Bachelor thesis

An integral communication strategy facilitating interaction between EV-drivers and Revolt's charging station

22 February 2024

Benthe Commissaris

IEM

List of acronyms

Battery-State-of-Charge (SOC)
Battery State-Of-Charge, explained in section 3.1.1.
Capacity (kWh)
Maximum power output. The amount of electricity a generator can produce when it is running at full blast. This maximum amount of power is typically measured in kilowatts (kW) in the automotive world and helps utilities project just how big of an electricity load a generator can manage. (Energy.gov, 2020)
Charge Point Operator (CPO)
Company that operates the charging network, provides delivery installation and maintenance of charging point. Explained in section 0.5.
Charging Behaviour Model (CBM)
Model based on literature review in chapter 3.
Client
The company who signed the contract with Revolt, commissioner of applying the charging points.
Communication tool
The way Revolt Energy expresses itself towards end-users e.g., newsletter, event, website page, commercial.
Desired charging behaviour
Less volatile in energy demand profile of EV riders. Where charging load shifts into off-peak hours and EV-drivers do not park over a longer period than necessary.
Dynamic Pricing (DP)
The desired pricing scheme of Revolt. It is the adjustment of prices over time. Financially by means of an end - or to several ends - like for instance to balance supply and demand; to prevent the need for grid extension; to achieve end-user energy saving; to raise awareness; to engage end-users and decentralised producers more actively. (Breukers & Mourik, 2013). More details
in section 0.6.
Electric Vehicle (EV)
Vehicles with an electric battery. This can be hybrid or fully electric.
End-user
The person who is targeted for an ICS, this is the clients of Revolt and EV-drivers.
Integral Communication Strategy (ICS)
The product consisting of a roadmap of communication with supporting tool.
Interaction
The communication towards clients and users. To increase interaction this thesis will focus on an ICS with a supporting tool. The interaction is quantified by objectives.
Mobility Service Provider (MSP)
They link CPOs and EV-drivers and provide charging cards.
Objective
In this thesis there are two objectives: the willingness and satisfaction, who together operationalise the measurement of total interaction.
Peak shaving
levelling out peaks in electricity use by industrial and commercial power consumers. (Peak Shaving, n.d.)
Purchase Decision Process (PDP)
Model designed by Davis (1989), stretched in section 4.1.
Technology Acceptance Model (TAM)
Model designed by Davis (1989), stretched in Section 5.1.
User
The EV-driver, user of the charging points of Revolt.

Readers guide

This research addressed a worldwide issue of the climate crisis by exploring dynamic pricing adaptation for Electric Vehicle charging to unburden the Dutch electricity grid. This might reduce the reliance on coal-generated energy, aiming to mitigate the impact on climate change. Given the importance of accurate solutions and to ensure correct interpretation, the skeleton of this research is visualised in the contents.
This research follows the Double Diamond Method (DDM) of the British Design Council (2005), employing both divergent and convergent thinking. Additionally, introductions of chapters or sections are made grey throughout the research. Per phase the input per chapter in the diamond is described below:

Chapter 0
provides concepts and complexity of dynamic pricing explained. It shows background information on the discussed concepts of this research. However, it is important to note that it does not count towards the academic research itself! Therefore, it is suggested to start from Chapter 1, and refer to chapter 0 for explanation on concept.

Chapter 1
is the start of the divergent thinking and provides the methodology of this research on 'why' this research is conducted. Stating the context analysis, description of the research question and elaborating on the problem-solving approach towards the research goal. The theoretical framework is outlined in chapter 1, with in Appendix E the principles.
Chapter 2
provides the environmental analysis of the company and current state of the core problem environment. To show the relationship towards the normative goal of this research.

Chapter 3
starts the systematic literature review into EV-driver behaviour, resulting in a conceptual Charging Behaviour Model (CBM) related to the research question: 'Which DP approaches in literature work effectively changing end-users' behaviour?'. Showing relevancy in which concepts could potentially drive EV-drivers behaviour towards the normative goal of this research.
Chapter 4
provides a literature review into the Purchase Decision Process (PDP) related to the research question: 'Which marketing components can stimulate end-user to interact with Revolt Energy's DP?'. Outlining which components could potentially stimulate EV-drivers behaviour to reach the normative goal of this research.
Chapter 5
provides a literature review into the Technology Acceptance Model (TAM) related to the research question: 'Which supporting technology tools can stimulate end-user to interact with Revolt Energy's DP?'. Pointing out how certain supporting technology components could potentially stimulate EV-drivers behaviour towards the normative goal.

Chapter 6
provides the conceptual framework. This framework is the model of this research and is linked to the theoretical framework collected information from the systematic literature review. It visualised the variables included to reach the normative goal of this research and forms the basis for data collection.
Chapter 7
outlines the data gathering method. The Critical Success Factors (CSFs) describe the validation of the data collection to come to the solution set for the research goal.
Chapter 8
outlines the data analysis. Where results of the data collection are discussed based on their CSFs and validated into a solution set.

Chapter 9
defines the selection on the suitable strategy and the outcome of a suitable solution set.
Chapter 10
enhances on the contribution to practice. The feasibility and integration of the research's outcome, the ICS, is elaborated here.
Chapter 11
compactifies the conclusion, recommendation, and discussion of this research outcome.

Contents

Management summary

This research is conducted as the final assignment for the Bachelor of Industrial Engineering and Management at the University of Twente in cooperation with Revolt. This research aims to investigate the problem of insufficient information and technological support for dynamic pricing for end-users at Revolt's charging stations which lead to lack of satisfaction and willingness from the end-user to interact with Revolt's charging stations.

Revolt is a company focusing on all-in-one services regarding Electric Vehicle (EV) charging points. Overall, in the Netherlands, the fees charged by charging point operators (CPOs) are not transparent towards EV drivers. Therefore, the Dutch government implemented fresh regulations for CPOs to provide clear and transparent pricing information by 2024.This non-transparent pricing information and the growing demand for EVs in Europe lead to the concerning consequence; that the electricity grid is put under pressure due to inefficient energy usage. The usage of electricity is desired to be more equally distributed over the day, which requires EV-drivers to adapt their charging behaviour to equally spread their electricity usage. Revolt sees a solution for this by implementing dynamic pricing (DP) - adjusted prices over time. Revolt wants to implement DP in their product service of 'Revolt Energy', because dynamic pricing can unburden the grid.

The goal of this research is to develop an Integral Communication Strategy (ICS) that provokes the implementation of dynamic pricing from the end-user perspective. Possible solutions for the strategy are based on a theoretical framework, which is concluded by a systematic literature review (SLR). The ICS is designed to stimulate end-users' understanding and interaction with the charging points to influence the charging behaviour towards a less volatile electricity usage. In addition, the development of an ICS will provide transparent price information to the end-user. The research question is:

"Which combination of information and accepted technology is suitable for Revolt to stimulate desired end-user charging behaviour?"

Methodology

This research is constructed via methodologies. The research starts with gaining understanding of the core problem via a managerial problem-solving method of Heerkens (2012). The research design is based on the Double Diamond model created by the Design Council of the United Kingdom (2005), which leads to four phases:

1. The discovery phase analyses the current internal environment and performs a systematic literature review to serve as input to obtain knowledge in the research field, concluded in 26 lessons.
2. Information gained under (1) is input for the define phase. The integration of the theoretical models and top 26 lessons leads to a conceptual framework of variables, directly influencing the total interaction of the end-user. The framework is the basis for data collection. The dataset is measured by Critical Success Factors (CSFs).
3. In the develop phase, the results of the data collection are measured against the CSFs to develop a suitable ICS. Within the given time and scope a selection of the implemention steps is made.
4. In the deliver phase a roadmap ticket is implemented with the focus on feasibility and integration for Revolt. This specific roadmap ticket is chosen based on literature and self-collected data analysis. It is designed to be implemented in such a manner that end-user behaviour will be stimulated towards a desired energy profile. This research its main deliverable is the development roadmap ticket for an ICS, visualised in Figure A. The ICS development roadmap ticket outlines the strategy's implementation plan, aimed at facilitating interaction between EV-drivers and Revolt's charging station during dynamic pricing usage.

Management summary

Development roadmap

Ticket: Integral communication strategy (ICS)

Details

The ICS is part of the Revolt Energy service. Consisting of the needed communication with supporting technology from the end-users perspective to interact with EPEX-spot market dynamic pricing. It consists in total of 6 tasks:

1. Fixed digital communication on website;
2. Real-time digital communication on website;
3. Mobile application;
4. Incorporation of real-time pricing in financial services;
5. Creation of ROI model
6. Elaboration pro-social behaviour.

Dependency on other tickets

This development is dependent on development with the CPO and MSP partners, software mobile application development, Revolt Energy, Dynamic pricing and EPEX spot trading.
(H1Pr9, H1So2, H1So4, H1Pl3)

Priority

This development is dependent on development with the CPO and MSP partners, software mobile application development, Revolt Energy, Dynamic pricing and EPEX spot trading.
(H1Pr9, H1So2, H1So4, H1Pl3)

Budget

36,972 €

Potential partners

This development is dependent on development with the CPO and MSP partners, software mobile application development, Revolt Energy, Dynamic pricing and EPEX spot trading.
(H1Pr9, H1So2, H1So4, H1Pl3)

Timing

Start: now
Finish: 2 weeks up to 1 year

Technical

Mobile application:
- Notifications
- Real-time pricing
- Insight in information

Webpages:
- Real-time pricing
- Audio-visual support

Functional

Customised providence of information towards customers and end-users on their economical and environmental benefits to effectively increase willingness and satisfaction on Revolt Energy.

Figure A; Development roadmap ticket for an ICS

Recommendation

The recommendation for implementation of an ICS for dynamic prices in the service of Revolt Energy, is to follow the top 26 lessons (on page 54) as design guidelines. Primarily, Revolt should focus on social norms. These social norms should enhance word-of-mouth or other normative social influences—to enrol other EV-drivers in demand response programs. This research suggests that this factor has the greatest impact on the overall interaction. Social norms should be supported by effective communication with end-users.

Secondly, for effective communication, an investment in technology is needed by Revolt. Most preferred is a mobile application for the end-user, to help them acquire efficient charging behaviour in their daily routines, enabling daily information to increase primarily the end-users' economic and environmental benefits. To implement this, a partnership should be sought, which can aid in the service of Revolt Energy.

Additionally, the information via digital communication, like information on the website, should always be accessible. Moreover, my research shows that with the incorporation of audio-visuals the satisfaction of end-users can be stimulated for increased interaction.

Thirdly, for implementation of an ICS other factors such as internal resources, technical and financial services, and the complex structure of dynamic prices should be further evaluated by Revolt. An example of financial evaluation is outlining the financial processing and Return on Investment (ROI) model for a client, aiming to avoid increased financial risks associated with the implementation of DP.

Management summary

Department	Tasks	Time	Cost
Marketing	1.Digital communication with support of audio-visuals on webpage (fixed) c. What is DP d. Economical & environmental benefit of DP 2.Digital communication with support of audio-visuals (real-time) b. EPEX spot-market prices	1. 1 month 1a. 2 weeks 1b. 2 weeks 2. 1 month 2a. 1 month	1. 0€ 1a. 0€ 1b. 0€ 2. 3.200€ 2a. 3.200€
Operations	1.Development of mobile application c. Personalised notifications d. Real-time insight EPEX	1. 6 months- 1 years 1a. 3 months 1b. 6 months	Options: i. Insource: 61.010€ ii. Outsource: 33.772,80€ iii. Partnering: 0€
Finance	1. Incorporation of real-time pricing in financial services 2. Creation of Return of Investment model	1. 1 month 2. 3 months	1. 0€ 2. 0€

Table A; Feasibility of an ICS per department of Revolt

The feasibility of an ICS per internal department of Revolt is outlined in Table A. The extent to which effective communication encourages end-users is dependent on available budget- and time resources. While Revolt can create content in-house, a significant portion of the budget should be allocated for building a mobile application. Therefore, the mayor decision on development of technology for an effective ICS is a time- and cost wise decision on: (1) outsourcing a mobile application, (2) insourcing a mobile application with a software developer, (3) establish a partnership or (4) outsourcing by creation of dynamic data on web pages.

To conclude, with respect to the urgency of the electric grid pressure and non-transparent pricing schemes, Revolt can use its current flexibility to implement an ICS for DP at their charging stations. This ICS, guided by the top 26 lessons, can stimulate a desired charging behaviour profile whilst maximising Revolt's revenue, contributing towards a more equally distributed electricity demand of Revolt's network and a more sustainable future.

0. Introduction

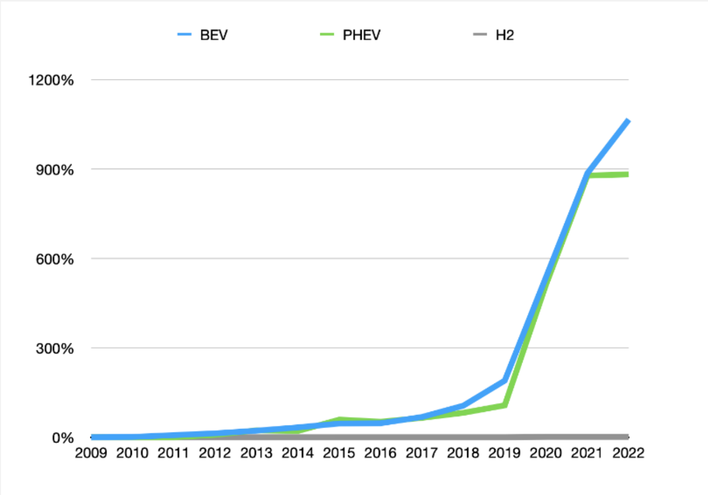
Chapter 0 describes relevant context-dependent factors - such as background, company, service, stakeholders, dynamic pricing (DP) strategy and problem identification - to develop a suitable research methodology. It does not elaborate on the academic reporting but is only used for better understanding of concepts used in this research. If you are familiar with the concept used in this research, it is suggested to start from Chapter 1.

0.1 Background

According to the RIVM (n.d.), the Netherlands aims to reduce greenhouse gas emissions and become a climate-neutral country by 2050. Electrification of the transport sector is an important part of this objective, as it is a major contributor to the Netherlands' total greenhouse gas emissions.

The Netherlands wants to have 1.9 million electric cars on the road by 2030, which requires a significant increase in the number of charging points in the Netherlands. The target is to have around 1.7 million public charging spaces installed by 2025. This requires 10% of all public park spaces to be electric charging points. Which around a third should be fast charging points. According to the RIVM this should ensure that there are sufficient charging facilities for all electric cars in the Netherlands, making it increasingly easy and attractive for motorists to switch to electric driving.

The Netherlands' vision for the future in terms of charge points and EV adoption is ambitious, and there is high focus on innovation and technological developments to achieve these goals. Figure 1 gives visualisation of the aims regarding electrification goals of EV in Europe. (Energietransitie | RIVM, n.d.) On the vertical axis is the percentage of increment per year of sustainable vehicles.



BEH = battery EV, **PHEV** = plug-in hybrid EV, **H2**= hydrogen.

Figure 1; Electrification goals of EVs in Europe (Energietransitie | RIVM, n.d.)

With the growing demand for EVs in Europe the electricity grid is put under pressure. TenneT fears for a power shortage from 2030 and onwards (Reliance on Sustainable Energy May Cause Electricity Supply Problems: Grid Operator, 2023). To repressure the grid, usage of electricity should be more equally distributed throughout the day. Where EV-drivers could also adapt their charging behaviour to equally spread their electricity usage.

0.2 Company description

Revolt is a start-up, based in Amsterdam. It focuses on all-in-one EV charging point services. Their mission is to take away the huge investment and the hassle of installing a charging point for companies. Their vision is to make an ecosystem that will charge all forms of sustainable mobility, making clean energy available anytime, anywhere and to everyone.

Revolt offers subscription-based charging points with implementation and maintenance in combination with batteries towards clients. The end-user of the charging point is the EV-driver. The Revolt HUB, this (third from left) charging point is accompanied by a digital advertising platform. To enable electrified projects with higher capacity demands Revolt now owns three batteries as a service. Products are shown in Figure 2.

Figure 2; Revolt's products

Revolt is constantly active in innovating their products and is active in the Netherlands. Revolt is currently in the phase of scaling up and investing into internationalisation and implementation of being a clean energy supplier. Another future perspective lies with the development of Revolt Energy described in the next section.

0.3 Service description

Revolt Energy is an additional service to their products. Where Revolt Energy's aim is to charge transparent low prices at the charging points with use of only green energy. Revolt can buy, store and trade energy using their charging points and batteries for Revolt Energy, visualized in Figure 3.

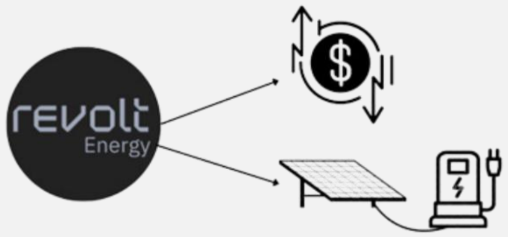


Figure 3; Revolt Energy

Two operational changes are in progress for that:

1. A *second allocation* point must be installed behind the metre of the client's property.
2. A *partnership with a selected energy supplier* who trades on the EPEX-spot market with green energy.

Unfortunately, due to insufficient integration with grid operators, lead times of the application of a second allocation point are enormously high. Lead time investigation is out of the scope of this research, as this is part of the operations. Revolt wants to make the energy supply and pricing of charging more transparent towards the users, as all products are now dependent on the energy supplier of the client's property. Revolt wants to change towards their own supply of energy and the use of dynamic pricing (DP).

Revolt wants to collect data of problem occurrence and build the operational process of rolling-out the service line of Revolt Energy. Currently, they do this via a trial-and-error method, this results in high lead-times.

To explain more in depth about the operations; Revolt Energy's current situation is that the user charges at Revolt's charging point and pays to Revolt via their charging card (Dutch: laadpas). The company client where Revolt has their stations buys energy from a supplier, Revolt reimburses that via a fixed fee per kWh used. Hence, Revolt is dependent on the energy contracts of the client. They have no control over the energy provision and are not able to control what type of energy flows through their products and its pricing.

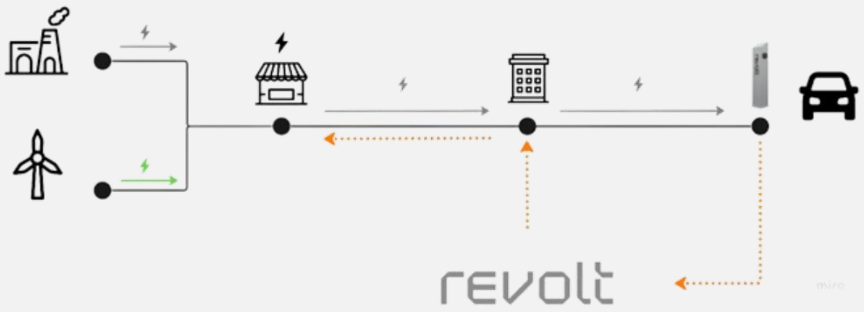


Figure 4; Revolt's current energy pricing flow

Revolt Energy operates with the norm that the user charges at the charging point to Revolt and Revolt buys its energy directly from an energy supplier. In this manner Revolt creates a better control over its energy prices and consumption. In technical aspects a second allocation is implemented and a partnership with an energy supplier who works with a DP model is created to achieve this norm. Extra cables and an extra metre must be implemented as well during this process, which means extra costs.

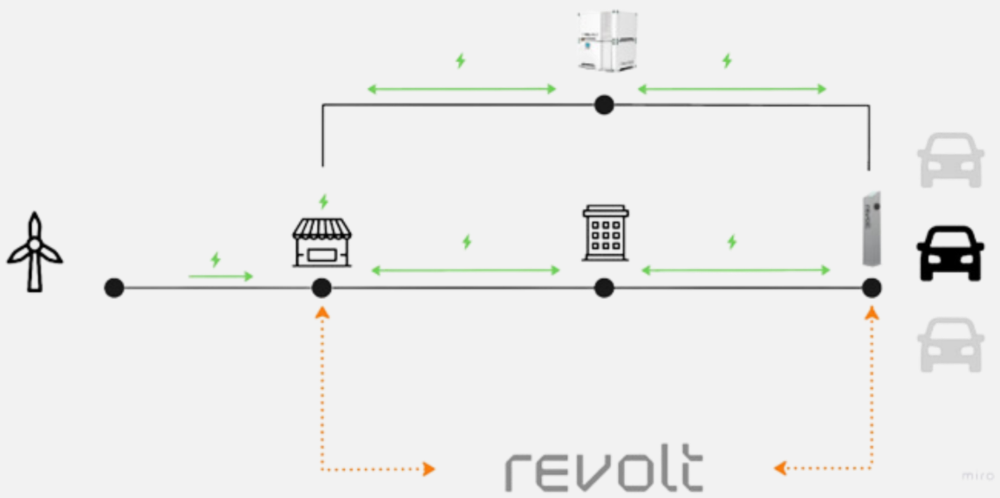


Figure 5; Revolt's desired pricing flow

0.4 Stakeholders

There are several stakeholders involved in providing charging infrastructure to EV-drivers. In this Section a description of the important ones. Figure 6 presents the relationship between these players and the role of Revolt which is discussed. As this research can impact different stakeholders 0.4.1 discusses this on micro, meso and macro level.

According to the Netherlands Enterprise Agency and Visser (2019) the Charge Point Operator (CPO) is the company that operates the charging network, provides the delivery, the installation and maintenance of the charging points. In the case of public charge points they are often the owners of the charging points
CPOs are often the ones that set the price for the energy provided through the charging point. It is important to note that the price the CPO charges per kWh is not necessarily the price that the EV-driver pays per kWh. That is because EV-drivers often make use of an E-mobility provider, who may charge extra.

MSPs, or E-mobility service providers are the link between CPOs and EV-drivers. To charge an EV you often need a card to activate the charge point. The MSP is the provider of these cards. The MSP needs to have a contract with the CPO to enable the use of the charge point and charge the end-user (in this research called client) for kWh used. The end-user in turn has a contract with the MSP, where they either have a subscription or pay per charge. Some examples of Revolt's clients/end-users can be corporates, hotels, and destination locations like PON, Huis ter Duin and Vliegveld Twente.

Grid operators strive to provide end-users with a sustainable and dependable electrical grid. Therefore, they are highly interested in reducing peak demand and finding effective ways to integrate renewable energy sources (RES) into the grid (European Network of Transmission System Operators for Electricity 2018). Meanwhile, energy providers are aiming to include renewable generation in their energy portfolio to comply with emissions regulations (Drake et al. 2016). They are the supplier of electricity for the charging points and communicate with the CPO. By using DP to induce desired demand profiles, both these stakeholder groups can significantly benefit.

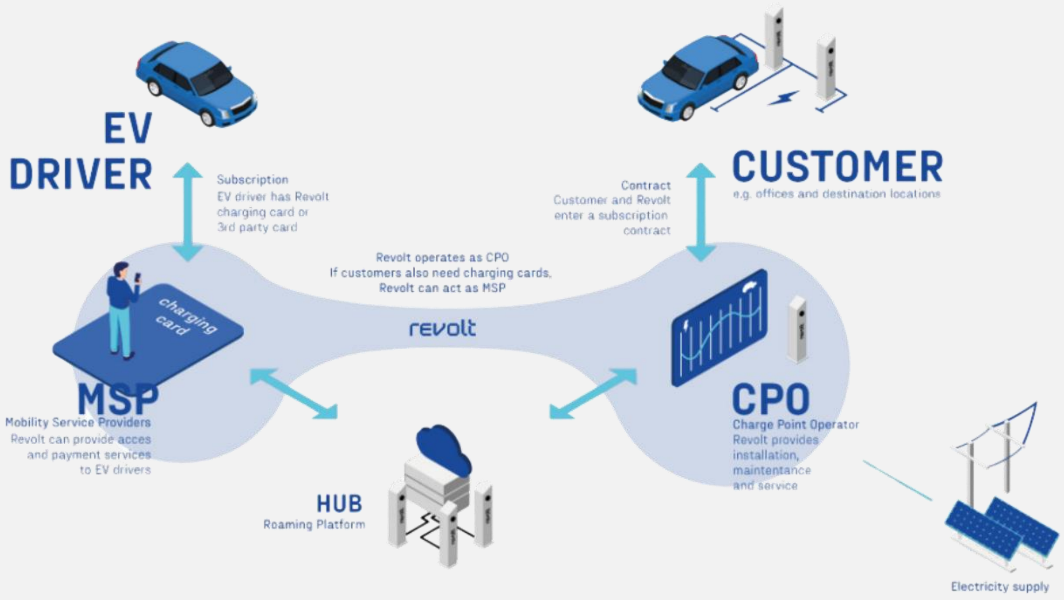


Figure 6; Revolt's position in the MSP and CPO environment

0.4.1 Impact on stakeholders

On a **micro level**, the clients and end-users of Revolt Energy may be positively impacted by the ICS by being able to charge their vehicles for a lower price, more efficiently with their energy usage, and with less hassle and positively affect our electricity grid, which is now at its capacities. The ethical issues connected to this impact include the need to protect the privacy and data of the end-users, ensuring that the communication is not misleading or manipulative, and respecting the end-users' autonomy in deciding when and how to charge their vehicles which also involves employees of Revolt.

On a **meso level**, Revolt may benefit from the research outcome by increasing end-user satisfaction, loyalty, and trust, and by reducing complaints, errors, and maintenance costs. The ethical issues connected to this impact include the need to ensure that the outcome is aligned with Revolt's values, mission, and goals, and that it does not compromise the confidentiality, safety, health, or rights of the employees, contractors, or suppliers involved according advised by Lindsay & Martella (2020b).

On a **macro level,** the impact of the outcome may be positive for the contribution to environmental benefits for the society at large. Due to promoting sustainable and responsible energy consumption, reducing the reliance on non-renewable energy by electric driving. As EVs emit zero tailpipe emissions during driving, which can help improve air quality and reduce health problems caused by air pollution in cities. By charging your EV with electricity from renewable energy sources, you can reduce our dependence on fossil fuels, which are finite resources and contribute to climate change according to NREL et al. (202 C.E.). By supporting DP, you can help increase the use of renewable energy sources in the electricity grid. Which in turn will help reduce our dependence on non-renewable energy sources. Through this the prices of charging points become more transparent with implementation of the research's outcome. Next to that, the Dutch government proposed new regulations to cap the fees where operators should provide clear and transparent pricing information by 2024 at the station. With the correct implementation via this research's strategy the implementation of dynamic pricing serves for more fair and transparent charging prices and contributes to a societal benefit. The ethical issues connected to this impact include the need to ensure that the research outcome is transparent, inclusive and that it contributes to the common good and the public interest.

Thus, the relevant stakeholders in this research project are the end-user of Revolt Energy, Revolt as a company, and the EV-drivers. It is important to integrate their needs, perspectives, and interests into my analysis to ensure that the research is relevant, respectful, and responsive to their concerns.

0.5 Charging methods

Charging points can provide AC and DC solutions. AC charging and DC charging are two different methods used to charge Electric Vehicles (EVs). AC (alternating current) charging is the process of transferring electrical energy from an AC source, such as a wall socket or a dedicated charging point, to the vehicle's battery through an on-board charger. AC charging is slower than DC charging, but it is widely available and can be done with a standard household socket. DC (direct current) charging, on the other hand, involves transferring electrical energy directly from a DC source, typically a high-power charging point, to the vehicle's battery without the use of an on-board charger. DC charging is faster than AC charging and can provide up to 80% charge in as little as 30 minutes, depending on the vehicle and the charging point. The main difference between AC and DC charging is the speed of charging. Thus, AC charging is slower but can be done anywhere there is a power outlet, while DC charging is faster but requires specialised equipment. (*AC / DC Charging*, n.d.)

0.6 EV charge pricing model

Charging prices on the charging point also have constraints towards the EV-driver. Rephrasing from Section 0.5 the price of a charging session consists of two components: the price you pay to the charging point (CPO), plus the price for using the charging card (e-MSP). Together they determine the final rate. Figure 7 shows this process. As a CPO, it is difficult to say anything about the purchase price, because they do not know what the e-MSP charges. This lack of transparency is a hindrance. With the DP strategy the CPO will implement and maintain the dynamic prices, whilst the MSP will still add their charges on a session.

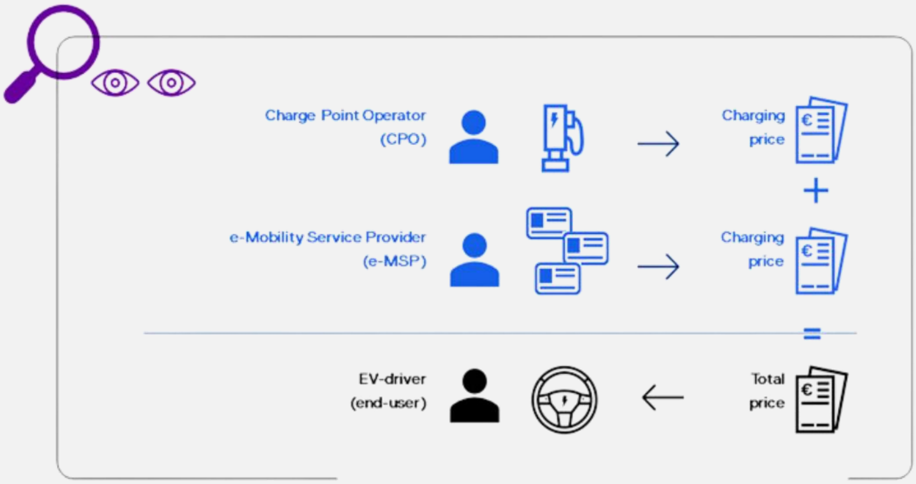


Figure 7; Build-up of pricing for EV-driver (Authoriteit consument & markt, n.d.)

Revolt wants to better meet the demand for electricity from EV-drivers, whilst increasing their utility. As they must deal with the rising electricity capacities problems, their goal is that users make more conscious and optimal use of the grid with the current capacity constraints. This is when demand and supply are equally distributed and widespread over the day. The charging point collects all the data from the MSP and CPO to process electricity and financial transactions.

Revolt operates as a CPO and provides installation, maintenance, and service of the charging point. But has a high potential to also function as an MSP to provide access and payment services to EV-drivers. If end-users also need charging cards, Revolt can function as an MSP through a Business-to-business (B2B) subscription model. In addition, they offer their expertise in charging infrastructure, unburdening the end-user. The advantages of implementing dynamic pricings at the system level should agree with the interests of various stakeholders in the energy system, such as transmission system operators, distribution system operators, generators, electricity retailers, and their target market: end-user. Which are discussed more in depth in 2.2 End-user analysis.

0.7 Dynamic pricing description

Breukers and Mourik (2013) state that DP for EV charging is a type of demand response that encourages end-users to alter their electricity consumption through financial incentives. It is a concept in the energy sector that has the potential to optimise energy use and reduce energy waste. In the Netherlands, DP is currently being used on the EPEX-spot market to optimise energy usage and reduce energy waste. This pricing method allows energy providers, like Revolt, to adjust their prices based on numerous factors, including supply and demand, weather conditions, and grid stability This Section discusses the concept of DP, how it is being used in the Netherlands, and the benefits in societal impact.

0.7.1 DP in context

DP allows energy providers to adjust their prices in real-time based on numerous factors. For example, if there is a sudden increase in demand for energy due to extreme weather conditions, energy providers can adjust their prices to reflect this increased demand. Similarly, if there is a sudden decrease in demand for energy, energy providers can adjust their prices to reflect this decrease in demand. This is done on the EPEX-spot market. (Basics of the Power Market | EPEX SPOT, n.d.)

In context of energy supply via charging points the charging cost can change depending on factors such as the time of day, day of the week, and the level of demand for charging services, allowing the charging provider to adjust pricing dynamically to optimally use their infrastructure and maximise revenue (International Energy Agency,2019). One of the means to involve the end-users in the management of the smart grid supply is via DP. The varying prices of electricity provision are conveyed to the end-users. In order that end-users get a sense of the actual prices of energy provision at the time end-users ask for it (Faruqui et al., 2010).
Revolt can function as a distribution system operator or an operator/aggregator, adjusting the price paid by EV-drivers for charging their vehicles based on the fluctuating market conditions of the EPEX-spot market.

0.7.2 DP and the EPEX-spot market

The EPEX-spot market is a European energy exchange where energy providers can buy and sell energy. It is the largest energy exchange in Europe, with over 400 energy providers participating in the market. DP is being used on the EPEX-spot market to optimise energy usage and reduce energy waste. (*About EPEX SPOT | EPEX SPOT*, n.d.)
The EPEX-spot market uses a system called the Day-Ahead Market (DAM) to determine energy prices. The DAM is a system that allows energy providers to submit their energy supply for the next day. Once all the energy supply is submitted, the DAM calculates the energy price for the next day based on the submitted supply and demand. Energy providers then use this energy price to set their dynamic prices for the next day.

0.7.3 Benefits of DP for Societal Impact

DP has several benefits for societal impact, including reducing energy waste, reducing carbon emissions, and promoting energy efficiency. By adjusting prices in real-time, energy providers can ensure that energy is being used efficiently and not wasted. This reduces the need for additional energy production, which can help reduce carbon emissions. (Breukers & Mourik, 2013) DP can also promote energy efficiency by incentivizing users to use energy during off-peak hours when energy prices are lower. This can help reduce peak demand for energy, which can lead to a more stable grid and reduce the need for additional energy production.

Dynamic prices give an incentive to end-users to change the way they use energy. They put end-users in the driver's seat and allow them to consume greener energy and at a lower price. This incentive is needed to relieve our pressured power grid and is therefore a prerequisite for a quicker energy transition (Hulshof, 2020).

0.7.4 DP for Revolt

The aim of using DP for Revolt is to incentivize EV-drivers to charge their vehicles at times when there is less demand on the grid or when renewable energy sources are generating more power, which helps to balance the energy system and reduce costs. When adjusting prices in real-time, charging providers can also maximise their revenue and ensure that their charging infrastructure is being used efficiently (Breukers et al., 2013).

0.8 Revolt Energy problem identification

For Revolt Energy the focus lies on controlling low and transparent prices and supply of energy of the charging points. Rephrasing from Section 0.3, Revolt is a company that focuses on unburdening difficulties around EV-charging. They have developed charging points for companies and event locations and provide the whole service around it. They have a new focus of service, which is called Revolt Energy.

The current main problem with the pricing of charging points in the Netherlands is the high fees charged by some operators. This is a untransparent process which discourage EV owners from using charging points. Ultimately slowing down the adoption of EVs in the country.

In addition to high fees, there are also issues related to inflation, as the overall cost of living increases the energy prices increase too. The rising energy prices can also make it more expensive to charge an EV. These issues make it difficult for EV owners to budget for the cost of charging their vehicles. It also creates uncertainty around the cost of charging, which influences behaviour of the user. To address these issues, the Dutch government has proposed new regulations to cap the fees charged by charging point operators and to provide clear and transparent pricing information to users by 2024 (*EUR-LEX - 32023R1804 - EN - EUR-LEX*, n.d.).

The amount of charging points can create a bottleneck that can overload the local electricity grid capacity when many EVs are charging at the same time. On the other hand, end-user behaviour can also contribute to the problem, as some EV owners may prefer to charge their vehicles during peak hours, further overloading the grid. To address this issue, it is necessary to not only invest in better availability of energy supply in charging infrastructure but also encourage more responsible charging behaviour among EV-owners. Because additionally, there is also the problem of "charging point sticking" (Dutch: laad kleven). Where the EV-driver sticks to the charging point for many hours, even whilst the vehicle is fully charged. This behaviour is unwanted, as it creates inefficient use of charging points.

0.9 summary Chapter 0

By correct use of DP, avoidance of overload on the grid and inefficient behaviour can be achieved. Overall, with the rising demand for the number of charging points Revolt is in an advantageous position with a product in this growing market. However, adaptations must be made towards co-optation of smart use of the available electricity. As Revolt is now dependent on the energy contract of their clients, they started an investigation with an additional service called: Revolt Energy. Which focuses on how to deliver their own dynamic energy supply to guarantee affordability (everyone) and sustainability (anytime) of their product. This they do with implementation of (1) a second allocation point or new connection and (2) a selected partnership with an energy supplier. The rising question of how Revolt Energy should best be brought to the market is crucial as applied theory of DP - changing prices over time - is complex for (potential) end-users.

1. Research Methodology

This chapter elaborates on the problem statement and problem-solving method. To start with the description of the action problem stating the current state of the service of Revolt Energy and the desired profile Revolt likes to achieve. Section 1.2 states the core problem. As the core problem is a discrepancy between norm and reality an operationalized statement Section 1.3 discusses this. These sections serve as qualification measurement of the research. In 1.4 the problem-solving approach discusses the research goal and research design and this research' research questions. These serve as lay-out guidelines to deliver high quality research. 1.5 discusses the theoretical framework which shows relationships as base of the optimization model. Lastly in 1.6 & 1.7 the scope and deliverables are discussed.

1.1 Action problem and baseline

The Managerial problem-solving method states that a problem exists when there is a discrepancy between the norm and reality (Heerkens et al.,2021). As a researcher it is important to solve this problem by bringing the reality closer to the norm. Rephrasing from Section 0.7, due to the lack of transparent price visibility at the charging points the clients and users (EV-drivers) are denied a choice. Defined by whether they want to charge for a particular price and time slot or not. This denial for choice creates inefficient energy demand peaks.

If the charging of EVs is not properly optimised, the overall load will result in voltage drops and in collapse of the whole distribution network. (*Energietransitie | RIVM*, n.d.) The use of charging EVs is shown in Figure 8, where peak demand of energy in Revolt's current network is visualised.

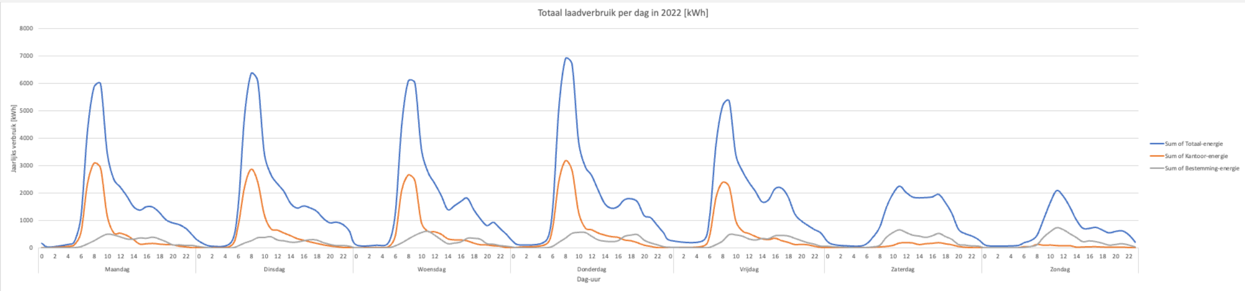


Figure 8; Total energy consumption within network of Revolt over 2022

Goodarzi et al. (2018) states that it is crucial for the grid operator to have control over shaping electricity demand, as this enables a more stable and reliable operation of the grid. Psychologists claim that energy information is so complex that end-users lack the capacity to make sense of it (Anderson and Claxton, 1982). Where energy experts lack the capacity to speak to end-users in a way that is meaningful to them (Parnell and Larsen, 2005).

Revolt, the provider of energy for EV-drivers, is confronted with this challenge of shaping electricity demand towards the desired profile of a less volatile demand profile and better predictability of electricity demand and peaks. This is achievable by load shifts into off-peak hours and change EV-drivers behaviour and to not stick for a longer period to a charging point than necessary. **To change EV-drivers behaviour, Revolt must 'interact' with EV-drivers to encourage the desired charging behaviour.** Revolt wonders how to best increase interaction in design for a communicative DP approach for its service of Revolt Energy. This results in the following action problem:

"Revolt Energy does not reach the desired interaction with current strategy."

1.2 Problem cluster and core problem

By conducting informal interviews with Revolt employees, the on-going problems are put in context. The problem cluster and evaluation towards the core problem is explained more in detail in appendix A. Via the MPSM steps of Heerkens (2012) the research question found from the problem cluster is formulated as:

"Which combination of information and accepted technology is suitable for Revolt to stimulate desired end-user behaviour?"

To define the core problem, operationalization is used with two objectives: '*willingness*' and '*satisfaction*'.
The *willingness* of end-user is the probability that clients or end-users want to charge with DP schemes. If more people have the willingness to charge with DP, the willingness of demand in the service of Revolt Energy will increase.
The *satisfaction* of end-user to make use of DP is the probability that clients or end-users are content with the service of Revolt Energy for charging EVs.
The probability of 60 percent is the norm formulated in consultation with Revolt's management. It is the minimum requirement for Revolt that Revolt Energy is worth investing in from the end-user perspective. Therefore, the operationalized core problem can be concluded as:

When considering an end-user confronted with dynamic pricing at a charging point, then both willingness as well as satisfaction should reach a level of at least 60%.

1.3 Reality and norm of core problem

Currently, there is no data available nor communication towards end-user about dynamic pricing at a Revolt charging point. To assess the impact of potential communication strategies, a baseline measurement is therefore set to null. Figure 8 in Section 1.1 shows the current end-user energy impact with this null baseline.

As the norm of the two variables willingness and satisfaction should at least increase to 60%, an ICS of Revolt Energy must develop to stimulate interaction with the end-user towards a desired charging behaviour.
This should create a real solution, where everyone benefits from the development of an ICS. The end-user will interact more with the DP strategy of Revolt due to their stimulation on *willingness* and *satisfaction* objectives. These objective in their place stimulate the desired charging behaviour. With the more desire charging behaviour Revolt stimulates towards a more equally distributed electricity demand peak. This equally distributed demand peals make grid operators more able to meet the demand constriction in The Netherlands.
Figure 9; Causal flow illustrates the causal processes and variables, which participate in a desired charging behaviour, in this research. This research focuses on the purple Section, development of an ICS.

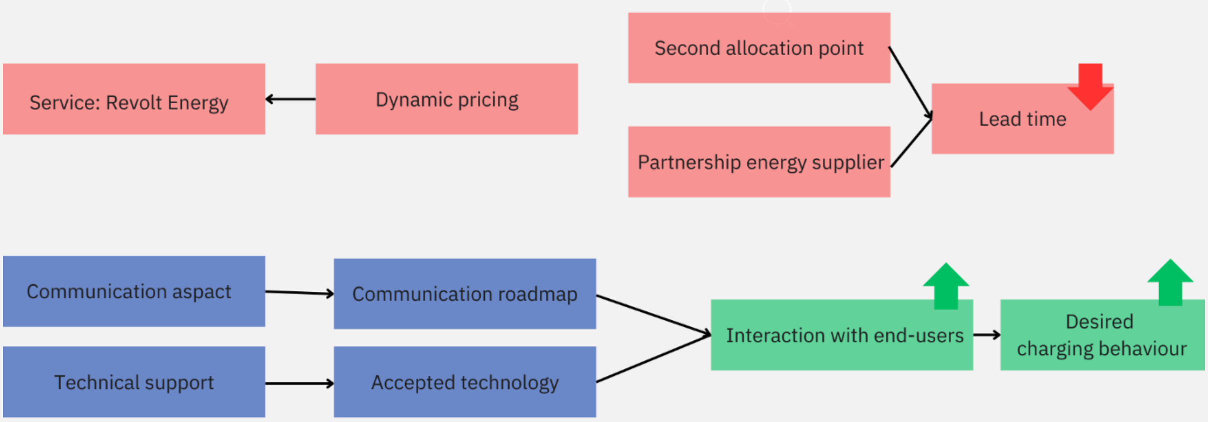


Figure 9; Causal flow

1.4 Problem-solving approach

In this section the problem-solving approach is outlined. 1.4.1 states the research goal, whereas 1.4.2 discusses the research design and research questions.

1.4.1 Research goal

Stated from the norm and reality of the core problem; this research is set out to progress knowledge via empirically testing if an ICS has a positive effect on the *willingness* and *satisfaction* of end-user to make use of DP at the charging point. Stating the research question as:

"Which combination of information and accepted technology is suitable for Revolt to stimulate desired charging behaviour? "

An ICS for Revolt Energy is defined by a communication roadmap with a supporting communication tool. Therefore, this research contributes to analyse informative, technical, and communicative factors influencing end-user charging behaviour. It attempts to understand the relevant roles of an ICS in EV-driver's charging behaviour in relation to Revolt's services, from the end-user perspective. Next to that, it demonstrates how an integral communication mix should be developed to stimulate interaction with end-users charging behaviour and create *willingness* and *satisfaction* for end-user to stimulate charging with dynamic prices. This relationship is again visualised in Figure 10, Research goal set-up.

