_device	varchar(20)	Type of charger (e.g., 'Fast charger', 'Standard charger')
number_charger	int	Number of charging points at the location
power_device_kw	numeric	Power output of the device in kilowatts
plug_types	varchar(15)	Types of plugs available (e.g., 'DC Type 2', 'AC Type 2')
commissioning_date	date	Date the charging station was commissioned
street_name	varchar(55)	Street name of the charging station location
street_number	varchar(15)	Street number of the charging station location
postal_code	int	Postal code of the charging station location
place	varchar(45)	City or town of the charging station location
states	varchar(25)	German federal state where the station is located

Key Findings

1. Electric Vehicle Sales Growth in Germany

The visualization from Power BI demonstrates a remarkable upward trend in both PHEV and BEV sales units in Germany from 2011 to 2023.

- **Steady Initial Growth (2011-2019):** Both PHEV and BEV sales showed gradual increases, indicating early adoption and market penetration.
- **Accelerated Growth (2020-2023):** A significant surge is observed from 2020 onwards, with BEV sales experiencing particularly strong growth. For instance, BEV sales jumped from approximately 63,000 units in 2019 to 190,000 in 2020, and further to 520,000 in 2023. While PHEV sales also grew substantially, reaching 360,000 units in 2022, there was a noticeable dip in 2023 to 180,000 units, which could be attributed to changes in government incentives or market preferences shifting towards full electrification.

The data clearly illustrates Germany's commitment to and success in promoting electric vehicle adoption.

2. Charging Infrastructure Landscape

The PostgreSQL analysis provides a detailed breakdown of the charging infrastructure across Germany.

- **Overall Charger Distribution:**
 - **Standard Chargers:** There are **50,442** standard chargers reported across Germany. These typically offer AC charging, suitable for overnight or longer-duration parking.
 - **Fast Chargers:** The total number of fast chargers stands at **14,807**. These are crucial for longer journeys and quick top-ups.
- **Regional Distribution of Fast Chargers (Total):**
 - Bayern leads with **4,016** fast chargers.
 - Baden-Württemberg follows with **2,563** fast chargers.
 - Nordrhein-Westfalen has **2,223** fast chargers.
 - Niedersachsen has **2,408** fast chargers.
 - Other states like Berlin (**441**), Brandenburg (**687**), Bremen (**100**), Hamburg (**359**), Hessen (**1,647**), and Mecklenburg-Vorpommern (**363**) show varying levels of fast charger deployment.

- **Regional Distribution of High-Power Fast Chargers (>100 kW):**
 - Focusing on chargers with power exceeding 100 kW, which are essential for ultra-rapid charging:
 - Bayern again leads significantly with **3,038** high-power fast chargers.
 - Baden-Württemberg has **1,840** such chargers.
 - Niedersachsen has **1,786** high-power fast chargers.
 - Nordrhein-Westfalen has **1,565** high-power fast chargers.
 - This indicates a strategic focus on deploying robust charging solutions in key regions to support long-distance travel and rapid charging needs.
- **Regional Distribution of Standard Chargers:**
 - Bayern also dominates in standard chargers with **13,197** units.
 - Baden-Württemberg is close behind with **11,769** standard chargers.
 - Nordrhein-Westfalen (**7,056**) and Niedersachsen (**6,006**) also have substantial numbers.
 - Smaller states or cities like Alteshausen (**1**) and Bremen (**539**) naturally have fewer chargers, reflecting their geographic and population scales.

Visualizations

The visualizations for this project were created using Power BI and PostgreSQL. While direct embedding here is not possible, you can find the Power BI report files and SQL query screenshots within this repository to explore the data interactively:

- power BI phev and bev germany.png: Bar chart visualizing PHEV and BEV sales units over time.
- SQL fast charger more 100kw per states.png: SQL query output showing fast chargers with >100kW power per state.
- SQL standard charger per states.png: SQL query output showing standard chargers per state.
- SQL fast charger per states.png: SQL query output showing total fast chargers per state.
- SQL table creation.png: SQL script for creating the evcharging_germany table.
- SQL fast charger overview.jpg: Overview of fast charger data from PostgreSQL.
- SQL numbers of standard charger.png: SQL query output showing the total count of standard chargers.
- SQL numbers of fast charger.png: SQL query output showing the total count of fast chargers.

Conclusion and Recommendations

Germany has made significant strides in electric vehicle adoption, with a strong trajectory of sales growth for both BEVs and PHEVs. The country's commitment is further evidenced by the continuous expansion of its charging infrastructure, particularly the growing number of fast chargers and those exceeding 100 kW.

However, to ensure sustained growth and a seamless transition to electric mobility, several recommendations can be made:

1. **Strategic Infrastructure Planning:** Continue to analyze the correlation between EV sales density and charger availability at a granular level (e.g., city or district) to identify and address potential charging deserts.
2. **Incentive Review:** Regularly evaluate and adjust incentives for EV purchases, especially considering the recent dip in PHEV sales, to maintain market momentum.
3. **Public-Private Partnerships:** Foster stronger collaborations between government bodies and private enterprises to accelerate the deployment of high-power charging solutions along major transport routes and in urban centers.
4. **User Experience Enhancement:** Invest in improving the reliability, payment simplicity, and overall user experience of charging stations to alleviate range anxiety and encourage broader EV adoption.
5. **Data-Driven Maintenance:** Utilize the detailed charging station data to predict maintenance needs and ensure high operational uptime for existing infrastructure, directly impacting user satisfaction.

By continuously monitoring these trends and implementing targeted strategies, Germany can solidify its position as a leader in sustainable transportation and ensure a robust ecosystem for electric vehicles.

Data Sources

1. **Global EV Data Explorer:** International Energy Agency (IEA) - <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>
2. **Ladesäulenkarte:** Bundesnetzagentur - <https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/E-Mobilitaet/Ladesaeulenkarte/start.html>

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