

# A NEW PROPOSITION FOR SMART CHARGING AT HOME

## PROJECT SCOPE AND PROBLEM DEFINITION

Electric vehicles, electric cooking, heating installations running on electricity; the future is electric. This electrification creates a continuously growing demand of electricity. However, the electricity grid network is not able to transport these amounts of electricity and is facing problems. Part of the problem is created by charging electric vehicles (EVs). As peak energy demand of a charging session of an EV's is approximately 10 times higher compared to a regular household demand (Geerts et al., 2020), this creates high peak demand on the local grid network. The challenge is to find better ways to charge these vehicles, especially in the future. This is what smart charging needs to do. Smart charging is adapting the time and or velocity of a charging session.

The main challenge addressed in this project is: **How can Vattenfall offer a valuable smart charging proposition to enable EV drivers to use smart charging at home?**

## DEFINING THE CHALLENGE

Three interesting scenarios of smart charging are found: simple scheduled charging using time-of-use (TOU) tariffs, charging to maximize local solar power production, or charging using Direct Load Control (DLC), in which the supplier of the solution can steer the charging session according to real-time data.

In comparison to other competitors in smart charging solutions, Vattenfall has the ability to influence energy tariffs, which was also something recognized by consumers during interviews. Also, in the Netherlands, there are currently no relevant TOU tariffs available. **Therefore, the development of a smart charging proposition primarily focused on the design of new TOU tariffs.** In addition, consumer preference towards all three smart charging scenarios is investigated. The challenge is to **design an implementation roadmap that incorporates these various scenarios of smart charging.**

## OUTCOMES

Two interesting TOU tariffs were developed. **Tariff Short Peak** is a tariff with a peak price between 19h to 21h. The peak price should discourage people from using electricity during that time period - e.g. avoid to charge the car. The other tariff - called **Daytime Plunge** - offers a low price during the night and during the day from 11h - 17h, when solar power usually peaks and wholesale energy prices are usually low. Interviews to investigate desirability of both tariffs reveal that interest in these tariffs vary among consumers, and is partly determined by the financial advantage that results from such a new tariff, but also by the type of consumer and their personal needs and routines. This variety in types of consumer and their preferences resulted in four different persona's that show the diversity of people among EV drivers. The size of these persona groups and preference among these groups for one of the two tariffs give insight in the order and pacing in which these tariffs should be introduced.

Next to the development of new TOU tariffs, it was found that giving a financial incentive for the other two scenarios of smart charging, namely charging using DLC and using your own solar power, interests EV drivers. In addition, DLC can serve as supporting technology that integrates TOU tariffs and maximization of solar consumption in the future.

The implementation roadmap brings together the introduction of new tariffs, DLC and solar compensation, with the customer groups and plots them into three horizons. Each horizon introduces a vision relevant for Vattenfall to determine the focus of smart charging for that period.

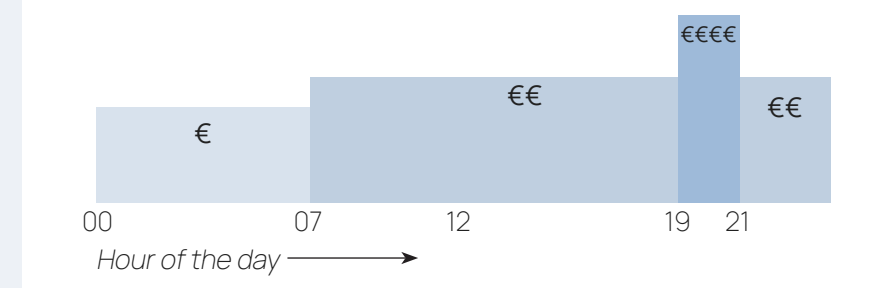
The combination of TOU tariffs, compensation for solar consumption and DLC enables Vattenfall to offer valuable smart charging solutions to diverse groups of EV drivers. By plotting the solutions into three horizons, Vattenfall makes sure to keep up with trends in the electricity market and EV domain, and enables to increase value for both the consumer and the business.

# NEW TIME-OF-USE TARIFFS

## Tariff Short Peak

Tariff type	Hours	Price
Low tariff	00:00 to 07:00	€
Normal tariff	07:00 to 19:00	€€
Peak tariff	19:00 to 21:00	€€€€

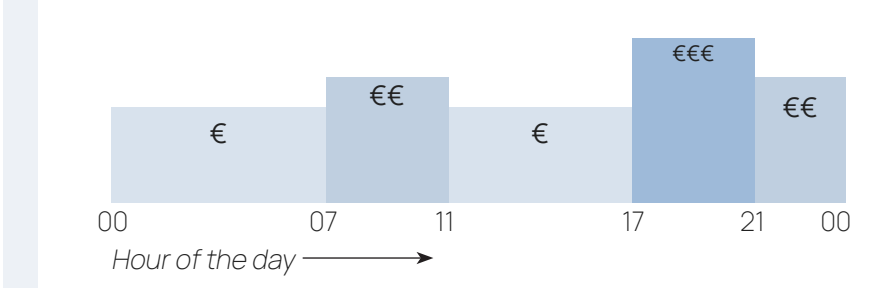
Illustration of the tariff



## Tariff Daytime Plunge

Tariff	Hours	Price
Low tariff	00:00 to 07:00	€
Normal tariff	07:00 to 11:00	€€
Peak tariff	17:00 to 21:00	€€€

Illustration of the tariff



## Time-of-use tariffs?

Time-of-use tariffs are tariff structures for electricity in which the price per kWh fluctuates according to a number of time blocks distributed over the day. You pay the price that applies in the time block in which you use the electricity.