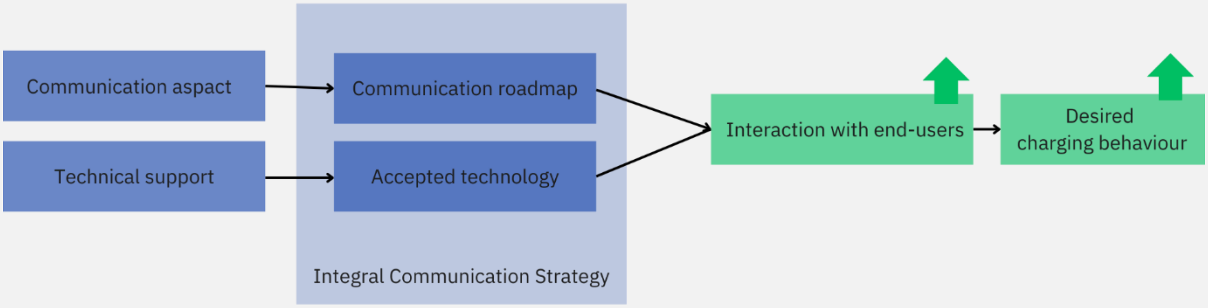


Figure 10; Research goal set-up

1.4.2 Research design and research questions

The chosen DDM is in line with the characteristic of the research. By defining a constructivist approach, a more divergent thinking (widely and deeply) can be created, followed by focused action of convergent thinking. (British Design Council, 2005). The process of divergent and convergent thinking will be found by answering the knowledge questions in my research design. DDM is scientifically validated and applicable for my research. During my research I follow this structure and its rules. It ensures that my work can be understood. To create the constructivist approach for my research design, four phases of the DDM are completed:

1. The *discover phase* involves analyses in the current internal environment completed and conducting a systematic literature review conducted to serve as data input to obtain knowledge in the research field, understand the problem and determine the importance of finding a solution. Data is gathered through a systematic literature review (SLR), and it is crucial to validate the data gathering process to ensure validity of the research outcome. Therefore, the deduction of the different variables for designing the current and desired states of the research outcome should be provided.
2. Information gained under (1) is input for the *define phase*. The integration of the theoretical models leads to a conceptual framework of variables that directly influence the total interaction of the end-user. The framework forms the basis for data collection, and variables are made measurable by Critical Success Factors (CSFs). These Critical Success Factors (CSFs) are used to evaluate the difference between current and desired success results. This research uses an online questionnaire to collect data. The online questionnaire allows to broaden the research sample size to provide recommendations most accurately towards the company. The methodology of the questionnaire is outlined in section 7.1 and the questionnaire construction and flow can be found in Appendix F.
3. In the *develop phase*, the data collection results are measured against the CSFs to develop a suitable ICS. For the analysis of data, a combination of qualitative and quantitative techniques is used outlined in Section 8.1. If it is shown that there is no significance in the assumption that the development of an ICS will stimulate total interaction, the development of an ICS will be stopped for the sake of confirmation bias. Furthermore, within the given time and scope, a selection of the implementation steps is made. This includes the incorporation of theory and knowledge obtained from the previous two phases into the design.
4. In the *deliver phase* a roadmap ticket is implemented with the focus on feasibility and integration for Revolt. Feasibility is crucial for ensuring the accuracy of the solution. This specific roadmap ticket is chosen based on literature and self-collected data analysis, and its viability for implementation. The aim is to stimulate end-users to adopt towards a more desired energy profile. This research's' main deliverable is the development roadmap ticket for an ICS.

For the design of this research, the research question is divided into manageable knowledge questions. The normative knowledge question goals should be the outcomes of using the strategy. The normative goal of the research is that there should be a strategy that stimulates interaction. In line, the ICS should be accurate, relevant, and implementable. I will use the research cycle and use a systematic literature review (SLR), processed in Appendix B, for scientific knowledge to integrate in the technical output of the ICS. These knowledge questions are set-up according to this Double Diamond model, which distinguishes four phases: Discover, define, develop, and deliver. For later reference to the knowledge questions, Appendix C shows a clear overview of all sub-questions and relatable methodology. Additionally, Appendix C provides per phase of the Double Diamond the relatable knowledge question with clear description on relation towards the research goal. In appendix C the investigation method and data analyse method are outlined.

1.5 Problem solving method

From the research goal and problem-solving approach this section shapes a theoretical framework as problem solving method. This theoretical framework is based on the theory outlined in Appendix D. This section only outlines the important variables in the framework which serve as a base of an optimized model later in Chapter 6. The outcome of theory is displayed in Figure 11, Theoretical framework.

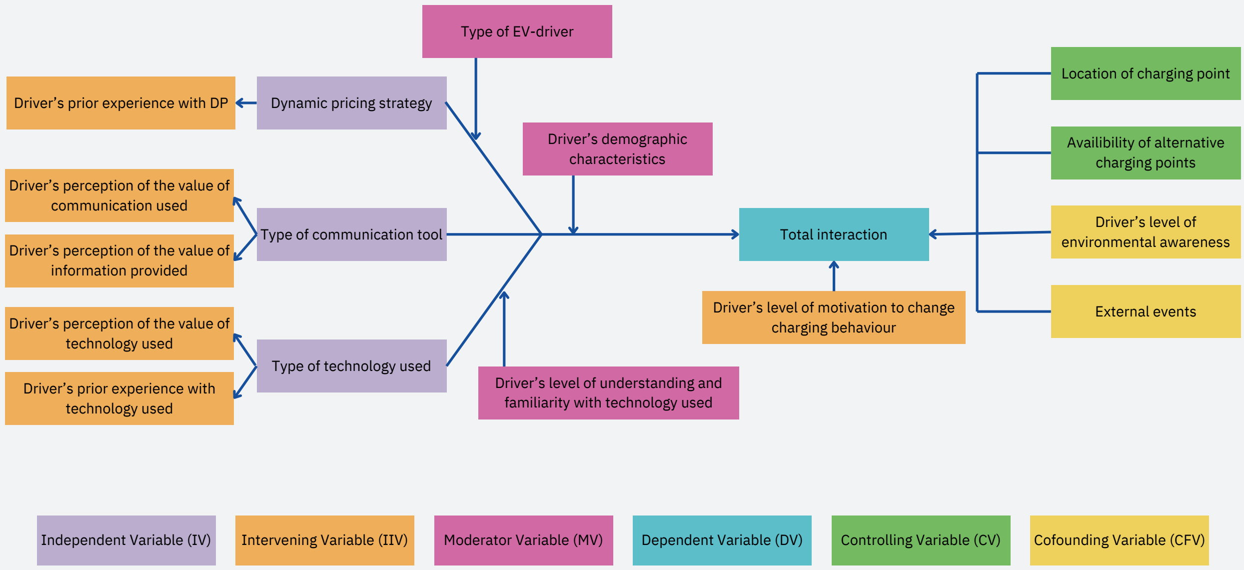


Figure 11; Theoretical framework

The purple independent variables include the company's DP strategy, its ICS, and the type of technology used to provide information to the driver. Additionally, several pink moderator variables such as the type of EV used by the driver, their level of understanding and familiarity with the technology used for providing information, and their demographic characteristics (e.g., income, age, gender, etc.) can influence the driver's strength of attitudes and behaviour towards DP and technology adoption.

The green controlling variables such as the location of the charging point, the availability of alternative charging points in the area as well as external events like weather conditions and gas prices can affect the demand and usage of the charging point and therefore directly impact the total interaction. However, the yellow confounding variables such as the driver's level of environmental awareness and concern, can influence the demand and usage of EVs and the charging point.

Moreover, the orange intervening variables such as the driver's perception of the value of the accepted technology and the information provided, their level of motivation to change their charging behaviour (e.g., personal beliefs towards sustainability and the environment), and their prior experience with DP and the technology used to provide information can affect their willingness to interact with the company and change their charging behaviour. They are influenced by the ease of DP strategy, type of communication used, and the ease of technology used. Understanding these variables and their relationships is crucial to optimise the blue dependent variable of total interaction between the company and EV-drivers to influence charging behaviour as research goal.

1.6 Research scope

The operationalized core problem statement will consider the degree of influence on end-user behaviour in the *willingness* and *satisfaction* objectives. The scope of this research is to develop a comprehensive ICS to increase interaction with end-users. To measure the effectiveness of the strategy, the *willingness* and *satisfaction* of stakeholders is analysed.
The focus of this research is to identify metrics that can communicate insights on adaptation needs and support informed decision-making for the target market.

Due to time limitations, this research will only analyse objectives for existing clients and in general the EV-drivers. Data from existing clients, EV-drivers in the network, and literature studies on DP approaches and end-user behaviour is analysed and generalised.

While research in decreasing lead times is important, it is out of scope for this research. The implementation of recommendations, evaluation of electricity demand peaks, and research on total price transparency are also out of scope, though they are considered for implementation recommendations. The focus of this research is on shifting end-user charging demand, rather than demand reduction.

Given the complexity of the subject, several assumptions have been made in this research, including the possibility of a second allocation point, DP being the pricing scheme, and only electric cars being in the population analysed.

1.7 Deliverables

Throughout determining insight of current market situation of Revolt Energy and objectives from end-user a suitable ICS will be the result, with the following deliverables:

- Presenting an ICS development roadmap.
- Presenting user-interface example of suitable ICS.
- Report with literature and substantiation of the recommendations and conclusions.

Literature review

The literature review exists out of four chapters: Chapter 2, Chapter 3, Chapter 4 and Chapter 5. Each chapter discusses a theoretical model and identifies factors influencing the total interaction. Next to that each Chapter includes a summarized conclusion at the end of each Chapter. To finalize the literature review, a top 26 lessons are drawn to conclude, which is considered when developing an ICS for Revolt Energy.

2. Context analysis

My research findings may have different impacts on various stakeholders. This chapter aims to identify variables that directly impact the overall interaction and contribute to the development of an ICS. Section 2.1 concentrates on the competitors already implementing DP. Section 2.2 focuses on Revolt's target market and discusses the segmentation necessary for tailoring an ICS. To gain insight into the internal environment, several methods are employed, such as conducting a SWOT analysis in Section 2.3 and reviewing financial statements in Section 2.4. Conclusion of this chapter is provided in section 2.5.

2.1 Competitor analysis

To analyse how competitors' market themselves in Dutch context and terms of DP approaches is important the focus is on competitors who provide insight in DP and usage for its end-users. The used supportive technology and information regarding the interaction are analysed here for creating information alternatives.

2.1.1 Competitors in the dynamic market of charging points

Multiple stakeholders participate in the DP market for charging points. Exanimating these stakeholders provide evaluation on possible solutions for an ICS. Found is that these parties focused on home charging. Some key players operating in the Dutch dynamic charging sector are stretched in Appendix E.

2.1.2 Perspective analysis

The competitor analysis of 2.1.1 in Appendix E resulted in Table 1; Competitors analysis and Figure 12; Competitors perception web. The third column of Table 1 contains the 'information' results that will serve as the input for the communication approach of our quantitative research. The research aims to identify the type of information desired by end-users and end-users. This competitor analysis reveals that all competitors leverage mobile applications as accepted technology, indicating that for Revolt to remain competitive, it should prioritise the development of a mobile application. Consequently, the research will proceed under the premise that Revolt will at least develop a mobile application as an accepted technology.

competitor	revenue model	information	supporting app
tibber	3,99 per month	kwh / euro, EPEX-spot price, CO2 emission reduction, status battery, km with current battery	✓
E-Flux		Kwh tariff, kwh charged, total cost	✓
powerpeers		CO2 emission compensation	✓
vandebron	3,50 per month	start tariff, kwh-tariff, time-tariff, incentive, kwh, energieusage (normal vs low)	✓
JEDLIX		battery status, charged km, slim loading options, start time of charging, end time of charging, type of car, total smart charged kwh, saved euros	✓
frank energie		actual market pricing of dynamic pricing, how much expected, real time and saved euros all in 1 dashboard	✓
ENGIE		kwh + euros, m2 + euros, graphic of energy usage, % less energy usage per month	✓
NextEnergy	5 euro per month 5 euro extra for gas	actual pricing, saving per group notifications,	✓

Table 1; Competitors analysis

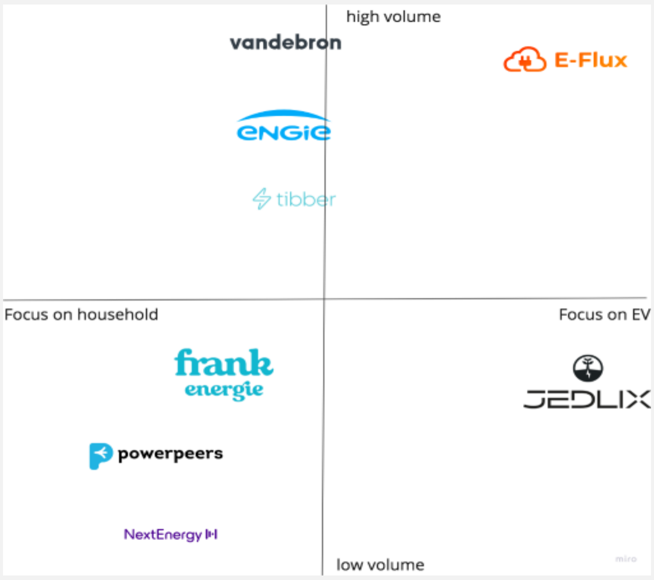


Figure 12; Competitors perception web

2.2 End-user analysis

Segmentation offers the first steps towards designing and tailoring communication approaches to the behaviours, motivators and needs of the end-users (Breukers et al., 2013). Stakeholders are analysed in Section 0.5. Here 2.1.1 analyses the clients of Revolt and 2.1.2 the EV-driver.

2.1.1 Clients

Revolt provides EV charging solutions for businesses-to-business. Their clients include facility managers, business owners, and commercial directors. In its marketing and sales communication, Revolt emphasises three key value propositions for their clients: carefree charging solutions, an initiative-taking and dependable partner, and user-friendly and innovative products with a sleek design.

To gain a better understanding of why current end-users have chosen Revolt over its competitors, a study was conducted consisting of ten semi-structured interviews by Janssens (2023) with clients. The findings of this study identified three main value drivers for clients: price, convenience, and scalability.

Price was identified as a key driver, with the monthly fee offered by Revolt being significantly cheaper than those of their competitors. As Revolt offers subscription-based charging points the client does not have to make a huge investment at once. Next to that, the client can also earn a bit from the charging points as they can add a margin per kWh charged.

Clients also valued the convenience provided by Revolt, as the company takes care of the technical feasibility, installation, maintenance, and service of their charging points.

The third value driver identified was scalability. Revolt provides real-time insight into the use of chargers, allowing clients to expand their charging solutions before it becomes necessary. This not only provides peace of mind for clients but also ensures that they are prepared for future growth.

2.1.2 EV-drivers

This research distinguishes business and private end-users of the charging points. Given that Revolt targets the business market, most of its end-users are business EV-drivers. These individuals lease their EVs from the companies they work for, and the company covers the investment and charging expenses for the business EV-drivers.

On the other hand, private EV-drivers have personally invested in their EVs and are responsible for paying their own charging sessions. As a result, their behaviour towards DP strategies differs from that of business EV-drivers. Private EV-drivers have a higher financial incentive, influencing their decision-making process. The differences in EV-drivers' behaviour is further elaborated on in Chapter 3.

2.3 SWOT analysis

SWOT analysis is a valuable tool that helps organisations identify several factors that can impact the success of the company. This identification is done in collaboration with Revolt, by leveraging its strengths and opportunities, and addressing its weaknesses. This SWOT is summarized in Figure 13, SWOT analysis for developing an effective ICS.

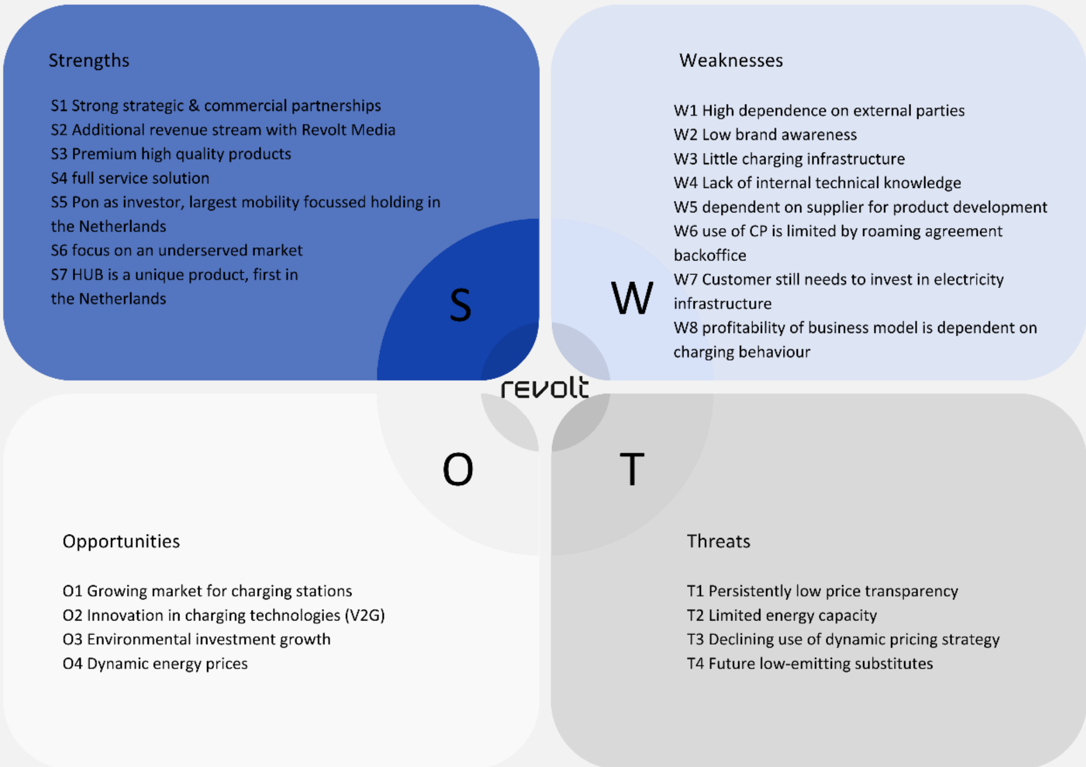


Figure 13; SWOT analysis for developing an effective ICS

Strengths include strong strategic and commercial partnerships, additional revenue streams with Revolt Media, premium high-quality products, and a full-service solution. Revolt has Pon as investor. Pon is the largest mobility-focused holding in the Netherlands. Next to that, the Revolt charging point with media screens (the HUB) is a unique product that is the first of its kind in the Netherlands.

Opportunities with developing an effective ICS should contribute to the expand of its business. These include the growing market for charging points, innovation in charging technologies such as Vehicle-to-Grid (V2G), environmental investment growth, and dynamic energy prices via energy provision for clients.

Weaknesses of Revolt include high dependence on external parties, low brand awareness, little charging infrastructure, lack of internal technical knowledge, dependence on suppliers for product development, and dependence on e-roaming agreements for the charged pricing model towards users. Clients need to invest in electricity infrastructure for the charging points. Revolts profitability of the business model is dependent on charging behaviour of users as their incorporated a marge on the pricing model at the charging station (0.15 euro per kWh charged).

Threats for Revolt can impact the success of its ICS. These include persistently low-price transparency, limited energy capacity, declining use of DP strategy, and future low-emitting substitutes.

2.4 Review financial statements

Revolt wants to invest in marketing as it is a young company. Being a young company demands for a higher priority for its brand awareness. Their 5-year business case is outlined in Figure 14, Revolt Business Case.

	Revolt Business Case - 5 jr. (capitalize instalment costs) Base case 31% conversion rate, increase of 1 charger per deal per year					
€ x 1.000	2022	2023	2024	2025	2026	2027
Laadpalen	199	750	2.533	5.368	9.460	11.176
Batterijen	3	3	9	24	36	36
Revenue	**281**	**1.732**	**8.700**	**24.320**	**51.457**	**75.774**
Cost of Sales	357	1.508	7.089	18.775	38.891	56.657
Gross Margin	**-76**	**223**	**1.611**	**5.545**	**12.566**	**19.117**
Gross Margin %	*-26,9%*	*12,9%*	*18,5%*	*22,8%*	*24,4%*	*25,2%*
Opex						
Direct Personnel costs	673	1.367	2.238	2.913	4.066	4.130
Indirect Personnel costs	162	445	582	807	1.126	1.263
Other costs	389	492	582	829	1.086	1.077
Total Opex	**1.225**	**2.304**	**3.402**	**4.549**	**6.279**	**6.470**
EBITDA	**-1.301**	**-2.081**	**-1.791**	**997**	**6.287**	**12.647**
Interest	48	178	278	338	245	-138
Depreciation	49	36	175	441	837	72
EBT	**-1.398**	**-2.295**	**-2.244**	**218**	**5.206**	**12.713**

Figure 14; Revolt Business Case - 5jr. Base case

However, unit economics provide a better perspective of the revenue per product. It is a method applied to analyse a company's cost to revenue ratio in relation to its basic unit, which can also be calculated for Revolt Energy. The service of DP with Revolt Energy will decrease the Charge rate (kWh) estimated by researchers up to 35%. (Vereniging van Dynamische Energieleveranciers (VvDE), 2023). From Figure 15 the unit economic for Revolt Energy with DP strategy state that an increase of the total margin by 25% can be reached. Additionally, it is estimated that a decrease of Energy costs by 30% can be achieved. 80% of its revenue comes from the margin on energy sales, which creates a potential in buying the energy directly and selling it via Revolt's network. The ICS contributes to this unit economic by stimulation on the increase of sales for Revolt Energy.

Unit economics						
	Office			Destination		
	One	Hub	Hub + One	One	Hub	Hub + One
Monthly fee per charger	€ 40,00	€ 15,00	€ 15,00	€ 15,00	€ -	-
Charge rate (kWh)	€ 0,25	€ 0,25	€ 0,25	€ 0,30	€ 0,30	€ 0,30
Reimbursement (kWh)	€ 0,14	€ 0,14	€ 0,14	€ 0,19	€ 0,19	€ 0,19
Fee	€ 2.600	€ 975	€ 975	€ 975	€ -	€ -
Energy	€ 9.245	€ 9.245	€ 18.491	€ 13.280	€ 13.280	€ 26.560
Advertising	€ -	€ 40.084	€ 40.084	€ -	€ 40.084	€ 40.084
Total revenue	**€ 11.845**	**€ 50.304**	**€ 59.550**	**€ 14.255**	**€ 53.364**	**€ 66.644**
Lease fee	€ 2.576	€ 24.470	€ 27.046	€ 2.576	€ 24.470	€ 27.046
Installation	€ 415	€ 1.500	€ 1.915	€ 415	€ 1.500	€ 1.915
Maintenance	€ 526	€ 5.097	€ 5.622	€ 526	€ 5.097	€ 5.622
Energy	€ 5.095	€ 5.095	€ 10.191	€ 8.186	€ 8.186	€ 16.373
Total Cost of Sales	**€ 8.612**	**€ 36.162**	**€ 44.774**	**€ 11.703**	**€ 39.253**	**€ 50.956**
Contribution Margin	€ 3.233	€ 14.143	€ 14.776	€ 2.551	€ 14.111	€ 15.687
%	*27%*	*28%*	*25%*	*18%*	*26%*	*24%*

Unit economics Revolt Energy						
	Office			Destination		
	One	Hub	Hub + One	One	Hub	Hub + One
Monthly fee per charger	€ 40,00	€ 15,00	€ 15,00	€ 15,00	€ -	-
Charge rate (kWh)	€ 0,18	€ 0,18	€ 0,18	€ 0,21	€ 0,21	€ 0,21
Reimbursement (kWh)	€ 0,21	€ 0,21	€ 0,21	€ 0,28	€ 0,28	€ 0,28
Fee	€ 2.600	€ 975	€ 975	€ 975	€ -	€ -
Energy	€ 9.245	€ 9.245	€ 18.491	€ 13.280	€ 13.280	€ 26.560
Advertising	€ -	€ 40.084	€ 40.084	€ -	€ 40.084	€ 40.084
Total revenue	**€ 11.845**	**€ 50.304**	**€ 59.550**	**€ 14.255**	**€ 53.364**	**€ 66.644**
Lease fee	€ 2.576	€ 24.470	€ 27.046	€ 2.576	€ 24.470	€ 27.046
Installation	€ 415	€ 1.500	€ 1.915	€ 415	€ 1.500	€ 1.915
Maintenance	€ 526	€ 5.097	€ 5.622	€ 526	€ 5.097	€ 5.622
Energy	€ 3.567	€ 3.567	€ 7.133	€ 5.730	€ 5.730	€ 11.461
Total Cost of Sales	**€ 7.084**	**€ 34.633**	**€ 41.717**	**€ 9.247**	**€ 36.797**	**€ 46.044**
Contribution Margin	€ 4.762	€ 15.671	€ 17.833	€ 5.007	€ 16.567	€ 20.599
%	*40%*	*31%*	*30%*	*35%*	*31%*	*31%*

Figure 15; Unit economics Revolt

2.5 Conclusion

It is evident that Revolt's affordable pricing, convenience, and scalability have so far resonated well with their clients. Which makes their end-to-end solution for businesses a significant factor in their success. As a result, it is crucial to consider these value propositions when developing an ICS. Besides, for Revolt to remain competitive, it should develop a mobile application as an accepted technology.

The behaviour of lease- and private EV-drivers differ. Private EV-drivers have a higher financial incentive, influencing their decision-making process.

Next to the drivers, with DP strategy the total margin of Revolt can increase by 25%. Additionally, it is estimated that a decrease of Energy costs by 30% with DP strategies.

3. EV-driver behaviour

3.1 Behaviour and concerns
3.2 Potential for Revolt Energy to influence charging behaviour
3.3 Conclusion chapter 3

Understanding the users' behaviour is crucial to address their conditions and needs for an ICS. User behaviour is influenced by numerous factors, and a comprehensive understanding of their charging behaviour has been summarised by the author through a literature review. Here, Section 3.1 examines the behaviour and conditions of the end-users. This section is divided into three subsections:

- 3.1.1 discusses the charging decision-making theory of Breukers et al. (2013) and Hajibabai et al. (2022).
- 3.1.2 aligns with the study of Chen et al. (2020) about the end-user's motivators.
- 3.1.3 shows studies of sociologists like Lutzenhiser (2002) and Wilhite (2000) for communicative conditions. Followed in Section 3.2 stretching the potential for Revolt Energy to influence charging behaviour. To compactify, section 3.3 stretches 16 statements learned in this chapter

3.1 Behaviour and concerns

3.1.1 Charging decision making

To analyse charging decision making, it is essential to get insight where EV-drivers charge mostly. From Figure 16 home charging is the primary source of charging load. From section 0.1 it is stated that The Netherlands wants to increase to 1.9 million electric cars on the road by 2030 and corporate are obliged to become more sustainable. Electric lease cars will become more popular. With the current digital era home charging will become more therefore popular. Where Figure 17 shows that during night-time hours most home charging occurs. Private AC charging (explained in section 0.6) will remain the dominant mode of charging (Todts and European Federation for Transport and Environment AISBL, 2020). They account for 90% of installed charging points, but only 60% of the charging capacity due to lower power levels. The charging at work will almost double over the next 10 years. Where Roland Berger (2020) states that public DC charging will increase, it will not take over public AC charging, nor charging at home or at work. EV sales currently keep outpacing EV infrastructure out roll (McKinsey, 2021).

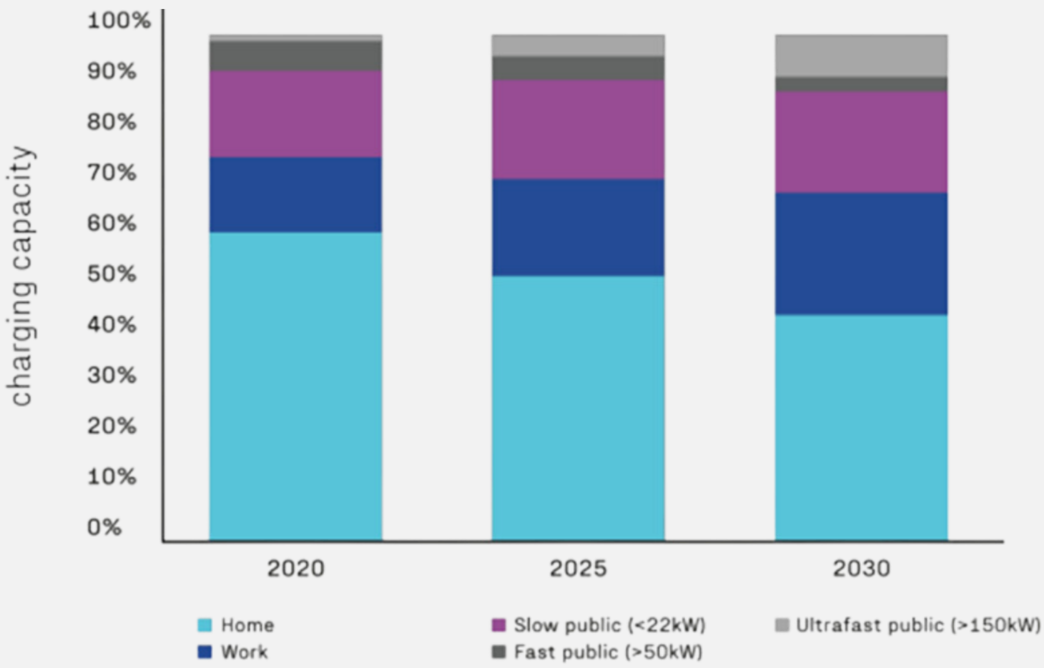


Figure 16; Charging capacity per charging mode 2020, 2025 and 2030 (Breukers et al. (2013))

Figure 17 gives the proportion of the number of vehicles in charging and charging locations over time. From this figure it can be stated that most end-users charge their cars during the weekdays between 07:00 to 13:00, which indicates charging at work. A second, but smaller, peak of energy consumption occurs between 15:00 to 18:00 when they have returned home. Smart technologies can reduce grid stress, costs for users and greenhouse gas emissions. Efforts should be made to stimulate charging even further at work to ease pressure on the grid (Breukers et al., 2013).

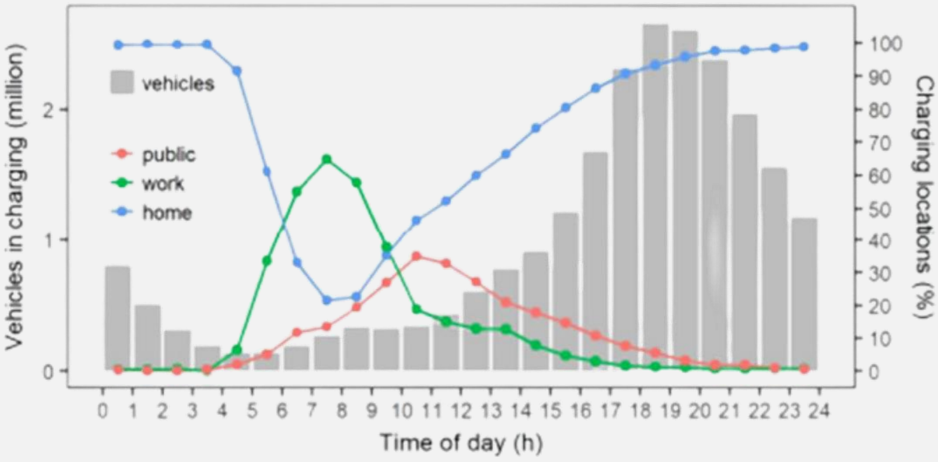


Figure 17; Number of vehicles in charging and the proportions by charging locations (Hu et al., 2017)

An interesting study on the game-theoretical strategy of Hajibabai et al. (2022), suggests that EV user charging behaviour depends on EVs' battery state-of-charge (SOC), travel plan and departure times. This user-adaptive charging schedule serves as a baseline of charging behaviour, reflecting the current EV charging situation for future analysis. However, charging behaviour is also dependent on the charger power, charger cost, distance to next charger, dwell time (time spent in the same position, area, stage of a process, etc.) and dwell location (Hu et al., 2012). EV-drivers want to minimise their total travel costs and charging expenses and overcharging penalties. This contributes to EV adaptation by lowering charge location search burden, visualised in Figure 18.

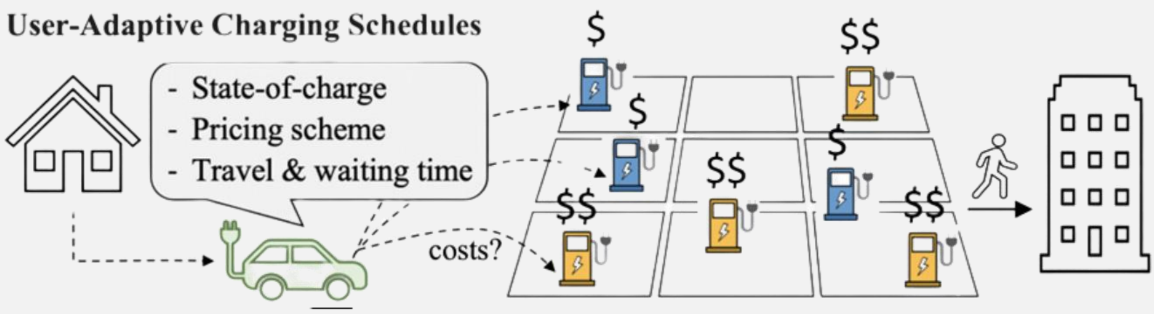


Figure 18; Game-theoretical strategy of Hajibabai et al. (2022)

Battery State-Of-Charge (SOC)

From the Game-theoretical strategy the EV-drivers' charging behaviour is partly dependent on the SOC. Hu et al. (2019) state that the behaviour of drivers in charging a battery EV (BEV) can be influenced by psychological factors such as personality and risk preference. EV-drivers tend to recharge at high battery SOC to avoid range anxiety. When the SOC drops below that comfort range, the drivers become anxious about using up electricity. This range anxiety phenomenon leads to unpleasant driving experiences according to Neubauer et al. (2012). They found in their behavioural science theory that drivers feel comfortable when the battery SOC is above 20%~25% and consider 32 kilometres (20 miles) as the comfortable range threshold. EV Project showed that most charging events started with a 20~80% SOC and the most frequent starting SOC levels are within 50~60%.

Pricing scheme

Investigating influence of pricing on EV-driver behaviour, most EV-drivers are currently subject to a fixed electricity price (Limmer, 2019). Fixed pricing means charging with a constant rate per kWh regardless of the time of day. However, it is found that in general users are extremely sensitive to the charging price (Jabeen et al., 2013). Next to sensitivity of prices, users consider charging speed also in their decision when charging (Yuan et al., 2016).
Non-fixed electricity prices you can save money on your electricity bill by charging your EV during off-peak hours compared to charging during peak hours (The Smart Electric Power Alliance, 2018). Another study also found that a fixed prices per billing cycle is often applied, regardless of energy usage (National Renewable Energy Laboratory (NREL) et al., 202 C.E.). Certain pricings may include peak demand charges based on the highest level of electricity demand during the billing period, while some utility companies now offer specialised pricings for EVs. These may take the form of time-of-use (TOU) pricings that apply solely to EV charging, with all other energy consumption charged at a flat rate according to the NREL.
While previous research on charging behaviour can provide some insights, it remains unclear how EV drivers would react to DP. Effects of pricing can change quickly depending on other factors. E.g. competition, government regulation and an economic crisis.

Travel and waiting times & flexibility

Based on data from public charging points in the Netherlands, Wolbertus and Gerzon (2018) investigate the impact of factors, like the start time, the day of the week or the parking pressure and the connection times on EVs charging time. From the observed factors, they identify that an EV-driver in the Netherlands travels around 50-80 kilometres per day. They found that start time is the factor with the highest influence on the charging time. From the explanation about AC and DC in Section 0.6 one may estimate that it takes around 30 minutes to 1 hour to charge an average EV for an additional range of 50-80 kilometres, when using a DC charger with capacity of 50kW. When using a normal charging point with a charging capacity of 7kW, charging an EV for the same distance can take about 4-8 hours, depending on the battery capacity of the EV. It is important to note that this is just a general estimate as it is dependent on specific circumstances of the type of EV and capacities of the charging point used. Hu et al. said in 2017 that at home morning charging is less common among EV-drivers, with workplace charging being the most prevalent. Peak demand for both the number of EVs charging and electricity usage occurs during the early evening, while public fast chargers account for the most significant share of power demand during the daytime.

Flexibility is necessary for making use of DP strategies. DP strategies make use of the flexibility of users to guide them towards a desired charging profile (Limmer, 2019). For example, users frequently have flexibility in the duration of their EV charging sessions. They do not always need to charge their vehicles as quickly as possible since they often park for extended periods. This presents an opportunity for intelligent charging management to shift the charging load to off-peak hours. However, it is necessary for users to communicate their charging flexibility (Limmer, 2019). The user selects to schedule the charging at a time interval when the prices are more beneficial (in case of price variation during the day). To ensure a fair comparison among users an efficiency score can be used: e = total cost / total electricity consumption. This score represents the main logic behind an EV owner who strives to minimise cost while covering her driving need: charging most of electricity when prices are low and refrain from charging when prices increase.

3.1.2 Motivational objectives

Understanding why an EV-driver would adapt to DP is a motivational objective. To accept the DP scheme, behavioural changes (both intentional and routine behaviours) are needed. Behavioural changes allow increased responsiveness to pricing signals and the potential flexibility to shift electricity load (Breukers et al., 2013). In line with this research, behavioural changes influence the willingness and satisfaction objective of the problem statement.

Chen et al. (2020) found that motivators of EV-drivers to make use of DP should have environmental, economical, and technical benefits as well as personal and demographic factors (socio-demographic factors). From Section 3.1.1 it is stated that people are not motivated by pricing incentives only. Environmental motives, "the desire to contribute", control, comfort, ease, and wellbeing are important motivators as well according to Breukers et al. (2013). Additionally, they state that feedback on energy consumption has been shown to significantly improve the response from users. Different user segments need different tailored interventions consisting of a specific combination of DP mechanism, technology, and feedback. The different motivational objectives are discussed below as the economical, environmental, technical benefits, personal feedback, and socio-demographic factors.

The Green Integrated Sustainability (GIS) framework illustrates in Table 2 how the work of Dao et al. (2011) has evaluated the effectiveness of sustainable strategies of companies based on their impact on the natural environment, society, and economic performance. This framework has direct relevance to an approach for facilitating a sustainable transition to EVs in the power grid. They have categorised the contribution of the approach in two rows: "Today" and "Tomorrow", where "Today" represents the present contribution of the approach to a sustainable grid and "Tomorrow" represents how the approach can support the transition to EVs and high renewable energy penetration in a sustainable manner. This framework is of relevance when creating information towards relevant stakeholders in an ICS and evaluative motivators according to Dao et al. (2011).

	Internal (EV owner)	**External** (grid)
Today	**- Strategy** - Maximize individual utility of EV charging **- Pay-off** - Lower charging costs - Preference satisfaction	**- Strategy** - Induce desirable EV charging profile **- Pay-off** - Stable and reliable grid operation - Peak and volatility reduction
Tomorrow	**- Strategy** - Optimized (smart) EV charging becomes broadly available **- Pay-off** - Public becomes more open to EV adoption - Sustainable e-mobility - Charging cost savings	**- Strategy** - Induce EV charging matching RES generation profiles **- Pay-off** - Stable and reliable grid operation - Sustainable EV charging - Smooth EV transition coupled with high RES penetration

Table 2; Green Integrated Sustainability Framework adapted from Dao et al. (2011)

Environmental benefits

The NREL (2020) showed that environmental benefits like reducing CO2, improved air quality, reduced dependence on fossil fuels, increased use of renewable energy and lower carbon footprint. Recalling that EVs have a lower carbon footprint compared to gasoline-powered cars, meaning that by using an EV and charging during off-peak hours the carbon footprint can be reduced even more. This can be seen as a motivator for EV-drivers as information stimulus to increase willingness of making use of DP at the charging point.

Economical benefits

Economical benefits can be lower electricity costs, reduced charging costs, reduced fossil fuel cost dependence.

Technical benefits

Technical benefits examples are comfort of usage, increased grid stability, increased access to charging. Investigation into comforting technology and communicative approaches is aligned in Chapter 5. It is to avoid the need for expensive upgrades and overloading to meet peak demand (Smart Electric Power Alliance, 2018).

Personal feedback

Examples of feedback on EV-drivers' energy consumption could yield information to draw conclusions about their charging behaviour, or to provide motivational incentives to influence their charging behaviour. Environmental aware users have a higher willingness to know the potential impact of the product on the environment after usage (Sah, 2016). A combination of the above-described motivators can be used as information input to provide personal feedback. Feedback system be continuously improved and updated. "If-then" statements are a powerful process for reprogramming behaviour by replacing existing associations with new ones. These statements can directly influence behavioural change can be used as information output alternative as example on an “if-then” statement: **If** EV-drivers charge their vehicles during off-peak hours, **then** they would make use of renewable energy sources.

By collecting data on how often they charge during off-peak hours, the total amount of renewable energy used over a given period can be provided as feedback. This feedback allows users to compare themselves to others (socio-demographic factor) and stimulate their charging behaviour.

Socio-demographic factors

Socio-demographic factors are for example, social processes, age, income, education, gender, choice of destination. These factors influence motivation of EV charging to shift in real-time according to Hajibabai et al. (2022). For example, the timeframe where weekends and seasons impact the shape of the distributions of charging demand. Seasonal changes usually shift the arrivals at first destination locations of charging points of EV-drivers to earlier times in summer and spring for all the clusters. This is due to the earlier sunrise and people’s preference to start their days earlier in summer and spring. Arrivals on weekdays are approximately 1 hour earlier than during 265 weekends in all seasons (Limmer, 2019).

Destination is also of influence where most studies make a differentiation in charge near work, charge near home or park to charge and investigate the impact on drivers’ flexibility.

If social norms are addressed, pro-social behaviour is likely to occur on a longer-term found by Limmer. This is necessary for the longer-term goal to facilitate the transition to a more sustainable energy system. Also found is that the higher their education, the more likely the end-users were active end-users concluded by Breukers et al. (2013).

3.1.3 EV-drivers’ communicative conditions

The communicative conditions for EV-drivers give insight into what has an impact on the charging behaviour. Based on literature six statements of EV-driver conditions are stated:

1. The most successful feedback and communication shows that changes result in an increase rather than a decrease in comfort and ease according to Kraan et al. (2016). Breukers et al. (2013) found that end-users have the idea that behavioural change negatively affects comfort and ease, they are less motivated to change their behaviours.

2. Sociologists like Lutzenhiser (2002) and Wilhite et al. (2000) stress that in everyday life, energy is 'invisible'. People do not consume it consciously; it is a side-effect of other activities. Moreover, a broader social or sociological context compounds the problems of promoting energy efficiency. Shove (2003) showed that much of our energy use is habitual. Many energy-use habits are further consolidated as social conventions, Thus, individual users – even if they are aware of the problems and potential solutions – may feel unable to individually be effective and can feel helpless, disempowered or not responsible for the collective problem. Hence, the social environment needs to be supportive to make the changed behaviour last which is in line with the theory of Kraan et al. (2016).

3. People need at least 3 months to get used to new routines during which (and preferably longer than that) reminders and prompts are crucial (Abrahamse et al., 2007).

4. Highlighted in the review by Breukers et al. (2013), the response of end-users to DP differs per end-user segment. To stimulate co-providing behaviour, business propositions thus must differentiate on more than price only.

5. Working with a feedback system is only effective if it concerns a very interactive systems that deliver information that is constantly renewed and updated (like with a computer or smartphone) and that is of increasing complexity (Breukers et al., 2013).

6. Privacy issues must be taken seriously into consideration. Personal data about the user e.g.: their locations, their driving habits and their charging behaviour can be collected and can potentially lead to a privacy breach. It is important to have clear policies and regulations in place for the collection, storage, and sharing of user data. Users should also be given the option to opt-out of data collection and have control over how their data is used.

3.2 Potential for Revolt Energy to influence charging behaviour

The service of Revolt Energy has the potential to positively influence the charging behaviour of EV-drivers through personalised feedback and communication that considers the motivations of these drivers and the socio-demographic factors that may affect their behaviour.

Regarding the motivations of EV-drivers, there are key factors that Revolt can address: environmental, economical, technical benefits and personal feedback. To appeal to these motivations, Revolt can, for example, provide feedback on the CO2 emissions saved by using their charging points, the cost savings compared to traditional fuels, and the technical benefits of using EVs.

In addition, Revolt can also consider the socio-demographic factors that may affect user charging behaviour. For example, age and education level can affect awareness of environmental issues and willingness to use sustainable energy sources. Social processes can also play a role, such as the influence of friends and family on adopting sustainable behaviour.

Revolt can take these socio-demographic factors into consideration when communicating with end-users and users. For example, by tailoring feedback and communication to users' specific needs and motivating factors, Revolt can encourage them to adopt sustainable behaviour and optimise their charging behaviour.

Finally, Revolt can also use technological solutions to improve and optimise charging behaviour. For example, by implementing smart charging technology that considers the availability of renewable energy sources and optimises the load on the energy network. An idea for this could be a geographical map in the mobile app where you can see which charging point is available depending on the range of your battery SOC, pricing, and flexibility of driver.

3.3 Conclusion chapter 3

To ensure that all found factors from the review in Chapter 2 and 3 are considered during development of an ICS, the following 16 statements guideline for the design of communicative roadmap and supportive technology. These are based on the convergent thinking method of the DDM, deriving the essential aspects from literature into compact bullet-points. The Table 3, Motivational objectives can also serve as information output alternatives for an ICS.

1. For Revolt to remain competitive, it should at least develop a mobile application for Revolt Energy.
2. The segmentation of clients, business EV-drivers and private EV-drivers offers first steps towards design and tailoring communication approaches to the behaviours, motivators and needs of the end-users.
3. Clients' need for choosing Revolt over their competitors are price, convenience, and scalability. Business EV-drivers have a lower price incentive than private EV-drivers. It is important to integrate these needs and perspectives into an end-to-end solution to provide significant success of the research. This success is to be ensured that the research is relevant, respectful, and responsive to their concerns.
4. Charging decision of an EV-driver is based on the SOC. Drivers feel comfortable when the battery SOC is above 20%~25%. EV-drivers typically initiate charging when their vehicle's state of charge (SOC) is between 40% and 50%, with an average SOC of 41%.
5. Start time is considered as the factor with the highest influence on the connection time with the charging point. Where currently, most end-users charge their cars during the weekdays between 07:00 to 13:00.
6. Flexibility is necessary for changing charging behaviour. Users must be able to communicate their charging times to manage charging schedules.
7. Information about the type of car is crucial to provide accurate information.
8. Charging decision of an EV-driver is in general sensitive to the charging price, however charging speed is also taken into consideration. Therefore, differentiation on more than pricing only should be considered in the communication approach.
9. Motivators of EV-drivers can be divided in motivational objectives: economical benefit, environmental benefit, technical benefit, and personal feedback.
10. "If-then" statements are a powerful process for reprogramming behaviour by replacing existing associations with new ones.
11. If social norms are addressed, pro-social behaviour is likely to occur on a longer-term. Hence, the social environment needs to be supportive to make the changed behaviour last.
12. Feedback systems should be developed as interactive systems that deliver information. The information should be constantly renewed and updated.
13. Users must be enabled to study their historical usage as well to see what the impact of their changed behaviour has been on consumption and price.
14. Reward programs on smart charging benefits to improve end-user engagement and loyalty.
15. The incentives must be tailored to or developed from the perspective of the end-users and their daily routines as socio-demographic factors influence motivation of an EV-driver.
16. Clear policies and regulations in place for the collection, storage, and sharing of user data. Users should also be given the option to opt-out of data collection and have control over how their data is used. Additionally, charging point operators should implement secure systems to protect user data from unauthorised access or theft.

