Project MidSommaR

Smart charging public and private charge points in the city of Utrecht to alleviate grid congestion.

TotalEnergies | Gemeente Utrecht | JEDLIX

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1. Introduction

1.1 Context & Motivation

The Netherlands, a leader in promoting environmental sustainability, has experienced a surge in electric vehicle (EV) adoption. This positive shift towards cleaner transportation, however, occurs simultaneously with a pressing challenge: grid congestion. One way for grid congestion to occur is when the demand for electricity surpasses the existing power grid's capacity to efficiently deliver it, resulting in so called consume congestion. This is caused by general population growth, spatial pressures, and the electrification of industry, transportation, and homes. Therefore, local grid operators are considering implementing measures and regulations to manage peak power loads to avoid grid congestion. The most drastic measure would be a complete shutdown of all public chargers during peak hours. This potential shutdown would pose a significant disruption to EV drivers reliant on public charging stations, particularly those requiring charging during these critical peak hours.

The other way is when the supply of electricity surpasses the grid's capacity, causing so called feed-in congestion. On sunny days, the Netherlands' extensive network of solar panels – with penetration rates reaching 25% in Utrecht and an impressive 44% in Leidsche Rijn (source: municipality of Utrecht) – experiences curtailment due to voltage spikes. Curtailment is the process of limiting electricity being generated and fed into the grid, in times where the grid cannot transport the excess supply. Curtailment has been applied more often with the increase of decentralized renewable energy generation. This situation frequently leads to households losing 10-20% of their potential solar energy production.

This phenomenon highlights the intricate balancing act necessary to integrate renewable energy sources like solar power into the existing grid infrastructure while concurrently accommodating the increasing demand for electricity from EVs. One way of alleviating grid congestion, and optimally utilizing solar energy, is smart charging. This technology allows electric vehicles to delay their charging time to occur at off-peak hours and at times of high solar generation. This project is a national first showcase for the effectiveness of simultaneous smart charging on both private and public charging infrastructure, as operated by two entities: TotalEnergies and Jedlix.

1.2 Introducing TotalEnergies & Jedlix

TotalEnergies: In the Netherlands, where sustainability is a top priority, TotalEnergies stands out as a leading Charge Point Operator (CPO), operating a robust network of over 17,000 charging points across the country. But our commitment goes beyond just infrastructure. TotalEnergies is actively pioneering smart charging solutions. These innovative technologies maximize the use of renewable energy, alleviate grid congestion, and prevent grid imbalance. By focusing on both infrastructure and intelligent charging strategies, TotalEnergies is helping the Netherlands pave the way for a cleaner, more sustainable future for electric mobility.

Jedlix: Jedlix is the leading smart charging service provider in Europe operating on the intersection of e-mobility and energy. The Software as a Service platform optimizes the charging & discharging of electric vehicles and facilitates their insertion into the power grid at scale. Jedlix teams up with energy companies, Charge Point Operators & eMobility Service Providers and car manufacturers to reduce the total cost of ownership of Electric Vehicles, monetize the flexibility of their charging process on energy and balancing markets, and to optimize the use of renewable energy. Jedlix services are integrated in numerous smart charging apps and EV drivers could also try the Jedlix branded smart charging app.

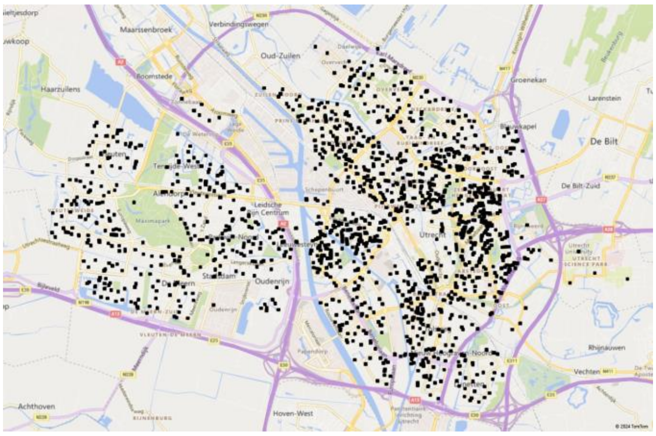

Figure 1: Public charging network in the city of Utrecht

2. Project Description

This project, called MidSommaR, aims to demonstrate the effectiveness of smart charging technology in alleviating grid congestion on June 17th, in the city of Utrecht.

