PATRIZIA

Powering the Future

Assessing Infrastructure Investments with Machine Learning

In the era of sustainability and digital transformation, data intelligence has become a key tool for making informed and future-proof investment decisions. This paper discusses how data intelligence and machine learning can improve investment decisions in the Electric Vehicle (EV) charging sector.

The selection of locations for charging stations has traditionally been a complex task. However, with the help of machine learning and the use of points of interest (POIs), we can now make more precise assessments. In short, we make use of the Data Intelligence toolset: a machine learning algorithm used in the PATRIZIA Amenities Magnet Report, together with data on purchasing power and household size, form an index for evaluating potential EV charging investment locations. It's important to note that each project comes with its unique set of prerequisites. Some projects take advantage of existing infrastructure, such as supermarkets or parking spots, while others focus solely on fast charging solutions. The latter are particularly future-oriented, offering quick charging solutions that are vital for EV owners and serve as a significant incentive for prospective EV adopters.

To accommodate these specific requirements, this paper will present use cases on how machine learning methods, local expertise, and data have been successfully implemented within PATRIZIA to assess investment locations. In the context of the booming German EV market, which is projected to reach a volume of US$103.4bn by 2028 (€96bn), this research illuminates how data intelligence can transform our approach to infrastructure investment opportunities in the EV charging sector, making it a sustainable and future-proof choice.

Benchmarking EV-stations with AI

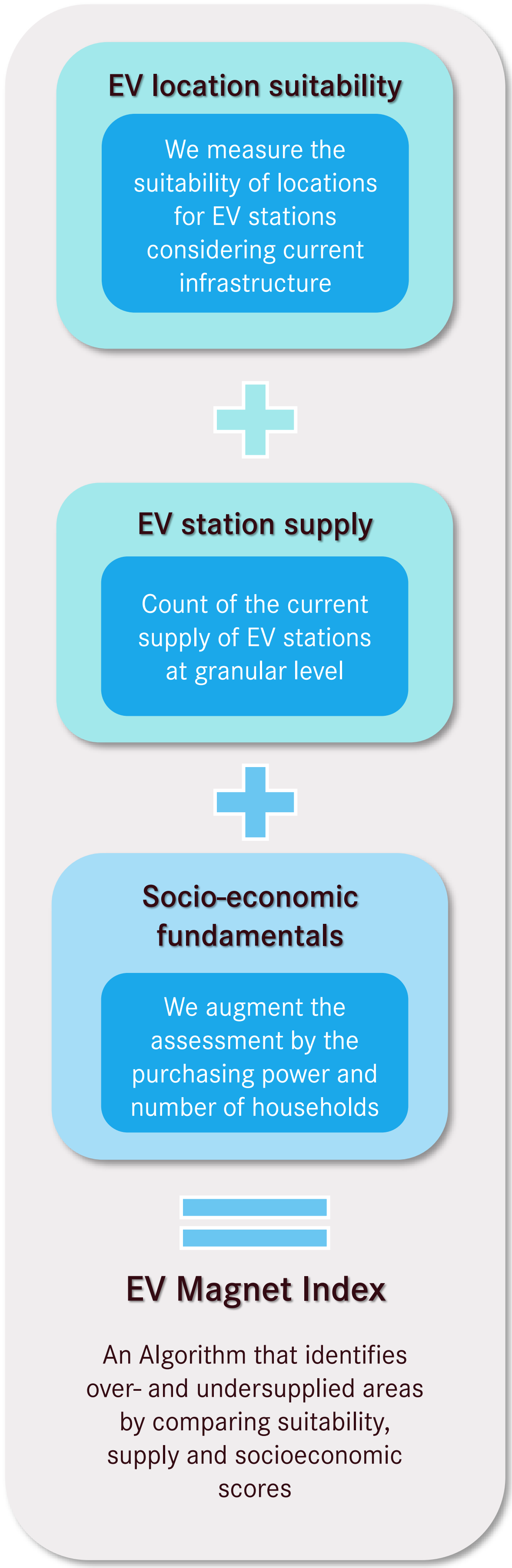
The data-driven process can be expressed through a simple equation with three pillars.