Table 3; Motivational objectives

Motivational objectives	**Information output**
Economical benefit	pricing scheme (real-time EPEX spot-market pricings + their additional margin), kWh/euro (compared to price per litre benzine), saved euros, lower electricity costs, reduced charging costs (make comparison with competitors), reduced fossil fuel cost dependence (comparison with diesel prices)
Environmental benefit	CO2 emission reduction, total off-peak charged kWh, CO2 emission compensation, improved air quality, reduced dependence on fossil fuels, increased use of renewable energy
Technical benefit	Battery SOC, km possible with current battery, increased availability of charging point, kWh charged, charged extra km, slim loading option with start time and end time charging, increased grid stability,
Personal feedback	Graphical insight energy usage, energy usage (normal vs now), total saved euros dashboard (in comparison with old contracts or competitors). % less energy usage per month. If-then pro-social behaviour statements.

4. Purchase Decision Process

Chapter 4 dives deeper into the topic of decision-making strategy for electric vehicles, building on the concepts introduced in Chapter 3. This Chapter enables the influence of ICS on the theory of Kotler and Armstrong (2008) about the end-users purchase decision process. Section 4.1 outlines the theory of Kotler and Armstrong (2008). Section 4.2 investigates how this process influences charging behaviour. Section 4.3 discusses the potential for Revolt in this process and Section 4.4 stretches the conclusion.

4.1 How does an end-user make a purchase decision?

As the segmentation is made between client, business EV-driver and private EV-driver they all follow a different purchase decision process. Where the client is pushed on the purchase of Revolt Energy the EV-drivers are pushed on whether to charge at a certain price at a certain location.

According to the existing literature of Liang and Lai (2002); Darley et al., (2010), users follow five steps in making purchase decisions: problem identification, information search, evaluation of alternatives, purchase, and post-purchase behaviour. The process begins with the recognition of a need, which can be triggered by either an internal or external stimulus according to Kotler and Armstrong (2008). Users then search for information from both internal and external sources, including the internet. The amount and frequency of information obtained can affect their decision-making process. Users compare and assess options based on product characteristics and needs, with more complex decisions requiring a consideration of which alternative list satisfy their needs according to Kotler and Armstrong (2008). Finally, they make their purchase decision, which can be influenced by various factors, such as personal values, brand loyalty, and social influence (socio-demographic factors). Post-purchase behaviour includes product usage, satisfaction, and feedback, which can have an impact on future purchase decisions and brand loyalty. Visualised in Figure 19.

Figure 179; Buyer decision process (Kotler and Armstrong, 2008)

Need recognition

The first stage in the user decision-making process is the recognition of a problem or need, which arises from the perception of a difference between the desired and actual state of an individual.

The type of problem recognized by the user determines the focus of the strategy. If the problem is active, which refers to a situation where the user has recognized a problem or need and is actively searching for a solution, the strategy should convince the user that a particular product is the best solution. In the case of an inactive problem, which refers to a situation where the user is not currently aware of a problem or need that requires a purchase decision, the strategy aims to help the user recognize the problem and then offer a solution. (Darley et al., 2010)

In case of the service of Revolt Energy's dynamic pricing, the active problem is that the end-user cannot charge their vehicles as desired, as capacity overloads and the load is balanced over all vehicles which impacts the speed of charging. However, from the problem statement in the research methodology it can be stated that the end-user has insufficient information and technological support to interact, which makes the problem inactive.

Information search

The second stage in the user decision-making process is information search, which is a learning process influenced by the user's previous knowledge and experience with the product (internal search) and information gathered from external sources (external search). Which information the end-user needs to influence their behaviour is discussed in Chapter 3. The ease of obtaining information and the importance of the purchase also influence the user's information search.

Evaluation of alternatives
The evaluation of alternatives is the next stage and depends on the type of user choice. Affective choice involves focusing on how a product makes the user feel, while attitude-based choice involves general attitudes and impressions or heuristics.

Purchase decision
The third type of user choice is distinct and involves a comparison of specific attributes across all brands being considered, prioritising practical aspects such as product characteristics and price, and is primarily influenced by learning and motivation according to Mensah and Amenvor (2021). The decision-making stage is manifested in the user's actual behaviour.

Post-purchase behaviour
The user decision-making process is concluded with post-purchase evaluation, during which the user compares the product's actual performance to their expectations. According to Schiffman and Kanuk (2010), an essential element of post-purchase evaluation is reducing any uncertainty the user may have had about their choice. This evaluation generates feedback, which increases the user's experience level and is integrated further into the learning process, influencing future related decisions.

4.2 How to influence charging behaviour?

There is no universal approach to influencing charging behaviour, and targeting individual behaviour is necessary as load shifting and reduction depend on the end-user's lifestyle (Breukers et al, 2013). Therefore, this section explores on how charging behaviour can be influenced by the stated charging behaviour lessons from Chapter 3. The approaches are based on the segment and the motivational objectives.

Economical benefit

Limmer (2019) suggests that implementing time-varying pricing policies for electric vehicle users can unlock flexibility and influence charging behaviour.

The pricing policy is to set two to four levels of prices to avoid an overly complex structure that is not accepted by the end-user. End-users cannot be expected to change their behavioural patterns too often. If the distribution of price levels over the day changes too often, there is an increased risk of frustrating end-users that just learned to adapt their consumption to one pricing structure and must reconsider the management of energy-related practices according to Dütschke & Paetz (2013). Thus, timely announcement of events (e.g., day-ahead) increases participants' responsiveness. However, outlined in chapter 5 one might discuss finding convenient and faster channels to reach the clients.

An automated energy system can support users in translating price signals into actions, enabling more complex pricing arrangements with higher update frequencies. Additionally, bonus (rewards) and malus (penalties) events based on the availability of renewable energy in the local grid can lead to a decrease of up to 20% in electricity usage during malus events and an increase of up to 30% during bonus events. An example of a bonus event could be lower electricity rates during 'greener' periods of time. If the price of electricity was raised by 100%, the end-users reacted with a decrease of consumption by 10.6% on average (Agsten, 2012).

Real-time pricing can calculate the price elasticity of consumption, with a significant price elasticity of −0.106 on average - i.e., if the price of electricity was raised by 100%, the end-users reacted with a decrease of consumption by 10.6% on average. However, it is important to note that the price incentives did not reflect the current available price spreads within given energy markets and regulatory frameworks by Bellard et al. (2012). To engage users in a demand response program and give them control over appliances, the pricing scheme must be understandable. The timely announcement of events, such as day-ahead, can increase participants' responsiveness (Dütschke & Paetz, 2013). Time of use theory suggests using two to four levels of prices, including peak, partial peak, off-peak, and weekend pricing, with prices varying according to the socio-demographic factor of season created by Stromback et al. (2011). Time of use interventions targeting habitual behaviours can also be effective (Breukers et al., 2013).

In conclusion, automation coupled with a learning process is crucial for success.

Environmental benefit

Personal feedback and historical insight of information is most suitable for unlocking the potential of EV-drivers' contribution to a cleaner environment. Behaviour is based on the willingness to adapt to the environment objective (Breukers et al., 2013). By building awareness in the environmental benefits for individual it possibly stimulates charging decisions. In combination with possible other benefits promotions (economical benefit) on eco-friendly choices could stimulate desired charging behaviour. For example, energy providers in the Netherlands offer in their loyalty program to plant each year a tree for each customer they have. It could also be done the other way around, giving strikes for not making eco-friendly choices. For example, that plastic bags nowadays cost extra.

Technical benefit

Technically, an adequate infrastructure for monitoring and metering, for data storage and processing and for the communication between stakeholders, charging providers and distribution system operators, is required. Cloud-based EV charging management systems can represent a scalable solution (Mierau et al., 2013). Data privacy is increasingly important, and techniques such as secure multi-party computation can help protect the data of EV-drivers. Another area of current research is the use of blockchain technology for EV charging billing. Additionally, adequate user interfaces are crucial for user acceptance (Geelen and Keyson, 2012). Which should stimulate comfort and ease of use and thus this research's objectives.

Personal feedback

Personal feedback could be implemented in an individual's daily routine acting on the motivational objectives. Personal feedback can be given in two forms: (1) Insight into historical data and (2) direct stimulus via notifications. The frequency of providing feedback for historical data can be done in the timeframe hour, week, month, or year. Research suggests that the direct stimuli should be given several times a day to encourage shifting charging behaviour. The direct stimulus should be personalised and is dependent on the decision-making metrics of variables from Chapter 3: battery SOC, driver's schedule (flexibility) and cost of electricity during different time slots. For example, during the summer and spring seasons people prefer to start their days early, due to the earlier sunrise.

Further Breukers et al. (2013) state that to change routine behaviours, a minimum of 3 months is necessary to have the potential to make the 'new' behaviour lasting. The longer the intervention, the better the chances that new behaviour lasts 3 months and needs a new stimulus again to last longer. Which is tricky as it also might feel for the end-user as a big brother effect and can cause negative behaviour. Therefore, the feedback must be direct, without time-delay and positive. Direct feedback allows people to walk around in the house and experience how turning devices on or off as well as other behavioural changes affect energy usage. This helps to make energy visible and to set priorities about behaviours that can be changed and how that will affect energy usage.

Socio-demographic factors

Recalling from Chapter 3, socio-demographic factors such as weekends and seasons have been shown to impact the shape of distributions. From the personal feedback, earlier sunrises can tend to impact for tailoring the timing of direct stimuli.

As highlighted in lesson 11 of Chapter 3, prosocial behaviour is more likely to occur in the long term when the social environment is supportive. To influence others, users require a simple and user-friendly dashboard that provides accurate information on cost benefits, personal contribution towards a CO2-neutral future, and sustainability levels. This way, loyal users can display their impact and encourage others to make the switch as well. Other ways to stimulate social interest need to be considered, e.g., comparison with other end-users. In the Energy@Home project from Bellifemine (2011) for example, the end-users' interest curve in the project started to go down some months after the start of the project. To stimulate the interest of the participants, a personalised newsletter (containing a graph comparing the end-user's weekly consumption with the weekly average) was introduced. This was successful in regaining the end-user's interest, as it resulted in a further decrease in end-users' consumption.

4.3 Potential of Revolt to influence charging behaviour within purchase decision process

In line with an acknowledgment of multiple motivations (motivational objectives) and diverse (options for) behaviours of chapter 3 and to react to the different phases of the end-user purchase decision process, timing of interventions is crucial. DP intervention of an ICS can focus on facilitating one or more of the following end-user tasks created by Foster and Mazur-Stommen (2012):

- Becoming aware and learning about one's energy consumption.
- Gaining or maintaining control over one's energy consumption.
- Saving costs.
- Being reassured those previous actions or investments have worked.
- Getting support in motivating other end-users to reduce energy consumption.
- Accomplishing other benefits like increased comfort, indoor climate, health impacts, social aspects

Per task a different end-user needs must be satisfied. The six tasks are implemented in the PDP for designing an ICS:

Need recognition

During the need recognition phase an ICS should help to recognize the problem and offer a suitable solution. It should address the specific problem and needs of the end-user. Revolt's task is to let the end-user become more aware and learn about one's energy consumption. It could involve modifying product characteristics, pricing policies, distribution channels, and marketing communications.

For the product characteristics it is essential to design a pricing scheme that is easy to understand and not overloaded with information to the user to engage automation coupled with a learning process, which is crucial for success. Stimulating the comfort and ease of use of the service should be addressed. A simple and user-friendly dashboard with accurate information on the willingness objective will stimulate. To simplify the pricing scheme, the day can be divided into a limited number of time blocks of prices. Engagement can happen through a change in energy-related practices offering adequate information or mature enabling technology (e.g., in-car displays or automated devices) if the price structure is more dynamic.

For the communication channels, it should be implemented in an individual's daily routine acting on the motivational objectives. About the potential of offering automated devices (e.g., as part of a new dynamic pricing 'package') to 'activate' end-users, there is some positive evidence available. Since automated solutions are intended to be integrated in energy practices, this interaction should fit the needs, wishes and capabilities of the end-users. With an electric car, the end-user can specify when the car should be recharged, but he/she is not interested when—within the time specified—the charging occurs. Unlocking the potential of the drivers' contribution. In addition, people may change their willingness and satisfaction—changing from an initially hesitant attitude to a more enthusiastic one or changing from enthusiasm to weariness with a particular technology.

Information search

During the information search phase, an ICS should provide accurate supporting information for end-users to make the best decision and choose the service of Revolt Energy for charging their cars according to the desired profile. In this phase it should focus on facilitating and gaining maintenance control over end-user's energy consumption and saving costs.

Evaluation of alternatives

During the evaluation of alternatives phase an ICS can influence behaviour by highlighting the positive feelings resulting from using the product and contributing to attitude formation through appropriate marketing communications tools, like the accepted technology to increase satisfaction of the end-user. For example, to stimulate the interest of the participants, a personalised newsletter (containing a graph comparing the end-user's weekly consumption with the weekly average) can be introduced. The end-user should be reassured that previous actions or investments have worked.

Purchase decision

During this phase, an ICS should consider all attributes possible from competitors, as highlighted in Chapter 2, and show based on the willingness the compatibility of each objective. It then gets support in motivating other end-users to reduce energy consumption.

Post-purchase decision

During the post-purchase decision phase, the end-user must be reassured that previous actions or investments in services of Revolt Energy have been satisfactory. Therefore, an ICS should include a post-purchase in-check moment for evaluation and feedback to create a higher satisfaction of the user and influence the learning process of Revolt.

4.4 Conclusion Chapter 4

The timing of interventions is crucial to react to the different phases of the end-user's PDP. In designing an ICS for each phase, the end-users' specific needs and tasks must be addressed. For the need recognition phase, the communication strategy should help end-users recognize the problem and offer a suitable solution. To engage automation coupled with a learning process, a pricing scheme should be designed that is easy to understand and not overloaded with information. A simple and user-friendly dashboard with accurate information on the willingness objective will stimulate engagement. During the information search phase, the communication strategy should provide accurate supporting information for end-users to make the best decision and choose the service according to their desired profile. In the evaluation of alternatives phase, an ICS can influence behaviour by highlighting the positive feelings resulting from using the product and contributing to attitude formation through appropriate marketing communications tools. During the purchase decision phase, the communication strategy should consider all attributes possible from competitors and show based on the willingness and the compatibility of each objective. In the post-purchase decision phase, the end-user should be reassured that previous actions or investments have worked.

Different tasks in each phase should be considered for designing an ICS in the PDP. For example, to simplify the pricing scheme, the day can be divided into a limited number of time blocks of prices. Two to four levels of prices should be set in the pricing policy to avoid an overly complex structure that is not accepted by the end-user according to Dütschke & Paetz (2013). Implementation of 'bonus' events and 'malus' events can decrease up to 20% in electricity usage during malus events and increase up to 30% during bonus events. An adequate infrastructure for monitoring and metering, data storage and processing, and communication between stakeholders is essential. Data privacy is increasingly important, and secure multi-party computation can help protect EV-drivers' data.

Marketing communication mix is also important for keeping end-users engaged and actively participating in the project in the long term. Personal feedback via direct stimulus and historical insight of information can unlock end-users' contribution. Notification of price changes in advance leads to better responsiveness, and direct stimuli should be given several times a day to encourage shifting charging behaviour. The direct stimulus should be personalised and dependent on the decision-making metrics of variables: battery SOC, driver's schedule, and cost of electricity during different time slots. In addition, a personalised newsletter can be introduced to stimulate the interest of the participants. This mix is discussed in Chapter 5.

5. Technology Acceptance Model

5.1 What does a customer need to accept technology?
5.2 How can different communication channels with supporting technology influence charging behaviour?
5.3 How communication channels and supporting technology influence purchase decision process.
5.4 How to tailor communication approached to inform segments and influence charging behaviour within purchase decision process

Chapter 5 focuses on the metric of how information outputs should be delivered to end-users. Stating the marketing components and supporting technology tools which can stimulate interaction with DP schemes from the theory of Chapter 4. Section 5.1 discusses the technology acceptance model (TAM) from Fred Davis (1989). Section 5.2 stretches how these communication channels and supporting technological tools can influence the charging behaviour of end-users. Section 5.3 focuses on the communication channels for an ICS which can be implemented per phase of the PDP. Section 5.4 shows approaches tailored to the segmentations of: clients, private EV-drivers, and lease EV-drivers. Section 5.5 draws a conclusion on what to consider when tailoring the integral communication strategy from this chapter.

5.1 What does an end-user need to accept technology?

Technological improvements can significantly influence electricity consumption and reduce up to 50% given the use of best available technologies (Ellis and Jollands, 2009) & (Eichhammer et al., 2009). Technology should fit end-user needs, wishes and abilities. Found that 20% reduction in household carbon emissions could be achieved by behavioural changes (Dietz et al., 2009), technology and behaviour must complement each other. End-users would nevertheless have to understand and be able to act in line with how the technology functions and adjust it to match their needs and daily routines. To act on the ability of the end-user it must provide an easy interface, give personal feedback, and must communicate on flexibility of the end-user (Breukers et al, 2013).

A commonly used model to evaluate technology acceptance from end-users is the Technology Acceptance Model (TAM), given in Figure 20. The TAM is a widely used theoretical framework for understanding users' acceptance and adoption of innovative technologies. The model was first proposed by Fred Davis in 1989 and has been extended and refined by several researchers since then.
The TAM proposes that a user's intention to use a technology is primarily determined by two key factors: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness refers to the degree to which a user believes that a technology will improve their performance or productivity. Perceived ease of use refers to the degree to which a user believes that a technology is easy to use and understand.

According to the TAM, these two factors are affected by four other variables:

1. *External variables*: External variables refer to factors outside the control of the user, such as social norms, job requirements and technical support. These variables can influence the user's perception of usefulness and ease of use.
2. *Perceived ease of use*: The perceived ease of use of a technology is affected by factors such as the user's prior experience with similar technologies, the complexity of the technology, and the availability of training and support.
3. *Perceived usefulness*: The perceived usefulness of a technology is affected by factors such as the user's expectations of the technology, the perceived compatibility of the technology with the user's needs and the perceived relative advantage of the technology over other alternatives.
4. *Behavioural intention*: The user's intention to use a technology is affected by their perceived usefulness and perceived ease of use of the technology.

The TAM suggests that a user's perception of a technology's usefulness and ease of use are the primary determinants of their intention to use the technology.
However other factors, such as external variables and prior experience, can also influence these perceptions. E.g. social influence, fast communication, or perhaps hands-free options, which are included in the Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al., 2003. Due to higher similarity in variables and construction with the previous described models, the TAM is chosen to be more suitable for this research. By understanding these factors, designers and developers can better design and market innovative technologies to increase user acceptance and adoption.
The experiences of the 'early adopters' of automated devices in combination with dynamic pricing turn out to be positive, these experiences can be used as a 'lever'—by word-of-mouth or other normative social influences—to enrol other households in demand response programs like dynamic pricing for charging points (Kraan et al., 2016).

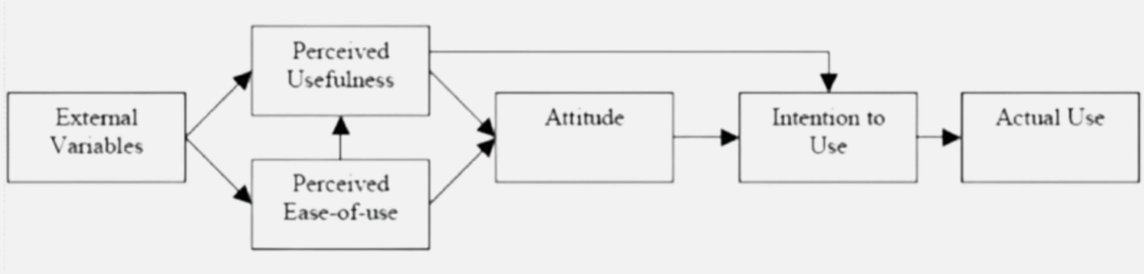


Figure 18; Technology Acceptance Model (Davis, 1989)

5.2 How can different communication channels with accepted technology influence charging behaviour?

This section focuses on outlining the different communication channels on the market. As an ICS component is the communication used, the different channels are outlined in section 5.2.1. Section 5.2.1 discussed the capabilities of supporting technologies for communication per motivational objective, to stimulate charging behaviour.

5.2.1 Which communication channels are on the market to influence charging behaviour?

Communication, one of the most representative of human activities and the basis for social interaction. It is defined as the exchange of ideas, information, and feelings. Communication effectiveness is determined both by understanding the message and getting the desired reaction from the part of the receiver. There are various communication approaches that can be used to influence behaviour found in literature. The effectiveness of these communication approaches in influencing behaviour depends on several factors, such as the target audience, the behaviour to be changed, the context, and the message content. In general, communication approaches that are tailored to the needs and preferences of the audience, provide relevant and credible information, and offer clear and actionable advice are more likely to be effective in influencing behaviour (Blythe, 2006).

From the review of Mensah and Amenuvor (2021) there are four types of communication channels:

Face-to-face communication

Face-to-face communication involves direct interaction between two or more people. It is often used in personal settings, such as during consultations with healthcare professionals, counselling sessions, educating or in sales situations with the support of a visual presentation. Face-to-face communication can be effective in building trust, providing personalised information and feedback, and motivating behaviour change by taking the problem questions of the targeted group away. This can be leveraged towards the research goal of stimulating a more desired charging behaviour.

Digital communication

Digital communication includes a range of technologies that enable communication over digital channels, such as email, social media, mobile apps, web page and text messaging. Digital communication can be used to provide timely and targeted information, reminders, and incentives, and can reach large audiences at low cost to influence charging behaviour. However, it may be less effective in building personal relationships and providing tailored advice.

Audio-visual media

Audio-visual media includes presentation slides, displays, videos, podcasts, and webinars. Audio-visual media can be used to provide engaging and interactive content, which can be customised to specific audiences. They can also be used to provide demonstrations, simulations, and virtual reality experiences to influence charging behaviour. However, is has limited reach.

Printed materials

Printed materials include flyers, posters, brochures, and other print media. Printed materials can be used to disseminate information to large groups of people and can be designed to be visually engaging and easy to read for influencing charging behaviour. However, they may be less effective in engaging audiences compared to, the above stated interactive communication methods. Printed materials are easier to implement permanently in end-users' personal daily routines.

5.2.2 What are technology capabilities to influence charging behaviour?

In literature assumptions are made regarding technological implementations for changing end-user behaviour via interaction about energy consumption and DP - these are discussed in this section.

From earlier statements this research assumed that technology must be implemented in the daily routine of an individual, have an ease of use, and can send notifications. At minimum, a mobile application should be developed to be competitive in the market of DP (lesson 1).

A wide range of supportive and feedback technologies currently exists for shifting energy profiles. For example, in household energy consumption, smart metres and in-house-displays are considered essential technical devices. These technologies provide feedback in various forms and have been proven to improve user response significantly (Stromback et al., 2011). More advanced technology like the smart metres support behaviour changes in response to pricing. The smart metres produce larger peak reductions and display more price-responsiveness, making them useful in demand charges applications. However, further research and piloting are needed to validate their effectiveness (Faruqui and Sergici, 2010). Other useful technologies for households include ambient displays such as energy orbs, smart apps, websites, email services, as well as simple devices such as paper mailings, fridge magnets, calendars, or stickers (see Faraqui and Sergici, 2010).

To make DP effective for end-users, technology combined with user education and engagement is crucial, especially when using complicated automated devices. Stromback et al. (2011) found that end-user education led to an average 4% rise in overall consumption and 6% peak reduction.

Technology must be a combination of scheduling, notifications, information insight, and feedback. Direct simple feedback where households can respond directly is particularly effective when showing possible unfamiliar displays. A simpler interface with a restricted set of options enables users to make faster and better decisions compared to a complex interface with more options (Stein et al., 2017). However, it is suggested that interfaces prioritize displaying the benefits to the end-user, rather than solely focusing on energy consumption and production feedback. This approach will equip users to make informed trade-offs and interact more effectively with smart energy systems. It is also worth noting that the interface's ambience can influence the user's acceptance of the feedback. Furthermore, it is recommended to provide background information, patterns, and feedback changes through a website or the invoice (Geelen and Keyson, 2012). For instance, in the case of the ICS, displaying information near the desired activity could potentially increase the number of people taking advantage of the EV-driver willingness incentives.

Besides, auction-based mechanisms (Mechanisms to manage the charging tariffs of electric vehicles that involve competitive bidding) allow higher flexibility towards users to charge their EVs over a longer period comparing to non-auction-based mechanisms (Mechanisms to manage the charging tariffs that don't involve competitive bidding). Recalling Chapter 4, users' flexibility is needed to stimulate charging behaviour with DP approaches. Recalling chapter 5.1, incentives should be tailored to the preferences and daily routines of end-users, research on end-user segmentation and preferences regarding smart grid technologies is needed (Breukers et al., 2013) & (Kraan et al., 2016).

5.3 How communication channels and accepted technology influence purchase decision process?

This section discusses which communicative approach works best when, and which accepted technology is most fitting.

Application of DP is a demand response program, as users respond to the various prices based on energy demand. It is said that end-user engagement in demand response programs is a continuous change process that involves stimulating users towards more conscious decision-making. In the activation phase, user interaction is targeted towards achieving active participation and explicit consideration of old and new practices. As new practices are adopted, behaviour becomes habitual again, and in the continuation phase, user interaction is aimed at supporting and reinforcing the new energy practices (Breukers et al., 2013).

Section 5.2.1 suggests that face-to-face communication approach should be used early in the PDP to build trust and provide personal feedback for motivational changes. Digital communication can provide timely and targeted information. Providing real-time information and recommendations is most crucial in the post-purchase phase of the PDP, where audio-visual media can support this information. Printed materials are easier to implement permanently in end-users' personal daily routines and help in the post-purchase phase.

From section 5.2.2, technology can be a useful tool for educating users about DP and influencing their charging decisions. By using the available technology like a mobile application, websites, and YouTube, users can be educated and made aware of their motivational objectives, which can help influence their purchasing decisions.

End-user engagement can be effective if the communication is in line with the phases of the purchase decision process (PDP) of chapter 4 and tailored towards their end-user segment. Outlined in section 5.4.

5.4 Potential of Revolt to tailor a communication approach to influence charging behaviour within purchase decision process

This section integrates the literature review of Chapter 3, 4 and 5. Firstly. it discusses how communicative approaches affect potentially the purchase decision process (PDP). In the subsections the communicative approach per segment (client, business EV-driver and private EV-driver) ware discussed. The focus of clients in the PDP is on purchasing services of Revolt Energy, whilst lease- and private EV-driver the focus is on the implementation of services of Revolt Energy.

In Chapter 2 it was said that clients desire a charging solution that is hassle-free, provided by a dependable and initiative-taking partner. A high standard delivered service of Revolt Energy is in the PDP essential for the clients. This service should be based on an innovative and user-friendly design.

For business- and private EV-drivers the PDP regards to whether to interact with DP at the charging point. It is based on their adaptive charging decision-making, which considers battery SOC, pricing scheme, and flexibility of the driver - see Chapter 4. The awareness to motivational objectives makes the impact of the communication approach in the PDP stronger. Furthermore, business EV-drivers have lower financial incentives and are reliant on their company's decisions and offerings with regards to their vehicles. Private EV-drivers have only access to Revolt's charging points on destination sites. This all makes that an effective communication approach towards business- and private EV-drivers will differ from clients.

Problem recognition

During the problem identification face-to-face communication can be used to build personal relationships and provide tailored advice towards end-users' problems. Printed materials are most used in the problem identification phase for marketing. Audio-visual media like presentation slides can be used to support the problem identification and offer a solution to the end-user. Audio-visual media can be universally designed and used over longer period to support visualisation of the problem recognition information. However, in this phase this does not have significant additional value.

For clients' a face-to-face communication is the most important in this phase. It is to build a personal relationship and provide personal advice. This can be enhanced by utilisation of supporting digital communication, audio-visual media, and printed materials. These channels offer suitable solutions to the client's identified problems. Incorporation of external variables such as socio-demographic factors affect the acceptance of technology, which should be considered to enhance on during this phase towards clients.

The request of business- and private EV-drivers is similar: whether to charge or not at a specific location, at a specific time for a specific price. The business EV-driver is dependent on the company's decision, any problem should be recognized in the strategy to offer the solution. As Revolt has access to locations with a visual media screen (HUB), here an extra communication channel can be deployed to reach the EV-driver on catching attention to charge at Revolt's charging point with the DP. The media screen can show motivational objectives to the user, identifying the problem and providing a solution that aims to support and reinforce new energy practices. External variables, such as socio-demographic factors, influence the willingness of EV-drivers in their charging decisions and should be incorporated in communication channel in this phase.

Information search
During the information search digital communication can provide timely and targeted information to stimulate the learning process on internal and external search. Audio-visual media like displays, videos, podcasts, and webinars are useful to stimulate motivational objectives of end-users – see Chapter 3. Like videos on YouTube can provide more in-depth explanations of the technology and its benefits, also helping users already to evaluate alternatives and make informed decisions about their purchase decision and influence their charging behaviour. The supply of information via digital communication should always be permanently to serve end-users at any time. To all segments prior experience with similar technologies, the complexity of the technology, and the availability of training and support should be acted on with digital communication (web pages and social media), audio-visual media and printed materials as state in Chapter 5.3.

For clients, this phase should focus the client's desire for a carefree solution, sufficient, easy-to-use, sleek interfaces meeting their objectives.

For the business EV-driver face-to-face communication might be effective for a training, as the business EV-driver has little to no prior knowledge and is pushed by their company to interact with the services of Revolt. Another possibility is to provide permanent access to audio-visuals, printed material, and web pages to increase the perceived ease of use and usefulness and stimulating desired charging behaviour. Personal feedback can also be provided via the accepted technology of a mobile application.

For the private EV-driver face-to-face communication might be too expensive. Like videos on YouTube can equally provide in-depth explanations of the technology and its benefits. Helping to evaluate alternatives and make informed decisions about their purchase decision and influence their charging behaviour.

Evaluation of alternatives
During the evaluation of alternatives, web paged comparisons and videos can help evaluate alternatives based on their information search. Comparing specific attributes across all brands, prioritising characteristics, and price, influenced by learning and motivation. The evaluation of service and technology acceptance is inevitable.

For clients Revolt should highlight their reliability as a partner and emphasise the positive feelings resulting from using their services. Digital communication or printed materials should reassure clients that previous actions have worked, encouraging participation.

For business- and private EV-drivers all attributes possible (location, price, availability, etc.) from competitors should be considered. The competitiveness of motivational objectives must be highlighted towards EV-drivers. Information via a mobile application gives the opportunity to intervene during travel times of the driver.

For private EV-drivers web paged comparisons and videos can help evaluate alternatives based on their information search. Comparing specific attributes across all brands, prioritising characteristics, and price, influenced by learning and motivation. Where the evaluation of service and technology acceptance is inevitable.

Purchase decision
Based on the perceived usefulness and perceived ease-of-use influence end-users make a purchase decision. The purchase decision is a cumulative of all influencing variables on the decision-making process and end-user's intention to use technology.

For clients Revolt should consider all attributes from competitors and highlight the competitiveness of their motivational objectives, as well as provide interfaces that provide insight into these objectives via at least a mobile application. The client's attitude towards the technology, as determined by their perceived usefulness (PU) and perceived ease of use (PEOU), is crucial in determining their willingness to purchase. Web page comparisons and videos can aid in evaluating alternatives based on the client's information search. Comparing specific attributes across all brands, prioritising characteristics, and price, influenced by learning and motivation, can help with the decision-making process.

For business- and private EV-drivers during the purchase decision the PU and PEOU should be acted on with technology. The purchase decision is a cumulation of all influencing variables on the decision-making process and end-user's intention to use technology. The mobile application should provide easy interfaces with information on the motivational objectives in their daily routines. The price incentive and providing personal feedback should be prioritized.

Post purchase decision
The use of a mix of communication should be engaged on to provide real-time information.

For clients, the ease of use is of high importance, and the care should be taken away from the client. A mobile application or back-office web page with easy interfaces and sufficient information should provide insight into historical data and direct stimuli via notifications. Digital communication can be used to let clients socially engage their end-users to increase actual use of services. Engagement towards the innovation process is inevitable for customization.

Business- and private EV-drivers should be reassured that interaction with Revolt Energy has worked according to their motivational objectives. EV-drivers may be more likely to delay charging their devices until prices are lower if communication or accepted technology provides real-time pricing information. As stated in Chapter 3 this information should at least be provided several times per day by a direct stimuli as personal feedback. Additionally, printed materials give the opportunity to implement in end-users' personal daily routines. For example, a glass-sticker in the car or a print for on car-key chains to communicate where the end-user can find information and increase ease of use. Next to that, providing evaluation on their charging and behaviour feedback can create higher satisfaction and stimulate the learning process based on the motivational objectives.

5.5 Conclusion Chapter 5

The needs, wishes and abilities of end-users should guide the development of technology. According to the Technology Acceptance Model (TAM), a user's intention to use a technology is determined by perceived usefulness (PU) and perceived ease of use (PEOU). PU refers to the extent to which a user believes that a technology will enhance their performance, while PEOU refers to the degree to which a user believes that a technology is easy to use and understand. In addition to incorporating technology into users' daily routines, auction-based mechanisms and intelligent charging controls can help shift energy usage to off-peak hours.

Incentives should be tailored to end-users' preferences and daily routines. Effective communication channels are face-to-face, digital, audio-visual, and printed materials. Face-to-face communication is best for building personal relationships and providing tailored advice. Printed materials are commonly used in problem identification, while the supply of information via digital communication should always be permanently to serve end-users at any time. Infographics and videos can elaborate on explanations.

Communicative approaches show potential in the purchase decision process (PDP). Focus of the PDP for clients is on purchasing services of Revolt Energy, whilst lease- and private EV-driver is focused on the implementation of services of Revolt Energy.

During the problem identification face-to-face communication can be used to build personal relationships and provide tailored advice towards end-users' problems.

During the information search digital communication can provide timely and targeted information to stimulate the learning process on internal and external search. Audio-visual media can provide more in-depth explanations helping users to evaluate alternatives and make informed decisions about their purchase decision and influence their charging behaviour.

During the evaluation of alternatives, web paged comparisons and videos can help evaluate alternatives based on their information search. The evaluation of service and technology acceptance is here inevitable.

During the purchase decision the perceived usefulness and perceived ease-of-use of communication channel and accepted technology influences end-users. The purchase decision is a cumulation of all influencing variables on the decision-making process and end-user's intention to use technology.

During the post purchase decision, the use of a mix of communication should be engaged on to provide real-time information incorporated in technology.

Conclusion Literature review

From the literature review in Chapters 3, 4 and 5 the information is processed in 26 lessons. This process is done via convergent thinking method of the DDM. The used criteria for deriving the guidelines is frequency of occurrence in literature and relevance on stimulation on interaction for desired charging behaviour. These top 26 lessons serve as input for further research. The 26 lessons are divided into six segments: user segmentation, charging decision process, purchase decision process, information output, DP scheme, technological design, communication channel.

Top 26 lessons

Segmentation:

1. The segmentation of **end-user** (**business EV-drivers** and **private EV-drivers**) offers first steps towards design and tailoring communication approaches to the behaviours, motivators, needs and tasks of the end-users.
2. **Clients'** need for choosing Revolt over their competitors are price, convenience, and scalability. **Business EV-drivers** have a lower price incentive than **private EV-drivers**. It is important to integrate these needs and perspectives into providing an end-to-end solution to provide significant success of my analysis to ensure that the research is relevant, respectful, and responsive to their concerns. (investigated via the TAM)

Charging decision:

3. Charging decision of an EV-driver is in general extremely sensitive to the charging price, however charging speed is also taken into consideration. Therefore, differentiation on more than pricing only should be considered in the communication approach.
4. Charging decision of an EV-driver is based on the battery SOC, pricing scheme and flexibility in time. Drivers feel comfortable when the battery SOC is above 20%~25%. EV-drivers typically initiate charging when their vehicle's SOC is between 40% and 50%, with an average SOC of 41%.
5. Flexibility is necessary from the EV-driver perspective to communicate their charging flexibility to manage charging intelligently and utility.
6. Start time is considered as the factor with the highest influence on the connection time with the charging point. Currently, most Revolt **end-users** charge their cars during the weekdays between 07:00 to 13:00, which should be more widespread over the day.

Purchase decision process:

7. An ICS should help **end-users** recognize the problem and offer a suitable solution during the need recognition phase.
8. An ICS should provide accurate supporting information for **end-users** to make the best decision and choose the service according to their desired profile during the information search phase.
9. A communication channel mix of face-to-face communication, digital communication, audio-visual media, and printed material can provide accurate information during the whole purchase decision process. This mix should stimulate the **end-users** to make the best charging decision according to the desired profile during. (1) Face-to-face communication can build trust, provide personalised information, and feedback, and motivate behaviour change. (2) Digital communication can offer timely and targeted information, reminders, and incentives to reach large audiences at low cost. (3) Audio-visual media can be used to provide engaging and interactive content, which can be customised to specific audiences. They can also be used to provide demonstrations, simulations, and virtual reality experiences. (4) Printed materials like flyers and posters can disseminate information and be visually engaging. Which can be implemented into daily routines engagement. For example, a glass-sticker in the car or a print for on car-key chains to communicate where the end-user can find information and increase ease of use.

Information output:

10. Information input about the type of car is crucial to provide accurate information, e.g., where Jedlix makes use of.
11. Information output objectives for EV-driver can be divided into motivational objectives: economical benefit, environmental benefit, technical benefit, and personal feedback. Influenced by socio-demographic factors.

12. Feedback systems should be developed as interactive systems that deliver information that is constantly renewed and updated via technical applications. Personal feedback as direct stimulus and historical insight of information can unlock **end-users**' contribution towards the desired charging behaviour. In advance notifications of price changes lead to better responsiveness. This direct stimulus should be given several times a day to encourage shifting charging behaviour. Next to that, **end-users** must be enabled to study their historical usage as well to see what the impact of their changed behaviour has been on consumption and price.
13. The objectives must be tailored to or developed from the perspective of the **end-users'** preferences and their daily routines, as socio-demographic factors influence the willingness of an EV-driver. Timing of interventions is crucial in designing an effective ICS for each phase of the end-users' purchase decision process.
14. Addressing social norms is crucial for long-term prosocial behaviour, where marketing communication should engage and support **end-users** to maintain changed behaviour; however, end-users often lack the capacity to understand their energy consumption due to its complexity.
15. Reward programs on smart charging benefits to improve **end-users'** engagement and loyalty is essential for success.
16. "If-then" statements are a powerful process for reprogramming behaviour by replacing existing associations with new ones for usage in the communication channel (lesson 9).
17. **End-user** education is crucial even with automated devices.
18. A personalised newsletter can be introduced to stimulate the interest of the **end-user**.

DP scheme:

19. A pricing scheme that is easy to understand and not overloaded with information can help engaging automation coupled with a learning process. The pricing policy therefore must be set between two to four levels of prices to avoid an overly complex structure, to avoid non acceptance of the EV-driver. Where implementation of 'bonus' events and 'malus' events can increase flexibility of the EV-driver.
20. Timely announcement of events (e.g., day-ahead) increases EV-drivers' responsiveness to DP schemes.
21. Word-of-mouth and social norms can be effective in encouraging adoption for DP.
22. Auction-based mechanisms for DP schemes and intelligent charging controls can help shift energy usage to off-peak hours for EV-drivers.

Technological design:

23. For Revolt to remain competitive, it should at least develop a mobile application for Revolt Energy communicative channel for EV-drivers.
24. Technology should be developed with the needs, wishes, and abilities of **end-users** in mind. Therefore, a simple and user-friendly dashboard with accurate information on the willingness objective can stimulate engagement. Technological tools should include scheduling, notifications, information insight, and feedback.
25. Via the Technology Acceptance Model (TAM) a determination of an **end-user's** intention to use a technology based on perceived usefulness (PU) and perceived ease of use (PEOU) can be validated.
26. An adequate infrastructure for monitoring and metering data storage, processing and communication between stakeholders is essential. Data privacy is increasingly important, and a secure multi-party computation can help protect user data.

6. Data model framework

From the three models identified in the literature review and the top 26 lessons, this chapter aims to develop integrating of the literature variables into a framework. The validity of the internal coherence of the variables from the systematic literature review in the conceptual framework is taken out of scope and the assumption is made that the framework is correct. Section 6.1 focuses on the integration of these variables of three models, where Section 6.2 discusses the variables, based on the principles outlined in appendix D. It is important to note that this framework will not be internally validated in this research. It primarily serves as visualisation tool to inform the design of a more precise data collection method, outlined in Chapter 7.

6.1 Integrated models

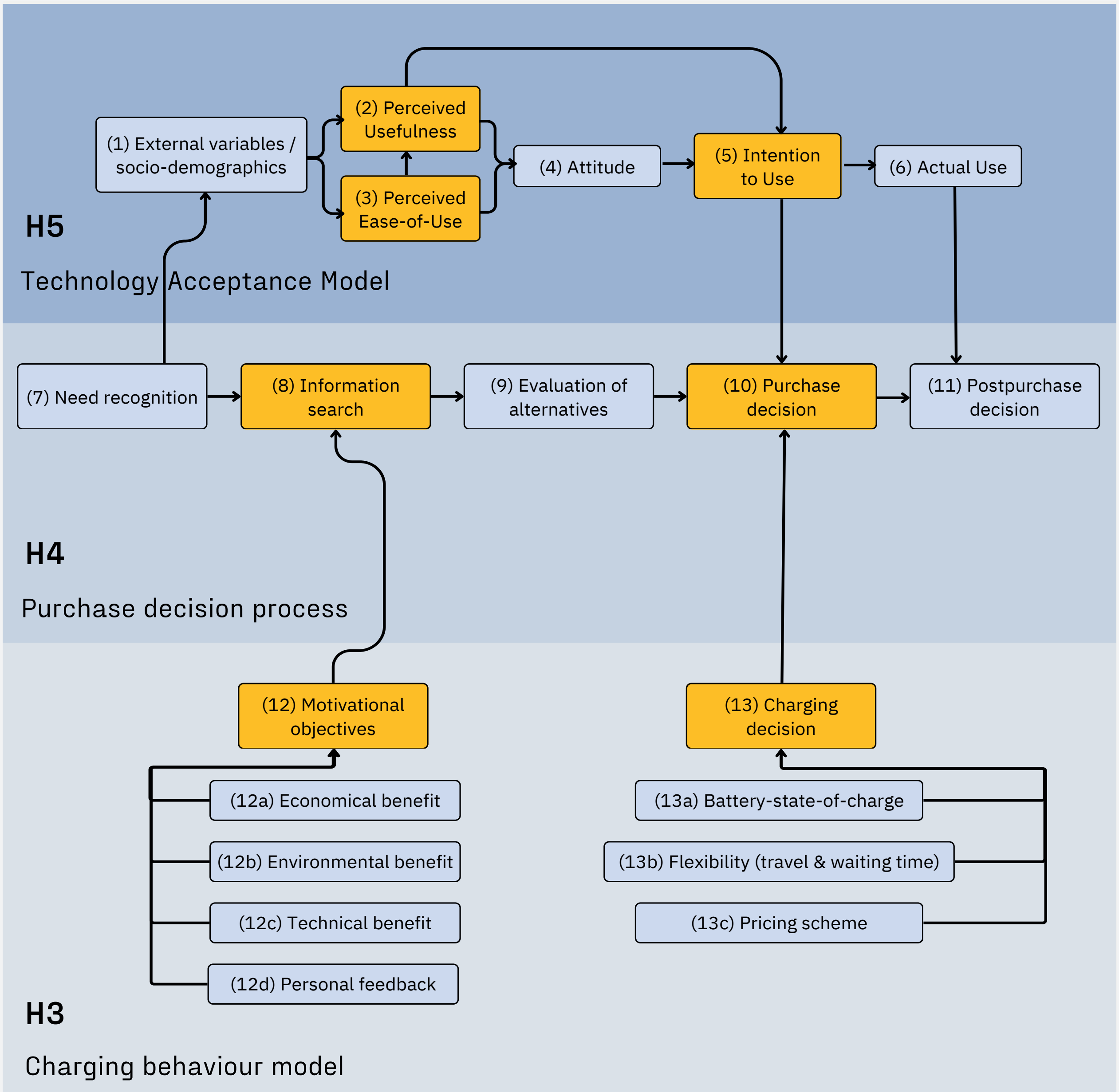


Figure 21; Literature integrated models

External variables / socio-demographics factors (1) influencing the need recognition of end-users (7):
Discussing Figure 21, the socio-demographic variables of the TAM, such as age, gender, income, education, and occupation, can influence the need recognition phase of the PDP by affecting the level of awareness and interest that individuals have in EVs and the associated charging infrastructure. For example, individuals with higher income and education levels may be more likely to recognize the need for a more environmentally friendly transportation option and may be more receptive to purchasing an EV. In contrast, individuals who live in rural areas with limited charging infrastructure may have less confrontational recognition of need or interest in EVs. Therefore, the socio-demographic variables of the TAM can influence the need recognition phase of the PDP by shaping individuals' attitudes and beliefs towards EVs and the associated charging infrastructure. In Figure 21 there are five connectors between the three models. These connectors are discussed below.
Motivational objectives of end-users (12) influencing the information search (8) phase of the PDP:
The motivational objectives of end-users and clients, such as the desire for economic, environmental, technical, and personal benefits, can influence the information search phase of the PDP by shaping the criteria that

individuals use to evaluate different charging points and pricing schemes. For example, an end-user may prioritise a charging point with a lower cost per kilowatt-hour to achieve economic benefits, while another end-user may prioritise a station with a high-speed charging rate to achieve personal benefits. Similarly, a client may prioritise a charging point with a prominent level of reliability to achieve technical benefits, or a station with a low environmental impact to achieve environmental benefits. Therefore, the motivational objectives of end-users and clients can influence the information search phase of the PDP by shaping individuals' preferences and priorities when evaluating different charging options.

Charging decision of an EV-driver (13) influencing the purchase decision (10) of EV-drivers:
The charging decision within the CBM is from of an EV-driver perspective. Their charging decision is based on their battery state of charge (SOC), flexibility, and the pricing scheme of a charging point, can influence the purchase decision of clients by affecting the demand for charging infrastructure. For example, if charging points with a particular pricing scheme are consistently busy during peak hours, clients may choose to invest in additional charging infrastructure to meet the demand. Alternatively, if charging points are consistently underutilised, clients may choose to reduce the number of charging points or modify the pricing scheme to improve utilisation rates. Therefore, the charging decision of an EV-driver can influence the purchase decision of clients by affecting the supply and demand dynamics of the charging infrastructure market.