# TYPES OF EV DRIVERS

**Pieter**

Age: 55  
Occupation: Software developer  
Status: Married  
Location: Hillegom

**Personality**

- Strong minded
- Has his things in order
- Likes to optimize his life

**Needs**

- Luxury
- Ease
- Comfort

**Goals**

- Wants to retire early
- Prefers high quality food and products
- Save up money for holiday home

**Bio**

Pieter is married and has 3 kids who moved out a few years ago. He and his wife both work 4 to 5 days a week. In general, they live a normal to luxurious life, and do not have to worry about money. In their free time, they like to go to museums. In daily life, they pay little attention to the environment. However, as they are a wealthy couple, they have invested in solar panels and drive an electric vehicle.

EV driver since 2018  
Solar panels, since 2019  
Lives semi detached house

**Anne**

Age: 40  
Occupation: Teacher  
Status: Married  
Location: Soest

**Personality**

- Creative
- Caring
- Energetic

**Needs**

- Support

**Goals**

- Save up money for travelling
- Wants to become "special needs coordinator"
- See friends more often

**Bio**

Anne is married and has 2 small kids. She loves her job as a primary school teacher. Depending on the weather, she likes to travel by bike or car to school. Her life revolves around her kids, and in the future she would like to see friends more often. She acquired an EV because she is environmentally aware and it pays off in the long term.

EV driver since 2021  
Solar panels since 2020  
Lives in terraced house

**Lars**

Age: 34  
Occupation: Construction worker  
Status: Girlfriend  
Location: Zaandam

**Personality**

- Habitual
- Technology enthusiast
- Tough

**Needs**

- Flexibility
- Entertainment

**Goals**

- Attend a football match this year
- Buy a boat
- Become Team manager

**Bio**

Lars lives with his girlfriend in their small family home in Zaandam. They have been together for several years, and don't have kids (yet). He works irregular work shifts as a welder for large construction sites. He likes his job and the irregular work shifts. At the weekend, he likes to go to festivals, hang out with friends or do little home repairs.

EV driver since 2019  
No solar panels

**Hans**

Age: 67  
Occupation: Retired  
Status: Married  
Location: Almelo

**Personality**

- Laissez-faire
- Protective

**Needs**

- Freedom
- Weekly activities
- Physical exercise

**Goals**

- Enjoy life
- Visit friends abroad
- Stay healthy for his grandchildren

**Bio**

Hans has been married for 38 years. After living in Amersfoort, he and his wife moved to Almelo, to enjoy their retired life. Their grandchildren visit often. Also, he has taken up new hobbies.

EV driver since 2020  
Solar panels, since 2019  
Lives semi detached house

# IMPLEMENTATION ROADMAP FOR SMART CHARGING SOLUTIONS

	2024	2025	2030
	<b>HORIZON 1</b>	<b>HORIZON 2</b>	<b>HORIZON 3</b>
<b>VISION</b>	Encourage improved electricity consumption	Support maximization of solar power consumption	Enable a self-sufficient home energy system and make EV's part of the decentralized grid
<b>TRENDS</b>			
<b>EXPLANATION</b>	Due to the development of electrification and the desire to save on electricity bills, Vattenfall should offer EV drivers a TOU tariff that encourage improved electricity consumption. 'Improved' means to avoid periods when wholesale prices are usually high and risk of local congestion is high. Also DLC is introduced as smart charging scenario to keep up with competition and adopt the technology that is needed in future horizons.	The future changes of net metering legislations establishes the introduction of this new horizon, that focusses on solar energy. Although in the future the new legislation naturally provides a financial incentive for people to maximize consumption of solar energy, Vattenfall should support their customers. Therefore, the focus of the second horizon is to focus on solar energy maximization. Tariff Daytime Plunge is the TOU tariff that should be introduced, as the low tariff during the day can further incentivize people to make use of electricity during hours that solar panels usually generate electricity.	Once the majority of EV's and charge points are able to comply with V2X technology, the third horizon will make its introduction. The battery of the car is charged and discharged during optimal hours, and functions as battery to the home and local distribution network. Vattenfall still delivers energy on times that solar panel production is low, or when wholesale prices are low. New TOU tariffs are introduced according to current market prices and congestion situations.
<b>INTRODUCTION OF SMART CHARGING PROPOSITIONS</b>	<b>TARIFF SHORT PEAK</b> → solar compensation → <b>TARIFF DAYTIME PLUNGE</b> → <b>NEW TOU TARIFF</b>		
<b>CUSTOMER</b>	market size: 105.000	market size: 280.000    market size: 170.000	total market size: 900.000
<b>MONITOR &amp; INSIGHT</b>	Provide insight in appliances with high energy consumption in the home to support effective behavior changes.	Provide insight in how much solar energy is being used by the home, and what for. Enable multi tariff entry for charging schedules.	Enable functionalities that give people freedom to choose to what extent their EV battery is available to their home and to other homes.

Mare de Koning  
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Strategic Product Design

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