Amenities Magnet Index:

The PATRIZIA Amenities Magnet Algorithm serves as a base for the first two parts of the equation. **We measure the supply of EV charging spots in an area and assess the general suitability of potential charging locations**. Our step-by-step approach for achieving an accurate assessment is as follows:

- **Data Collection:** The data is used to create scores that measure the attractiveness of potential EV station sites relative to the current supply. EV stations with a greater number of available spaces or enhanced power capability are given a higher weighting.
- **Algorithm Calibration:** The next step involves adjusting the Amenities Magnet Algorithm to consider factors important to EV charging. These factors primarily include access to high-traffic areas, car parks and other supermarkets. By taking these factors into account, the algorithm can more accurately assess the suitability for potential ev-charging station locations.
- **Score Estimation:** Once the algorithm has been adjusted, it is used to estimate scores for both the suitability and supply of EV stations, separately. These scores provide a quantitative measure of the potential success of an EV station at a particular site.
- **Identification of Area:** The final step involves identifying over- and undersupplied attractive areas. This is done by subtracting the supply scores form the attractiveness scores. The resulting value gives an indication of the demand-supply gap at a particular site.

In simpler terms, two scores are calculated: one for the supply of EV charging stations – i.e. the competition in an area – and another for the specific attractiveness for EV charging stations – i.e. the presence of valuable infrastructure nearby, focused on motorways/primary roads. The difference between these scores indicates the readiness for a new EV charging point. Combined with socio-economic data on purchasing power and population (see below), this produces the **EV Magnet Index**, which provides investors with insights into where the most attractive locations for charging stations are.



Algorithm backtesting

As an example, we conducted a back testing of these scores specifically for Munich, Germany. The maps on the top in the figure below display points of interest. The map on the top left illustrates the locations of other EV charging spots in Munich, while the map on the right depicts POIs that contribute to general suitability. The scores derived from these factors are presented below. From a supply perspective, the northern part of Munich fares better, not necessarily due to a higher number of individual EV points, but because of the availability of more parking spaces which positively contributes to the score. In terms of suitability in the map to the right, the highest scores are found in densely populated urban areas – unsurprisingly.

Location benchmarking

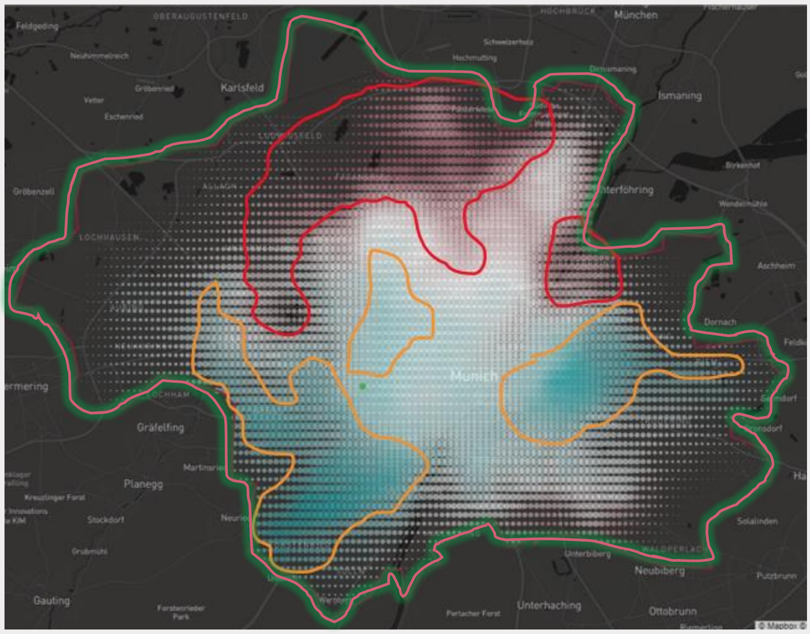
The figure above represents the “EV Station Magnet Score”, which forms the initial part of our Index. This score is calculated as the difference between suitability and supply, resulting in a range from 100 to -100. A positive score indicates areas that are both attractive and undersupplied, while a negative score suggests the opposite. As depicted in the map of Munich (Figure 2), the eastern and southwestern regions of the city centre are recommended for EV investment due to their attractiveness and lack of supply. Conversely, the northern part of the city, characterised by a high density of EV stations and lower attractiveness, is marked by negative values, indicating high competition and fewer infrastructural Points of Interest (POIs).
By comparing potential investment locations within the same benchmark, we gain insights into promising areas for future investments. However, to further calibrate our understanding and algorithms, we also need to consider the socio-economic context.