Intention to use (5) technology by end-users influencing the purchase decision (10) of end-users:
The intention to use technology by end-users can influence the purchase decision of clients by shaping the level of demand for charging infrastructure and influencing the overall market trends. For example, if a significant percentage of end-users express an intention to use EVs and charging infrastructure, clients may choose to invest in additional charging infrastructure to meet the anticipated demand. Similarly, if a significant percentage of end-users express a willingness to pay higher prices for faster charging, clients may choose to invest in high-speed charging points to meet this demand. Therefore, the intention to use technology by end-users can influence the purchase decision of clients by shaping the overall demand for charging infrastructure and the market trends that emerge in response to this demand.
The intention to use technology by end-users influences the purchase decision of clients because clients are interested in investing in charging infrastructure that is used by many end-users. The higher the number of end-users that express an intention to use EVs and the associated charging infrastructure, the more likely clients are to invest in additional infrastructure to meet the demand. This creates a positive feedback loop where the intention to use technology by end-users drives the expansion of charging infrastructure, which in turn makes it more convenient for additional end-users to adopt EVs and charging infrastructure.

Actual use (6) of end-users influencing post-purchase decision (11) of end-users:
The actual use of technology by end-users influences the post-purchase decision of clients because it provides feedback on the effectiveness and usability of the charging infrastructure. If end-users have positive experiences with the charging infrastructure, they may leave positive reviews and recommend the infrastructure to others, which can increase the likelihood that clients will invest in additional infrastructure. Conversely, if end-users have negative experiences with the charging infrastructure, they may leave negative reviews or avoid using the infrastructure, which can decrease the likelihood that clients will invest in additional infrastructure. Therefore, the actual use of a certain technology by end-users can have a significant impact on the success and future expansion of charging infrastructure.

6.2 Conceptual framework and validation

The establishment of a conceptual framework is a crucial step in many research projects. Is shows insight into which variables directly influence the total interaction. According to Jabareen (2009), these frameworks are the outcome of qualitative processes of theorization, underscoring the importance of ensuring that the relationships between variables are accurately defined before embarking on research. To this end, a theoretical framework is presented in appendix D, which aids to identify the various relationships between variables and prevent any omissions in the conceptual framework.

In attempting to develop an accurate conceptual framework, the theoretical framework in appendix D is used. The conceptual framework is an analysis on the top 26 lessons derived from a systematic literature review and the three models in: the Charging Behaviour Model (CBM), the Purchase Decision Model (PDP), and the Technological Acceptance Model (TAM). CBM is outlined in Chapter 3, the PDP in Chapter 4, and the TAM in Chapter 5.

Lessons 3-6 focused on CBM, lessons 7-9 focused on PDP, and lessons 23-26 focused on TAM. Understanding the relationships between these lessons and the conceptual variable within these models is crucial for optimising the interaction between the company and EV-drivers. This optimization directly influences the total interaction of charging behaviour, particularly within the context of DP.

The conceptual framework is depicted in Figure 22, where here an explanation of each type of variable involved in the framework is provided.

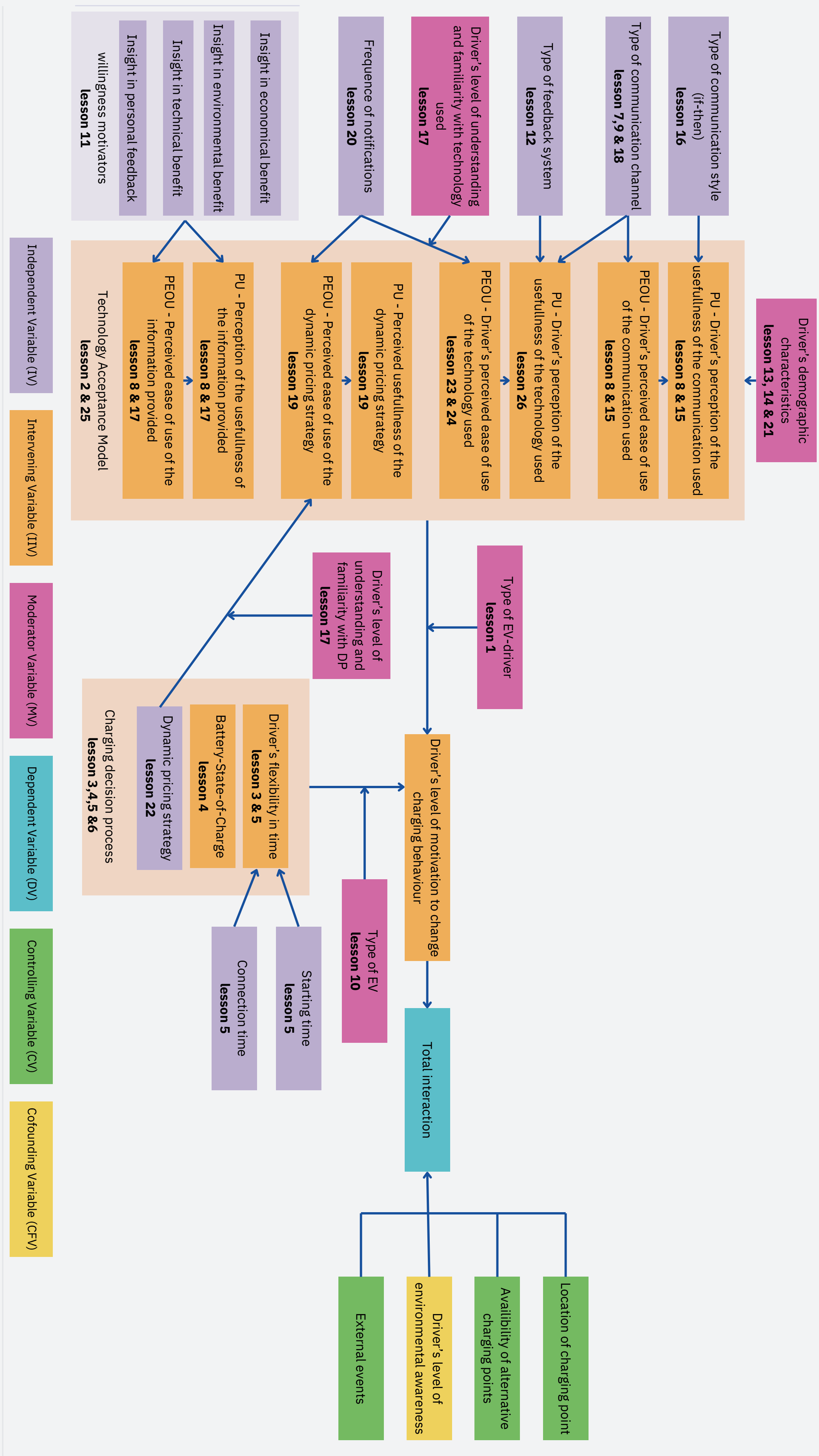


Figure 22; Conceptual framework

6.2.1 Independent Variables

The purple independent variables (IVs) in Figure 22 can be manipulated by Revolt in their ICS to influence EV-drivers' attitudes and behaviours towards DP and technology adoption. The following nine IVs are based on the top 26 lessons and collaboration with involved stakeholders. Which is detailed in Table 4 and coloured purple in the conceptual framework of Figure 22.

a) *The type of communication style*, specifically the use of if-then statements, can be considered an independent variable in the model because it is a variable that can be manipulated or controlled by the researcher. The researcher can choose to use several types of communication styles, such as using if-then statements or not using them, to examine their impact on the dependent variable (total interaction between the company and EV-drivers). The type of communication style is not directly influenced by any other variable in the model, but it is a variable that can be intentionally manipulated by the researcher to see how it impacts the dependent variable. Therefore, it is an independent variable in the model.

b) *The type of communication channel* is an independent variable in the model because it is a characteristic of an ICS that the company chooses to use, and it is not influenced by the EV-driver's behaviour or other variables in the model. The company can choose to communicate through various channels, such as face-to-face, audio-visual media, digital communication, and printed materials, and this choice can affect the driver's perception and motivation towards DP and technology adoption.

c) *The type of feedback system* is an independent variable in the model because it is a characteristic of the technology used to provide information to the driver, and it is not influenced by the driver's behaviour or other variables in the model. The company can choose to use either direct stimuli or historical data insight feedback system, and this choice can affect the driver's perception and motivation towards DP and technology adoption.

d) *The frequency of notifications* is an independent variable in the model because it is a characteristic of an ICS that the company chooses to use, and it is not influenced by the EV-driver's behaviour or other variables in the model. The company can choose to notify the driver about DP and other information at different frequencies, such as daily, weekly, or monthly, and this choice can affect the driver's perception and motivation towards DP and technology adoption.

e) *The insight in economical benefit* is an independent variable in the model because it is a characteristic of the information provided to the driver, and it is not influenced by the driver's behaviour or other variables in the model. The company can provide the driver with information on the economical benefit of using DP and sustainable charging behaviours, and this information can affect the driver's perception and motivation towards DP and technology adoption.

f) *The insight in environmental benefit* is an independent variable in the model because it is a characteristic of the information provided to the driver, and it is not influenced by the driver's behaviour or other variables in the model. The company can provide the driver with information on the environmental benefit of using DP and sustainable charging behaviours, and this information can affect the driver's perception and motivation towards DP and technology adoption.

g) *The insight in technical benefit* is an independent variable in the model because it is a characteristic of the information provided to the driver, and it is not influenced by the driver's behaviour or other variables in the model. The company can provide the driver with information on the technical benefit of using DP and sustainable charging behaviours, and this information can affect the driver's perception and motivation towards DP and technology adoption.

h) *The insight in personal feedback* is an independent variable because it shares the same characteristics as the previous IV, *insight in technical benefit*.

I) *The DP scheme* is an independent variable in the model because it is a characteristic of the pricing strategy that the company chooses to use, and it is not influenced by the driver's behaviour or other variables in the model. The company can choose to implement different DP schemes, such as time-of-use or peak-demand pricing, and this choice can affect the driver's perception and motivation towards DP and technology adoption.

Table 4; Independent variables

Independent Variable	options
a) Type of communication style	i) If-then statements
b) Type of communication channel	i) Face-to-face ii) Digital communication iii) Audio-visual media iv) Printed material
c) Type of feedback system	i) Direct stimuli ii) Historical data
d) Frequency of notification	i) Daily ii) Weekly iii) Monthly iv) Yearly
e) Insight economical benefit	i) Day pricing scheme diagram ii) KWh/euro (compare to price per litre benzine) iii) Saved euros iv) Lower electricity costs v) Reduced charging costs (make comparison with competitors) vi) Reduced fossil fuels cost dependence (comparison with diesel prices)
f) Insight environmental benefit	i) CO2 emission reduction ii) Total off-peak charged kwh iii) CO2 emission compensation iv) Improved air quality v) Reduced dependence on fossil fuels vi) Increased use of renewable energy
g) Insight technical benefit	i) Battery SOC ii) Km possible with current battery iii) Increased availability of charging point iv) KWh charged v) Charged extra km Slim loading option with start time and end time charging vi) Increased grid stability
h) Insight personal feedback	i) Graphical insight energy usage ii) Energy usage (normal vs now) iii) Total saved euros dashboard (in comparison with old contracts or competitors) iv) % less energy usage per month v) If-then pro-social behaviour statements
i) DP scheme strategy	i) Real-time per hour pricing scheme ii) Two to four levels of pricing iii) Bonus/malus events

6.2.2 Intervening Variables

Let us recall from the models outlined in the literature review (CBM, PDP and TAM) that the conceptual framework in Figure 22 has eleven orange intervening variables, namely:

a) *driver's perception of the usefulness of communication*
b) *perceived ease of use of the communication used*
c) *driver's perception of the usefulness of technology used*
d) *perceived ease of technology used*
e) *perceived usefulness of DP strategy*
f) *perceived ease of DP strategy*
g) *drivers' perception of the usefulness of information provided*
h) *perceived ease of provided information used*
i) *flexibility in time of driver*
j) *battery SOC*
k) *driver's level of motivation to change charging behaviour*

These can affect the driver's willingness to interact with the company and change their charging behaviour. These variables are considered intervening variables as they mediate the relationship between the independent variables (type of communication channel, type of feedback system, frequency of notifications, insight in economical benefit, environmental benefit, technical benefit, personal feedback, and DP scheme) and the dependent variable (EV charging interaction). The inclusion of these variables in the model is based on the Technology Acceptance Model (TAM) and its focus on the perceived usefulness and perceived ease of use as significant determinants of user acceptance of technology.

The effectiveness of an ICS can be influenced by the driver's perception of the usefulness and perceived ease of use of the communication and technology used, respectively.

Furthermore, the ease of ICS, ease of insight in motivational objectives, type of communications used, and the ease of technology used can influence the intervening variables, which in turn can affect the driver's charging behaviour. By considering these intervening variables in the model, the research aims to understand how they mediate the relationship between the independent variables and the dependent variable in the context of EV charging interaction.

6.2.3 Moderator Variables

The pink moderator variables in Figure 22 driver's level of understanding and familiarity with the technology used, driver's socio-demographic characteristics, type of EV-driver (business or private), driver's level of understanding and familiarity with DP, type of EV, starting time charging and connection time of charging are considered moderator variables in the model.

Moderator variables are variables that affect the strength or direction of the relationship between the independent and dependent variables. In this case, these moderator variables can affect the relationship between the independent variables (type of communication channel, type of feedback system, frequency of notifications, insight in economical benefit, environmental benefit, technical benefit, personal feedback, and DP scheme) and the dependent variable (EV charging interaction).

For example, a driver's level of understanding and familiarity with the technology used can moderate the relationship between the type of feedback system and the EV charging interaction. If the driver is more familiar with the technology used, they may have a better understanding of how to use the feedback system, which can result in a stronger relationship between the type of feedback system and the EV charging interaction. Similarly, the type of EV can moderate the relationship between the DP scheme and the EV charging interaction. If the EV has a larger battery capacity, the driver may be more willing to use a DP scheme as they have more flexibility in terms of charging times.

The starting time of charging and connection time of charging can also be considered moderator variables, as they can affect the strength of the relationship between the independent variables and the dependent variable.

For example, if a driver has a limited time window for charging, the frequency of notifications may have a stronger effect on their charging behaviour compared to a driver with a more flexible schedule.
Driver's socio-demographic characteristics (e.g., income, age, gender, etc.) and type of EV-driver (business or private) can also affect the strength of the relationship between the independent variables and the dependent variable. For instance, a business driver may have different charging needs and motivations compared to a private driver, and therefore may respond differently to the independent variables in the model.
Thus, these moderator variables can affect the relationship between the independent variables and the dependent variable and can provide insights into how distinct groups of drivers may respond differently to the proposed communication and pricing strategies.

6.2.4 Dependent Variable

The total interaction is the blue dependent variable in Figure 22, because it is the main outcome that this research is trying to measure and predict. The research aims to investigate if an ICS can positively affect the willingness and satisfaction of end-user to make use of DP at the charging point, leading to increased interaction with the DP strategy. The research seeks to determine the effect of the independent variables (type of communication channel, type of feedback system, frequency of notifications, insight in economical benefit, environmental benefit, technical benefit, personal feedback, and DP scheme) on the dependent variable, which is the total interaction.
The dependent variable is measured by monitoring the extent of interaction with the DP strategy at the charging point, which can be obtained through data collection methods such as questionnaires, interviews, or observation. By manipulating the independent variables, this research seeks to establish the strength of the relationship between the independent variables and the dependent variable.
Overall, the dependent variable is critical to the research because it is expected to provide valuable insights into the effectiveness of an ICS and the impact on end-user' willingness and satisfaction to interact with DP. By achieving a real solution where everyone benefits, this research can contribute to the development of more sustainable energy practices by stimulating desired charging behaviour, reducing peak loads, and making it easier for grid operators to meet energy demands.

6.2.5 Control Variables

External events, location of charging point, and availability of alternative charging points are considered the green control variables in Figure 22, because they could potentially affect the willingness and satisfaction of end-user to interact with the DP strategy of Revolt, and the total interaction.
To control for external events, the researcher could conduct the questionnaire over a specific period, taking note of any major events that could potentially affect the participants' responses. The researcher could also ask specific questions related to external events to control for their influence on the total interaction.
Regarding the location of the charging point, the researcher could control for this by selecting participants who frequent charging points in similar locations, such as urban or suburban areas. Additionally, the researcher could ask participants about their location to control for any differences in responses based on geographic location.
Finally, the availability of alternative charging points could be controlled by asking participants if they have access to alternative charging points, as well as the frequency and distance of those charging points. This information could be used to control for the availability of alternative charging points and any potential effect they may have on the total interaction.
Thus, to collect data the researcher could include questions related to these control variables and use statistical methods to control for their influence on the dependent variable. Additionally, the researcher could select participants who are similar in terms of these control variables to control for any potential confounding effects.

6.2.6 Confounding variables

The driver's level of environmental awareness is a confounding variable in the model because it directly affects the dependent variable, which is total interaction. The yellow confounding variables in Figure 22 are extraneous factors that are not of primary interest but can affect the outcome of the study. In this case, the level of environmental awareness may influence the willingness of the driver to interact with the DP scheme, and therefore, impact the total interaction.

For example, a driver who is highly environmentally aware may be more willing to interact with the DP scheme as they are more conscious of the environmental benefits of EVs. On the other hand, a driver with a lower level of environmental awareness may not be as motivated to interact with the DP scheme.

To control for the confounding variables of the driver's level of environmental awareness, the researcher could include this variable as a covariate in the statistical analysis. By doing so, the researcher can examine the direct effects of the independent variables on the dependent variable while controlling for the influence of the driver's level of environmental awareness. Additionally, the researcher could also ask questions in the questionnaire that directly measure the driver's level of environmental awareness, allowing for more precise control of this confounding variable in the analysis.

6.3 Guidance on the conceptual framework

The conceptual framework shows a developed integration of guidelines and variables to increase interaction.

For practical implementation this conceptual framework in Figure 22 serves as guideline for sectioning your data collection, if aiming for increased interaction between end-users and charging stations. As different CPO operate in different sectors, data collection will take place in different fields, resulting in different outcomes. However, the conceptual framework can be used as generic framework to build data collection and finding a solution for stimulated interaction with the charging stations.

For this research focus for data collection is implemented on Revolt's operating sectors, businesses, and destination sites.

6.4 Conclusion Chapter 6; Conceptual framework

The conceptual framework results from the literature review and the investigation on theory of frame working. The conceptual framework provides a clear overview and is functional understanding the solution set for a stimulating ICS. The variables in the conceptual framework influence the core problem of this research, total interaction. This is visualised in Figure 22; Conceptual framework provide a better understanding for the solution set of a stimulating ICS. All variables are further examined in Chapter 7 by data collection for an ICS selection.

7. Critical Success Factors

7.1 Data gathering construction and method
7.2 CSFs to increase interaction and method
7.3 CSFs and objectives

From the conceptual framework in Chapter 6, Chapter 7 focuses on examination of the conceptual framework via data gathering and Critical Success Factors (CSFs) towards solutions set for an effective ICS. Section 7.1 outlines how the conceptual framework will validify the solution set via data gathering. Next to that, the data gathering method is validified. It is important to acknowledge the potential limitations such as selection bias arising from factors like internet access and technological literacy. Section 7.2 validifies the results of the data collection. The designing of Critical Success Factors (CSFs) is done here to investigate the influence on the total interaction (DV of the conceptual framework) in the data collection. Section 7.3 validifies the CSFs on the two objectives of the core problem of this research.

7.1 Data gathering construction and method

The data gathering construction is built on the conceptual framework. To avoid any respondents' bias to occur independent feedback to confirm on truth is done via consultation of stakeholders. Here it is crucial to discover the truth in my data collection and analysis and validate the sources to prevent any bias to occur. With this I inform all participants in my data collection beforehand about the data collection method, data usage and ensuring privacy in line with the Code of Conduct for Research Integrity (2018). The data gathering method is underpinned by the conceptual framework to find the results influencing total interaction from end-user perspective. In addition, it is iterated with supervisors. The data gathering design is presented in Appendix F. In Appendix F is outlined how the questions are linked to the variables influencing total interaction. The outcome will also communicate potential pitfalls and usage conditions to prevent any misinterpretation of the research outcome in Section 8.3.

A data gathering method provides validity of the variables in the conceptual framework in Chapter 7 towards a solution set. This research uses an online questionnaire to collect data. The online questionnaire allows that anyone can participate and broaden the research sample size. In this research the questionnaire is distributed in the researchers' professional EV-drivers network and Revolt's network, this to provide recommendations most accurately towards the company. According to literature, validation of an online cross-sectional questionnaire depends on several factors, for example the sample size and operationalisation.
For the online questionnaire to state that it is valid a certain size of sample is aimed for. In general, the larger the sample size, the larger the precision and reliability of the results. The optimal sample size may vary based on the specific research context and statistical analysis planned. Therefore, a minimum of respondents is set at 40 respondents to draw a valid conclusion by the management of Revolt.
The questionnaire length of 12 minutes with 28 questions can be considered as reasonable. It is important to ensure that respondents do not experience questionnaire fatigue. Therefore, we use a mix of Likert scale questions and open-ended questions that can provide a comprehensive understanding of respondents' opinions while also allowing for more in-depth insights. Next to that, data is put in randomised order to all respondents to minimise respondents' bias. Additionally, a multi-departmental approach to the questionnaire is used. Asking whether the respondent has an EV, and with the answer 'no', the respondent to complete the remaining questionnaire from a perspective of a potential EV-driver.
The type of questions uses the Likert scale to measure respondents' attitudes, opinions, or agreement levels. The Likert scale provides a structured approach and allow for quantitative analysis and provide a neutral midpoint to operationalize a range of responses. Next to that, the open-end questions capture qualitative insights and provide an opportunity to express thoughts. These open-end questions can help in new perspectives and provide context to complement the quantitative data. It is important to carefully design and analyse open-ended responses, as they may require more effort and time for interpretation.

Pilot testing helps ensure that the questionnaire is well-designed, user-friendly, and effectively captures the intended information (Dillman et al.,1993). Therefore, a pilot test with a small group of respondents has been conducted to identify any issues with question clarity, questionnaire flow, or technical glitches. Ensuring that this research' questionnaire adheres to ethical guidelines. Additionally, careful consideration about respondents' profile questions have been considered and obtained approval from an ethics committee board. The questionnaire flow can be found in appendix F, together with the results discussed in Chapter 8.

7.2 CSFs to increase interaction within ICS

Based on the conceptual framework, this section proposes specific Critical Success Factors (CSFs). The CSFs are linked to the overall level of interaction and questionnaire response. The CSFs are used to validify the solution set resulting from the data gathering method. It answers the knowledge question: Which CSFs are needed to influence charging behaviour via an ICS. The most prominent solution will be chosen in Chapter 8.

The drafting of these CSFs norms is based on the conceptual framework, the data gathering method and consultation with Revolt.
Recalling 7.1 the Likert scale is a promising data measuring method, scaling values from 1-5. The Likert scale is mostly used throughout the questionnaire. However, the open-end questions are assessed by percentages of data outcomes, placing this on a 1-10 scale.

Three conditions for a significant questionnaire response and valuable ICS state:

1. A measurable anonymous profile of at least 35 respondents creates a significant need for recognition of problems. *(Q1-Q9)*
2. If there is a willingness to invest in additional technology lower than the value of 3 on the Likert scale, there is no indication of continuing the deeply invested ICS. *(Q10)*
3. At least 80% of the end-user must find the concept of DP at the charging point useful. *(Q13 & Q14-1)*
4. There is an agreement from respondents on wanting to make use of DP for charging EVs with at least a mean of 7.0 out of 10. *(Q14-2)*

Higher awareness and understanding of energy consumption and DP concepts can positively correlate with increased interaction with charging points that use DP. Therefore, it is important what you bring in communication during the problem recognition phase and the information search in **what** to integrate within the strategy.

5. At least 80% of the end-users must understand the concept of DP. *(Q11)*
6. The communication stimulates only on the 2 most prominent motivational objectives for end-users, during the information search resulting from the questionnaire with a minimum average of 5.0. *(Q12)*
7. The communication is easy to use (client friendly use) and accessible for end-user throughout the purchase decision process (pre and post). Therefore, at least the 3 most preferred schemes, technology and information outputs are integrated in an ICS resulting from the questionnaire (recalling lesson 13). *(Q15-Q17&Q25)*
8. The usefulness of information to motivate charging behaviour and increase interaction must be perceived with a minimum value of 7.5 out of 10. *(Q18)*

How you bring these 8 statements above is of importance in terms of the effectiveness of the if-then statements and direct stimuli, such as notifications, in influencing behaviour change that can impact the level of interaction with charging points that use DP. Which refer to the following CSFs:

9. The 2 most preferred types of communication channel integration by all respondents (potential and current end-users) per phase in the purchase decision process is leading. *(Q19-Q20 & conclusion literature review)*
10. An ICS is implemented in daily routine for the end-user in pre- and post-purchase decisions. *(Q22)*
11. If-then statements are found motivating to change charging behaviour. *(Q23-Q24)*
12. An ICS is successful when at least a form of pro-social behaviour is stimulated by respondents during the post-purchase decision phase with a value of 7 out of 10. *(Q26-Q27)*

7.3 CSFs and objectives

Recalling Section 1.2, the *willingness* objective of end-user; is the probability that end-users want to charge with DP pricings. Willingness is created by the will of investing (CSF2), the will to modify charging behaviour (CSF 3), the will of make use of DP (CSF 4), the perceived value of information provided (CSF 6) and the perceived value of communication used (CSF 11).

The *satisfaction* objective of end-user; is the probability that clients or end-users are content with the service of Revolt Energy for charging EVs. Satisfaction is created by the success of understanding DP (CSF 5), perception and experience with ease of use (CSF 7), perception of usefulness of information (CSF 8), perception and experience of the value of technology used (CSF 10) and pro-social behaviour (CSF 12).
To come to a probability statement for both objectives the aggregated averages are taken.

8. Data collection results

This chapter focuses on which CSF can be best focused on for analysing communication strategies. Appendix F provides the results per question with a discussion of analysation per question. In Section 8.1 the most important results are summarized. To create a more feasible ICS, the individual scores on the CSFs are normalised in 8.2 to compare them internally. Section 8.3 outlines the results of the scores per CSF. Section 8.4 stretches the weights of CSFs. To conclude in Section 8.5 the results in terms of the norm and reality are state. Section 8.6 concludes the found results. Discussion on feasibility of the results follows in Chapter 9.

8.1 Questionnaire results

The data result analysation per question, outlined in Appendix F, show that of the 82 respondents a notable concentration was in the western provinces. In Noord-Holland, Zuid-Holland, and Utrecht. This shows the importance of considering regional nuances in charging infrastructure and alternatives for the motivational objectives. Another socio-demographic factor, education, has proven to be a significant influencer. It can be stated that higher education level is correlating with a more conscious lifestyle. For example, this research shows familiarity of DP at charging points appears to people with at least an HBO background.

Secondly, the questionnaire shows a high familiarity with DP **by 83.1%, explaining DP benefits for EV drivers may not be necessary.** However, a significant number of respondents shows interest in being pioneers in the EV market, which can show a bias compared to the segmentation of Revolt's end-user.

Thirdly, the distinction between lease and private EV-drivers has raised questions for segmentation of the willingness of EV-drivers. 92.1% of respondents drives an EV, wherefrom 49.2% lease and 40.7% private and 10.2% in a buy-option of the company. Most respondents charge at home (42.4%) and only 11.9% at work. Lease EV-drivers charge more at home namely in 55.2% of the cases. This is in line with the theory of Chapter 3.

Fourthly, it is found that the low monthly costs and delivery of green energy are the main drivers for EV-drivers to choose a certain energy provider. 15.3% choose for another option, like availability of DP, flexibility, integration of car, charging point, solar panels, etc. This leads to the conclusion that the focus on economical and environmental benefit is valued the most by respondents.

Fifthly, the awareness of pricing at the charging point is low. 72% of the respondents does not look at the price per kWh at a charging point. From this 72%, 49% is a lease driver. This is in line with the theory of Chapter 3, stating that lease drivers are less price sensitive. Next to that, in line with Chapter 3 these questionnaire results also show that socio-demographic factors (e.g.: time and place) are of influence on the charging behaviour.

Sixthly, private driver's stimulation on economic incentive for lower budget can more easily be targeted. Lease drivers' respondents think they spend 211 euro on average monthly on electric charging. Whilst, on average respondents are willing to spend 160 euro monthly on electric charging when they drive privately. For marketing Revolt Energy this can be used to show people the need for recognition (first phase PDP).

Seventhly, 86.9% of the respondents were not familiar with Revolt and none of the respondents is a client of Revolt. Suggesting that new clients with EV-driver float should be the primary segment to focus on for Revolt Energy.

The general conclusion from the results shows high willingness of the respondents to adapt to DP and a willingness to invest in additional technology, this to reduce their reliance on non-renewable energy sources. The willingness to invest in additional technology, like a mobile application, shows **possibilities for exploring partnerships with other parties.** As Revolt currently does not have the resources to build additional technology**. Suggesting** a f**ocus on development of extra technology services for Revolt Energy.**

Results show the emerging of CSF 6 that the two most prominent motivational objectives are divined are the economic and environmental benefit. This questionnaire result is visualised in Figure 23. Where the x-axis shows the preferred statement based on ranking and the y-axis the number of respondents. Measuring the perceived usefulness of DP and its impact on willingness to adopt it at charging points, the value measured is 4.0/5.0. As the value is significant high, it suggests that respondents find DP useful in motivating charging behaviour.

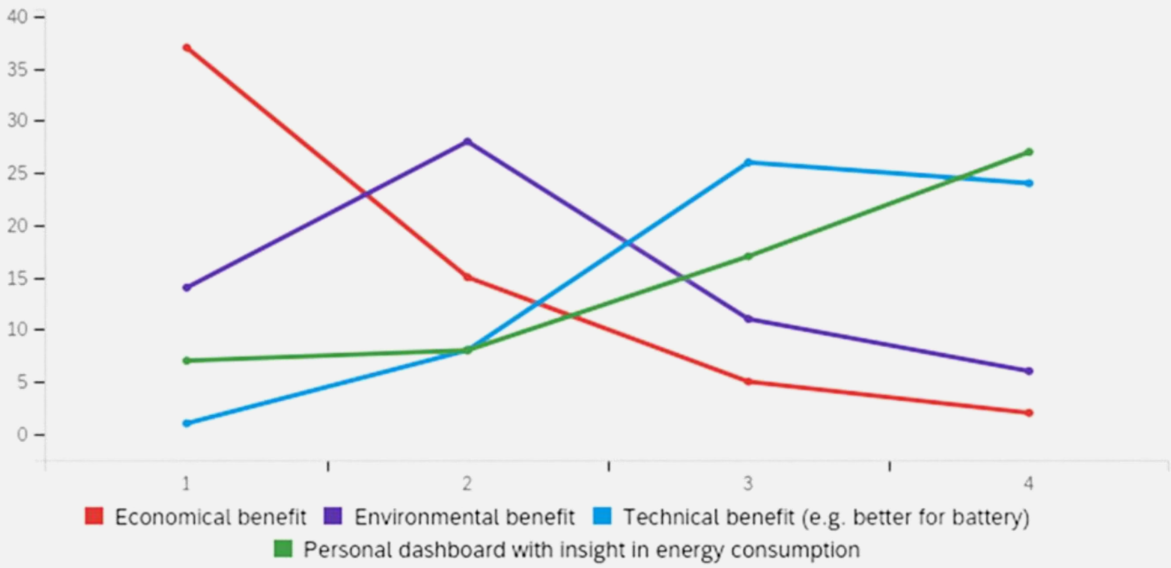


Figure 19; Questionnaire result, motivational objectives

The results reveal that hourly EPEX-spot rates are most favoured by 42.4% of the respondents followed by the bonus-malus rates, peak rates, and last flat rate (current state), shown in Figure 24. Where the x-axis reveals the order of preferred pricing scheme based on ranking, the y-axis refers to the number of respondents. However, this is an estimation of the ranking. To analyse statistical accuracy the PlackettLuce model by Turner et al. (2020) is suggested for internal validity. Due to time limitations this is taken out of scope.

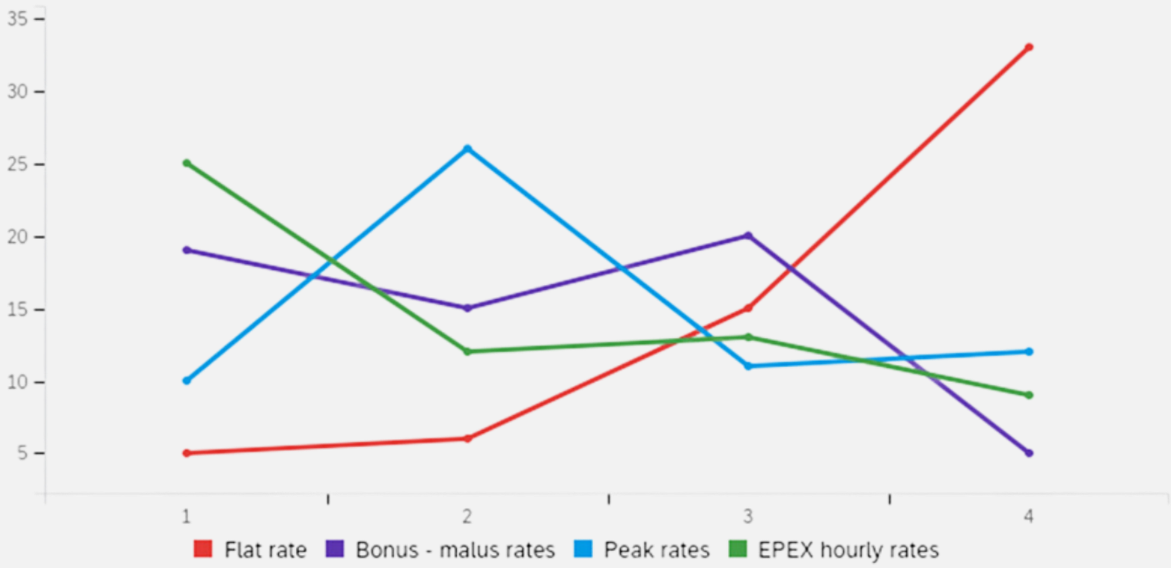


Figure 24; Questionnaire result, pricing scheme

Insights into preferred technology interfaces for pricing information state that the mobile app is the most favoured (42.5%), followed by QR codes on charging points (28.3%). **Thus, focusing on a mobile application to present DP is perceived as most useful.** Examination on the information output providing insight information through the technology the top five desired information outputs for inclusion in Revolt's technology interface is: €/kWh (economical), kWh charged (technical), current charging level of battery (technical), % green energy usage per month (environmental) and total % off-peak charged kWh (technical). **This leads to the conclusion that within the technical user-interface the technical benefits are more prone to stimulate interaction with DP, whilst for motivation of charging behaviour the focus should be on the economical and environmental.**

Here the perceived usefulness and ease of use of the information outputs are crucial factors influencing the motivation to interact with charging points using DP. With a mean agreement score of 3.88 for usefulness and 3.75 for ease of use, respondents affirm that insightful information positively impacts their motivation to engage with DP and charging points.

In Section 5 of the questionnaire, the focus is on understanding the purchase decision process (PDP) and drivers' perceptions of communication used during this process. The first phase of the PDP is explored, emphasising the importance of communication strategies tailored to this initial stage. Respondents primarily seek information about DP on the internet (35%), followed by energy providers (22.1%), specific websites, social media, knowledgeable friends, YouTube, and consultants. **This underscores the significance of digital communication in this phase**.

Subsequently, the questionnaire investigates the effectiveness of different communication channels during the information search phase. Online explanations (digital communication) are considered the most useful by 66.67% of respondents, followed by video explanations, printed materials, and face-to-face communication. **The results highlight the importance of digital communication, particularly with audio-visual support** from Figure 25. Where the x-axis reveals the score from 1-5 of the preferred communication tools, the y-axis refers to the number of respondents.

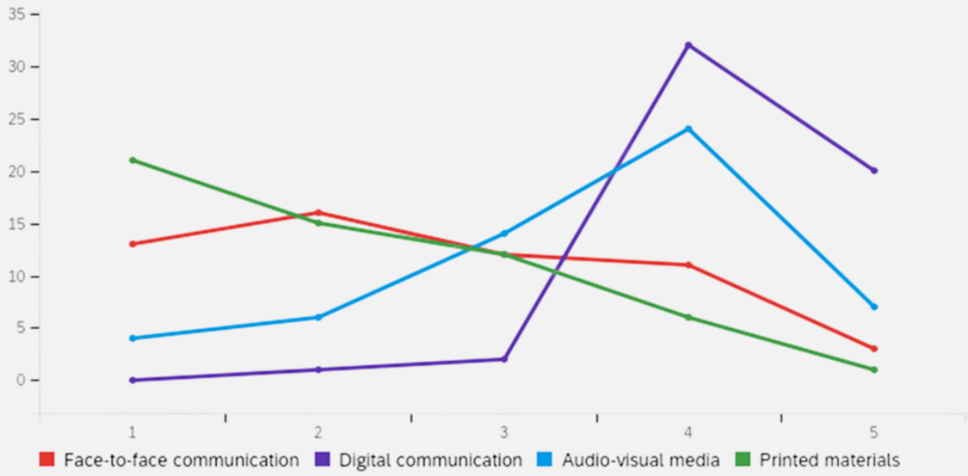


Figure 25; Questionnaire results, communication channel

Furthermore, the questionnaire explores ways to integrate information output into EV-drivers' daily routines. The majority (36 respondents) expresses a preference for being informed via a mobile app, with 12 of them specifically desiring push notifications on optimal charging times and locations. **This reinforces the importance of mobile applications for stimulation of user engagement and interaction with DP**.

The sequential focus of the questionnaire shifts to drivers' perceptions of communication used. "If-then" statements related to willingness objective are evaluated for their impact on EV-drivers' motivation to change charging behaviour. The economic incentives prove to be the most motivating, followed by technical incentives and pro-social behaviour. These findings inform an ICS to emphasise key motivators and encourage prosocial behaviour. Also, the influence of these if-then statements as direct stimuli assessed via notifications is found to be useful and has a positive impact on actual technology which is in line with the Technology Acceptance Model (TAM). Evident and clear communication as: “If you charge between 13:00-15:00 today, then you save 0.40 cent per kWh charge” is to be mostly effective. With the mean of 7.3/10 respondents want to be able to choose when they leave and the minimum amount of energy they want to charge, where the system will then automatically charge accordingly. Showing the willingness to this type of information output is high which suggests increase in pro-social behaviour within this design in the technology. However, developing this kind of software technology is complex and requires resources.

In Figure 26 the results are put in the conceptual framework. For further elaboration on results, the results are discussion per question in appendix F.

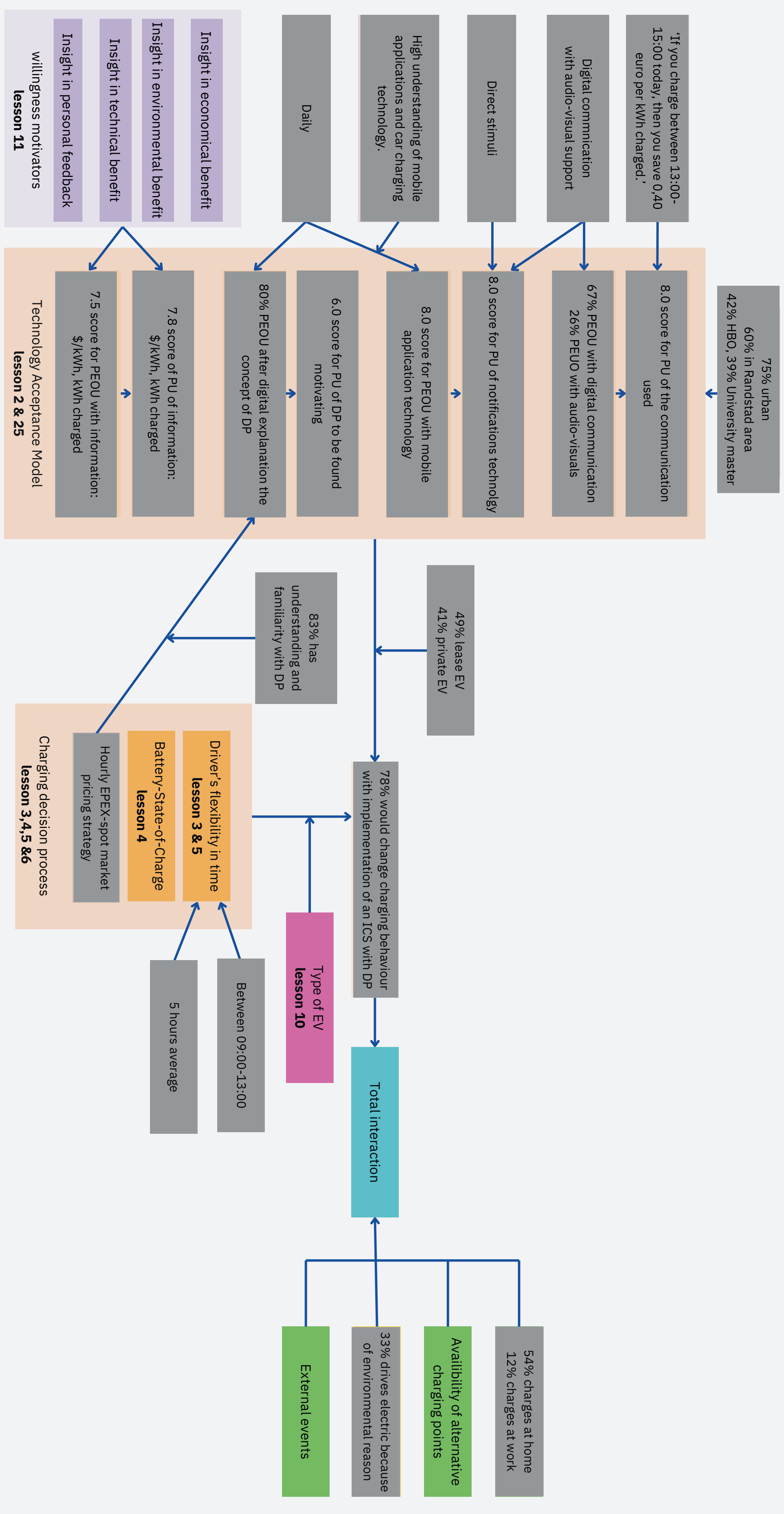


Figure 26; Results in the conceptual framework

8.2 Scores per CSF

Based on the questionnaire report in Appendix F and summary of result in Section 8.1, the *willingness* and *satisfaction* of end-user is to be concluded via the measurement of the CSFs. Therefore, each CSF is given an average score chosen in collaboration with Revolt.

Per CSF the relatable questionnaire questions, description of CSF and their scores are outlined in Table 5 for 3 segments: all respondents, lease EV-drivers and private EV-drivers. In Appendix G the scores per segment are more outlined on their output.

The score averages serve as an indication of the relative importance of each CSF according to the respondents. As the questionnaire uses several types of scaling, the results are normalised to the scale 1-10. In terms of normalisation the used Likert scale can be multiplied by 2, as the relative distance between the numbers is the same. When looking at the percentages of the results of the multiple-choice questions, linear interpolation and z-transformations are used for question 12,15 and 17. For the ranking questions and linear scaling this applies for question 16, 19 and 20.

The multiple scores come from that there are multiple questions applicable for 1 CSF, example is CSF 2 – Score Lease. Another multiple answer question within the brackets, as given in CSF 7 comes from the use of ranking of questions, where within the question different scores are provided towards a perceived information output.

Table 5; Scores per CSF, all respondents

CSF	*Description*	*Questions*	*Score all respondents*	*Score Lease*	*Score Private*
2	Willingness to invest	10	(8.1)	(7.92)	(8.22)
3	Perceived usefulness DP	13, 14-1	(8.0)	(4.28) (8.00)	(8.14)
4	Willingness to interact with DP	14-2	(8.0)	(7.7)	(8.4)
5	Understanding of DP	11	(8.3)	(8.0)	(8.15)
6	Motivation for information search	12	(5.9, 3.8)	(2.5, 1.8)	(5.4, 1.0)
7	Ease of use of perceived information output	15 16 17 25	(5.0, 3.9, 3.5, 0.0) (10.0, 8.0, 2.7) (10, 10, 8.3) (7.3)	(2.4, -4.7, -5.9) (10.0, 6.7, 4.8) (10.0, 9.1, 8.2) (7.1)	(-0.7, -0.9, -2.7) (8.7, 6.1, 2.9) (10.0, 8.6, 5.0) (7.5)
8	Perceived usefulness of information	18	(7.8)	(7.6, 7.5)	(7.9, 7.7)
9	Preferred communication channel	19 20	(8.7, 5.0) (7.6, 3.5)	(10.0 ,4.6) (7.9, 3.9)	(10.0, 9.2) (6.8, 3.2)
10	Preferred method of implementation in daily routine	22	(5.4)	(6.0)	(6.0)
11	Perceived motivation of information format	23 24	(8.4, 7.8, 6.3, 6.2) (6.1)	(8.2, 6.0, 7.4, 7.8) (6.5)	(8.5, 6.6, 7.9, 7.7) (5.8)
12	Stimulation on pro-social behaviour	26, 27	(6.1, 7.7)	(6.1, 7.4)	(5.9, 8.3)

8.3 Results of CSFs

This section focuses on if the results of Section 8.2 for all respondents meet the requirements of the 12 CSFs outlined in Section 7.2 9.

CSF 1 criterion is approved as 67 respondents completed the questionnaire. This creates a measurable anonymous profile that shows a significant need for recognition of problems indicated in the questionnaire. Where 74.6% of the respondents live urban and 59.7% is based in Noord-Holland, Zuid-Holland, and Utrecht. Next to that, most of the respondents (41.8%) have the education level of HBO. Followed by 38.9% a university master.