2.1 Smart Charging Strategies

Smart charging offers a solution to grid congestion by optimizing EV charging schedules:

- Delay charging: Schedule charging sessions for off-peak hours, typically overnight, when electricity demand and prices are lower. This reduces stress on the grid during peak usage times.
- Dynamic pricing: Integrate with dynamic pricing models to charge when electricity is more affordable. This benefits both EV owners (cost savings) and the grid (reduced peak demand).
- Charging at peak solar supply: Prioritize charging during peak solar production times, maximizing self-consumption and further reducing reliance on the grid. Moreover, with the abolishment of the netting scheme (salderingsregeling) and the implementation of feed-in fines by energy suppliers, capturing electricity from one's solar panels adds even more value for the homeowner with an EV. This way, the issue of feed-in congestion can be alleviated by charging EV's within the same low voltage network, i.e., charge the car that's parked at the public charger or at your neighbor's house when the sun is shining.

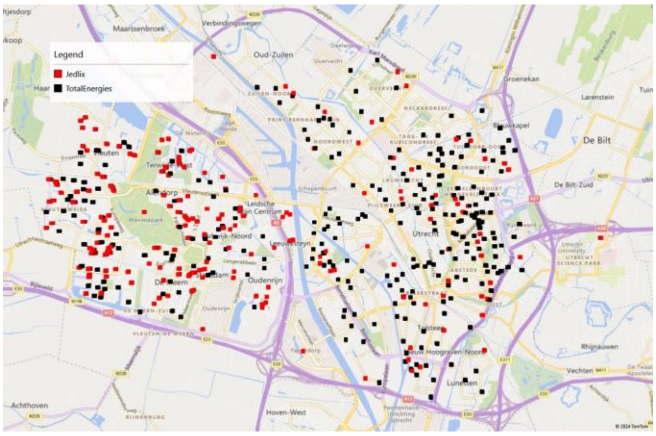

Figure 2: Chargers included in the project.

2.2 Project Implementation

TotalEnergies and Jedlix showcased smart charging strategies for their respective charging networks. For this demonstration TotalEnergies has applied smart charging to 360 of its charging points in the city of Utrecht, Netherlands. Smart charging shifts the demand away from the peak hours between 4:00 PM and 9:00 PM, to off-peak hours, between midnight and 8:00 AM the next day, when the stress on the grid is lower. This load shift means that the same amount of energy is delivered to charging stations but distributed over time.

Jedlix has applied a similar tactic to 251 private charging stations within the same city, by incentivizing users to adjust their charging schedules through their app. Users are encouraged to charge during the day where there is a surplus of solar energy or delay charging until after peak hours.

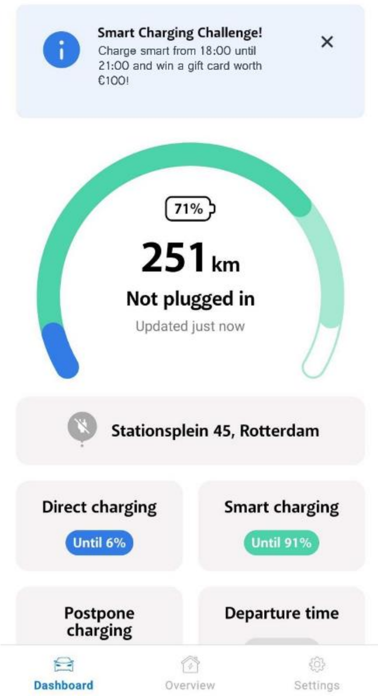

Figure 3: Jedlix' in-app promotional messaging

The MidSommaR project aims to demonstrate that smart charging can be a powerful tool for managing grid congestion and fostering a more sustainable energy future, especially as EV adoption continues to grow.