EV Station Magnet Index – Strategy design

EV station index

Values close to 100 signal highly suitable locations with low supply of EV stations

Values close to -100 signal weak locations with currently high supply of EV stations



EV amenities index, Munich 2023

Suitability - Supply

Suitable and undersupplied

100

50

0 Suitable and well supplied

-50

-100

Not suitable and oversupplied

Q25

Q50

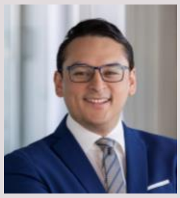
Q75

Q100

Socio-economic fundamentals

Socio-economic data, such as purchasing power and household size, is valuable data as it plays a crucial role in determining the optimal locations for new electric vehicle charging stations. This information provides insights into the potential demand for EVs and consequently, the need for charging infrastructure. For instance, areas with higher purchasing power may have a greater propensity to demand fast-charging EVs. Similarly, a large population is also a prerequisite for the spread of e-vehicles. By considering these socio-economic factors alongside the ones described above such as proximity to transportation corridors, and existing charging infrastructure, decision-makers can ensure that new EV charging stations are strategically located to meet current and future demand, thereby promoting the widespread adoption of EVs and contributing to broader sustainability goals. This multi-faceted approach to infrastructure planning is essential for the successful transition to a more sustainable transportation system. Ultimately, the **EV Magnet Index** was created taking into account the EV station magnet score of each location, the purchasing power and the number of households. Based on these factors, a 5-group category system was created, i.e. very poor, poor, medium, good, very good.

Applied for EV charging stations



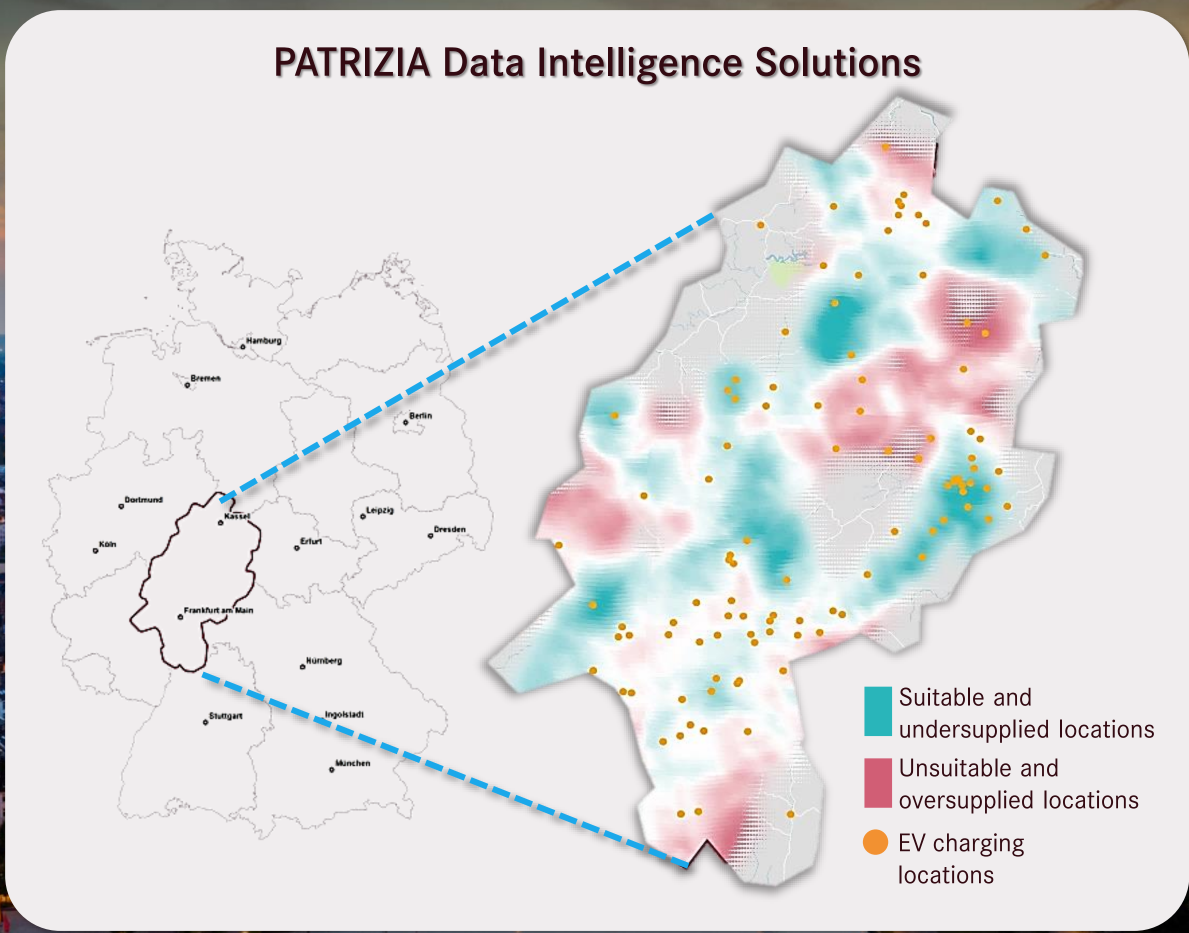
“The PATRIZIA Amenities Magnet algorithm was adapted to evaluate the attractiveness of EV charging locations compared with existing supply, to identify areas of focus, and equally, areas to avoid.“