CSF 2 criterion is approved with a value of 8.1 out of 10, respondents are willing to invest in additional technology to further reduce their reliance on non-renewable energy sources. This indicates that there is a *willingness* from end-users for continuing invested ICS for DP for EVs.

CSF 3 criterion is approved with a value of 8.0 out of 10, respondents find DP useful for motivating to modify their charging behaviour. Which shows that at least 80% of the end-user must find the concept of DP at the charging point useful.

CSF 4 criterion is approved with a value of 8.0 out of 10, where there is an agreement from respondents on wanting to make use of DP for charging EVs higher than the set value of 7.0. Where lease EV-driver show a value of 7.7 and private EV-drivers 8.4.

CSF 5 criterion is approved with a value of 8.3 out of 10, where more than 80% of the end-user must understand the concept of DP. Which shows that with the digital explanation the success rate is easily increasable and might not be necessary to be effective for total interaction.

CSF 6 criterion states that the two most prominent motivational objectives should have a minimum value of 5.0. The found most prominent objectives for end-users are the economical benefit (5.9) and the environmental benefit (3.8).

CSF 7 criterion states that respectively a DP scheme of hourly rates, peak rates or bonus-malus rates should be applied in the technology.
Preference of technology resulted respectively in the following three tools: a mobile app, QR-code on charging point and a webpage.
The sequential preference of information outputs is preferred as: €/kWh (economical), kWh charged (technical) and current charging level of battery (technical). To increase the ease of use and accessibility for end-user throughout the purchase decision process (pre and post) these sequential orders should be the guideline.

CSF 8 criterion is approved with a mean of 7.8 where the usefulness of information to motivate charging behaviour and increase interaction can be perceived with implementation of an ICS.

CSF 9 criterion states that internet (chosen by 35.0%) and energy providers (chosen by 22.1%) are the two most preferred types of communication channel integration by all respondents (potential and current end-users) per phase in the purchase decision process. Where online explanations (digital communication) followed by video explanations (audio-visual communication) are most successful.

CSF 10 criterion states that via a mobile application is the most preferred technology by 42.5%, for an ICS to be implemented in daily routines for the end-user in pre- and post-purchase decisions.

CSF 11 criterion is approved with the mean of 6.1, showing that the statement of: “If you charge between 13:00-15:00 today, then you save 0.40 cent per kWh charged.” is most motivating.

CSF 12 criterion is approved with the mean of 7.1 showing that positive experiences are shared more easily than negative experiences and stimulate pro-social behaviour.

From these CSF statements an overall conclusion about the difference in segmentations is the following. It is resulted that lease EV-drivers prefer bonus-malus pricing over hourly rates, and a display over a webpage. Private EV-drivers are more strongly inclined to share positive successes in the form of pro-social behaviour compared to lease EV-drivers. Next to that, private EV-drivers prefer €/kWh over kWh charged and have in general a better understanding of the concept of DP. They perceive information stronger to motivate their charging behaviour and increase interaction in comparison with leas EV-drivers.
Besides, the results suggest that a mobile app in combination with direct stimuli of notifications should be developed to increase *satisfaction*. Which therefore can increase the total interaction of end-users. This is in line with the literature review and its conclusional lesson 12, 13, 18 and 23. However, these results have their limitation, all limitations are incorporated in Section 11.2 and 11.3.

8.4 Weighting of CSFs

Section 8.4 discusses the normalised results of the data collection. This section underlines the weighting of CSF scores. Weighting the CSFs gives the opportunity to build Revolt's ICS roadmap on priority and significance in feasibility for end-user's engagement in interaction.

Table 6; Weighted CSFs

CSF	Description	Weight	All (Weight x score)	Lease (Weight x score)	Private (Weight x score)
4	Willingness to interact with DP	0.17	(1.36)	(1.31)	(1.43)
12	Stimulation on pro-social behaviour	0.14	(0.97)	(0.95)	(0.99)
2	Willingness to invest	0.12	(0.97)	(0.95)	(0.99)
7	Ease of use of perceived information output	0.11	(0.89)	(0.81)	(0.70)
10	Preferred method of implementation in daily routine	0.14	(0.76)	(0.84)	(0.84)
11	Perceived motivation of information format	0.09	(0.65)	(0.67)	(0.64)
8	Perceived usefulness of information	0.08	(0.62)	(0.61)	(0.63)
5	Understanding of DP	0.06	(0.50)	(0.48)	(0.49)
3	Perceived usefulness DP	0.05	(0.40)	(0.31)	(0.41)
6	Motivation for information search	0.03	(0.18)	(0.08)	(0.16)
9	Preferred communication channel	0.02	(0.16)	(0.18)	(0.17)

The weights are based on Revolt's management criteria and are assigned as a sequence. Later divided by the sum of the sequence (66). A higher weight indicates a higher importance in priority. The result of the weight multiplied with the scores gives the index score per CSF. On the CSFs where there are more numbers within a matrix, the highest score is taken. CSF 1 is taken out of scope, as it does not apply for an ICS. This all is sequenced in Table 6; Weighted CSFs and put in order of importance of all respondents.

Differences between the index scores for all respondents compared to only lease and private EV-drivers is that they prefer daily integration of technology used (*CSF 10)* over information outputs (*CSF 7*) and the type of communication channel integration (*CSF 9)* over decision on motivational objectives during information search (*CSF 6*).

8.5 Results core problem; norm and reality

In this section the gap between reality and norm of the core problem is analysed in conclusion to results of Section 8.1-8.4. The result for the two objectives of the core problem: *willingness* and *satisfaction* are discussed over all respondents and if the solution to the core problem is met by the measurement of CSFs.

As stated in 1.1, the reality of the core problem objectives is that Revolt currently has no interaction to influence EV-drivers' charging behaviour and the baseline is set on null. The norm of the core problem state that both objectives should at least increase to 60%.

As stated in Section 7.2, *willingness* is made quantitative via the questionnaire and analysed through CSF 2, CSF 3, CSF 4, CSF 6, CSF 11. *Satisfaction* is made quantitative and analysed through CSF 7, CSF 8, CSF 10, CSF 12.

Analysing the results per objective in Section 8.4 the *willingness* objective shows to have the overall index scored: (1.0, 0.4, 1.4, 0.3, 0.7) respectively. Resulting in an aggregated average of 0.7. Indicating on average an increase of precisely 73% of willingness with implementation of an ICS. Where lease contribution is indicated on 0.6 in probability and private EV-driver on 0.5 in probability. Thus, the *willingness* of end-user increases when the communication with accepted technology used, shows to fit their needs to maximise their economical and environmental benefit.

The objective s*atisfaction shows* to have the overall index numbers of: (0.5, 0.9, 0.6, 0.8, 1.4) respectively. Resulting in an aggregated average of 0.8. Indicating on average an increase of precisely 82% of satisfaction with implementation of an ICS. Where lease contribution is indicated on 0.9 in probability on and private EV-driver on 0.9 (90%) in probability. Thus, the *satisfaction* of end-user increases when the end-user must do as little as possible to maximise their economical and environmental benefit.

The total interaction is the aggregation of weighted averages of all CSFs, resulting in the aggregated average of 0.9. Indicating on average an increase of precisely 92% of total interaction with implementation of an ICS towards DP of all respondents. Where, lease EV-driver indicate on average 0.8 and private EV-drivers on average 0.7.

To conclude, the norm is reached, and an ICS of Revolt Energy stimulates interaction with the end-user towards a desired charging behaviour.

8.6 Conclusion Chapter 8

This chapter's conclusion emphasizes how to design an ICS. The questionnaire results reveal several insights for the design of an ICS for Revolt Energy. Results highlight the importance during the information search of the PDP that digital communication with audio-visual media as support stimulates interaction. Also results indicate a substantial awareness among respondents regarding DP. Providing opportunity for Revolt Energy to focus also on more advanced features and services. Respondents significantly show interest in investing in technology suggesting Revolt should explore outside their internal resources for a functional application which provides easiness of concepts. Development of a mobile application shows most promising for stimulation of interaction. Within the interface technical benefits are more prone to stimulate interaction with DP, whilst for motivation of charging behaviour the focus should be on the economical and environmental.

The results are normalised and weighted to an index score of the CSFs in Section 8.4. This resulted in the sequence of CSFs to focus on for an ICS roadmap. With the implementation of an ICS the *willingness* increases to 73% and *satisfaction* increases to 82% compared to the baseline of null. The aggregation of weighted averages of the CSFs leads to an increase of 92% of interaction with DP with implementation of an ICS. Concluding, that the norm of this research' core problem can be reached with implementation of an ICS.

9. Selection of strategy

9.1 Which communication strategies to be integrated

Chapter 7 sets up the Critical Success Factors (CSFs), comparing them with the actual conditions from Chapter 2's internal environment analysis. The CSFs standard is summarised in Section 8.5, Conclusion Chapter 8. Moving to this Chapter, 9.1, exploration on the implications of this standard and pinpoint communication strategies for the developmental process.

9.1 Which communication strategies to be integrated

This section outlines the feasibility of a roadmap implementation the conclusional design of Chapter 8 for an ICS integration at Revolt.

Section 9.1.1 outlines the resulted CSF sequence and framework variables to be integrated. Based on section 8.4 for implementation of an ICS from the conceptual framework variables perspective, showing the integration for a user-interface.

Where Section 9.1.2 sequences the conclusion on the design of an ICS in the PDP perspective of Chapter 5. Showing how the ICS should be applied according to the design preferences of respondents.

9.1.1 CSF sequence and framework variables to integrate in ICS

As the highest weighted CSF, willingness to interact with DP, scored a 1.36 in Section 8.5it can be stated that there is interest in an ICS for stimulating between charging stations using DP and the end-user. To develop an ICS, it is concluded from the sequence in Section 8.5:

Primarily, to enhance the total interaction the focus of an ICS should be on social norms. For example, pro-social behaviour. This involves prioritising satisfaction and product quality, achievable through the development of mobile applications with daily direct stimuli, feasible in the preferred technology with notifications. Enhancing on a significant number of respondents that want to make use of DP for charging EVs.

Secondly, concluded from Section 8.2 stating that the results of CSFs, it is of high importance that notification of price differentiation should be developed. Where direct stimuli should be given several times a day to encourage shifting charging behaviour. In line with the conclusion of Chapter 4, the direct stimulus should be personalised and dependent on the decision-making metrics of variables: battery SOC, driver's schedule, and cost of electricity during different time slots. Subsequently, a crucial step is increasing willingness, which can be effectively achieved by investing in additional technology to reduce reliance on non-renewable energy sources. During the information search phase, emphasising digital communication as the preferred channel enhances both economic and environmental benefits.

The third priority involves providing hourly EPEX-spot market prices through a mobile application, displaying information outputs such as €/kWh (economic), kWh charged (technical), and the current charging level of the battery (technical). This aims to improve ease of use and accessibility for end-user throughout the entire purchase decision process.

Fourthly, recognizing the importance of mobile applications for EV-drivers ensures their convenience and efficiency. The fifth step involves implementing if-then statements through notifications, enhancing the user experience.

The provision of accurate information about charging and charging sessions is a sixth key aspect. This is followed by explaining the concept of DP through a digital communication channel as the seventh step.
Eighthly, to maximise the usefulness of DP, digital communication should be further used. The ninth focus revolves around the most prominent motivational objectives: economic and environmental benefits.
Tenthly, using the internet for initial digital communication and subsequently incorporating audio-visual communication contributes to a more successful overall strategy. This chronological approach ensures a seamless integration of various elements to optimise an ICS.
A visualisation of the needed communications inter-face resulting from Chapter 8 is visualised in Figure 27.

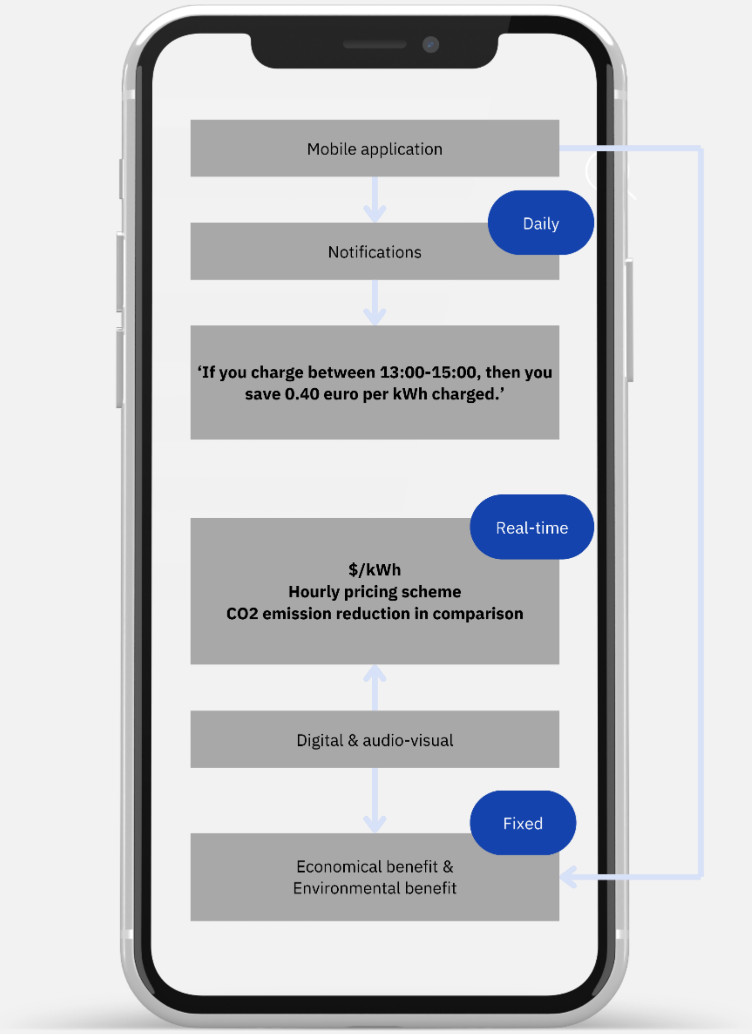


Figure 27; Conceptual integral ICS interface

9.1.2 Sequence and framework variables put in the PDP perspective

Phase-oriented implementation of an ICS is essential to influence charging behaviour. In line with the theory of Chapter 5; implementation is sought to be according to the PDP segmentate end-users have different needs and wishes (lesson 1, lesson 7-9 and conclusion literature review). Therefore, the implementation of an ICS for each phase must be addressed according to the resulted preferences of respondents to stimulate the desired norm of this research core problem.

For the need recognition phase, an ICS should help end-users recognize the problem and offer a suitable solution via **digital communication.** Using the **if-then statement**: ‘‘*If you charge between 13:00-15:00 today, then you save 0.40 cent per kWh charged*." To engage automation coupled with a learning process, a real-time **hourly pricing scheme** should be designed that is easy to understand and not overloaded with information. A simple and user-friendly dashboard in a mobile app with accurate information with the **focus on economical and environmental benefit** will stimulate engagement the most.

During the information search phase, an ICS should provide accurate supporting information for end-users via **digital communication or audio-visual communication** to make the best decision based on economical and environmental benefit and choose the service according to their desired profile.

In the evaluation of alternatives phase, an ICS can influence behaviour by highlighting the positive feelings resulting from users’ *willingness* to use the product and contributing to attitude formation through the communications tool of a **mobile application**. Recalling Section 8.2: Results of CSFs, it is of high importance that notification of price differentiation should be developed. Where **direct stimuli** should be given several times a day to encourage shifting charging behaviour. When recalling conclusion Chapter 4: The direct stimulus should be personalised and dependent on the decision-making metrics of variables: battery SOC, driver's schedule, and cost of electricity during different time slots.

During the purchase decision phase, an ICS should consider all attributes possible from competitors. Therefore, an ICS should show its compatibility based on the willingness and satisfaction objectives.

In the post-purchase decision phase, the end-user should be reassured that previous actions or investments have worked. They do this with a higher *satisfaction* motivation of positive experiences than negatives. Therefore, the **quality** is key.
An ICS implementation per phases and segmentation is visualised in Figure 28, Purchase decision process roadmap.

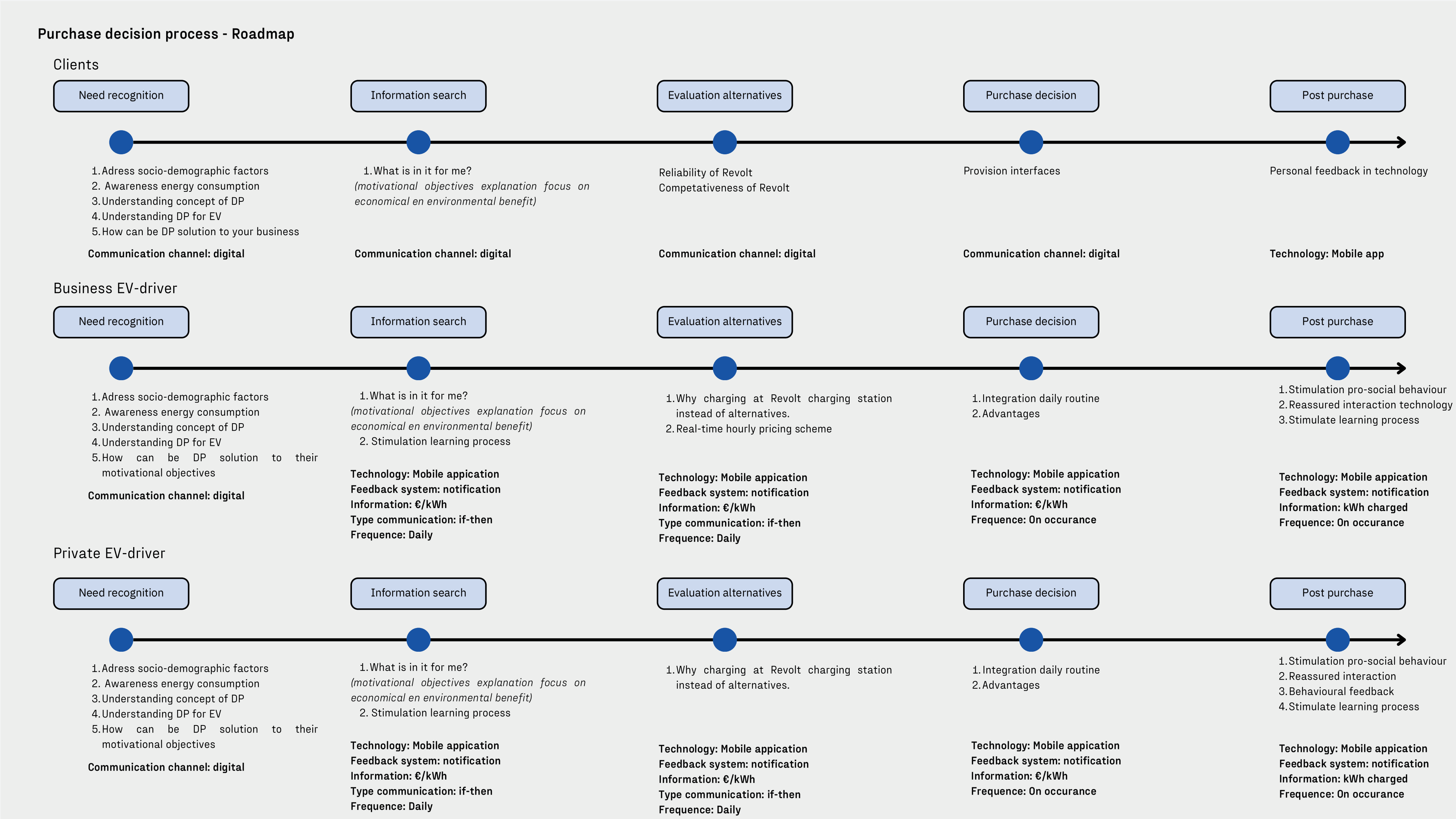


Figure 28; Purchase decision process roadmap

10. Design validation; feasibility & integration

The last phase of the Double Diamond model includes development of the ICS using the problem statement. A conclusion can only be drawn if the results are verified. Therefore, taking a step back to Chapter 0 and Chapter 6, this research outlines Revolt's resources, knowledge, and capabilities for an ICS. As a progress in the development phase, it is vital to specify the available resources in terms of budget and time, detailed in Section 10.1 (feasibility). This section extends in Section 10.1.2 to explore how feasible it is to integrate CSFs within the company. Section 10.2 shows the roadmap of an ICS plotted over time (integration). Presenting the outcome for integration of this research for Revolt, is given in Section 10.3 (development roadmap ticket). This chapter shows the roadmap how to increase the total interaction.

10.1 Feasibility of ICS

10.1.1 CSFs in creation of ICS

In this section the feasibility in terms of time and costs, indications of possibilities of developing certain aspects of an ICS will be discussed, based on the CSF statements as found in Section 7.2.

CSFs 1-4

Recalling Section 8.3 these CSFs are conditional factors for success rate of the data. As these are achieved, conclusions on the dataset are further analysed.

Recalling lesson 9&11 and CSF 5&6

Digital explanation about the concept of DP was provided in the questionnaire, which showed a high understanding rate. Therefore, digital communication is sufficient and feasible for the communication department. They can provide within a timespan of a marketing sprint (2 weeks) a communication template for digital communication, with focus on the economical and environmental benefit.

Audio-visual media can be created in Canva in straightforward design. Bigger projects can be outsourced in production, where the whole script, wishes and deadline should be provided.

Recalling lesson 4,10,19,23, and CSF 7&10

The most important aspect with the highest urgency making DP scheme feasible is the operational financial aspect (CSF 7). The offsetting of energy towards the client is to be investigated to become dynamic with the current system. Within the Revolt organisation investigation on the integration of a real time hourly pricing scheme of DP into the financial service back-end is necessary. This would at least take two months of investigation, with implementation time approximated at two months.

Revolt does not have the internal resources to develop a mobile application. To develop a mobile application a software developer should be recruited for a partnership with a mobile application provider, two examples are Stekker.app and Jedlix. Another option is a collaboration with Data lab, they can help to provide a dashboard or a mobile application with correct information outputs according to the outcome of the questionnaire. They are also able to create a mobile application for Revolt, this will have excessive cost and take at least half a year. However, via Webflow they can create webpages, also with loading of dynamic data via a specific API or HTML–5 tool, but this takes support of Goodkarma and can take up to 1 month, but this has financial consequences. As Revolt is limited to tier financial resources, focus must lay on the internal resources for development.

The QR-code on charging points has already been applied on their charging points since October 2023. Therefore, a DP scheme and content on these QR-codes on charging points is most feasible in the short term. In long term perspective a mobile application can be developed.

Recalling lesson 12,13,25 and CSF 8&10

Feasibility in providing useful information and ease of use via the preferred feedback system can be created by a mobile application, in which users can adjust preference and make it tailored, with direct stimuli on a daily frequency of notification.

Recalling lesson and CSF 9

Using the current website of Revolt, online explanations (digital communication) followed by video explanations (audio-visual communication) can be placed. The content can be made by the marketing department, with support of a marketing agency. Timewise this will cost a maximum of three weeks to develop. As the second preferred outcome was the feasibility for Revolt to pop-up in the internet environment as an energy provider, marketing wise it can be accomplished by their google advertisement.

Recalling lesson 8,16,20 and CSF 11

Feasibility to implement the timely announcement of if-then statements can be reached via notification (direct stimuli), through sending automatic generated email notifications. Currently Revolt sends email campaigns for Sales, which also can be used for email notifications towards end-users of Revolt Energy. However, this asks a lot of internal operational resources daily.

Therefore, the feasibility of implementation of the if-then statements can also be realised by developing of a mobile application.

Recalling lesson 4&7&14&21 and CSF 3-5&12

Feasibility to stimulate pro-social behaviour is made possible by the media screen on Revolt's HUBs. Which can be used as a screen to explain DP charging of the charging points and sharing visual media considering as well as elaborate on the possibility to charge at the HUB. These designs are made in Canva and can be created within a marketing sprint of 2 weeks.

Next to that, positive experiences make people through word-of-mouth. Therefore, it is of importance to create a premium user experience.

Recalling lesson 26

Requirements from Revolt regarding communicative marketing components and accepted technology show that Revolt is dependent on partners for their technical performance in terms of infrastructure, installation, maintenance, and service, which should be considered on the roadmap. For example, the timeline of the technical aspect of application to a second allocation point will take at least 5 months and CPO platform innovations take around two months. This is discussed in Section 9.2.

10.1.2 Feasibility per internal department

Analysing the company's workforce provides insights into its human resources, such as the skills, knowledge, and experience of its employees that create the feasibility of how to create an ICS. From section 9.1.2 the feasibility is broken down per internal department of Revolt, shown in Table 7. Together with the time- and cost investment per task to the development process of an ICS and the CSF index score show how much, in comparison to the willingness and satisfaction, a certain task can increase the total interaction.

The extent to which effective marketing encourages users is depending on the available budget and time resources. The estimation of required resources is based on the specific goals Revolt aims to achieve. The development of a new product depends on actual needs. While Revolt can create content in-house, a significant portion of the budget should be allocated for building an app.
Time- and cost wise a decision should be made on:
(**1**) outsourcing the development of a mobile application / dashboard by a third party will take around 6 months to complete and will cost around EUR 33,772.80.
(**2**) Insourcing the development of a mobile application to a software developer can take up to years, with a minimum of 1 year and will have a cost on average of EUR 61,010 per year based on a historical quotation received.
(**3**) To establish a partnership will take around 7 months to complete and integrate in the correctly implemented form around 9 months.
(**4**) Outsourcing the creation of web pages with dynamic data takes 1 month and costs around EUR 3,200 to create website content services based on historical quotation received.

An estimation of the correlation of CSFs with the internal department tasks is made, based on the conduction of analysing the CSF index score. The various index scores are averages to provide an aggregate measure, offering insight into the potential correlation toward the *willingness* and *satisfaction* of the end-user, shown in the 5th column of Table 7; feasibility internal department, where w=willingness and s=satisfaction. Some CSFs are applicable for more development tasks. Therefore, these index scores are divided over the number of tasks.

E.g.: The satisfaction of the development of mobile application score = (0.89/2) + (0.76/2) = 0.83.
In the formula of 0.89/2: Concluded in Table 6 is the average of CSF 7 is 0.89, Table 7 indicates that development of a mobile application has two tasks. Therefore, the average of 0.89 is divided by 2.
In the formula of 0.75/2: Concluded in Table 6 is the average of CSF 10 is 0.76, Table 7 indicates that development of a mobile application has two tasks. Therefore, the average of 0.76 is divided by 2.

Department	Tasks	Time	Cost	CSF index score
Marketing	1.Digital communication with support of audio-visuals on webpage (fixed) a. What is DP b. Economical & environmental benefit of DP 2.Digital communication with support of audio-visuals (real-time) a. EPEX spot-market prices	1. 1 month 1a. 2 weeks 1b. 2 weeks 2. 1 month 2a. 1 month	1. 0€ 1a. 0€ 1b. 0€ 2. 3,200€ 2a. 3,200€	1 CSF 5 (s) - 0.50 CSF 6 (w) - 0.29 CSF 9 (s) - 0.11 (w: 0.31, s: 0.28) 2 CSF 4 (w) - 1.37 CSF 9 (s) - 0.11 *(w: 1.37, s: 0.06)*
Operations	1.Development of mobile application a. Personalised notifications b. Real-time insight EPEX	1. 6 months- 1 years 1a. 3 months 1b. 6 months	Options: i. Insource: 61,010€ ii. Outsource: 33,772.80€ iii. Partnering: 0€	1 CSF 2 (w) - 0.97 CSF 7 (s) - 0.89 CSF 10 (s) - 0.76 CSF 11 (w) - 0.65 *(w: 0.81, s: 0.83)*
Finance	1. Incorporation of real-time pricing in financial services 2. Creation of Return of Investment model	1. 1 month 2. 3 months	1. 0€ 2. 0€	1 CSF 7 (s) - 0.89 (w:0, s:0.45) 2 CSF 3 (w) - 0.40 *(w:0, s: 0.40)*
Sales	1. Elaborate on pro-social behaviour making the need for recognition increase.	1. On-going	1. 0€	1 CSF 12 (s) - 1.39 *(w: 0, s: 1.39)*

Table 7; Feasibility per internal department with CSF score

10.2 Constraints to implementation of an ICS

A constraint for the implementation of Revolt Energy in general is that the technical service is dependent on energy providers applying a second allocation point or an extra metre. This has huge lead times. Besides the technical service needs good communication between the Operations team and the energy provider partner about technical implementation and financial reinforcements.

From literature we know the following. Limited end-user understanding of the DP model received criticism from end-users who found its complex structure too difficult to implement. More than a third of dynamic end-users did not register on the web portal, which meant they never received the price information needed to make informed consumption decisions (Kessels et al., 2016). While automation can alleviate the challenge of reacting to complex and constantly changing price signals, it can also enhance the overall flexibility of residential users. Manual control schemes are considered a starting point in the learning process of adopting smart end-use solutions. As manual options are sometimes preferred over automated schemes. Active users who manually shift their loads achieved better outcomes than passive end-users with energy management systems. This finding emphasises that automated solutions require the conscious examination of settings and consumption preferences by end-users for active acceptance. As technology becomes more dependable and options become easier for end-users to understand, this situation may change. Where the ICS therefore should have a dual focus on not only automation but also manual integration.

Because of the growing adaptation of EVs and limited availability of charging points, end-users might be discouraged to drive electric. The limited availability of charging points impacts the willingness of the end-user to interact with charging points, influencing their charging decision and behaviour. They will make their charging decisions based on availability of charging points instead of the combination of pricing scheme, flexibility, and battery SOC state by Kessels et al. (2016).

From Section 0.5, the total transparency towards the purchase price to the end-user can currently not be guaranteed, as the e-MSP adds their own pricing to the total cost. Revolt should function as their own MSP provider to guarantee total transparency in pricing.

The marketing budget of Revolt is limited, and it is desired to insource as much as possible.

10.3 Integration in development roadmap timeline

Revolt is the problem owner of their services; therefore, they should be pro-active in the design implementation of an ICS. Revolt works with a development roadmap with specifications for integration for a new product or service to be plotted and integrated on their timeline, outlined in Figure 29. This figure's timeline shows when specific development roadmap tickets are to be developed. The development tasks of an ICS are plotted as a task within a horizon and category. The horizons serve as indicators revealing how the development contributes to enhancing the value proposition of Revolt in the market. Horizon 1 is closer in time frame then horizon 2, and horizon 2 closer than horizon 3. Meanwhile, the categories demonstrate how the integration of roadmap development will be implemented within Revolt's portfolio with a given number. The horizons and categories are stated as:

1. Horizon 1: optimisation
2. Horizon 2: new product of market
3. Horizon 3: disruption (new product + market)

1. Category 1: product
2. Category 2: software
3. Category 3: platform

To illustrate, the green ticket H1 So2 is places on the horizon 1 with the category software, given the number 2.

Figure 21; Revolt's development roadmap timeline

For an ICS is to be integrated in Revolt's development roadmap a development roadmap **ticket** should provide indication for the development process of the additional product or service into their stated horizons and categories. With integration of an ICS development roadmap ticket on the timeline, the development an ICS can follow the pathway of consistency of follow-up in Revolt's development roadmap.

In Table 8 the development tasks per internal department are plotted over the horizons and categories to provide insight into integration on the development roadmap timeline of Revolt. The **green** tickets in Figure 29 indicate the dependency of the tasks of an ICS ticket on the already implemented tickets on the development roadmap. The **red** tickets indicate are to be reassigned on the timeline, due to delay in accomplishments.

Table 8; Feasibility integration on development roadmap timeline

Department	Tasks	Horizon	Category
Marketing	1.Digital communication with support of audio-visuals on webpage (fixed) a. What is DP b. Economical & environmental benefit of DP 2.Digital communication with support of audio-visuals (real-time) a. EPEX spot-market prices	1a. Horizon 1 1b. Horizon 1	1a. Software (4) 1b. Platform (3)
Operations	1.Development of mobile application a. Personalised notifications b. Real-time insight EPEX	1a. Horizon 1 1b. Horizon 1	1a. Software (2) 1b. Platform (3)
Finance	1. Incorporation of real-time pricing in financial services 2. Creation of Return of Investment model	1. Horizon 1 2. Horizon 1	1. Platform (3) 2. Software (4)
Sales	1. Elaborate on pro-social behaviour making the need for recognition increase.	1.Horizon 1	1.Product (9)

10.4 Development roadmap ticket

For consistent follow-up and clear overview of the impact of further development of a ticket, Revolt takes the following eight elements to be included in a development roadmap ticket:

1. Potential partners or external
2. Dependency on other ticket
3. Budget
4. Timing
5. Priority
6. Details
7. Technical
8. Functional

Based on all the gathered information in this research, these eight elements are put in the ticket system concluded in Figure 30: ICS ticket. This ticket shows implementation and feasibility of an ICS for Revolt's development roadmap. Figure 31 provides an example of the product user-interface of an ICS design. Next to that, this research's outcome is sequenced in order of Purchase Decision Process in Figure 28 in section 9.1.2. These 3 figures (Figure 28, 30 and 31) together form the basis of this research's outcome.

Development roadmap

Ticket: Integral communication strategy (ICS)

Details

The ICS is part of the Revolt Energy service. Consisting of the needed communication with supporting technology from the end-users perspective to interact with EPEX-spot market dynamic pricing. It consists in total of 6 tasks:

1. Fixed digital communication on website;
2. Real-time digital communication on website;
3. Mobile application;
4. Incorporation of real-time pricing in financial services;
5. Creation of ROI model
6. Elaboration pro-social behaviour.

Dependency on other tickets

This development is dependent on development with the CPO and MSP partners, software mobile application development, Revolt Energy, Dynamic pricing and EPEX spot trading.
(H1Pr9, H1So2, H1So4, H1PI3)

Priority

This development is dependent on development with the CPO and MSP partners, software mobile application development, Revolt Energy, Dynamic pricing and EPEX spot trading.
(H1Pr9, H1So2, H1So4, H1PI3)

Budget

36,972 €

Potential partners

This development is dependent on development with the CPO and MSP partners, software mobile application development, Revolt Energy, Dynamic pricing and EPEX spot trading.
(H1Pr9, H1So2, H1So4, H1PI3)

Timing

Start: now
Finish: 2 weeks up to 1 year

Technical

Mobile application:
- Notifications
- Real-time pricing
- Insight in information

Webpages:
- Real-time pricing
- Audio-visual support

Functional

Customised providence of information towards customers and end-users on their economical and environmental benefits to effectively increase willingness and satisfaction on Revolt Energy.

Figure 30; ICS ticket

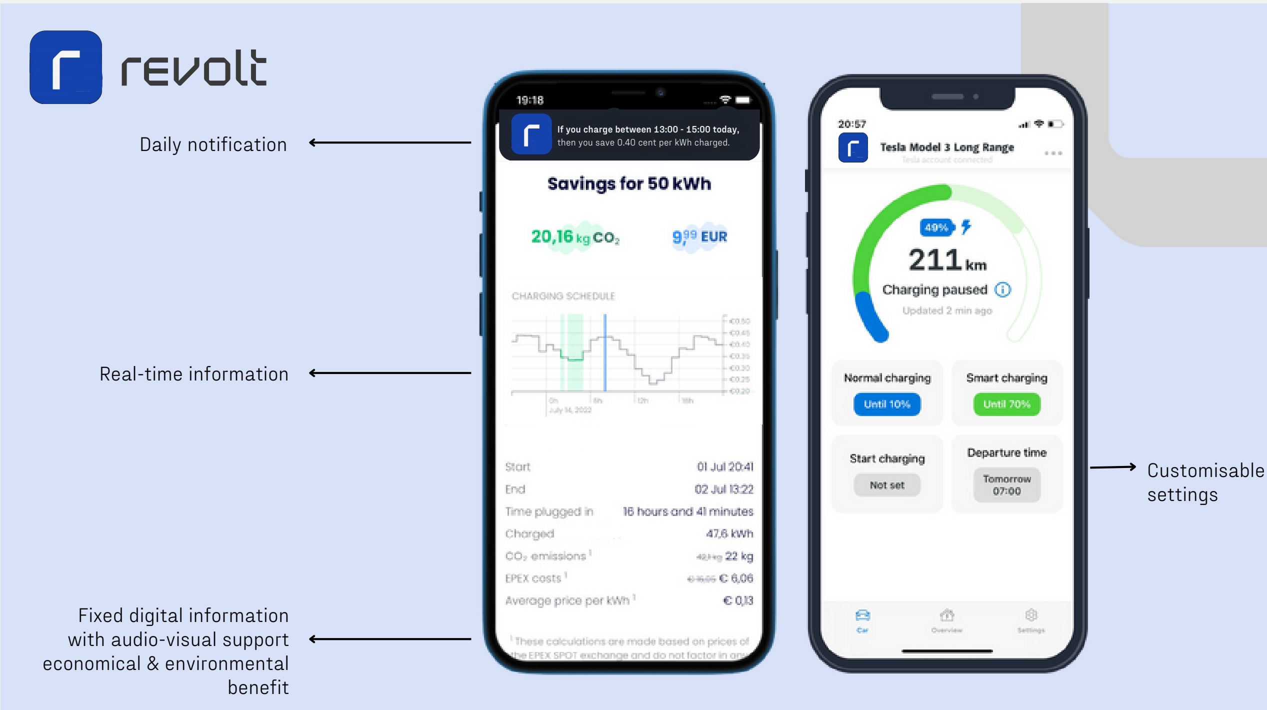


Figure 31; Research outcome; User interface of ICS

11. Conclusion, recommendation & discussion

11.1 Conclusion
11.2 Recommendation
11.3 Evaluation
11.4 Reflection

This chapter focuses on the outcome of the research. Section 11.1 discusses the conclusion, section 11.2 the recommendations for Revolt and section 11.3 an evaluation on the research outcome.

11.1 Conclusion

Revolt is a company that focuses on how to deliver their own dynamic energy supply to guarantee affordability (everyone) and sustainability (anytime) on their charging points for companies and event locations. As the provider of energy for EV-drivers, Revolt is confronted with the challenge of shaping electricity demand towards the desired profile of a less volatile demand profile and better predictability of electricity demand and peaks. To change EV-drivers' behaviour, Revolt must interact with EV-drivers to encourage the desired charging behaviour of a less volatile and better predictable energy demand profile.
As the applied theory of DP - changing prices over time - is complex for (potential) clients and EV-drivers, the question is how Revolt should best increase interaction in design for a communicative DP approach for their services.

By identifying effective strategies and communication channels, Revolt can encourage drivers to adopt sustainable charging behaviours while maximising their revenue through DP. This can also contribute to reducing carbon emissions and achieving their mission for a more sustainable future.

Currently, Revolt has no interaction to influence EV-drivers' charging behaviour. The desired state is to stimulate EV-drivers to change their charging behaviour. Therefore, this research focuses on this gap, stating:
'***The willingness and satisfaction of end-user to make use of DP at the charging point should at least increase to a probability of 60%.***'
The objectives '*willingness*' and '*satisfaction*' are measured by the quantity and quality impact of the developed product of this thesis: An ICS on end-user.
The probability of 60% is the norm formulated in consultation with Revolt's management. It is the minimum requirement for Revolt to state that an ICS for Revolt Energy stimulates interaction with the end-user towards a desired charging behaviour.

During the comprehensive analysis in literature, the establishment of a framework and questionnaire findings conclusions have been revealed. From literature, the conclusional top 26 lessons are crucial for stimulating the *willingness* and *satisfaction* of end-users via interaction and serve as the basis for this conclusion and establishment of framework and questionnaire. The top 26 lessons can be found on page 62. Some lessons to highlight are:

1. For Revolt to remain competitive, it should at least develop a mobile application to encourage desired behaviour.
2. Notification of price changes in advance leads to better responsiveness, and direct stimuli should be given several times a day to encourage shifting charging behaviour. Where "if-then" statements are found powerful for reprogramming behaviour.
3. Addressing social norms, pro-social behaviour is more likely to occur on a longer-term.
4. Users must be enabled to see their economical and environmental benefit to study historical usage as well as to see what impact changed behaviour has on consumption and price.
5. Timing of interventions is crucial for unlocking end-users' contribution to react to the distinct phases of the end-users purchase decision process, where the phases of the PDP are considered.

Via description of several CSFs the results of the questionnaire are quantified to analyse the output. Via normalisation and aggregation of index scores, this research's' data collection found that *willingness* can be increased up to 73% and *satisfaction* up to 82% in probability with implementation of an ICS. Hence, it can be stated that by implementation of an ICS for DP, guided by the top 26 lessons, a desired charging behaviour will be stimulated (E.g., the found if-then statement).

Therefore, when Revolt considers adding more charging stations, it is important to consider the potential environmental impact of increasing their energy demand. While Revolt is a profit-driven company with a goal of minimizing material usage and energy consumption, it is important to also consider the long-term environmental impact of their actions. It is worth noting that relying solely on EV cars is not a complete solution, as their production still relies on fossil fuels. It is important to acknowledge that the risks associated with their operations and sphere of influence are influenced by political decisions and investments. Regulations are constantly changing, including the new Afier regulation (Alternative Fuels Infrastructure, n.d.). The aim of this research is to significantly reduce the environmental impact of energy consumption in Dutch society, thereby alleviating the increasing pressure on the Dutch grid by developing an ICS. It is important to acknowledge that the current research does not consider travel times and social media feedback implementation. However, these aspects could be explored in future research to enhance the effectiveness of the approach. The implementation of an ICS Revolt has the potential to motivate end-users to participate in achieving a more evenly distributed electricity demand, which is crucial for a sustainable future.

11.2 Recommendation

Grounded by the literature, experiments, and the questionnaire a set of recommendations is advised for Revolt. These recommendations contribute by making this theoretical plan for an ICS work well during implementation and prepare Revolt for potential difficulties to stimulate interaction with end-users towards a more desired charging behaviour. On the design of an ICS only weighted CSFs scoring higher than 0.50 are incorporated to narrow down the scope for feasibility. With the research goal to stimulate the objectives: *willingness* and *satisfaction* from the null baseline towards a 0.6 probability score.

The first recommendation is to focus on addressing social norms. As highlighted in section 8.4, pro-social behaviour CSF scores the highest in index (0.97) towards influencing charging behaviour. As this is also suggested by the theory of Breukers et al. (2013), which provided that the experiences of the 'early adopters' of automated devices in combination with dynamic pricing turn out to be positive influencing demand-response programs.
It is essential to have effective communication with the end-users to explain the importance of their value for the Dutch electricity grid, to provide transparency in their purchase of energy and of course to highlight their economical benefits. This involves prioritising satisfaction and product quality. Engaging for longer than 3 months, as people need at least 3 months to get used to new routines. These early adaptors experiences can be used as a 'lever'—by word-of-mouth or other normative social influences—to enrol other EV-drivers in demand response programs. Resulted from the data collection 83.1% of respondents is familiar with DP where 26.4% identified themselves as pioneers / early adaptors.
Thus, with primary focus on pro-social behaviour the product is more likely to be interacted with on long-term. Next to that, from section 2.5 DP strategy is estimated to increase the total margin by 25%, as result of decrease of energy costs by 30%. Therefore, there is an enormous potential in buying the energy directly and selling it via Revolt's network, as 80% of the revenue comes from the margin on energy sales. Nevertheless, it is difficult to determine the capabilities, constraints, and space for extra investment based on these numbers only. It would be important to consider additional factors such as the company's cash reserves, debt levels, and market opportunities to make a more informed assessment of its financial position.

The second recommendation is the investment in technology of a mobile application for applying DP as the willingness of invest from end-users scored for the weighted CSF an 0.97. Besides, a mobile application shows in section 8.5 to be stimulating the *willingness* and *satisfaction* of the end-user with a CSF index score of 0.8. Therefore, it shows the most promising perspective for stimulation of total interaction. As a mobile application can be implemented in the daily routine and is stated to be the most preferred communication tool by respondents with 42.5% followed by QR-code on charging points. When taking feasibility and respondents' significant willingness to invest in technology into account, partnering with Jedlix and/or Stekker.app is most desirable. As they offer white-label mobile applications, which reduce costs and create internal knowledge of software development and make it possible to implement more complex technologies. This all will assist to life the success of Revolt Energy. However, from literature it is stated that it is important to have clear policies and regulations in place for the collection, storage, and sharing of user data. Additionally, implementation of secure systems to protect user data from unauthorised access or theft is advised.

The third recommendation is to optimise the communication tool integration on if-then statements with daily, real-time, and fixed information as this scored a 0.89 in section 8.4, applied according to the ease of use of perceived usefulness of information output. Next to that, resulting from the questionnaire, daily notifications with if-then statements are received as motivational by end-users showing to stimulate the *willingness* and *satisfaction* of end-users with a CSF index score of 0.6. In line with literature and the questionnaire the economical benefit is the most important *willingness* objective with a value of 62.7% (see section 8.2). Secondly, the statement with an economical benefit is valued highest with 4.2/5. The statement follows is: ''If you charge between 13:00-15:00 today, then you save 0.40 cent per kWh charged." Whereas the most preferred information is €/kWh (chosen by 21.9%) and kWh charged (chosen by 21.4%) this information is found useful for motivating charging behaviour with the mean of 3.8/5, where information increases the ease of use to interact with charging points. Integration of the economical benefits with DP should be integrated in technology as information output to stimulate the total interaction with Revolt Energy.

The fourth recommendation is to guarantee total transparency building trust and quality for the product, as this scored best within the preferred method of implementation with weighted CSF index of 0.76. A transparent pricing shows in section 8.5 to be stimulating the *willingness* and *satisfaction* of the end-user with a CSF index score of 0.8. For example, the implementation of real-time hourly rates based on the EPEX spot-market with implementation of a DP scheme. As this resulted, with preference by 42.4%, from the questionnaire. Regarding transparency in charging fees at the charging point Revolt should also offer MSP services via direct marketing at the charging point. Where EV-drivers can directly subscribe to Revolt as MSP and CPO provider to avoid MSP charging costs.

The fifth recommendation is to maximise the usefulness of DP, with fixed digital information online explanations on the website about the concept of DP for clients and EV-drivers. This is in line with the CSFs perceived motivation of information format and perceived usefulness of information scoring a 0.65 and 0.62 as weighted CSFs. As this resulted to be the most preferred channel by 66.7% of the respondents. The supply of information via digital communication should always be permanent to serve end-users at any time. As feasibility is high, insourcing it via the marketing department provides sufficient information for end-users in their exploration phase for changing energy services toward Revolt Energy. Here, incorporating audio-visuals is suggested as the second most convenient method for motivating dynamic charging behaviour.