3. Results

This chapter details the outcomes of the MidSommaR project, which investigated the effectiveness of smart charging technology in alleviating grid congestion on June 17th in Utrecht, Netherlands.

3.1 Charging Graphs

The graphs below showcase the charged kW per 15 minutes for both companies:

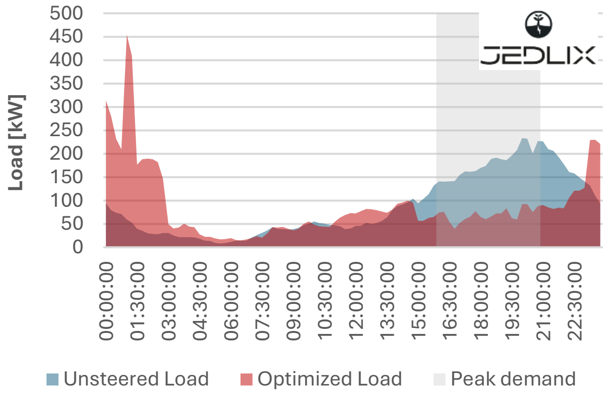

Figure 4: Jedlix' unsteered and optimized load

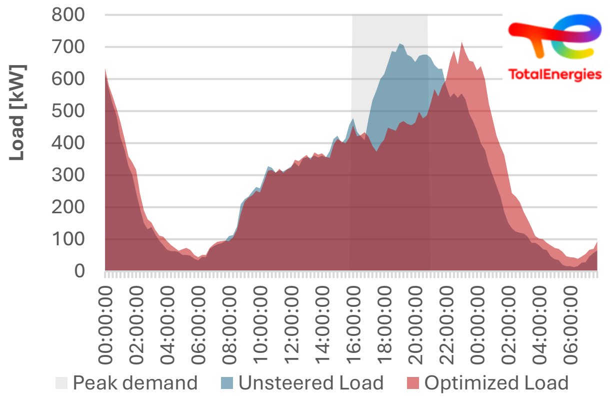

Figure 5: TotalEnergies' unsteered and optimized load

3.2 Reduced Power

The total amount of power reduction achieved through smart charging will be expressed in kW during the peak, and the relative overall reduction in power demand, compared to the scenario without steering.

3.3 Steering Sessions and Chargers

For the impact on Jedlix's network the number of charging sessions steered to off-peak hours or alternative days is has been gathered (steered sessions), as well as the number of private chargers that were impacted by smart charging directives (steered chargers).

Similar data was recorded for the smart charging done by TotalEnergies: the number of charging sessions influenced by power reduction strategies (steered sessions) and the number of public chargers with reduced power during peak hours (steered chargers).

3.4 Steered kWh and Delay

Next, for Jedlix's network, the amount of kWh shifted from peak hours to off-peak hours or alternative days for their private chargers (steered kWh) is collected.

For the chargers within TotalEnergies' network, the total amount of kWh shifted from peak hours to off-peak hours is collected (steered kWh). Congruently, the average delay of the charging session from the steered sessions compared to the original schedule is recorded (average delay of charging session per user).

To give an indication on how much a single user of both TotalEnergies' charging stations were impacted, the average kWh steered per user is calculated.

3.5 Results overview

Table 1: Results overview

Indicator	TotalEnergies	Jedlix	Total
Peak load reduction (kW)	249	233	**482**
Peak load reduction (%)	37%	59%	**40%**
Steered Sessions	265	100	**365**
Steered Chargers	161	100	**261**
Steered kWh (total)	790	555	**1345**
Steered kWh per session	7.17	Unknown	
Time delay per session	1:54:00	Unknown	
Avoided kwh solar curtailment	-	20	**20**