PD Dr. Marcelo Cajias,
Head of Data and Performance Intelligence

Corymbia – Germany

The machine learning approach has already been successfully implemented at PATRIZIA, demonstrating a strong synergy between data intelligence and infrastructure. The most significant project so far is with “Corymbia”, PATRIZIA’s EV charging infrastructure platform. This project centers on fast-charging stations on ‘Tegut’ supermarkets, allowing us to leverage an existing infrastructure network. This strategy helped to minimise initial setup costs and take advantage of the high customer traffic at these locations. In this project, we partnered with an external firm that brought its own rating system into play. Moving forward, this process could be handled internally.

The figure below provides a glimpse into our analysis. It displays the potential locations in the German state Hessen and their corresponding EV magnet scores on a map. The index results can also be viewed in a table format, presenting socio-economic data for each post code area. This detailed view was particularly useful as it enabled the infrastructure team to concentrate on the most and least promising locations for a more targeted approach. It also facilitated a comparison with the external analysis, enabling us to verify the accuracy of our findings.



Note: Analysis of locations considered for Mercury rollout in the Hessen region. Information as of 30 September 2023.

Use cases

QuestSeneca

A machine learning approach was used to examine various locations from retail portfolios across Germany, using the entire country as a benchmark. This is part of a collaboration between PAT Infrastructure and PAT Real Estate to install EV chargers in the QuestSeneca retail portfolio. Corymbia, the EV infrastructure platform, is considering the rollout for this project. The background coloration solely represents thea EV station index score. However, the EV station index reveals that Gartz in the north-east and Langweid am Lech in the south exhibited the least favorable combination of EV score and socio-economic data for potential EV charging locations in comparison to the rest of Germany. Brilon in North Rhine-Westphalia, situated between the Ruhr region and Kassel, demonstrated one of the highest potentials, characterised by low competition, high suitability and favorable socio-economic indicators. A similar scenario was observed for Altdorf in Bavaria, near Nuremberg. Based on the photos of the locations alone, it is not obvious which retail site will be more successful. They all appear quite similar, despite being located in different regions. The EV Magnet Index reveals the distinguishing features and potential USPs of the venues to assist the team in examining these locations more closely and providing a base for negotiation.

"PATRIZIA's inhouse data intelligence capabilities provide Corymbia with a valuable tool to select the most attractive locations. Securing the best locations for EV charging is essential to ensure long-term profitability."