The sixth recommendation is when applying Revolt Energy also might look at the possibility to extend the market to home chargers. As in Section 3.1.1 the results of the experiment of the charging decision shows that around 50% will charge at home, up till 2050. This is in line with the questionnaire results in section 8.1, showing that 54.2% of the respondents charge at home. There, the EV-driver has more flexibility in time and the willingness for DP is more accurate as energy demand peaks mostly occur during hours just before or just after working hours.

Continuing the previous recommendations, additional research is required for internal consistency. Constraints regarding internal resources, technical services, time, and complex structure should be further evaluated as this is not incorporated within this research but are found to be crucial for further development. For example, a financial Return of Investment (ROI) model for Revolt's clients, specified in Appendix H. Next to that, Revolt should not increase their financial risks due to implementation of DP, as there is a daily financial risk of increased charging prices with implementation of DP. Additionally, the charging behaviour profile of end-users could be put over the EPEX spot market prices to show indication of profits for Revolt when applying Revolt Energy services towards clients. It will show the quality of service, which is in line with Revolt's policy. Furthermore, an ICS is a recommendation from the end-user's perspective, not considering the internal perspective. A further investigation on the prospect of ICS is effective. An example like a simple A-B test could be conducted to evaluate if an ICS leads to increased interaction, outlined in Appendix H.

11.3 Evaluation

In literature Konstantina Valogianni et al. (2020) state that price schemes like adaptive pricing might be more effective than DP in the case of smoothening the energy demand - desired behaviour profile of end-users. Next to that, suggested is 'sustainable pricing' which considers factors like competition, government regulation, economic crisis, etc. could be of interest. These types of pricing scheme are taken out of scope, as the company desires the implementation of DP. However, this statement should not be overlooked when seeking to encourage the desired charging behaviour of a less volatile and better predictable energy demand profile.
The internal validity of the framework is taken out of scope and the assumption is made that the framework is correct. For comprehensive correctness, it is essential to also assess the internal validity as the framework is based on assumptions from literature.

In construction of the framework the TAM is used instead of the UTAUT. The UTAUT combines the TAM and six other models. For example, consumption behaviour suggest that some triggers based on user interface options like simple colouring can influence different individuals, or integration possibilities into navigation software and adaptation loops on user feedback. The UTAUT is said to be the strongest predictor of use of intention and is significant in mandatory and voluntary setting (Zhou, Lu & Wang, 2010; Venkatesh, Thong & Xu, 2016). However, due to simplification reasons, the TAM model is used in this research. For stronger predictor, the UTAUT integration might be suggested for showing a broader set of solutions.

In review of literature on behavioural change of the end-users' theories on behavioural changes and social cognitive theories are suggested to enhance more on. Examples of behavioural change theories are the Theory of planned behaviour (TPB) (Ajzen, 1985) or the Transtheoretical model (TTM) (Prochaska, 1977). For social cognitive theories I would refer to the social cognitive theory (SCT) or the Self-Efficacy theory from Bandura (Simply Psychology, 2024a). Theories can be used in the context that understanding the factors that influence behaviour (TPB), providing clear stages and support for adaptation (TTM), leveraging peer influence and modelling (SCT), and enhancing confidence in using dynamic pricing (Self-Efficacy Theory). Which can all contribute to more effective engagement of strategies on behavioural change for end-users.

For personal feedback, only the theories found within the SSL are considered due to the time constraint. For more comprehensive research, examples such as social media sharing for feedback implementation within an ICS should be suggested.

Evaluation on the questionnaire has resulted from the respondents as they were able to leave comments. Overall, it was given a value of 4.0/5.0. Showing the perception of significance of the questionnaire is experienced positive. The questionnaire also showed that more that 80% of the respondents were familiar with the concept of DP, which makes the results positively biased. In line with results of Breukers et al. (2013) found.

Feedback on the questionnaire is that a few questions were found vague and unclear. For example, the question: '*To which degree do you agree …*' Further, certain notes for future investigation were highlighted by respondents. For example, the questionnaire lacked the reason for lowering the demand peaks for EV-drivers' electricity contract. As this was more put in the background as fixed information, this should also be highlighted when applying DP. Also highlighted is the fact that next to DP for EV-charging, batteries and accus are also found to apply an ICS for. Examples of competitors who do so are Jedlix and VanderBron stated by a respondent. Next to that, regarding the charging behaviour a technical matter is stretched that current electric cars often have a minimum threshold of 6-4 kWh. This means they do not reset to 0 kWh even when, for example, there are high prices or a significant amount of CO_2 emissions. This is detrimental to both users and the environment, and consequently, it also affects the business case for dynamic charging. Europe, RDW, or the Ministry of Infrastructure and Water Management should address this with the automotive industry for a minor technical adjustment. This aspect remains overlooked in the questionnaire. Further evaluation on the research ethics is stated in Appendix I.

11.4 Reflection

By the thorough literature review the outcomes of the questionnaire were not surprising. Next to that, I conducted my questionnaire in an EV-driver environment among people who like to be pioneers, for them DP is no new concept. As stated, socio demographic factors influence the dependent variable (total interaction) and might influence the outcomes of this thesis.

A lesson learned is that making assumptions is important to come to a result for a thesis. With assumptions you can narrow down the scope. As the scope of this thesis was very wide, even more assumptions could have been made and structured at the beginning to state directly which way you go with the outcomes.

In the questionnaire different scales were used for the ease of the respondents, unfortunately this made it difficult to normalise the outcomes. A thing learned here is to use 1 scale and that the questions should show directly the wanted output for CSF and not aggregated averages. Another thing here is to not make the questionnaire too large, with a maximum of 10 easy questions not taking longer than 2 minutes.

One thing I learned from the process of writing research is to start directly in the wanted lay-out. It saves time in the end to go over the whole thesis and change every single letter written. The decision to use google docs for its easiness of structuring and sharing was chosen, but it lacks ease for good lay-out structures.
The most important reflection is the importance of surroundings for me. I worked 5 days at the company, and it gave a lot of motivation towards the subject of the thesis. It even resulted in a full-time job, where I still collaborate with colleagues about DP developments.

Next to that, Cooper, and Schindler (2014) propose criteria for evaluating a good research study.
In terms of importance, the research problem is relevant and significant to IEM as it evaluates a conceptual solution model following scientific methods. It has practical implications as an implementation plan is made.
In terms of objectives, as a researcher my research has clear and specific objectives that are achieved through the guidelines of the MPSM of Heerkens (2021), where the *willingness* and *satisfaction* objectives are measured throughout the research.
In terms of literature review, the study is based on comprehensive and relevant reviews of the existing literature described in chapters 3-5.
In terms of conceptual framework: The study is grounded by a theoretical framework that explains the relationships between variables which created a conceptual framework. Input for the data collection and guideline for analysing the results.
In terms of methodology, the research design and methods are appropriate and valid for the research questions being addressed, as the research design is based on the Double Diamond model of the Design Council of the UK (2005).
In terms of data collection, the data collected should be dependable and valid. By taking a quantitative survey approach in the target market I hope to have established a representative sample of the population being studied.
In terms of data analysis, the analysis should be appropriate for the research questions being addressed, and the findings should be presented clearly and accurately. To make sure of validity of the analysis and statistic measurement chapter 8 shows the validity of the outcome for the given recommendation.
In terms of conclusions and recommendations, the conclusions are based on the findings of this research. Recommendations are made based on the conclusions and an implementation plan. With the extended research methodology, I hope to have set qualitative good research which meets the requirements for good research.

References

1. *About EPEX SPOT | EPEX SPOT*. (n.d.). *| Consulted on 11-05-2023* https://www.epexspot.com/en/about

2. Abrahamsen, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *Journal of Environmental Psychology*, *27*(4), 265–276. https://doi.org/10.1016/j.jenvp.2007.08.002

3. *AC / DC charging*. (n.d.). *| Consulted on 11-05-2023* https://www.evexpert.eu/eshop1/knowledge-center/ac-dc-charging-electromobil-current-alternating-direct

4. Agsten, M.; Bauknecht, D.; Brinker, W.; Conrads, R.; Diebels, V.; Erge, T.; Feuerhahn, S.; Heinemann, C.;
5. Hermsnmeier, J.; et al. eTelligence Abschlussbericht. Neue Energien brauchen neues Denken; EWE AG: Oldenburg, Germany, 2012.

6. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-t

7. *Alternative fuels infrastructure*. (n.d.). Mobility and Transport. https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable-mobility-europe/alternative-fuels-infrastructure_en#:~:text=Alternative%20Fuels%20Infrastructure%20Regulation,-In%20the%20context&text=The%20proposed%20regulation%20sets%20a,vehicles%2C%20vessels%20and%20stationary%20aircraft.

8. Anderson, C., & Claxton, J. D. (1982). Barriers to user choice of energy efficient products. *Journal of User Research*, *9*(2), 163. https://doi.org/10.1086/208909

9. *Basics of the Power Market | EPEX SPOT*. (n.d.). *| Consulted on 18-05-2023* https://www.epexspot.com/en/basicspowermarket

10. Baron, R., & Kenny, D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51, 1173–1182. https://doi.org/10.1037//0022-3514.51.6.1173

11. Batlle, C., & Rodilla, P. (2008). ELECTRICITY DEMAND RESPONSE TOOLS: STATUS QUO AND OUTSTANDING ISSUES. *Working Paper*.

12. Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., & Courchamp, F. (2012a). Impacts of climate change on the future of diversity. *Ecology Letters*, *15*(4), 365–377. https://doi.org/10.1111/j.1461-0248.2011.01736.x

13. Bellifemine, F. L. (2011). Analisi del valore di un sistema di Home Energy Management. *Energy@Home*.

14. Blythe, J. 2008. User behaviour. Cengage Learning EMEA.

15. Breukers, S. C., & Mourik, R. M. (2013). the end-users as starting point for designing DP approaches to change household energy consumption behaviours. In *Netbeheernederland*. DuneWorks. https://www.netbeheernederland.nl/_upload/Files/Dynamic_pricing_and_behaviour_change_99.pdf

16. Bhattacharya, S.; Ghavami, A.; Kar, K.; Gupta, A. Price-driven Charging of Plug-in Electric Vehicles: Nash Equilibrium, Social Optimality and Best-response Convergence. In Proceedings of the 2013 47th Annual Conference on Information Sciences and Systems (CISS), Baltimore, MD, USA, 20–22 March 2013; pp. 1–6

17. Chen, C., De Rubens, G. Z., Noel, L., Kester, J., & Sovacool, B. K. (2020). Assessing the socio-demographic, technical, economic, and behavioral factors of Nordic EV adoption and the influence of vehicle-to-grid preferences. *Renewable & Sustainable Energy Reviews*, *121*, 109692. https://doi.org/10.1016/j.rser.2019.109692

18. Cox, M. (2015). A basic guide for empirical environmental social science. ECOLOGY AND SOCIETY, 20. https://doi.org/10.5751/ES-07400-200163

19. Dao, V. T., Langella, I. M., & Carbo, J. A. (2011). From green to sustainability: Information Technology and an integrated sustainability framework. *Journal of Strategic Information Systems*, *20*(1), 63–79. https://doi.org/10.1016/j.jsis.2011.01.002

20. Darley, W.K., C. Blankson, and D.J. Luethge. 2010. Toward an integrated framework for online user behaviour and decision-making process: A review. Psychology & Marketing 27(2): 94–116.

21. Davis, F. (1987). User acceptance of information systems: the technology acceptance model (TAM). *University of Michigan*.

22. *Definition of power*. (n.d.). www.dictionary.com. https://www.dictionary.com/browse/power#:~:text=Scientific%20definitions%20for%20power,(especially%20for%20mechanical%20power).

23. *De klanten, partners en samenwerkingen van Alva | Alva charging services B.V.* (n.d.). Alva Charging Services B.V. https://www.alva-charging.nl/over-ons/onze-klanten-partners-en-samenwerkingen

24. Dietz, T., Gardner, G. T., Gilligan, J. M., Stern, P. C., & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(44), 18452–18456. https://doi.org/10.1073/pnas.0908738106

25. Dillman, D. A., Sinclair, M. B., & Clark, J. (1993). Effects of Questionnaire Length, Respondent-Friendly Design, and a Difficult Question on Response Rates for Occupant-Addressed Census Mail Questionnaires. *Public Opinion Quarterly*, *57*(3), 289. https://doi.org/10.1086/269376

26. Dütschke, E., & Paetz, A. (2013b). Dynamic electricity pricing—Which programs do users prefer? *Energy Policy*, *59*, 226–234. https://doi.org/10.1016/j.enpol.2013.03.025

27. *e-flux*. (n.d.). *| Consulted on 14-05-2023* https://e-flux.com/

28. Eichhammer, W. (2009, November 24). *Study on the energy savings potentials in EU member states, candidate countries and EEA countries: final report*. https://epub.wupperinst.org/frontdoor/index/index/docId/3926

29. *ENGIE*. (n.d.). Engie.com. *| Consulted on 14-05-2023* https://engie.com/

30. *EVs—what’s ahead*. (2022, April 12). McKinsey & Company. https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/electric-vehicles-whats-ahead

31. Ellis, M., Jollands, N., 2009. Gadgets and Gigawatts, Policies for Energy Efficient Electronics. International Energy Agency, Paris.

32. *Energietransitie | RIVM*. (n.d.). | *Consulted on 23-03-2023* https://www.rivm.nl/onderwerpen/energietransitie

33. *ENTSO-E Transparency Platform*. (n.d.). |*Consulted on 08-04-2023* https://transparency.entsoe.eu/

34. eTelligence Abschlussbericht. Neue Energien brauchen neues Denken. (2012). *EWE AG*.

35. *EUR-LEX - 32023R1804 - EN - EUR-LEX*. (n.d.). | *Consulted on 13-05-2023* https://eur-lex.europa.eu/legal-content/NL/TXT/?uri=CELEX%3A32023R1804&qid=1695643950239

36. *EV-drivers NL*. (n.d.). | *Consulted on 14-05-2023* https://jedlix.nl/

37. Faruqui, A., Sergici, S., & Ahmed, S. (2010). The impact of informational feedback on energy consumption — A questionnaire of the experimental evidence. *Energy*, *35*(4), 1598–1608. https://doi.org/10.1016/j.energy.2009.07.042

38. Foster B., and Mazur-Stommen, S. (2012) Results from Recent Real-Time Feedback Studies. Washington: ACEEE, February 2012. Report number B122

39. *Forget everything you know about energy companies* ⚡ *Tibber*. (n.d.). | *Consulted on 14-05-2023*https://tibber.com/

40. Frank energy. (n.d.). | *Consulted on 14-05-2023 Slimme diensten*. Frank Energy. https://www.frankenergie.nl/nl/slimme-diensten

41. *Gadgets and gigawatts : policies for energy efficient electronics | WorldCat.org*. (2009a). https://search.worldcat.org/nl/title/355680166

42. Geelen, D., Reinders, A. H., & Keyson, D. V. (2013). Empowering the end-user in smart grids: Recommendations for the design of products and services. *Energy Policy*, *61*, 151–161. https://doi.org/10.1016/j.enpol.2013.05.107

43. Goodarzi, S., Aflaki, S., & Masini, A. (2018). Optimal Feed-In Pricing Policies: the impact of market structure and technology characteristics. *Production and Operations Management*, *28*(5), 1108–1128. https://doi.org/10.1111/poms.12971

44. Harper, B. E., Tuckman B. W., Conducting Educational Research (New York: Harcourt Brace Jovanovich, 2012), p. 27 & 45

45. Hawkins, D.I., D.L. Mothersbaugh, and R.J. Best. 2010. User behaviour. New York: McGraw-Hill.

46. Heerkens, H., & van Winden, A. (2017). Solving Managerial Problems Systematically (1st ed.). Groningen: Noordhoff Uitgevers.

47. Henseler, J., Ringle, C. M., & Sarstedt, M. (2015, January 1). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

48. Hledik, R. (2014). Rediscovering Residential Demand Charges. *The Electricity Journal*, *27*(7), 82–96. https://doi.org/10.1016/j.tej.2014.07.003

49. Hoover, K. R., The Elements of Social Scientific Thinking, 5th ed. (New York: St. Martin's Press, 1991), p. 71.

50. Hu, L., Dong, J., & Lin, Z. (2019). Modeling charging behavior of battery EV-drivers: A cumulative prospect theory-based approach. *Transportation Research Part C: Emerging Technologies*, *102*, 474–489. https://doi.org/10.1016/j.trc.2019.03.027

51. Hulshof, (2020) *De revolutie is begonnen! - Frank Energie*. (n.d.). https://www.frankenergie.nl/nl/nieuws/fd-artikel-dynamische-energiecontracten-de-revolutie-is-begonnen

52. *IEEE Xplore Full-Text PDF:* (n.d.). https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9918676

53. International Energy Agency. (2019). Scaling-up the transition to electric mobility [OECD Publishing]. *International Energy Agency*. https://doi.org/10.1787/35fb60bd-en

54. Jabareen, Y. (2009). Building a conceptual framework: philosophy, definitions, and procedure. *International Journal of Qualitative Methods*, *8*(4), 49–62. https://doi.org/10.1177/160940690900800406

55. Jabeen, F., Olaru, D., Smith, B. W., & Speidel, S. (2013). EV battery charging behaviour: Findings from a driver questionnaire. *ResearchGate*. https://www.researchgate.net/publication/289630885_Electric_vehicle_battery_charging_behaviour_Findings_from_a_driver_questionnaire

56. Kessels, K., Kraan, C., Karg, L., Maggiore, S., Valkering, P., & Laes, E. (2016). Fostering Residential Demand Response through DP Schemes: A Behavioural Review of Smart Grid Pilots in Europe. *Sustainability*, *8*(9), 929. https://doi.org/10.3390/su8090929

57. King, P. S. (2013). Moderators/Moderating Factors. In M. D. Gellman & J. R. Turner (Eds.), Encyclopedia of Behavioral Medicine (pp. 1256–1258). Springer New York. https://doi.org/10.1007/978-1-4419-1005-9_971

58. Kotler, P., & Armstrong, G. (2010). *Principles of marketing*. Pearson Education.

59. Liang, T., & Lai, H. (2002). Effect of store design on user purchases: an empirical study of on-line bookstores. *Information & Management*, *39*(6), 431–444. https://doi.org/10.1016/s0378-7206(01)00129-x

60. Limmer, S. (2019). DP for EV Charging—A Literature Review. *Energies*, *12*(18), 3574. https://doi.org/10.3390/en12183574

61. Lindsay, R., & Martella, R. (2020). *Corporate Social Responsibility – Sustainable Business: Environmental, Social and Governance Frameworks for the 21st Century*. Kluwer Law International B.V.

62. Lutzenhiser, L. (2002). Readings in Economic Sociology. In *Wiley eBooks: Vol. pp. 345-356 In Biggart*.

63. Mierau, M.; Fey, S.; Kohrs, R.; Wittwer, C. Communication Solutions for a Cloud-based Charging Management System for a Fleet of Shared-use Electric Vehicles. In Proceedings of the 2013 World Electric Vehicle Symposium and Exhibition (EVS27), Barcelona, Spain, 17–20 November 2013; pp. 1–11.

64. Neubauer, J., Brooker, A., & Wood, E. (2012). Sensitivity of battery electric vehicle economics to drive patterns, vehicle range, and charge strategies. *Journal of Power Sources*, *209*, 269–277. https://doi.org/10.1016/j.jpowsour.2012.02.107

65. Nicole Woolsey Biggart. https://doi.org/10.1002/9780470755679

66. Marikyan, D. & Papagiannidis, S. (2023) Unified Theory of Acceptance and Use of Technology: A review. In S. Papagiannidis (Ed), TheoryHub Book. Available at https://open.ncl.ac.uk / ISBN: 9781739604400

67. Martin, D. W. (2004). Doing psychology experiments (7th ed.). Thomson Wadsworth.

68. Millar, M. M., & Dillman, D. A. (2011). Improving Response to Web and Mixed-Mode Questionnaires. *Public Opinion Quarterly*, *75*(2), 249–269. https://doi.org/10.1093/poq/nfr003

69. National Renewable Energy Laboratory (NREL), Zinaman, O., Bopp, K., Lee, N., & Beshilas, L. (202 C.E., July 22). EV Supply Equipment: Pricing Design Support to the Lao PDR. *NREL*. https://www.nrel.gov/docs/fy20osti/77747.pdf

70. Netbeheer Nederland. (2019, May 24). Basisinformatie energie infrastructuur. *Netbeheer Nederland*. https://Netbeheer Nederland. (2019, May 24). Basisinformatie over de energie infra-structuur. Netbeheernederland.Nl. https://www.netbeheernederland.nl/_upload/Files/Basisdocument_over_energie-infrastructuur_143.pdf

71. Netherlands Eneterprise Agency, & Visser, W. (2019, January). EV charging : Definitions and explanation. *Netherlands Enterprise Agency*. https://www.rvo.nl/sites/default/files/2019/01/Electric%20Vehicle%20Charging%20-%20Definitions%20and%20Explanation%20-%20january%202019_0.pdf

72. Parnell, R., & Larsen, O. P. (2005). Informing the development of domestic energy efficiency initiatives. *Environment and Behavior*, *37*(6), 787–807. https://doi.org/10.1177/0013916504274008

73. *Peak shaving*. (n.d.). https://www.next-kraftwerke.com/knowledge/what-is-peak-shaving#:~:text=Definition,industrial%20and%20commercial%20power%20users.

74. Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, *12*(1), 38–48. https://doi.org/10.4278/0890-1171-12.1.38

75. *Consulted on 14-05-2023|* Powerpeers. (n.d.). *Hoe werkt het*. Powerpeers.com. https://powerpeers.nl/over-ons/hoe-werkt-powerpeers/

76. *Reliance on sustainable energy may cause electricity supply problems: Grid operator*. (2023, January 12). NL TIMES. https://nltimes.nl/2023/01/12/reliance-sustainable-energy-may-cause-electricity-supply-

problems-grid-operator#:~:text=Grid%20operator%20TenneT%20expects%20a,dependent%20on%20the%20weather%20conditions.

77. Sanquist, T. F., Orr, H. M., Shui, B., & Bittner, A. C. (2012). Lifestyle factors in U.S. residential electricity consumption. *Energy Policy*, *42*, 354–364. https://doi.org/10.1016/j.enpol.2011.11.092

78. Schiffman, L. G., Kanuk, L. L., & Wisenblit, J. (2010). *User behavior*. *Self Directed Learning Is the Key to New Skills and Knowledge*. (n.d.). https://www.betterup.com/blog/self-directed-learning

79. Shapin, S., & Schaffer, S. (1988). Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life. *The British Journal for the Philosophy of Science*, *39*(3), 403–410. https://doi.org/10.1093/bjps/39.3.403

80. Shove, E. (2003). Converging conventions of comfort, cleanliness, and convenience. *Journal of User Policy*, *26*(4), 395–418. https://doi.org/10.1023/a:1026362829781

81. Simply Psychology. (2024a, February 1). *Albert Bandura's Social Learning Theory In Psychology*. & Bandura’s Self-Efficacy Theory of Motivation in Psychology https://www.simplypsychology.org/bandura.html https://www.simplypsychology.org/self-efficacy.html

82. Smart Electric Power Alliance. (2018, March). *Utilities and EVs: Evolving to unlock grid value | SEPA*. SEPA. https://sepapower.org/resource/utilities-electric-vehicles-evolving-unlock-grid-value/

83. Stein, S., Enrico, H., Nedea, A., & Rosefeld, A. (2017). *Evaluating Market User Interfaces for EV Charging using Bid2Charge*. IJCAI. https://www.ijcai.org/proceedings/2017/698

84. Smith, M.J. and Liehr, P. (1999) Attentively Embracing Story: A Middle-Range Theory with Practice and Research Implications. Scholarly Inquiry for Nursing Practice, 13, 187-204, Discussion5-10.

85. Stromback, J.; Dromacque, C.; Yassin, M.H. Empower Demand. The Potential of Smart Meter Enabled Programs to Increase Energy and Systems Efficiency: A Mass Pilot Comparison; VaasaETT: Helsinki, Finland, 2011.

86. Todts, W. & European Federation for Transport and Environment AISBL. (2020, January). Recharge EU: How many charge points will Europe and its Member states need in the 2020s. *Transport & Environment*.

87. Valogianni, K., Ketter, W., Collins, J., & Zhdanov, D. (2020). Sustainable EV Charging using Adaptive Pricing. *Production and Operations Management*, *29*(6), 1550–1572. https://doi.org/10.1111/poms.13179

88. Varallo, F. R., Dagli-Hernandez, C., Pagotto, C., de Nadai, T. R., Herdeiro, M. T., & de Carvalho Mastroianni, P. (2017). Confounding Variables and the Performance of Triggers in Detecting Unreported Adverse Drug Reactions. Clinical Therapeutics, 39(4), 686–696. https://doi.org/10.1016/j.clinthera.2016.11.005

89. *Vandebron - Duurzame energie van Nederlandse bodem*. (n.d.). | *Consulted on 14-05-2023* Vandebron. https://vandebron.nl/?gad_source=1&gclid=Cj0KCQiAgqGrBhDtARIsAM5s0_nxYVF4S26KbIxqKqz8ntFQoeWpV0ZCDi1TkM5xWOkgWTW5MLkRRvMaAgybEALw_wcB&gclsrc=aw.ds

90. *What is Generation Capacity?* (n.d.). Energy.gov. https://www.energy.gov/ne/articles/what-generation-capacity#:~:text=Capacity%20%3D%20Maximum%20Power%20Output&text=Capacity%20is%20the%20amount%20of,load%20a%20generator%20can%20handle.

91. *What is Generation Capacity?* (2020). Energy.gov. https://www.energy.gov/ne/articles/what-generation-capacity#:~:text=Capacity%20is%20the%20amount%20of,load%20a%20generator%20can%20handle.

92. *Welkom bij slim laden met Stekker*. (n.d.). | *Consulted on 14-05-2023* https://www.stekker.com/

93. Wilhite, H., Jochem, E., Sathaye, J. A., & Bouille, D. (2006). *Society, Behaviour, and climate change mitigation*. Springer Science & Business Media.

94. Wolbertus, R., & Gerzon, B. (2018). Improving EV Charging point Efficiency through Pricing. *Journal of Advanced Transportation*, *2018*, 1–11. https://doi.org/10.1155/2018/4831951

95. Yuan, W., MacKenzie, D., & Keith, D. R. (2016). Modeling the charging choices of battery EV-drivers by using state preference data. *Transportation Research Record*, *2572*(1), 47–55. https://doi.org/10.3141/2572-06

Appendices

Appendix A
Problem cluster and the core problem

Appendix B
Source review information output table

Appendix C
Overview concept methodologies

Appendix D
Theoretical framework

Appendix E
Competitor analysis

Appendix F
Questionnaire flow and results

Appendix G
Scores per CSF

Appendix H
Examples for future research

Appendix I
Research ethics

Appendix A: Problem cluster and core problem

1.4.2 Problem cluster and the core problem

Now that the action problem has been identified, the next step is to find the core problem. By conducting informal interviews with Revolt employees, the on-going problems have been defined. To gain insight into how the problems influence each other, a problem cluster is created. This problem cluster is shown in Figure 2.

Three sides of the occurring problems of Revolt (regarding Revolt Energy) can be identified:

On the **supply** side, in the future Revolt will face more often that the energy grid is over capacitated. The availability of energy for the charging points will not be sufficient regarding total capacity of the charging point and the wanted demand from its users. However, Revolt has no influence on the cause of overcapacity of the grid and therefore it cannot become a core problem of this research. *To explain: the building, which is asking for a higher demand of energy, will get as sufficient as the supply can be regarding the energy network. But this might be insufficient for the usage of energy in the building in combination with the charging points. Therefore, charging points must make smart use of available energy.*

On the **demand** side, the communication between what the charging point can offer and what the user is demanding is lacking. This causes a dis-balance between users and the capacity delivery of energy.

On the **operations** side, Revolt Energy can influence the dis-balance between users and the capacity delivery of energy. Revolt Energy aims to use DP models at the charging points via the two operational changes: (1) implementation of a secondary allocation points and (2) a partnership with one selected energy supplier. A secondary allocation point is a second electricity meter installed behind client's connection. Allowing to contract with its own energy supplier, independently of other measuring points on this connection.
However, there is insufficient argumentation and evidence for an ICS for Revolt Energy towards clients and users and no supporting interaction tool. This core problem statement is marked blue in Figure 2.

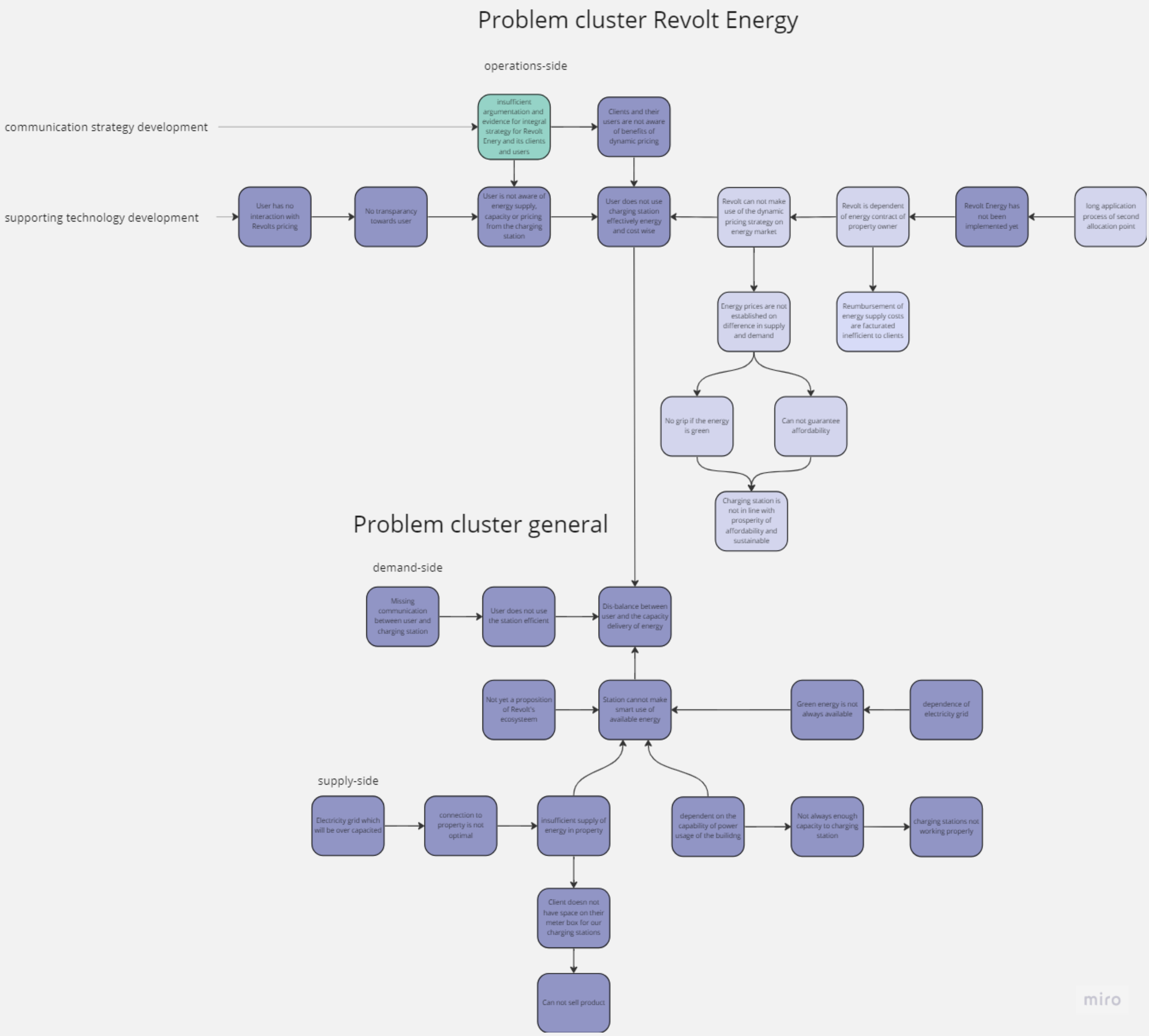


Figure 33; Problem cluster Revolt Energy

When taking a closer look at this core problem statement from figure 33, two potential core problems can be identified, which are shown in figure 34. The core problem can be state as:

“Insufficient information and technological support for an ICS of Revolt Energy towards users and clients.”

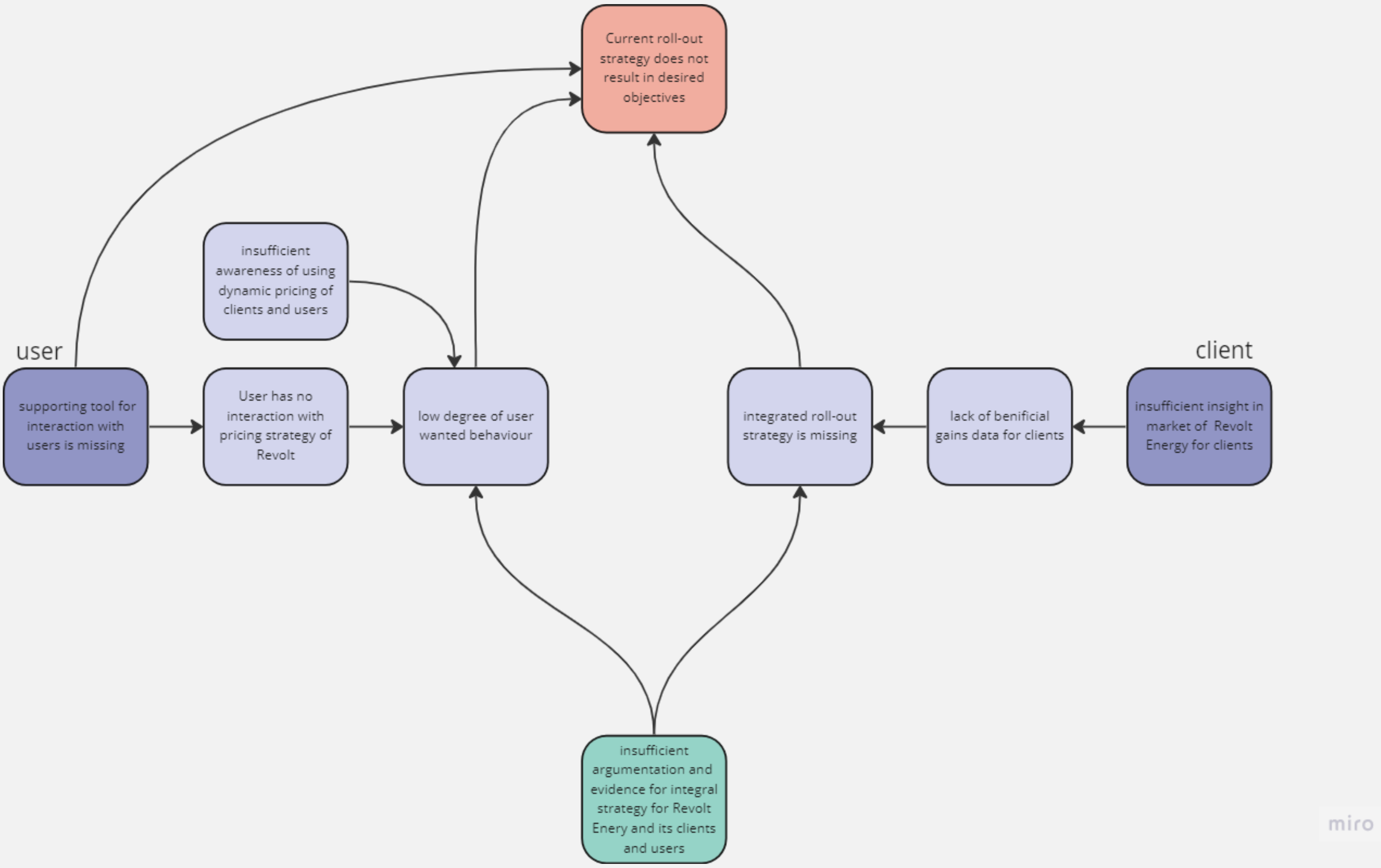


Figure 34; Problem cluster of action problem

Appendix B: Source review information output table

Source	objective	variable	Information output
(Hajibabai et all, 2022) [15]	Technical, economical	Users Charging decision	SOC, pricing scheme, travel & waiting time
(Hajibabai et all, 2022) [15]	Economical, technical	User preference of charging service	Prices, destination, departure time, availability
(Amjada et all, 2018)	Technical	Users' decision of charging duration	Parking pattern, charging approach, type, and number of charging at a given location, battery SOC, current and voltage limitations
(Hu et all, 2017)	Technical, economical	Users charging decision	battery SOC travel distance, charger power, charger cost, distance to next charger, dwell time, dwell location.
(Hu et all, 2017)	Socio-demographic factors	Behaviour of drivers	Psychological factors (personality and risk preferences)
(Wolbertus, 2018)	Technical, economical	Charging time of EVs (flexibility)	start time, the day of the week or the parking pressure, on the connection times of EVs.
(Sadeghianpourhamami, 2018)	Economical, environmental	Charging time of EV's (flexibility)	charging duration, charged energy
(Konstantina Valogianni et all, 2020)	Definition objectives	Motivators for DP usage of drivers	Environmental, economical, technical benefits and socio-demographic factors
(Amjada et all, 2018)	Environmental, technical	Supplier of EVs charging optimization objectives:	Reduce power losses, maximize aggregator profits, voltage regulation, avoid distribution network issues, minimize total cost of energy for users, frequency regulations, support for renewable energy sources, minimize the peak load

Tibber			kWh / euro, EPEX-spot price, CO2 emission reduction, status battery, km with current battery
E-Flux			KWh pricing, kWh charged, total cost
Powerpeers			CO2emission compensation
Van der bron			start pricing, kWh-pricing, time-pricing, incentive, kWh, energy usage (normal vs low)
Jedlix			battery status, charged km, slim loading options, start time of charging, end time of charging, type of car, total smart charged kWh, saved euros
Frank energie			actual market pricing of DP, how much expected, real time, and saved euros all in 1 dashboard
Engie			kwh + euros, m2 + euros, graphic of energy usage, % less energy usage per month
NextEnergy			actual pricing, saving per group notifications,

Appendix C: Overview concept methodologies

Overview concept methodologies

Knowledge question	Chapter	Type of research	Research strategy	Research population	Method of data gathering	Method of data processing
1.What is the current market situation of Revolt Energy?	Chapter 2	Explanatory, descriptive	Quantitative, qualitative	Employees of Revolt	Observation and literature study	perception web, top 26 lessons, information conclusion tables
2. Which DP approaches in literature work effectively changing end-users' behaviour?	Chapter 4	descriptive	qualitative	Approaches for changing charging behaviour	Literature study	SLR, Descriptive conclusion with list of possibilities
3. Which marketing components and accepted technology tools can stimulate end-user to interact with Revolt Energy's DP?	Chapter 5	descriptive	qualitative	Applications in energy market, European studies	Literature study and data from documents	SLR, Descriptive conclusion with list of possibilities
4. Which variables have direct influence on total interaction with client / end-users?	Chapter 6	descriptive	quantitative	Clients of Revolt, European EV-drivers	Data from earlier studies	List of summarised variables and conceptual framework
5.What are the variables for clients and users to increase interaction with Revolt Energy DP?	Chapter 7	evaluative	quantitative	Clients of Revolt and reachable EV-drivers	Data from earlier studies and output questionnaire	CSFs
5a: Which modelling can be best used to set up a cross-Sectional questionnaire approach?	Chapter 7	descriptive	qualitative	Quantitative approach modelling	Literature study	Descriptive design recommendations
6. Which variables can be best focused on for analysing communication strategies?'	Chapter 8	evaluative	quantitative	Clients of revolt, EV-drivers	Data output of questionnaire	Statistical analysis, google forms with consent
7. Which ICS would influence charging behaviour and with given constraints most?	Chapter 9	evaluative	Quantitative, qualitative	Owners of Revolt	Data output of questionnaire	CSFs
8.What is the road map to increase total interaction?	Chapter 10	development	qualitative	stakeholders	Data output of outcomes	Technology analysis, descriptive communication approach
9. What to conclude and recommend?	Chapter 11	explanatory	qualitative	Revolts network	observation	Implementation plan

Double Diamond phase description

1. **Discover**

In the first phase, I need to understand the abilities and of Revolt through gathering data and learning about the state of the problem and the importance of the solution via also the systematic literature review (SLR). Validity of data collection is of importance for validity of the outcome. From this knowledge, I need to deduce the different variables for the design solution and gaining knowledge over the current and desired state of the solution to deliver. The related knowledge questions are stated as:

Question 1: *What is the current market situation of Revolt Energy?*

Question 2: *Which DP approaches in literature work effectively changing end-users' behaviour?*

Question 3: *Which marketing components and accepted technology tools can stimulate end-user to interact with Revolt Energy's DP?*

These sub-questions are supposed to answer which approaches, information impulses and technology methods are used in literature to stimulate desired end-users' charging behaviour with DP and form the set of information data input related to the research goal.
Question 1 focuses on the metric of the needs of information output variables from the end-user perspective on adaptation needs. Which is based on competitors on the market and characteristics of user behaviour in their charging decision.
Question 2 focuses on the metric of how the information output should be delivered to stakeholders. Stating what type of variables, the implementation needs to effectively manage the workload of the charging points for satisfaction. Considering also which issues can affect daily routines to make informed decisions.
Furthermore, question 3 identifies the objectives for supportive technology available to affect driver behaviour in a user-acceptable way, with consideration given to Revolt's resources and cost incentives. The data processing method of the literature review is a descriptive statement of top lessons as conclusion of the literature review.

2. Define

After the discovery of viable solutions, the DDM progresses towards the next stage: defining. In this phase, definitions of measurable Critical Success Factors (CSFs) must be determined - to define and narrow down the desired success and evaluates results. This involves establishing a conceptual framework of variables and Critical Success Factors (CSFs) for each variable based on the information gathered in stage one. and formulate measurable CSFs. These CSFs align with the conceptual framework and should have a direct effect on the desired level of interaction with clients and EV-drivers. Measured by the willingness and satisfaction. The information collected in stage one is used to collect data in this stage.

Question 4: *Which variables have direct influence on total interaction with clients and users?*

Question 5: *What are the CSFs for end-users to increase interaction with Revolt Energy DP?*

Section of question 5 is: *Which modelling can be best used to evaluate conceptual frameworks on validity and reliability?*

Question 6*: Which CSFs can be best focused on for analysing communication strategies?*

Question 7: *Which ICS would work best to influence charging behaviour with given constraints?*

Question 4 makes preparation for data collection. It assesses the conclusion of literature into a conceptual framework. Assessing which variables relate to the research goal. Data collection is done via a quantitative cross-Sectional questionnaire approach with a structured questionnaire where available data serve as measurement of the variables in the conceptual framework.
Question 5 collects the validity and reliability of the data collection via formulation of Critical Success Factors (CSFs).

Question 6 interprets the data. Here the validity, reliability, and significance of the solution set, regarding the impact on charging behaviour is investigated. This is done according to CSFs from question 5.
Question 7 describes the solution set of ICSs and are put in perspective towards the research goal.

3. Develop

After defining the CSF's, the third phase starts - to develop. I need to define how to process data towards a design. In this phase I include the knowledge and theory from the previous two activities. Subsequently, feasibility is considered on performance and accuracy of solution. Therefore, knowledge question 8 is stated as:

Question 8: *What is the road map to increase total interaction?*
It aims for an implementation plan of an ICS roadmap, which includes identifying the company's capabilities and constraints, evaluate the feasibility of the most suitable solution set and create the roadmap of communication and the supporting tool outcome according to it and show an example of the possible outcome.

4. Deliver

The final phase is the delivery. Here a viable ICS is made for implementation for the company. It is important here to consider the different end-users to communicate the ICS as there is different stimuli for interaction.

Question 9: *What to conclude and recommend?*
Conclusion, recommendations, and final discussions and evaluation for the company is stated here.

To give an overview of the research design and relatable knowledge questions Appendix D: Overview concept methodologies, shows per concept what methodologies are constructed in this research for each knowledge question with the related Chapter in this research.

Appendix D: Theoretical framework

5.2.1 Theoretical framework

This Chapter defines the different variables and the possible relations, after which the theory can be combined into a theoretical framework.

“A conceptual framework is a proposed set of linkages between specific variables, often along a path from input to process to outcome, with the expressed purpose of predicting or accounting for specific outcomes” (Tuckman, 1972). Therefore, the conceptual framework is a tool to study all variables and their interconnections to observe a particular outcome. It presents an integrated way of looking at a problem under study (Smith & Lier, 1999). Miles and Huberman (1994) propose that conceptual framework can be ‘graphical or in a narrative form showing the key variables or constructs to be studied and the presumed relationships between them.’ The analysis of the relationship between variables forms an important part of the model. “Making a statement about the expected nature of the relationship is sometimes useful; such a statement is called hypo research.” (Martin, 1991) The theoretical framework (defined in Section 2.3) will serve as a tool to ensure that the correct hypo research is defined.

5.2.1.1 Independent Variable

The first variable that is discussed in this essay is the Independent Variable (IV). “An independent variable is one that influences another variable, called the dependent variable.” (Hoover, 1991). “This variable is manipulated by the researcher, and the manipulation causes an effect on the dependent variable.”(Cooper & Schindler, 2014). It is therefore important to keep in mind that the IV is measured or manipulated by the researcher, to determine its relationship to an observed phenomenon (Tuckman & Harper, 2012).

5.2.1.2 Dependent Variable

Another well-known variable within the conceptual framework is the Dependent Variable (DV) widely use in research. “This variable is measured, predicted, or otherwise monitored and is expected to be affected by manipulation of an independent variable.” (Cooper & Schindler, 2014). “It represents the presumed effect of the independent variable. Researchers always measure the dependent variable and never manipulate it.” (Tuckman & Harper, 2012).

5.2.1.3 Moderator Variable

The Moderator Variable (MV) is also widely used in research. “A moderator variable is a qualitative (e.g., gender, SES) or quantitative (e.g., amount of social support) variable that affects the direction and/or strength of the relationship between an independent or predictor variable and a dependent or criterion variable.” (King, 2013). In other words, a MV affects the relationship from IV on a DV. The MV affects the direction and strength of the relationship between the IV and the DV. Including the MV in the conceptual framework gives insights into the actual effect of the IV on the DV.