3.5 Extrapolation to Future Chargers in Utrecht

This project only includes a small portion of public charging stations in the city of Utrecht. Currently Utrecht holds 2.000 public charging stations, with an expected growth to 6.000 stations in 2030. Simulating the application of an equivalent steering signal for reduction of peak load on 2.000 chargers would result in a peak reduction of **4.6 MW (44%).**

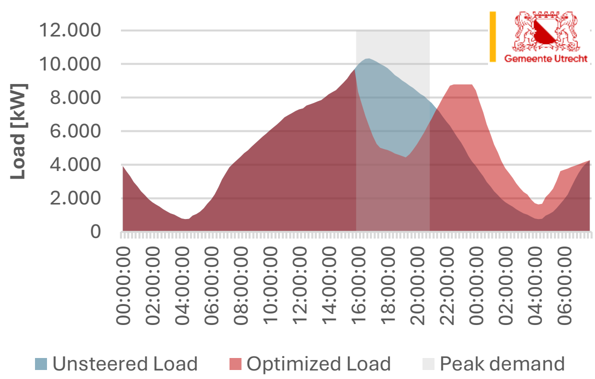

Figure 6: Utrecht's unsteered and optimized load

4. Conclusion

The MidSommaR project investigated the effectiveness of smart charging technology in alleviating grid congestion on June 17th in the city of Utrecht, Netherlands. This project, a collaboration between TotalEnergies and Jedlix, aimed to showcase the potential of implementation of smart charging strategies at the user level to manage grid stress while offering value to electric vehicle (EV) drivers.

4.1 Outcomes

Reduced Grid Congestion: By proactively shifting charging demand away from peak hours (typically evenings), the project has reduced pressure on the local power grid by **40%**. This could potentially prevent the need for drastic measures like forced shutdowns of public charging infrastructure the regional grid operator.

Value for EV Drivers: While some charging sessions may be delayed to off-peak hours, the project strives to minimize inconvenience for EV drivers. Smart charging strategies, such as dynamic pricing models and overnight charging, can offer cost savings and ensure vehicles are charged when needed. Additionally, Jedlix's app-based incentives for off-peak or delayed charging can further benefit private EV owners.

4.2 Overall Significance

The success of the MidSommaR project would demonstrate the potential of smart charging technology as a key tool for mitigating grid congestion in the face of increasing EV adoption. This approach offers a win-win scenario:

- **Grid Operators**: Benefit from reduced pressure on the grid during peak usage times.
- **EV Drivers**: Gain access to potentially lower charging costs and a more reliable charging infrastructure.

Furthermore, the project's findings can inform the development of future smart charging policies and infrastructure upgrades, paving the way for a more sustainable and efficient electric transportation ecosystem in Utrecht and beyond.

5. Recommendations

Building upon the insights obtained from the MidSommaR project, the following recommendations aim to guide future research efforts in optimizing smart charging strategies and fostering a more resilient and sustainable electric vehicle (EV) charging ecosystem:

5.1 DSO Collaboration:

- **Improve communication with the DSOs:** Create closer cooperation between CPOs and DSOs. This collaboration could involve:
  - Sharing (near) real-time charging- and MSR-level data to improve grid forecasting and management.
  - Jointly developing communication strategies to inform EV drivers about potential grid congestion and the benefits of smart charging.
  - Exploring incentive programs co-designed by DSO's and charging service providers to encourage EV driver participation.
- **Standardization and interoperability:** Promote the development of standardized protocols and data formats to ensure seamless communication and interoperability between different smart charging systems and grid operators.

5.2. Expanding Incentives for Off-Peak Charging (less grid congestion):

- **Financial incentives:** Analyze the effectiveness of various financial incentives, such as lower charging costs during off-peak hours or loyalty programs rewarding consistent off-peak charging behavior.
- **Non-monetary incentives:** Explore the impact of non-monetary incentives, such as gamification elements or social recognition programs, on encouraging user participation in smart charging initiatives.
- **Targeted incentives:** Develop targeted incentive programs that cater to specific EV driver segments based on factors like charging location (home vs. public) and driving patterns.