Anne Grandin,
Infractructure

Selected portfolio assets

Brilon

Gartz

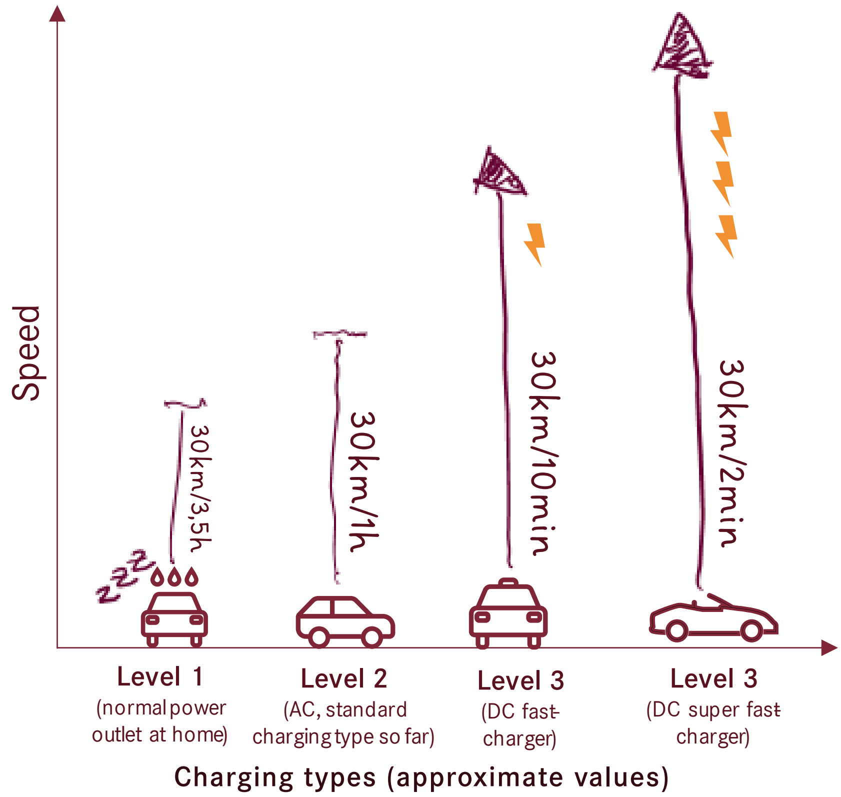
Langweid am Lech

Altdorf

Outlook

There are always limiting factors with external data; in our case the EV charging POIs, only included the number of parking spots but lacked detailed information on the variety of electric charging options available. Without delving too deeply into technicalities, it's crucial to understand that different vehicles have distinct batteries, which are compatible with various charging methods. These methods necessitate different levels of electrical energy transfer, thereby influencing the charging duration.

The figure below provides a brief, simplified illustration of how charging speed can vary depending on the type of charger used. For consumers, the key concern is the duration of the charging process, as it determines how long they have to wait before they can resume their journey. Currently, most public charging stations are equipped with level 2 chargers (AC), which provide a charging speed of 30 km per hour. In contrast, DC fast chargers can deliver the same amount in just 2-10 minutes. The charging types in the Corymbia project consist exclusively of level 3 chargers with charging powers of 300 kW.



Source: https://www.recurrentauto.com/research/charging-at-home-and-on-the-go

As we look towards the future, the demand for these rapid charging systems is anticipated to increase alongside the growth in EV ownership and advancements in technology. Therefore, gaining an understanding of the electric charging options provided by competitors becomes a key consideration. Consequently, there are several adjustments that need to be made in the near future:

- Incorporate data about the charging type to focus only on relevant ultra-fast chargers.
- Consider the frequency of customer visits to the supermarket location.
- Take into account the usage of highways.

Key Takeaways

Data Intelligence and Infrastructure: Machine Learning is utilised to make well-informed decisions when investing in EV charging infrastructure.

Strategic Approach to Infrastructure Planning: The gap between availability and suitability of locations indicates the readiness for the introduction of a new EV charging point.

Use cases: PATRIZIA projects serve as excellent examples of the successful application of machine learning and data intelligence in assessing potential locations for EV charging stations.

Future Trends: Different types of electric vehicles are compatible with different charging methods, which can influence the duration of charging. As the number of electric vehicles and advancements in technology continue to grow, the demand for rapid charging systems is expected to increase.

Transforming infrastructure investments for a greener future: The integration of data intelligence and machine learning is revolutionising the approach to infrastructure investment opportunities, making it a sustainable and future-proof choice. These methodologies are expected to become increasingly prevalent, driving innovation and sustainability in our journey towards a greener future.

Conclusion

The integration of data intelligence and machine learning in the decision-making process for EV charging infrastructure investments is not only innovative but also highly effective. By leveraging these technologies, we can make more informed, precise, and future-proof decisions. The use of the Amenities Magnet Algorithm, coupled with socio-economic data, allows us to identify optimal locations for EV charging stations, thereby promoting the widespread adoption of EVs. The successful implementation of this approach in the Corymbia project serves as a testament to its efficacy. As the EV market continues to grow, especially in Germany, these data-driven methodologies will undoubtedly play a crucial role in shaping a sustainable and efficient EV charging infrastructure. This research illuminates the transformative potential of data intelligence in infrastructure investment opportunities, making it a sustainable and future-proof choice. Moving forward, we anticipate that these methodologies will become increasingly prevalent in the sector, driving innovation and sustainability in our journey towards a greener future.

Rebecca Restle

Geodata scientist

Data intelligence