5.2.1.4 Control Variable

The next important variable that is found in most conceptual frameworks is the Control Variable (CV). “Control variables are factors controlled by the experimenter to cancel out or neutralize any effect they might otherwise have on observed phenomena.” (Tuckman & Harper, 2012).They might influence the DV, besides the IV, but cannot be manipulated. Think of the weather or the mood of people. “We can control such circumstances by making sure that they do not vary from a single level.” (Martin, 2004). This way they can be neutralized and the noise causing less precise measurements can be reduced.

5.2.1.5 Intervening Variable

Another particularly important variable that has a significant impact on the results of the research is the Intervening Variable (IVV). It is also known as the mediating variable, which is commonly interchanged by researchers with the moderating variable. “Mediators explain how external physical events take on internal psychological significance. Whereas moderator variables specify when certain effects will hold, mediators speak to how or why such effects occur.” (Baron & Kenny, 1986). One way to evaluate whether a variable is an IVV, is by thinking what the subject could experience, due to the IV. This internal process, the IVV, of the subject could then influence the dependent variable again. An important aspect of the IVV is that it theoretically affects the DV, but it is intangible and thus cannot be observed, manipulated, or measured. The IVV is also affected by the IV, MV and the CV, while the IVV itself affects the DV only.

5.2.1.6 Confounding variables

The last variable that is included in this essay is the Confounding variable (CFV). “Any circumstance that changes systematically as the experimenter manipulates the independent variable is a confounding variable.” (Martin, 2004) In other words, every variable that affects the IV and thus the DV systematically when conducting research can be identified as a CFV. Therefore, the CFV directly affects the IV and DV as can be seen in appendix E (Cox, 2015). “ Because confounding variables are a source of bias (Greenland, Morgenstern, 2001), it is critical to consider confounding variables when designing, analysing, and interpreting studies intended to estimate causal effects.” (Varallo et al., 2017).

Appendix E: Competitor analysis

Jedlix

Jedlix is a spin-off of Eneco and offers a white label app that allows EVs to be charged automatically at times when there is a lot of renewable energy available, and prices are low. The algorithm maximises charging during home solar panel electricity production peaks and off-peak electricity pricings, which can save up to 30%. For example, when you arrive at home and plug in your vehicle. Jedlix dynamically stops and starts charging your car based on the amount of available energy. The compensation they receive for doing so they share with the driver. And no matter what your car is fully charged before leaving home, as input of departure time is set. The company works with various energy suppliers and charging point companies and has partnerships with automakers such as Tesla and BMW. Eneco, Hyundai and Mobilise are currently end-users of Jedlix. (*EV-drivers NL*, n.d.)

Vandebron

Vandebron is an energy supplier that also offers electric charging services via their own charge card (Dutch: laadpas). The company offers 100% green energy and enables users to charge based on the current energy price. This allows users to save on their energy costs and contribute to a sustainable energy supply. Per month the end-user pays 3.50 euros (incl. vat) for the service of charge cards. Their charge costs exist starting pricing + kwh-pricing and/or time-pricing + monthly service cost. They make a price incentive by stating the first 3 months no service costs for use of their charge card. Vandebron makes use of their own electric riding app. Within the app there is an overview of all charging points via a geographical map, stating which costs the charging points manage. To inform EV-drivers on information in kwh, duration, CO2 saved in kg and total costs per charge. (*Vandebron - Duurzame Energie Van Nederlandse Bodem*, n.d.)

Powerpeers

Powerpeers is a platform where users can share their self-generated green energy with other users. The company also offers a charging service, in the sense of allowing users to charge their electric car with green energy from other Powerpeers users. It is also possible to charge based on the current energy price. They work with CO2 compensation projects, by giving CO2 emission rights to the 'Gold Standard keurmerk' like wind energy turbines in Aruba. Is from Vattenfall. (Powerpeers, n.d.)

E-Flux

E-Flux is a charging point manager that will offer dynamic charging by the end of 2023. The company provides back-office management for parties like Revolt. The company works with various energy suppliers and uses smart software to adjust the charging speed to the real-time energy prices. E.g., lower the speed of charging on peak hours, whilst increasing speed on off-peak hours. How they implement that exactly is yet unknown, they will market this service from Q3 2023. E-Flux focuses on business end-users and offers customised solutions. In combination with back-office management costs is in the form of a membership, exact costs are unknown. The supported technology they provide with this membership is a mobile app.(*E-flux*, n.d.)

Tibber

Tibber is an energy company that provides electricity and EV charging services to its end-users. They use DP strategies to adjust the cost of charging based on the real-time price of electricity. Their target market is households. Per month they charge 3,99 for use of smart energy contracts with them. Tibber's approach to DP for EV charging is to base the cost on the real-time price of electricity insight via technical support of an app. This means that drivers can save money by charging their vehicles during times when electricity is cheaper, such as at night or during off-peak hours. Tibber also offers its end-users the ability to see the carbon emissions associated with their charging sessions, allowing them to make more environmentally friendly choices. Tibber communicates with the EVs via 3G or 4G about the status of the battery. Tibber app also integrates the housing system. Input of charging session is when you want your car to be fully charged, output is that it calculates the cheapest hours to charge and does that automatically. (*Forget Everything You Know About Energy Companies ⚡Tibber*, n.d.)

Frank Energie

Frank Energie is a Dutch supplier that offers green electricity. They use DP, which means that their prices change according to market fluctuations and demand, to provide fair and flexible pricing options to their household end-users. (Frank energy, n.d.)

Engie

Engie is a French multinational energy company that operates in over 70 countries. They also use DP to offer competitive rates to end-users based on real-time market conditions and demand, as well as to incentivize energy consumption during off-peak hours to help balance the grid. (*ENGIE*, n.d.)

Stekker.app

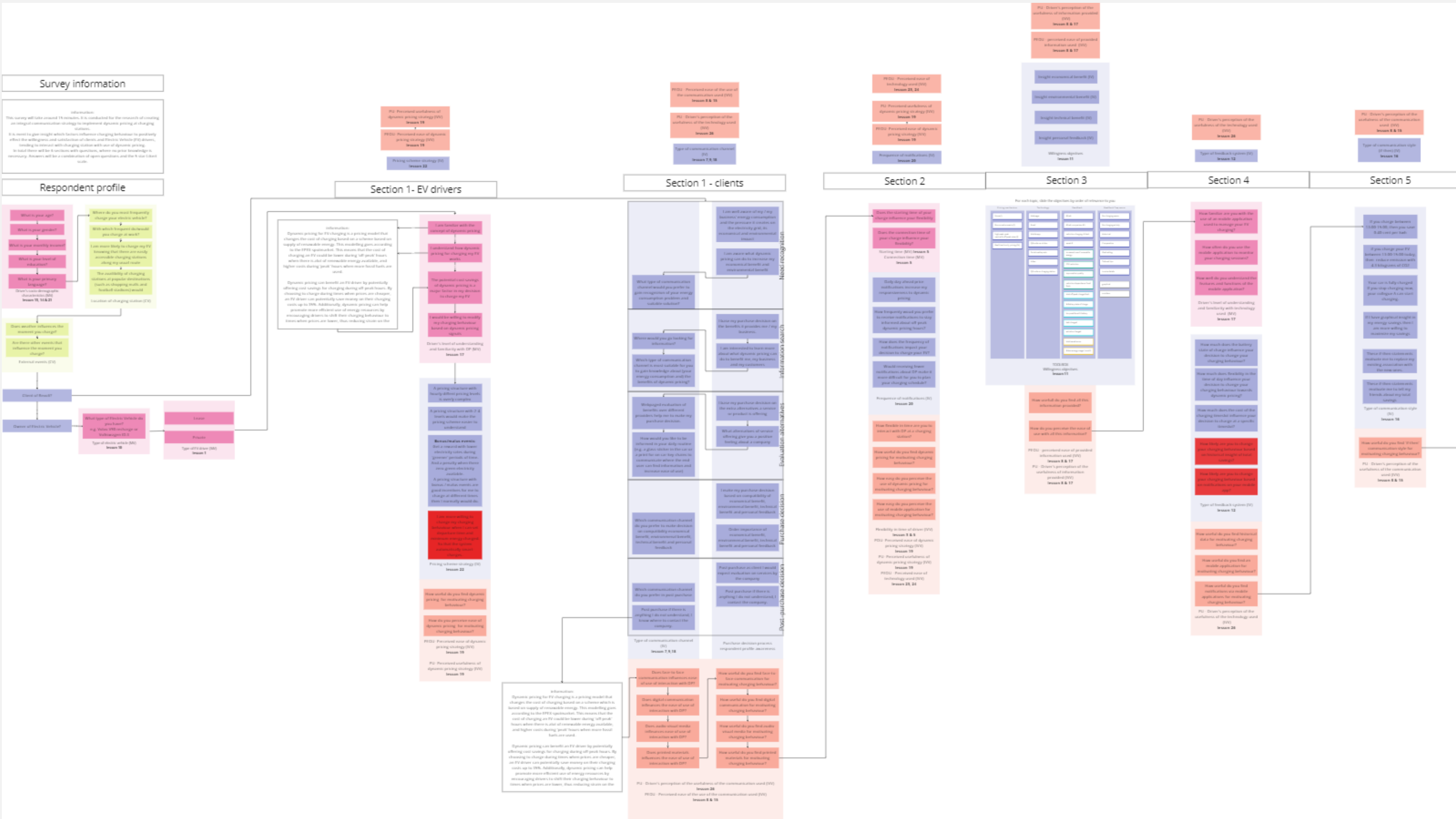
Stekker.app is a software company that stimulates smart, flexible charging for companies, CPOs, energy providers, individuals and building owners. Having smart interfaces, supporting various dynamic energy contracts offing integration for smart homes via IFTTT and enterprise solutions with an API, creating the opportunity to collaborate with CPOs. Making smart charging easy for the end-user with customizable setting and integrations of solar panels for example. (*Welkom Bij Slim Laden Met Stekker*, n.d.)

Alva charging

Alva charging is a CPO offering smart services for at home with an energy contract. This energy contract offers the EPEX spot market prices at the charging point via a secondary allocation point. They have a partnership with Pon Dealer Group. The service of AC and DC charge points, including the processing of transactions. (*De Klanten, Partners En Samenwerkingen Van Alva | Alva Charging Services B.V.*, n.d.)

Appendix F: Questionnaire set-up and results

The figure below shows the questionnaire construction. It outlines the variables from the conceptual framework, and how it is integrated into the interview questionnaire flow. Per section certain variables are questioned. For a readable version, access can be given by the researcher upon request.


Survey information
Respondent profile
Section 1 - EV drivers
Section 1 - clients
Need recognition
Information search
Evaluation alternatives
Purchase decision
Post-purchase decision
Section 2
Section 3
Section 4
Section 5

Bachelor research

FINAL Charging behaviour questionnaire

December 1st, 2023, 9:05 am CET

Start of Block: questionnaire information

Questionnaire introduction

This questionnaire serves as a basis for designing an effective ICS for supporting DP at charging points. It is meant to give insight into which factors influence the charging behaviour. The goal is to better satisfy the needs of clients and EV (EV) drivers, through responsive DP.

In total there is 6 Sections with in total 31 questions, which will take around 12 minutes.
The answers are a combination of open questions and the Likert scale.
There is no prior knowledge needed.

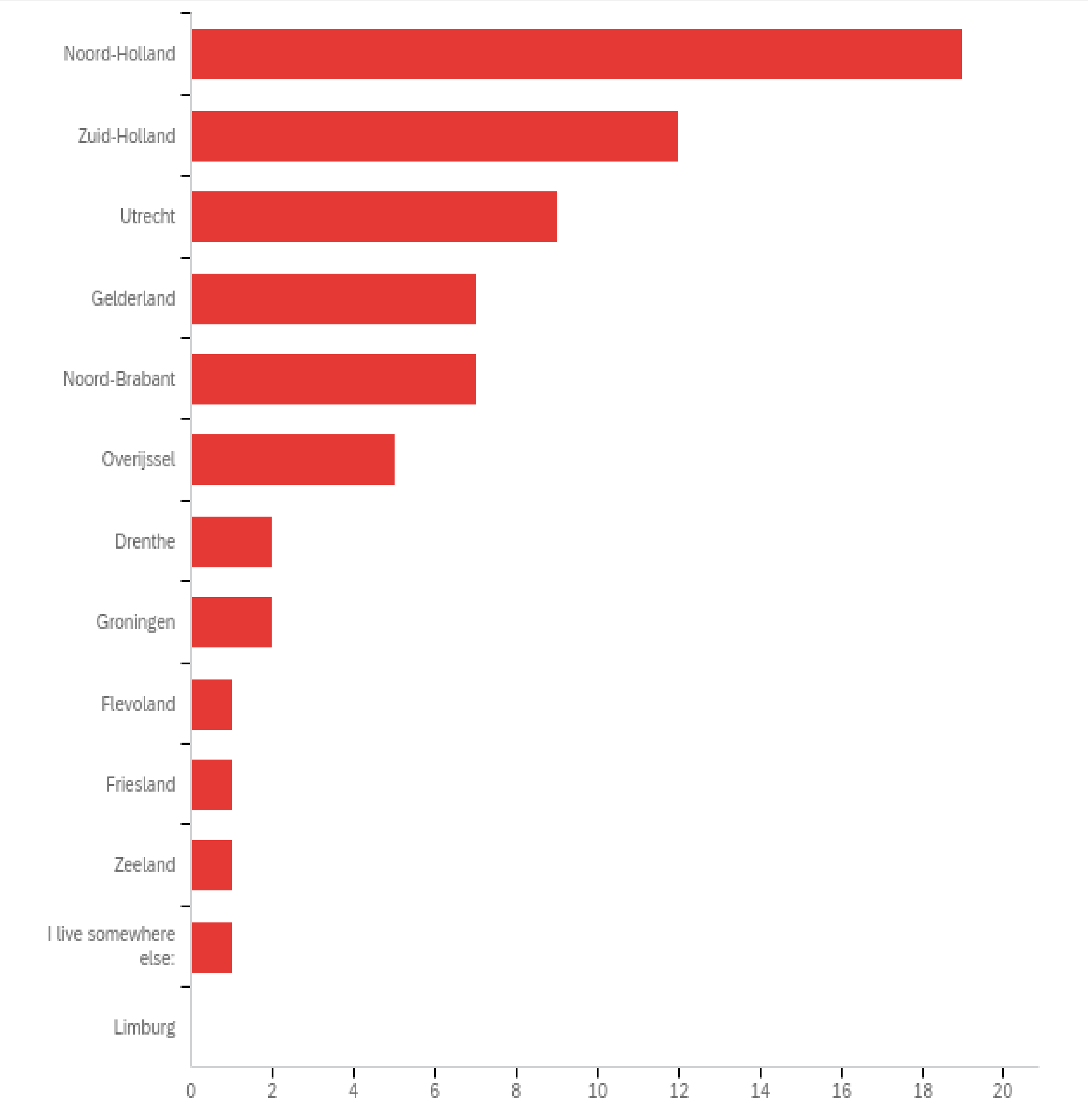
Please answer questions with full honesty.

End of Block: questionnaire information

Start of Block: Section 1.1 - respondent profile

Q1 - Where do you live in the Netherlands?

By making a distinction based on geographical location based on province, you can also look at the willingness/motivation of people and their communication preferences compared to other geographical locations. This can potentially lead to adjustments based on distinctions, as well as stating that geographical location indeed influences people's willingness to interact with the charging point.
Here 28,36% of respondents live in Noord-Holland and 17.91% in Zuid-Holland and 13.43% in Utrecht. It can be state that most respondents are based in the west of the Netherlands.

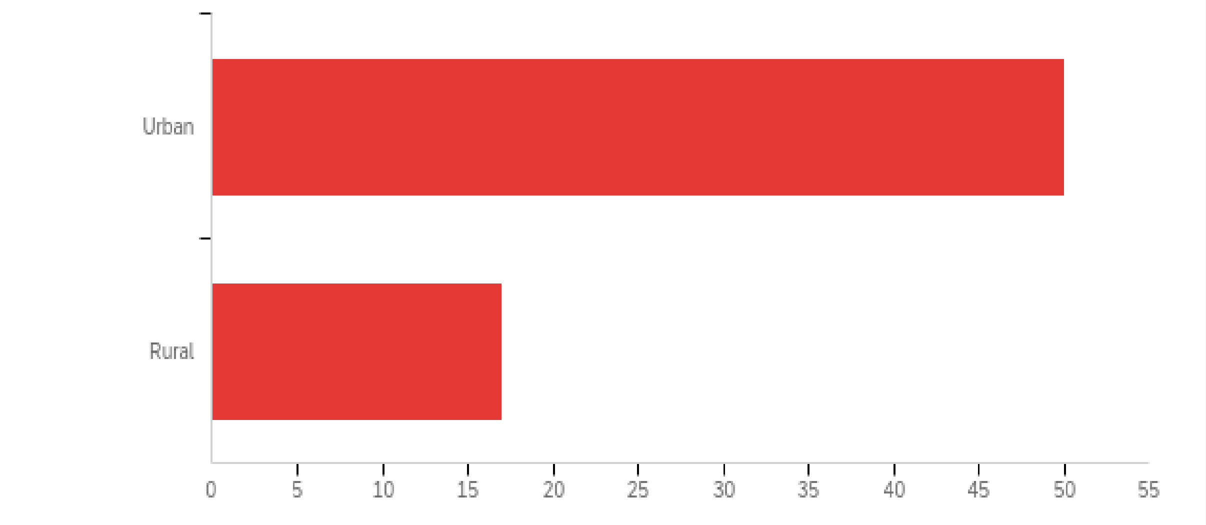


Answer	%	Count
Drenthe	2.99%	2
Flevoland	1.49%	1
Friesland	1.49%	1
Gelderland	10.45%	7
Groningen	2.99%	2
Limburg	0.00%	0
Noord-Brabant	10.45%	7

Noord-Holland	28.36%	19
Overijssel	7.46%	5
Utrecht	13.43%	9
Zeeland	1.49%	1
Zuid-Holland	17.91%	12
I live somewhere else:	1.49%	1
Total	100%	67

Q2 - Where do you live?

This indicates the availability of charging points, the availability of alternatives, and space. A demographic factor that influences whether they interact with charging points with DP or not. It is a variable that directly affects the overall interaction but also has an impact on motivation. If there are many alternatives available, motivation may be lower or higher.74,63% of the 67 respondents lives urban. Given the mean of 1.25 and s.d. of 0.19 (looking from the perspective of count of the respondents) On average people live urban and in the west part of the Netherlands.



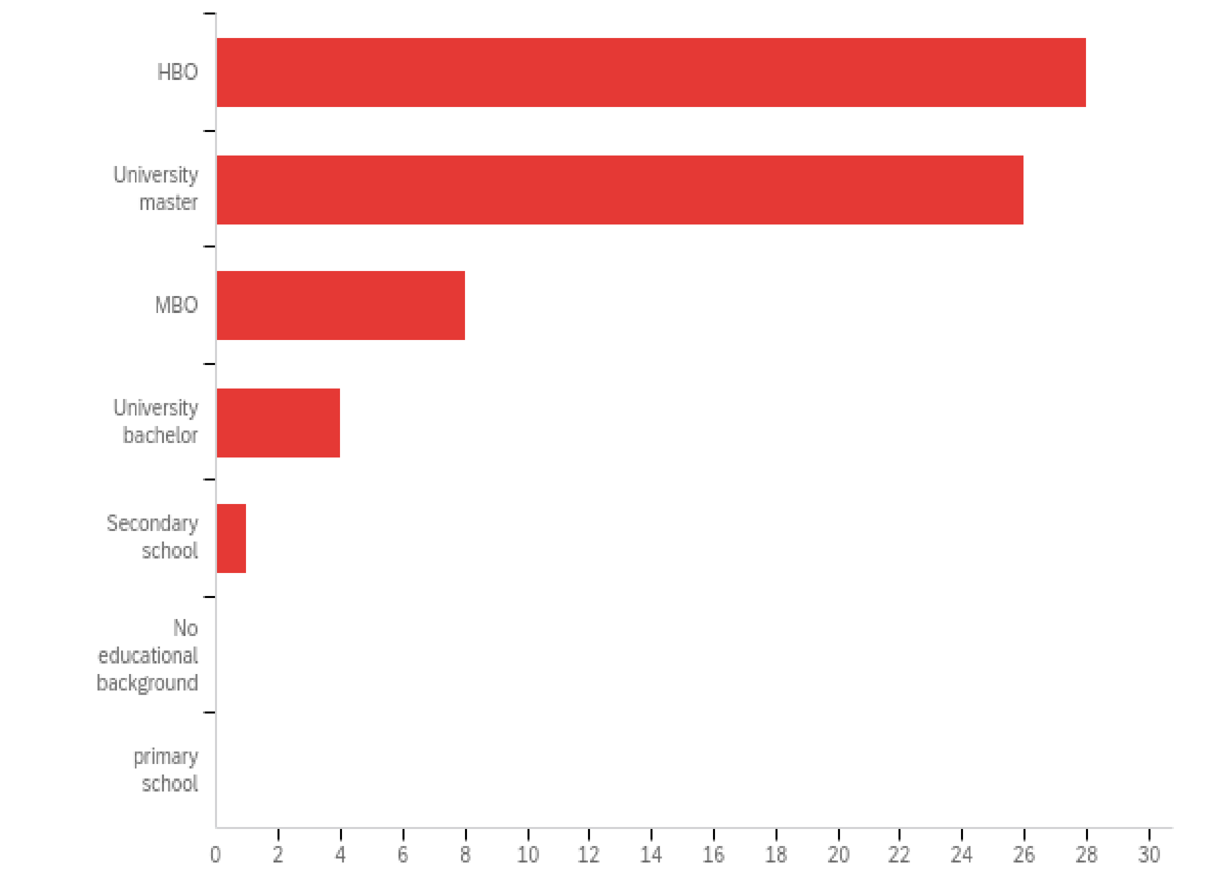
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Where do you live?	1.00	2.00	1.25	0.44	0.19	67

#	Answer	%	Count
1	Urban	74.63%	50
2	Rural	25.37%	17
	Total	100%	67

Q3 - What is your succeeded level of education ?

Education influences end-user motivation. Research has shown that highly educated individuals tend to have a more environmentally conscious lifestyle as the norm in their lives. They are more aware and make more conscious choices. Therefore, it is being investigated whether education influences motivation.

41.79% of respondents have studied a HBO, 38.81% a university master, 11.94% MBO and 5.97% University bachelor. So, on average people finished their HBO or University master.



#	Answer	%	Count
5	primary school	0.00%	0
8	University master	38.81%	26
7	University bachelor	5.97%	4
3	Secondary school	1.49%	1
2	No educational background	0.00%	0
4	MBO	11.94%	8
6	HBO	41.79%	28
	Total	100%	67

Q4 - What is displayed in the picture above?

A creative question in between. The HUB can be used for marketing DP. However, it is important for people to see that they can also charge at the HUB. If they do not see this, the focus of marketing should be on clarifying the function of the HUB.
When seeing the Revolt HUB. 40 respondents categorised it as a charging point, where from 9 as a DC charger. 10 identified it as only a media display, whereas 18 respondents could not identify the charging unit or media display.

What is displayed in the picture above?
Dc charger
Laadpaal
Onzin
Voice recorder
revolt charger with big display
Geen flauw idee
laadpaal
Geen flauw idee
Walkie talkie
Een AC laadpaal met twee aansluitingen en veel ruimte voor reclame via een scherm
Laadpaal
Laadpaal
a charging point / ad screen combo
Een laadpaal
Laadstation
laadpaal van de toekomst
Een object in een ruimte. Het lijkt op een bestelscherm, maar gezien het onderwerp van deze enquete en de naam Revolt op de zijkant, denk ik aan een futuristisch ontwerp van een laadpaal.
Laadpaal
Voicerecorder
Laadpaal
Walkman
een laadpaal met een reclamedisplay
Display
Lader met display
?

Snellader

Voice recorder

Gezien de inleiding vermoed ik dat het om een snellaadstation gaat.

Geen idee

Billboard

Moderne laadpaal

AI Robot werkend op zonne-energie.

Moderne laadpaal

Laadpaal

Laadpaal

Een kamer met een raam in het plafond en een apparaat met scherm twee knoppen en een status lampje

Tesla supercharger

Een laadpaal met een scherm

Laadstation

Fototoestel

?

Geen idee

Lijkt een strak ontworpen laadpaal

Batterij? Slecht te zien op smartphone

Snellader

de revolt Hub

Voice memo recorder :-)

Revolt laadstation

Laadpaal

AC laadpaal die behoorlijk groot is

Laadpaal

Laadpaal

Dc charger with display for commercials

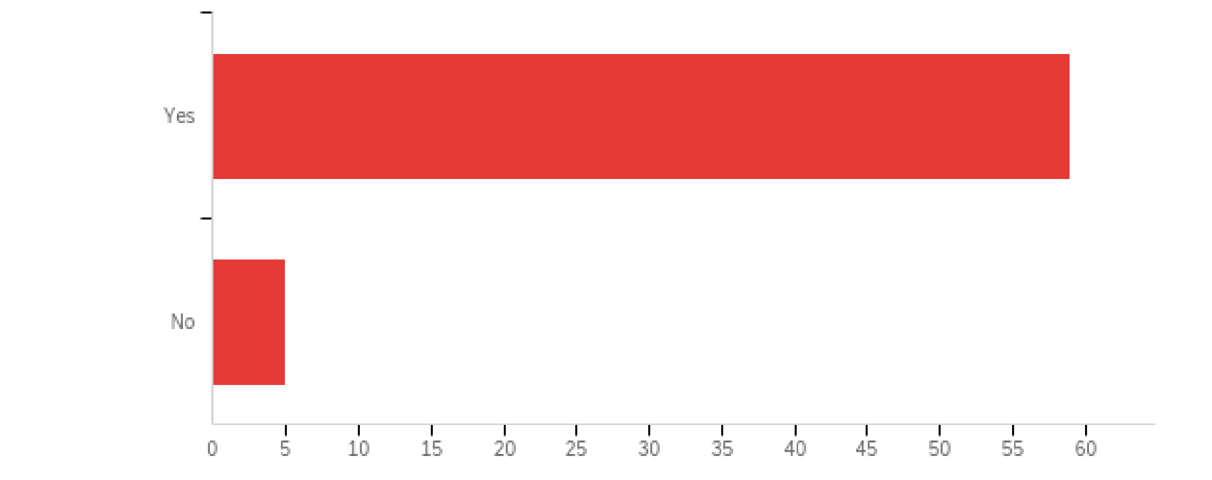
informatiezuil

reclamezuil

snellader
Charger with a large display
een revolt laadpaal
Waarschijnlijk een snellader.
snellaadpaal incl reclamezuil
Laadzuil
geen idee
snellader
een snellader

Q5 - Are you currently driving an EV (EV)?

If someone is an EV-driver, they have firsthand experience with charging behaviour. By examining the current behaviour of EV-drivers among those who respond "Yes," and testing potential EV-drivers among those who respond "No," the questionnaire can capture both the current behaviour and the potential future behaviour of EV-drivers. The latter group is instructed to fill out the questionnaire from the perspective of an EV-driver.
92.1% of the respondents are currently driving an EV. Which makes that 7.81%(5 respondents) can be seen as potential end-users.



#	Answer	%	Count
1	Yes	92.19%	59
2	No	7.81%	5
	Total	100%	64

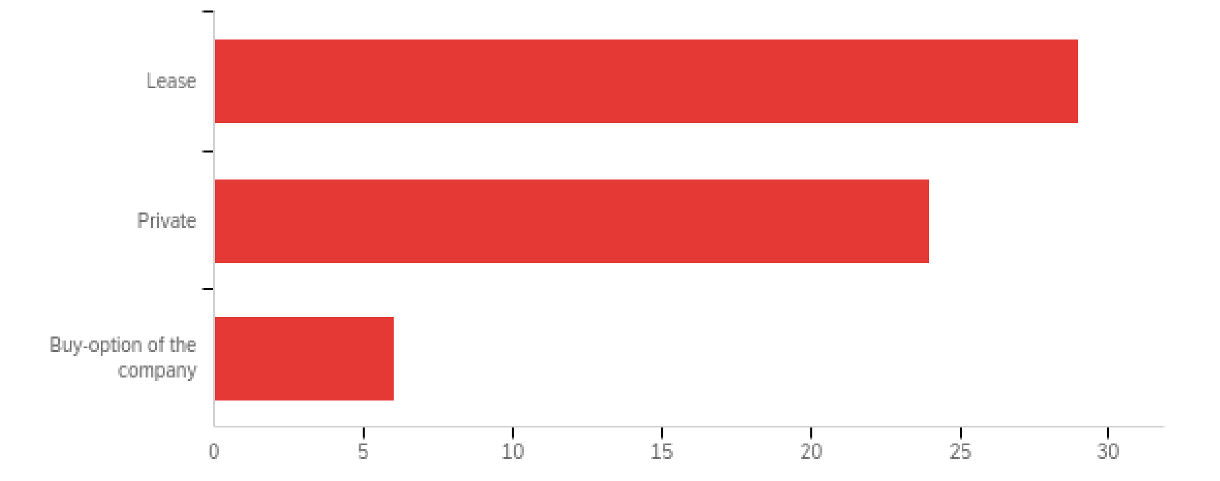
End of Block: Section 1.1 - respondent profile

Start of Block: Section 1.2 - if Q5 is yes

Q5.1 - What type of EV-driver are you ?

The type of EV-driver is important because there is an assumption that lease car drivers are less motivated by economical benefits. The results should show whether EV-drivers are indeed less motivated by economic benefits. This can be compared with question 5 and 9 for segmentation differences.

From the 92.1%, 49.15% drives in a lease car, 40.68% private and only 10.2% the buy-option of the company.



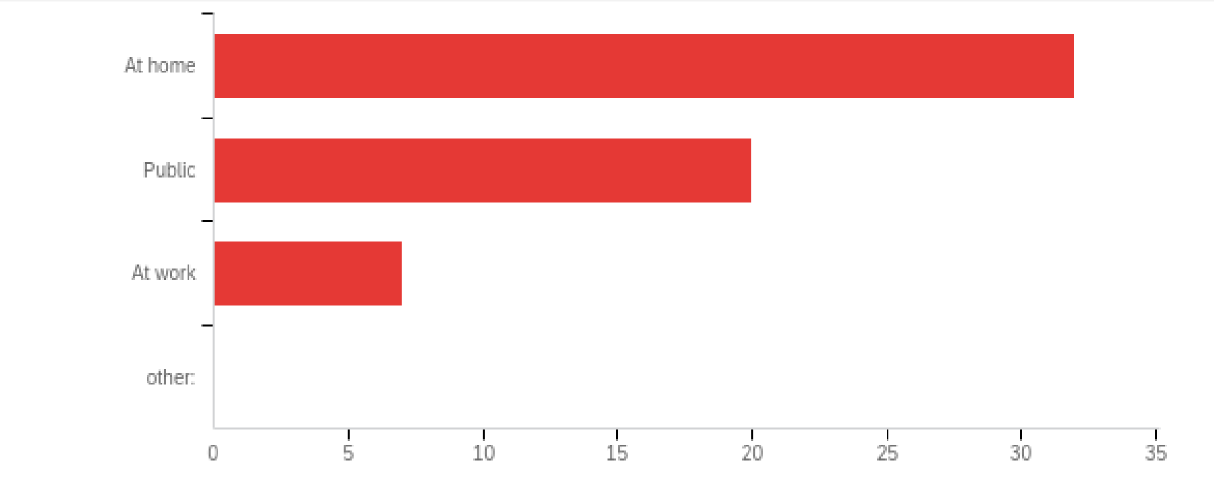
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What type of EV-driver are you ?	1.00	3.00	1.92	0.94	0.89	59

#	Answer	%	Count
1	Lease	49.15%	29
2	Buy-option of the company	10.17%	6
3	Private	40.68%	24
	Total	100%	59

Q5.2 - Where do you most frequently charge your EV?

The location where EV-drivers charge is important in terms of interaction and demographic location. The focus should be on the location where EV-drivers charge the most, as that is where the most potential gain can be achieved using DP. However, if it turns out that EV-drivers primarily charge at home, the focus should shift to encouraging more charging at work to relieve the grid and make a greener choice as an EV-driver.

In 54.24% people charge at home, 33.3% public and 11.86% at work.

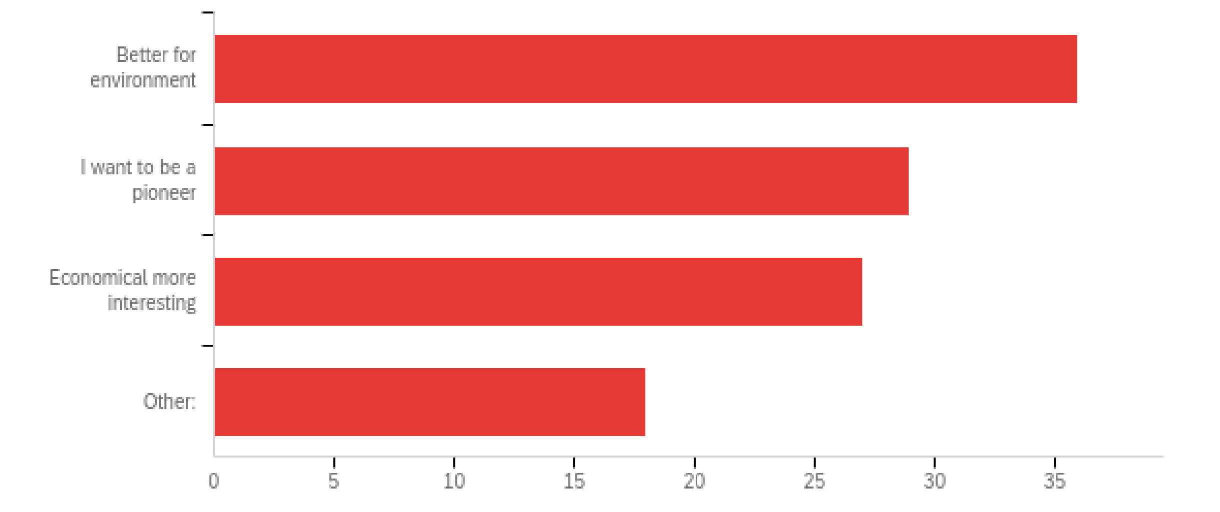


#	Answer	%	Count
1	At work	11.86%	7
2	At home	54.24%	32
3	Public	33.90%	20
4	other:	0.00%	0
	Total	100%	59

Q5.3 - Why do you drive electric? Multiple answers possible

This question is added later. This question is to find the reason for EV-driver to drive electric. Stating their highest motivational source.

32.73% of respondents drives electric because it is better for environment, 26.36% because they want to be a pioneer, 24.5% because economical more interesting and 16.36% because: better driving experience / driving comfort



#	Answer	%	Count
1	Better for environment	32.73%	36
2	Economical more interesting	24.55%	27
3	I want to be a pioneer	26.36%	29
4	Other:	16.36%	18
	Total	100%	110

Q5.3_4_TEXT - Other:

Other: - Text
Better driving experience, unbelievable software integration with charging infra.
Olie is eindig
Leuk
Leuk om in te rijden
Rijdt lekker
Deel met partner die elektrisch wil rijden ivm duurzaamheid
Het is leuker

Diesels mogen de binnenstad niet meer in straks

Gruwelijke wagen, Model 3 LR

Heel fijn en leuk autorijden.

Fiscale bijtelling

Rijdt veel fijner

Rijcomfort

Ik rijd al +14 jaar elektrisch voor test doeleinden

Enige optie vanuit werk aangeboden

Een EV rijden is véél leuker dan een auto op benzine of diesel.

rijdt lekkerder

End of Block: Section 1.2 - if Q5 is yes

Start of Block: Section 1.3 if Q5 is no

Display This Question:
If Are you currently driving an EV (EV)? = No

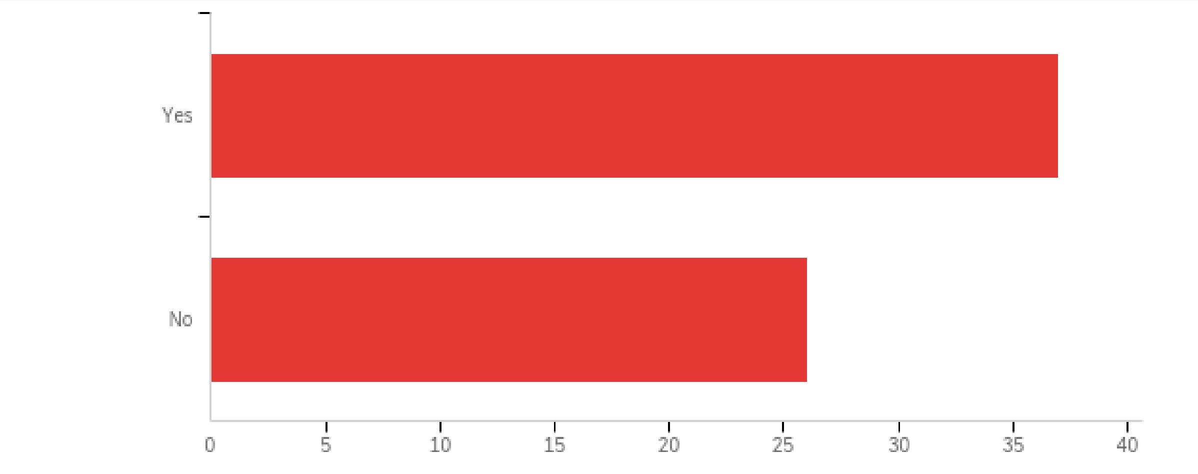
Please answer all the following questions as if you were an owner of an EV.

Page Break

Display This Question:
If Are you currently driving an EV (EV)? = Yes
And What type of EV-driver are you ? = Private
Or Are you currently driving an EV (EV)? = No

Q5.4 - Do you know the price per kWh before charging?

This shows the awareness of pricing of the EV-driver when charging.
58.73% knows the price per kWh before charging, 41.3% does not. Indicating that insignificant amount of people that is aware of pricing, whereas still 41.27% is not.

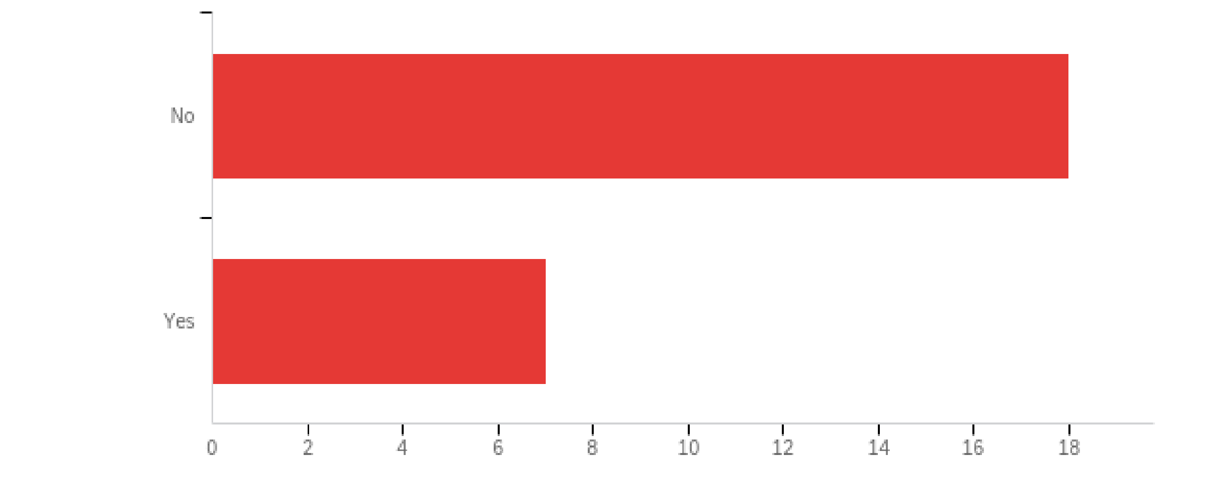


#	Answer	%	Count
1	Yes	58.73%	37
2	No	41.27%	26
	Total	100%	63

Q6 - Do you look up the price per kWh at the charging point?

This question indicates if people do look at the price per kWh at the charging point. Showing the willingness indication on economical benefits of charging points.

72% of the respondents does not look at the price per kWh at a charging point. With the knowledge that 49% is a lease driver, a relative high score is foreseen as lease drivers are less price sensitive. Nevertheless, it can be concluded that 72% of the respondents is not highly likely to be price sensitive. Meaning that conveniency of time and place is of high influence on the charging behaviour of respondents (socio-demographic factors).

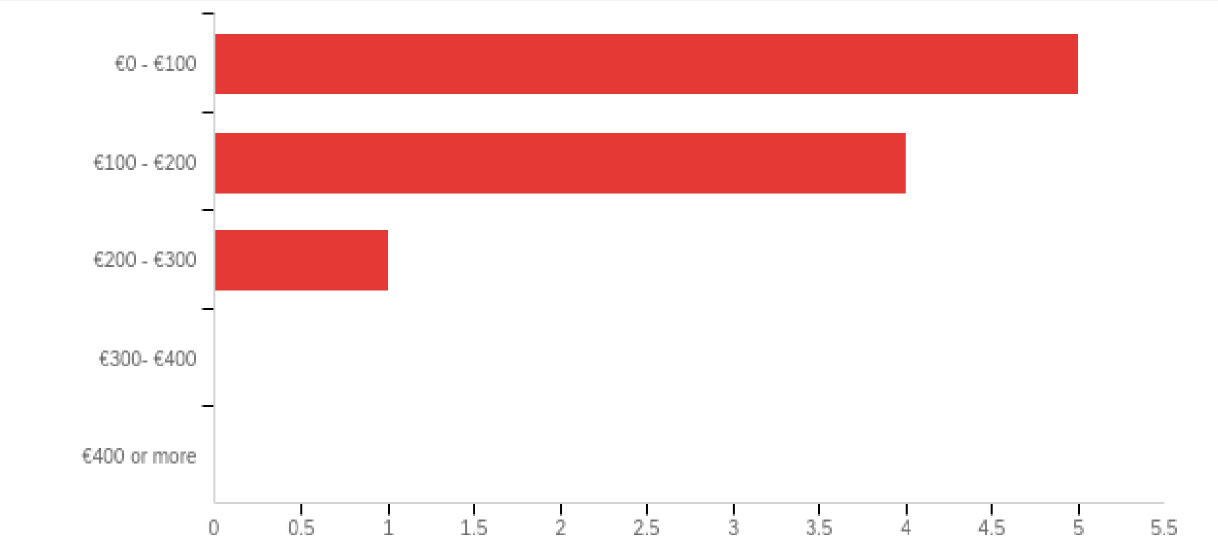


#	Answer	%	Count
1	Yes	28.00%	7
2	No	72.00%	18
	Total	100%	25

Display This Question:
If Are you currently driving an EV (EV)? = Yes
And What type of EV-driver are you ? = Private
Or Are you currently driving an EV (EV)? = No

Q7a - How much are you willing to spend monthly on electric charging ?

On average people are willing to spend 160 euro monthly on electric charging.



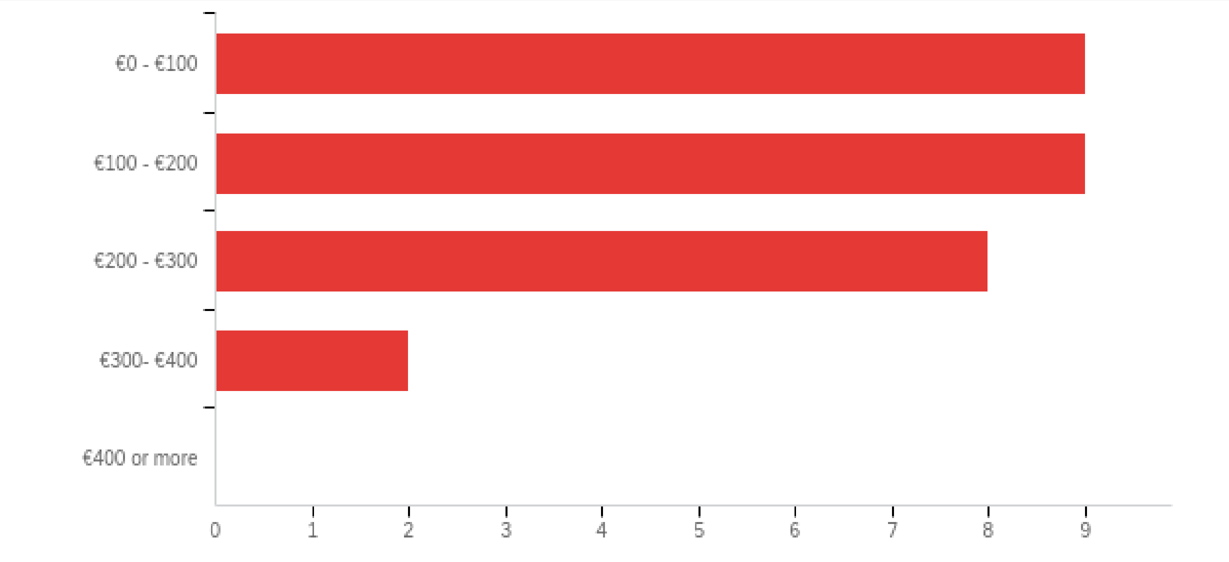
#	Answer	%	Count
1	€0 - €100	50.00%	5
2	€100 - €200	40.00%	4
3	€200 - €300	10.00%	1
4	€300- €400	0.00%	0
5	€400 or more	0.00%	0
	Total	100%	10

Display This Question:
If Are you currently driving an EV (EV)? = Yes
And What type of EV-driver are you ? = Lease

Q7b - What do you think you spend monthly on electric charging ?

If the budget allocated for charging is low, the focus should primarily be on the economical benefits. Even with a smaller budget available, individuals may be more motivated to charge during off-peak hours for cheaper rates. This can potentially impact motivation. One can calculate the price per kilometre by dividing the budget by the average number of kilometres, and if you drive X number of kilometres, your budget is Y. Geographic factors should also be considered, therefore.

On average people think they spend 211 euro monthly on electric charging, this is more then they state they wanted to spend on charging. For marketing Revolt Energy this can be a dynamic used to show people the need of recognition (first phase PDP).

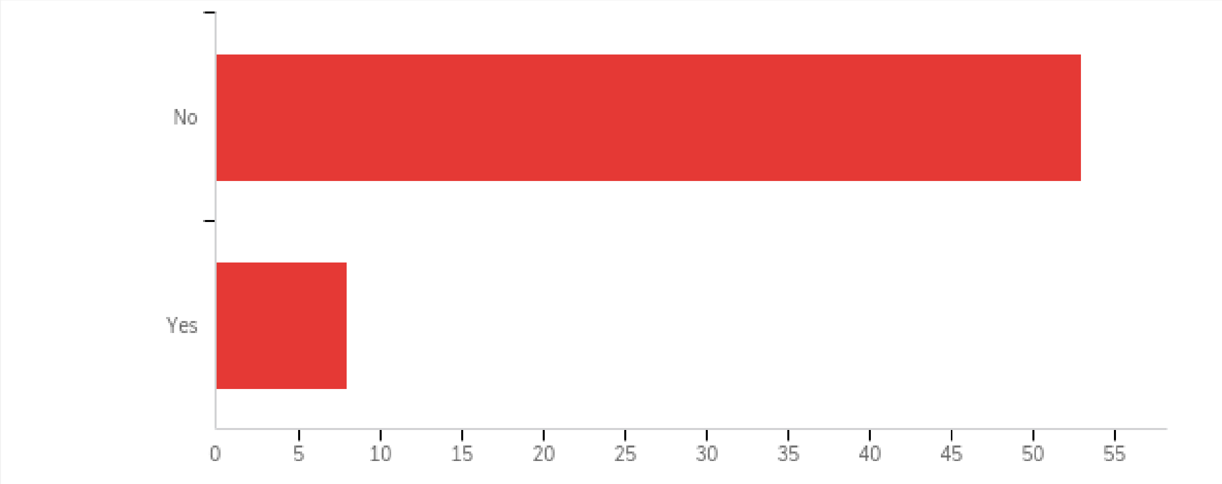


#	Answer	%	Count
1	€0 - €100	32.14%	9
2	€100 - €200	32.14%	9
3	€200 - €300	28.57%	8
4	€300- €400	7.14%	2
5	€400 or more	0.00%	0
	Total	100%	28

Q8 - Are you familiar with Revolt?

Energy's unique value proposition. As it will provide insights into whether a client of Revolt is sufficiently responding. An ICS can be tailored to these segments.

86.89% (53) of respondents were not familiar with Revolt and 13.1% was. Showing that tailoring in segmentation that does not know the value proposition of Revolt is core.



#	Answer	%	Count
1	Yes	13.11%	8
2	No	86.89%	53
	Total	100%	61

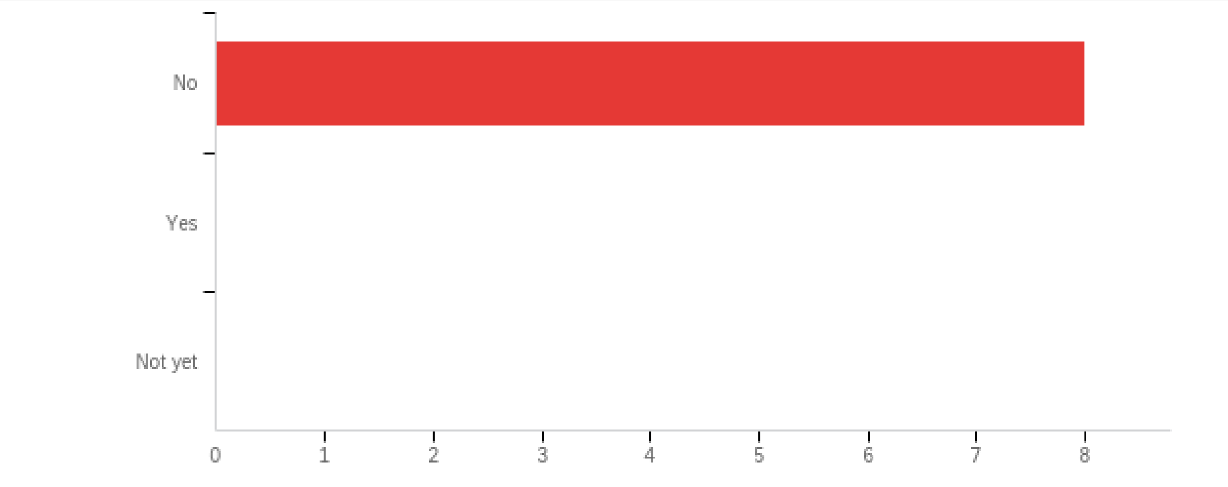
Display This Question:

If Are you familiar with Revolt? = Yes

Q8.1 - Are you a client of Revolt?

If the respondent is a client of revolt. This can be used for segmentation.

100% of respondents is no client of Revolt. Meaning focus on new clients with already end-users in the electric charging segment



#	Answer	%	Count
1	Yes	0.00%	0
3	No	100.00%	8
4	Not yet	0.00%	0
	Total	100%	8

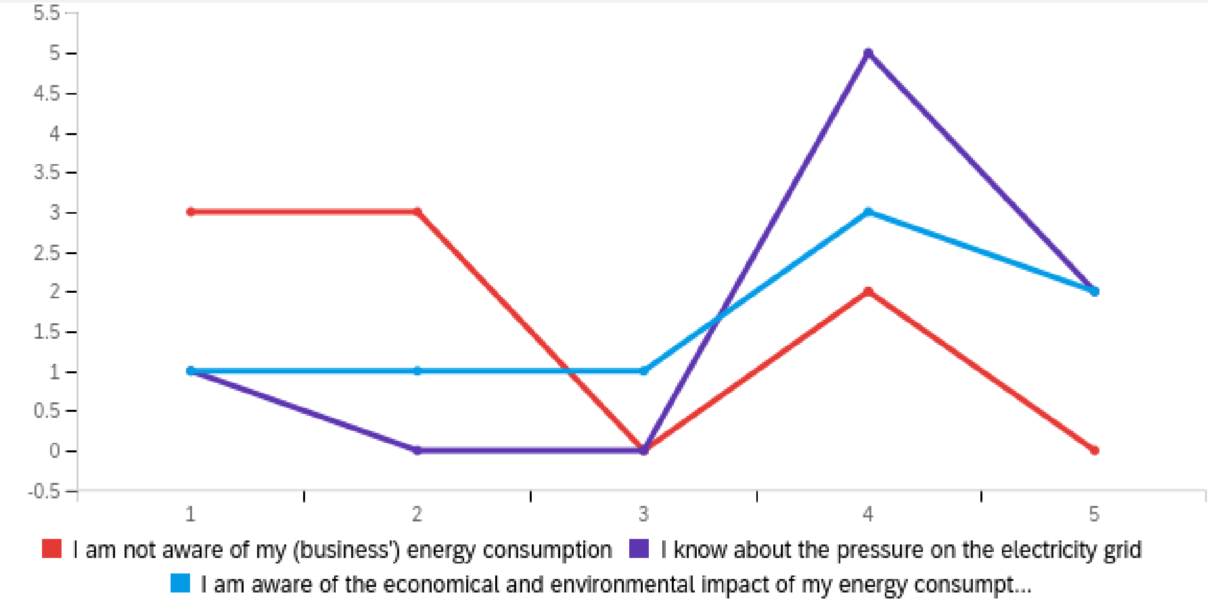
Q8.2 - Drag the slider to which number you most identify with.

This question aims to determine if clients of Revolt are aware of their energy consumption and its consequences. Examine the importance of energy consumption awareness among EV-drivers and how it influences their motivation to engage with DP. The findings can guide an ICS to emphasise the benefits of energy-conscious behaviour and increase their awareness in energy consumption and its consequences. Understanding their level of awareness will help shape an ICS to emphasise the importance of responsible energy use.

With the used Likert scale for the three statements the first statement has a mean of 2.13 people: which it can be concluded that on average respondents are not aware of their business energy consumption. Bringing awareness of consumption is of value for the proposition of Revolt Energy and helping clients in their consumption insights to also take the footprint of EV-drivers on business energy consumption within proposition.

The second statement has a mean of 3.88, which indicates that on average people are aware of the pressure on the electricity grid. Which shows that the respondents in general have an energy-conscious behavioural pattern.

The third statement has a mean of 3.50, indicating that respondents on average are aware of the economical and environmental impact of their energy consumption.

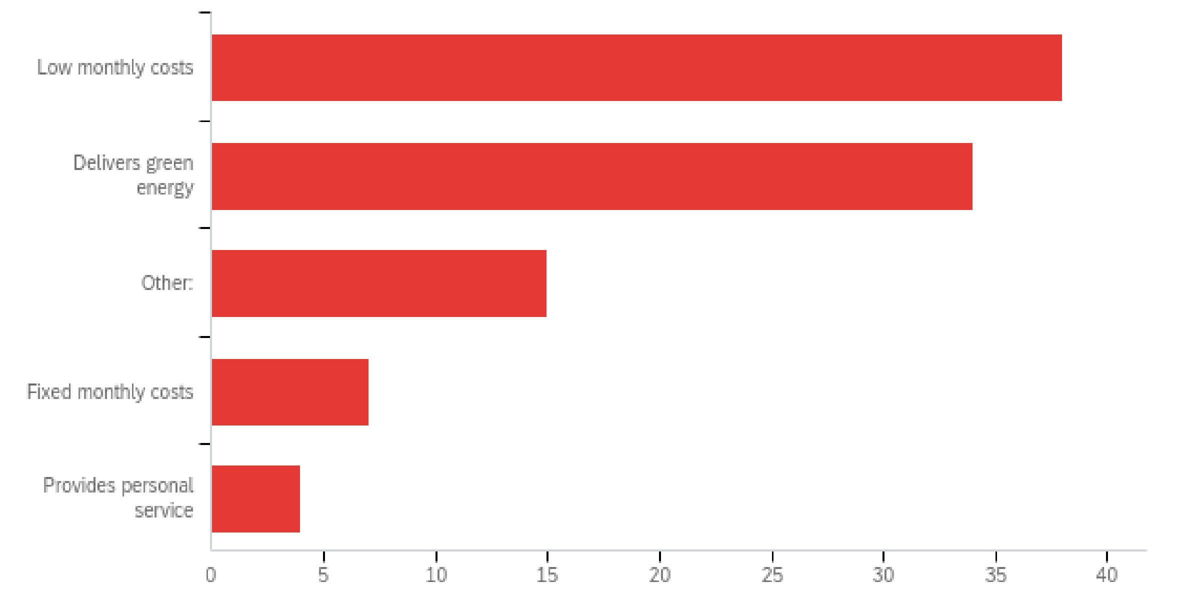


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I am not aware of my (business') energy consumption	1.00	4.00	2.13	1.17	1.36	8
2	I know about the pressure on the electricity grid	1.00	5.00	3.88	1.17	1.36	8
3	I am aware of the economical and environmental impact of my energy consumption	1.00	5.00	3.50	1.32	1.75	8

Q9 - What are the main reasons why you choose a certain energy provider? More options are possible

This information will guide the development of a competitive offering and help position Revolt Energy as a preferred choice. If Revolt Energy wants to come forward as a provider and offer a good deal, they need to

address end-user preferences. What is the most appealing aspect of their current energy contract with their energy provider? And how could Revolt Energy offer a better deal for the end-user?
The low monthly costs and delivery of green energy are the main drivers for EV-drivers to choose a certain energy provider. 15.3% choose for another option namely: availability of DP, flexibility, integration of car, charging point, solar panels, etc. Showing the focus on economical and environmental benefit is valued most by respondents.



#	Answer	%	Count
1	Low monthly costs	38.78%	38
2	Fixed monthly costs	7.14%	7
3	Delivers green energy	34.69%	34
4	Provides personal service	4.08%	4
5	Other:	15.31%	15
	Total	100%	98

Q9_5_TEXT - Other:

Other: - Text
dynamisch
Ik weet dat deze leverancier de goedkoopste aanbieder is in mijn omgeving
Leveringszekerheid
Duidelijke inzichtelijke kosten voor energie, minimaal 1 dag tevoren per uur bekend
Cooperatie
Flexibiliteit

dynamische tarieven
Dynamische tarieven
Goede app waar je continu de prijs kunt zien
Zit nu bij Tibber omdat zij integreren met auto, laadpaal, warmtepomp en zonnepanelen
Geen van bovenstaandere opties
duurzaamheid
Hoogste teruglevervolume en -vergoeding.
Beschikbaarheid variabele tarieven

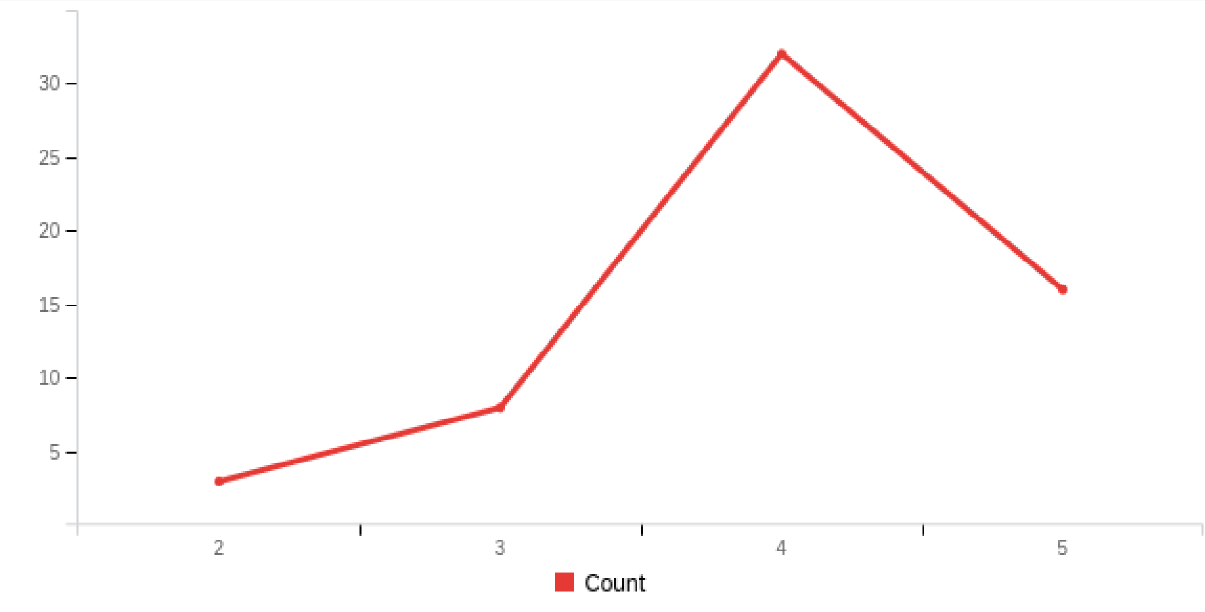
End of Block: Section 1.3 if Q4 is no

Start of Block: Section 2 - driver willingness to change charging behaviour

Q10 - Drag the slider to which number you most identify with.

To what extent is the respondent willing to invest in, for example, Revolt Energy? If they are not willing to invest in technology, Revolt may need to focus more on developing resources within their own human resources or emphasise other aspects before introducing Revolt Energy to the market. Assessing the respondents' willingness to invest in technology, as it can impact their motivation to adopt DP. The findings will inform an ICS regarding the level of emphasis on technology and its benefits Therefore it will help determine the level of market acceptance and guide an ICS.

With the mean of 4.03/5 respondents are willing to invest in additional technology to further reduce my reliance on non-renewable energy sources. Showing willingness of respondents to adapt to DP. Where focus of development of resources for Revolt Energy can be budgeted bigger and showing possibilities for exploring outside internal resources.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I am willing to invest in additional technology to further reduce my reliance on non-renewable energy sources.	2.00	5.00	4.03	0.78	0.61	59

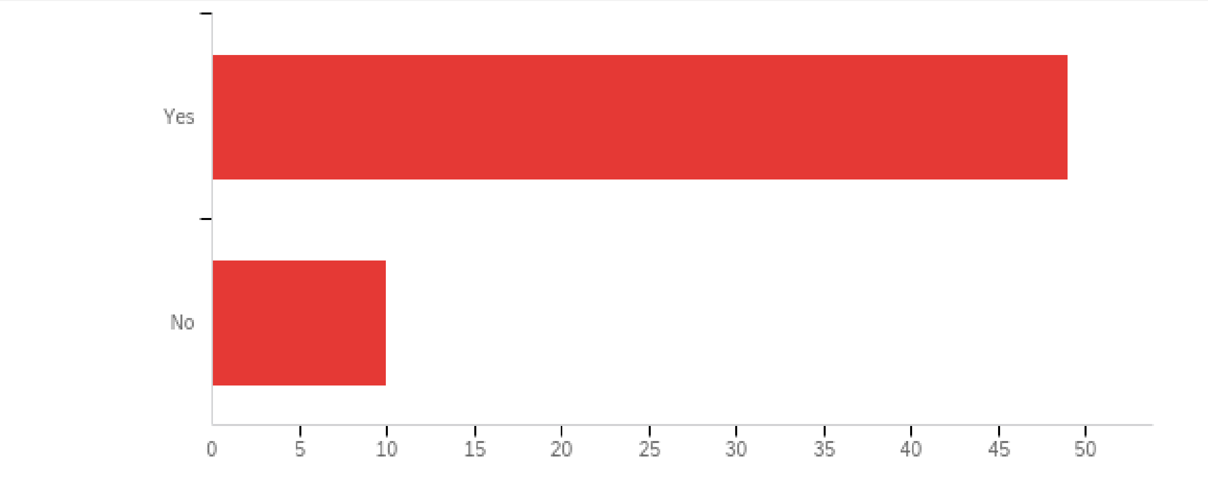
End of Block: Section 2 - driver willingness to change charging behaviour

Start of Block: Section 3 - understanding and familiarity DP

Q11 - I am familiar with the concept of DP (DP) for charging my EV.

Investigate the respondents' familiarity with DP and determine its influence on their motivation and interaction. The findings will help shape an ICS to educate and raise awareness about DP. By examining the respondents' awareness of how DP works for EVs and develop a marketing strategy to increase awareness and understanding of DP's benefits for EV-drivers. If many respondents answer "no" here, there should be a focus on explaining how DP works for EVs and developing a marketing strategy to raise awareness among EV-drivers about the problem and solution offered by DP. Higher awareness and understanding of energy consumption and DP concepts can positively correlate with increased interaction with charging points that use DP.

83.05% of respondents is familiar with DP. Showing that there is high awareness within the respondents group. High focus on explanation on DP benefits for EV-drivers therefore is not necessary. With this question it must be state that most respondents want to be pioneers, whereas information about DP is not new for them, which might be for the rest of the market and certainly for clients of Revolt. But it can be concluded that there is higher awareness and understanding of energy consumption and DP concepts can positively correlate with increased interaction with charging points that use DP.



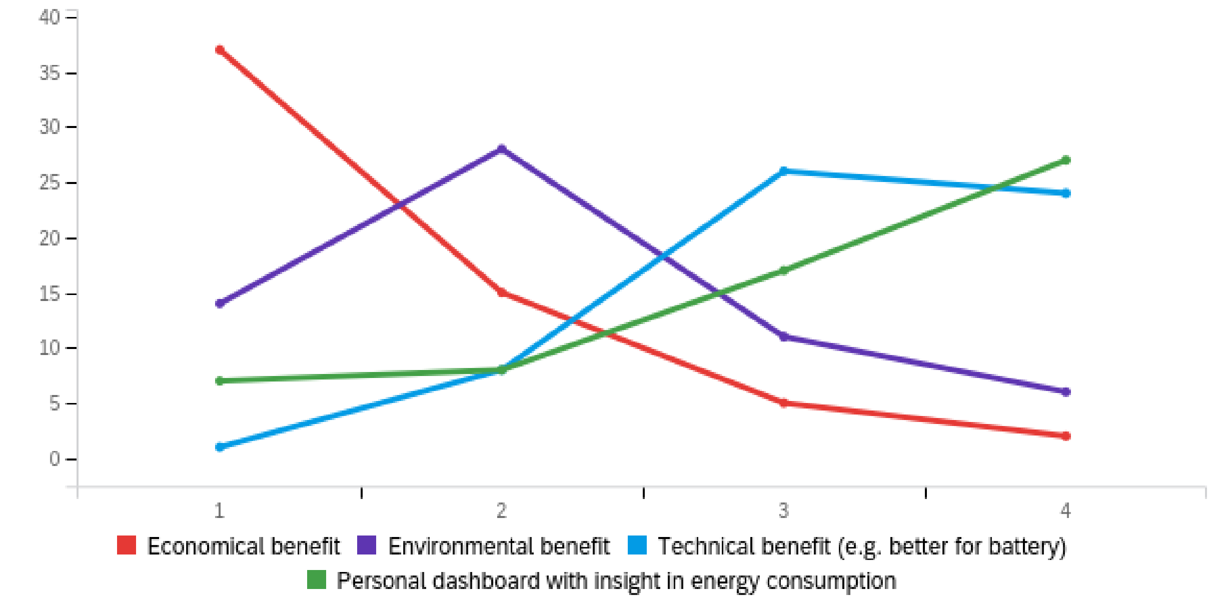
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I am familiar with the concept of DP (DP) for charging my EV.	1.00	2.00	1.17	0.38	0.14	59

#	Answer	%	Count
1	Yes	83.05%	49
2	No	16.95%	10
	Total	100%	59

Q12 - Drag and rank the following factors with respect to how important they are to you, when using DP for charging your EV.

These are the four motivational objectives that influence the information search. Based on the most prominent factor, the information about this factor should be more prominent on the communication channel and platforms during the information search phase of the PDP.

The most crucial factor when using DP for charging EVs is the economical benefit, then the environmental benefit, this is in line with the results of question 9. Focus on these two motivational objectives are state as the Critical success factor number 6.

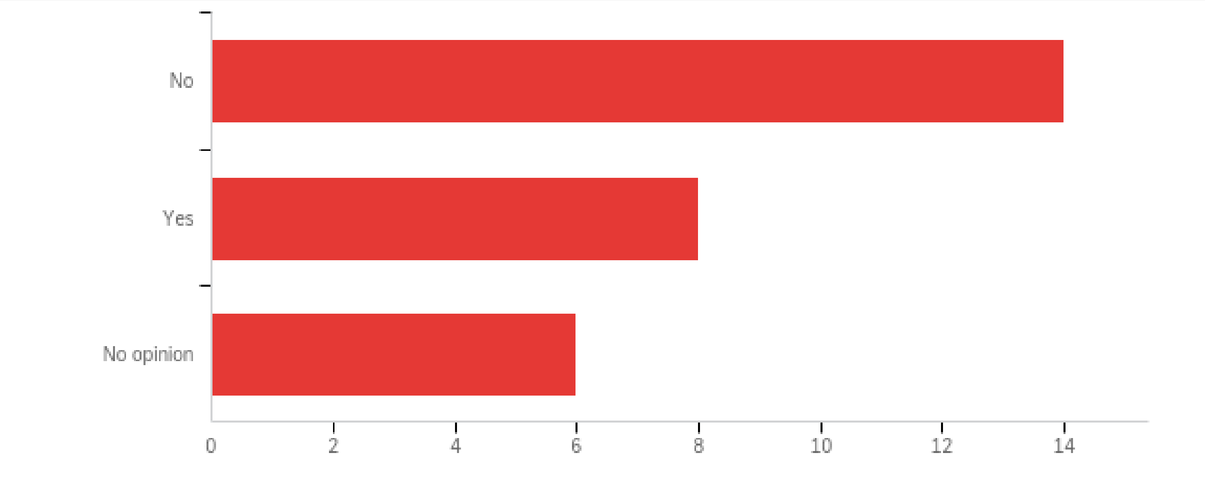


#	Question	1		2		3		4		Total
1	Economical benefit	62.71%	37	25.42%	15	8.47%	5	3.39%	2	59
2	Environmental benefit	23.73%	14	47.46%	28	18.64%	11	10.17%	6	59
3	Technical benefit (e.g., better for battery)	1.69%	1	13.56%	8	44.07%	26	40.68%	24	59
4	Personal dashboard with insight in energy consumption	11.86%	7	13.56%	8	28.81%	17	45.76%	27	59

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Economical benefit	1.00	4.00	1.53	0.79	0.62	59
2	Environmental benefit	1.00	4.00	2.15	0.90	0.81	59
3	Technical benefit (e.g., better for battery)	1.00	4.00	3.24	0.74	0.55	59
4	Personal dashboard with insight in energy consumption	1.00	4.00	3.08	1.03	1.06	59

Q13 - I only find DP useful, when my own contribution for lease is reduced.

If lease drivers are mostly stimulated by the means of economical benefit for them and reduction of the fixed own contribution, it might stimulate them to interact with DP.
With a mean of 2.14 respondents disagreed that they only find DP useful, when their own contribution for lease is reduced. Therefore, the individual component results of question 12 are to be the major objectives of the willingness for respondents.



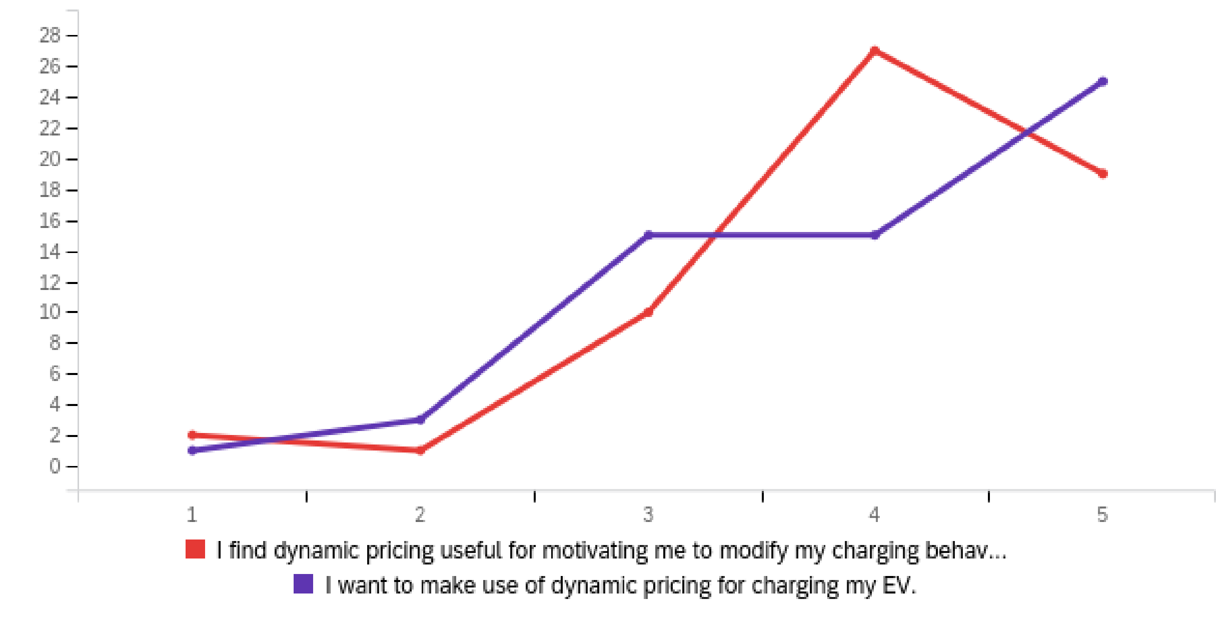
#	Answer	%	Count
1	Yes	28.57%	8
4	No opinion	21.43%	6
2	No	50.00%	14
	Total	100%	28

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I only find DP useful, when my own contribution for lease is reduced.	1.00	4.00	2.14	1.06	1.12	28

Q14 - Drag the slider to which level you agree with the statement.

Measure the perceived usefulness of DP and its impact on the willingness of respondents to adopt it at charging points. This information will guide an ICS to highlight the practical benefits and value of DP. Measuring the usefulness of DP and its influence on the actual use in the TAM model. The higher the score, the greater the impact of usefulness on the actual use of DP at charging points. This helps determine if DP appeals to the market and if it should be a primary focus of interaction and marketing efforts.

With the mean of 4.02 respondents find DP useful for motivating to modify their charging behaviour. Indicating high impact of the perceived usefulness on the actual use of DP at charging points. And can be state that DP appeals to be interesting for the market and should be put high effort for to develop for end-user perspective.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I find DP useful for motivating me to modify my charging behaviour.	1.00	5.00	4.02	0.93	0.86	59
2	I want to make use of DP for charging my EV.	1.00	5.00	4.02	1.02	1.03	59

End of Block: Section 3 - understanding and familiarity DP

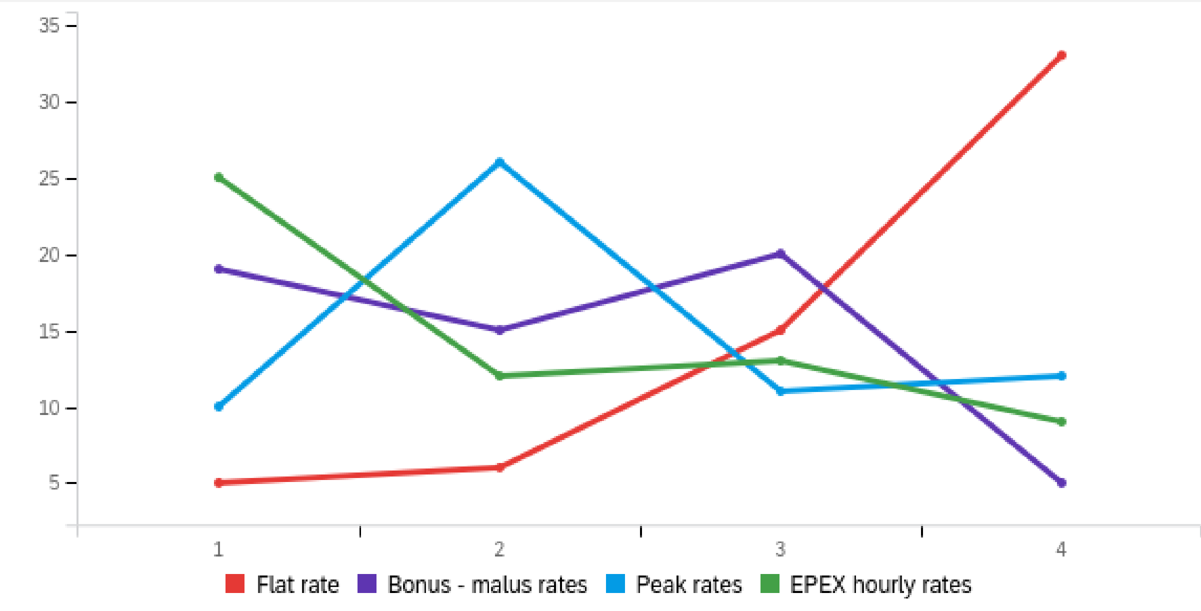
Start of Block: Section 4 - toolbox

Q15 - Rank the following pricing schemes at the charging point with respect to how much you like them, from most liked (1) to least liked (4).

What pricing scheme does the end-user prefer? Is there a demand or desire to use DP at the charging point? This indicates the potential for DP and whether EV-drivers are willing to use it. Explore the end-users' preferences for pricing schemes, including their willingness to accept DP at charging points. The findings will help determine the potential acceptance and demand for DP.

A conclusion is made on the ranking graph and the percentage scores and means. This is an estimation of the ranking, to analyse according to statistical accuracy the PlackettLuce model by Turner et al. (2020) could be used. Due to time limitations this is taken out of scope.

According to respondents the preference is in the following order: hourly EPEX-spot rates, bonus-malus rates, peak rates, flat rate. Where 42.37% of respondents preferred the hourly rates the most.



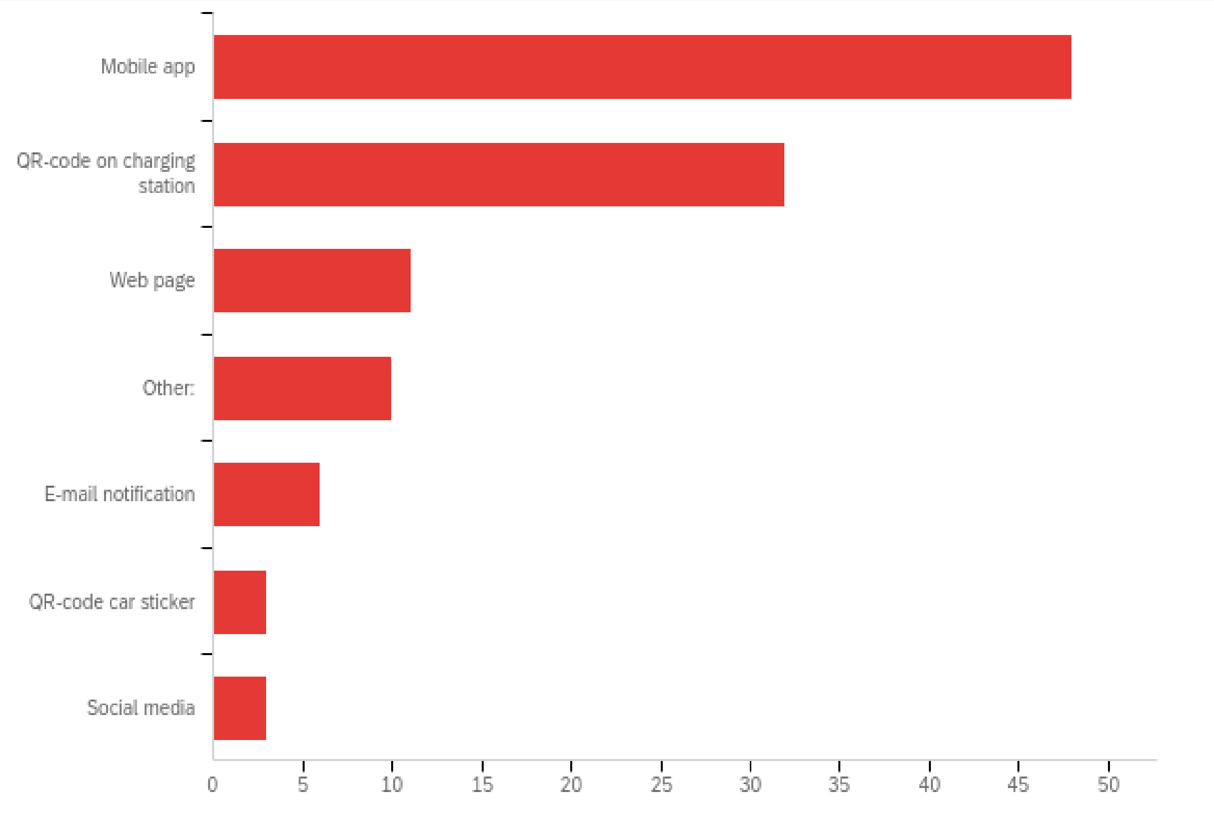
#	Question	1		2		3		4		Total
4	Price based on hourly kWh rates prices fluctuate per hour according to the EPEX- spot market, where supply and demand of energy is traded. This provides full pricing transparency.	42.37%	25	20.34%	12	22.03%	13	15.25%	9	59
3	Peak ratesKWh prices are divided in 4 levels over the days: high peak, peak, neutral & off-peak.	16.95%	10	44.07%	26	18.64%	11	20.34%	12	59
1	Flat rateE.g. always 0,50 cent per kWh	8.47%	5	10.17%	6	25.42%	15	55.93%	33	59
2	Bonus - malus rates Receive a fixed lower electricity rate during off-peak hours and a fixed higher pricing when there is less green energy available than average.	32.20%	19	25.42%	15	33.90%	20	8.47%	5	59

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Flat rateE.g. always 0,50 cent per kWh	1.00	4.00	3.29	0.96	0.92	59
2	Bonus - malus rates Receive a fixed lower electricity rate during off-peak hours and a fixed higher pricing when there is less green energy available than average;	1.00	4.00	2.19	0.98	0.97	59
3	Peak ratesKWh prices are divided in 4 levels over the days: high peak, peak, neutral & off-peak. Amp;nbsp;	1.00	4.00	2.42	0.99	0.99	59
4	Price based on hourly ratesKWh prices fluctuate per hour according to the EPEX- spot market, where supply and demand of energy is traded. This provides full pricing transparency.	1.00	4.00	2.10	1.12	1.24	59

Q16 - How would you like to be informed about the kWh price at the charging point? Multiple answers possible

How can prices be made more understandable to the end-user? Based on what is feasible within Revolt's development capabilities, choices can be made regarding which technologies and areas to focus on in the roadmap, considering time and budget constraints of feasibility. Identify how to make pricing more transparent to end-users and determine their preferences for technology interfaces. This information will guide the development of user-friendly interfaces and determine the most effective way to present pricing information.

The order of preference how people would like to be informed about the kWh at the charging point user friendly interface of mobile app (42.48%), QR-code on charging point (28.3%), webpage, display at charging point (or in car), email notification, social media, QR-code car sticker. Thus, focus on mobile app to present DP is most effective followed by QR-code on charging points.



#	Answer	%	Count
1	Web page	9.73%	11
2	QR-code car sticker	2.65%	3
8	Social media	2.65%	3
10	E-mail notification	5.31%	6
11	Other:	8.85%	10
13	Mobile app	42.48%	48
14	QR-code on charging point	28.32%	32

	Total	100%	113

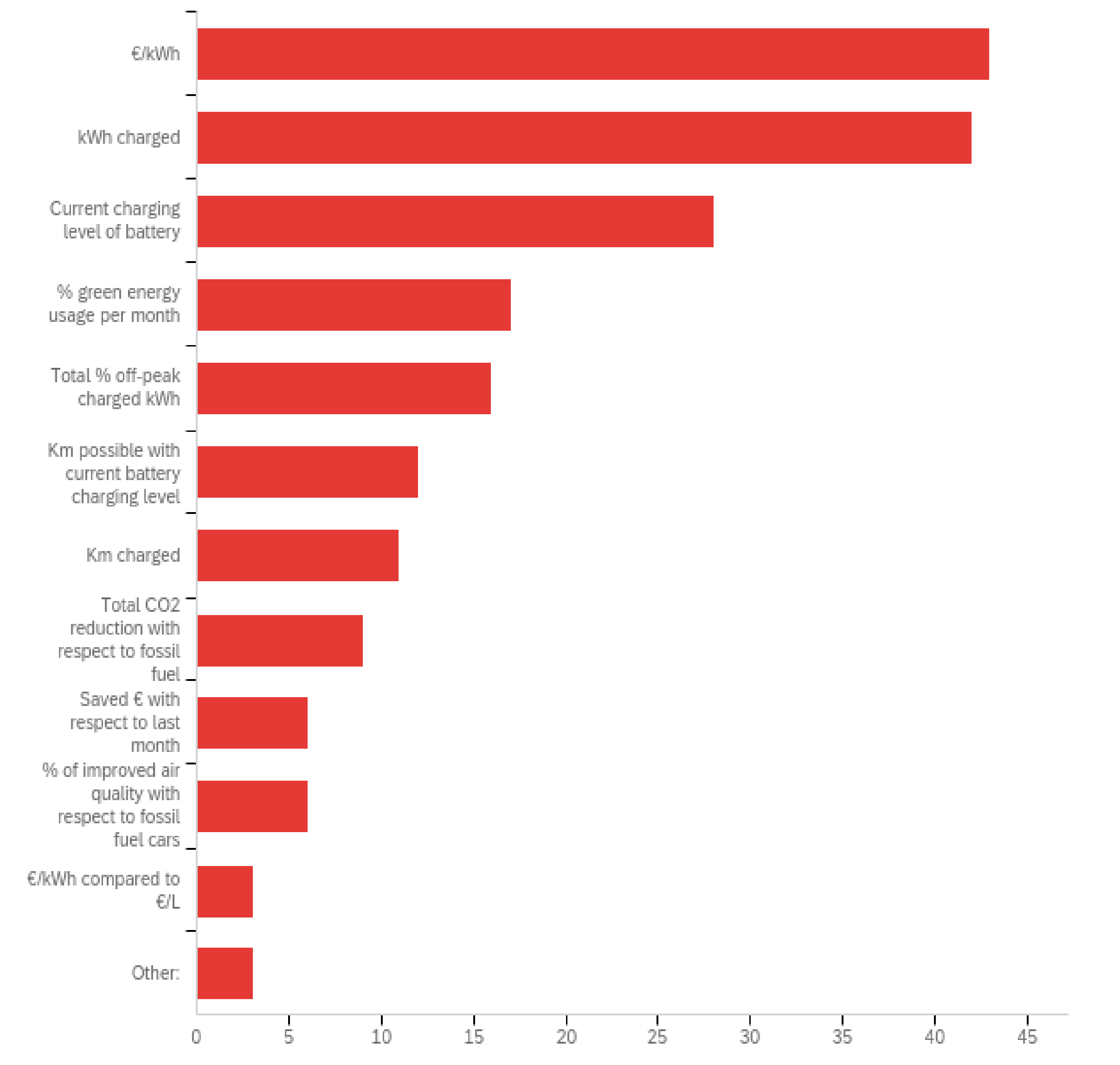
Q16_11_TEXT - Other:

Other: - Text
(digitaal) Bordje bij de paal
Scherm laadpaal
In auto navigatie, dag tevoren bekend en zoekbaar in de wagen
display
Display
Display on the charging point, or in the car
On the display of the charging point
in de auto
display at charging point
display

Q17 - Which information about electric charging would you like to receive? Multiple answers are possible.

This question explores various possibilities for providing insights through technology. It identifies the most desired willingness objective information and determines which insights should be made more visible in Revolt's technology. This will help prioritise the inclusion of key information outputs in the technology and guide an ICS. The top 5 choices should be incorporated into the technology user interface, whether in static or dynamic form, depending on Revolt's development possibilities.

The top 5 information about electric charging respondents would like to receive in order: €/kWh (economical), kWh charged (technical), current charging level of battery (technical), % green energy usage per month (environmental), Total % off-peak charged kWh (technical). From question 17 you see that within technical user-interface the technical benefits are more prone to stimulate interaction with DP, whilst motivation charging behaviour the focus should be on the economical and environmental.



#	Answer	%	Count
1	€/kWh	21.94%	43

2	€/kWh compared to €/L	1.53%	3
3	Saved € with respect to last month	3.06%	6
4	Total CO2 reduction with respect to fossil fuel	4.59%	9
5	% of improved air quality with respect to fossil fuel cars	3.06%	6
6	Total % off-peak charged kWh	8.16%	16
7	Current charging level of battery	14.29%	28
8	% green energy usage per month	8.67%	17
9	Km possible with current battery charging level	6.12%	12
10	kWh charged	21.43%	42
11	Km charged	5.61%	11
12	Other:	1.53%	3
	Total	100%	196

Q17_12_TEXT - Other:

Other: - Text
Only these two, other info comes from the car
Laadsnelheid
Delta tussen actuele elektrische kilometer en brandstofkilometer

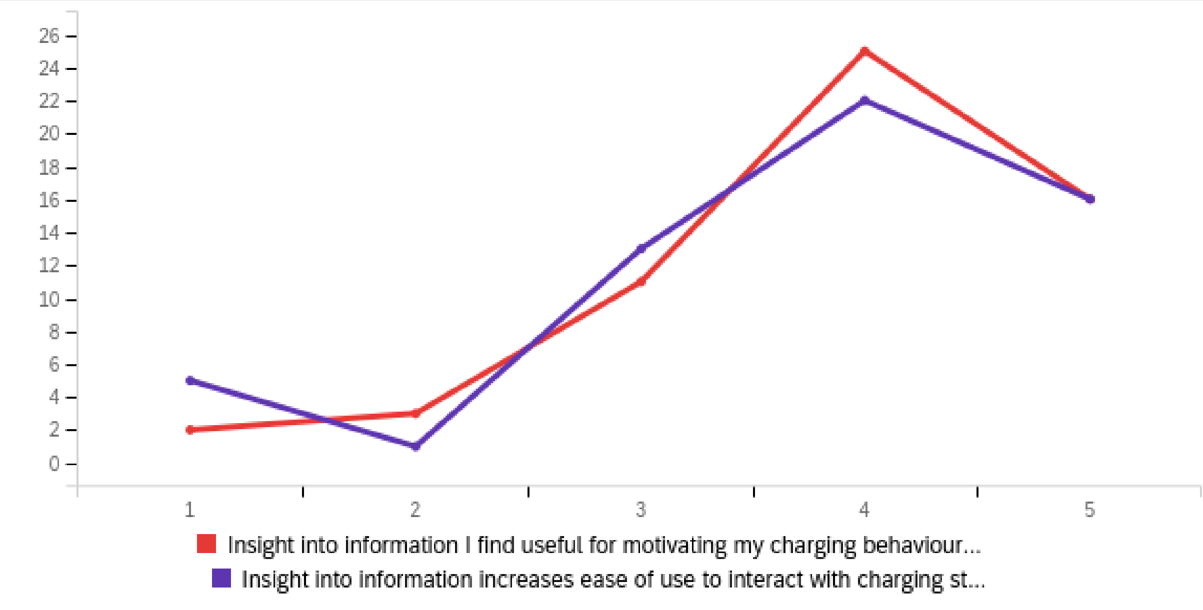
Q18 - Drag the slider on how much you agree with being informed does to you.

The findings will guide an ICS to ensure that the information is useful, user-friendly, and effectively influences behaviour, assessing the perceived utility.

1 - To provide certain segments with information output, it must be found useful to change their behaviour as well. The impact of information has a certain degree of influence on the motivation to interact with the charging point using DP. The usefulness comes from the TAM model and influences the actual use in the TAM.

2 - To provide certain segments with information output, it must be found easy to use according to the TAM model to influence the actual use of a certain technology. The impact of information has a certain degree of influence on the motivation to interact with the charging point using DP. The ease of use comes from the TAM model and influences the actual use in the TAM.

With a mean of 3.88 and 3.75 people agree that insight into the chosen information output is found useful for motivating charging behaviour and interact with the charging point using DP.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Insight into information I find useful for motivating my charging behaviour.	1.00	5.00	3.88	0.99	0.98	57
2	Insight into information increases ease of use to interact with charging points.	1.00	5.00	3.75	1.14	1.31	57

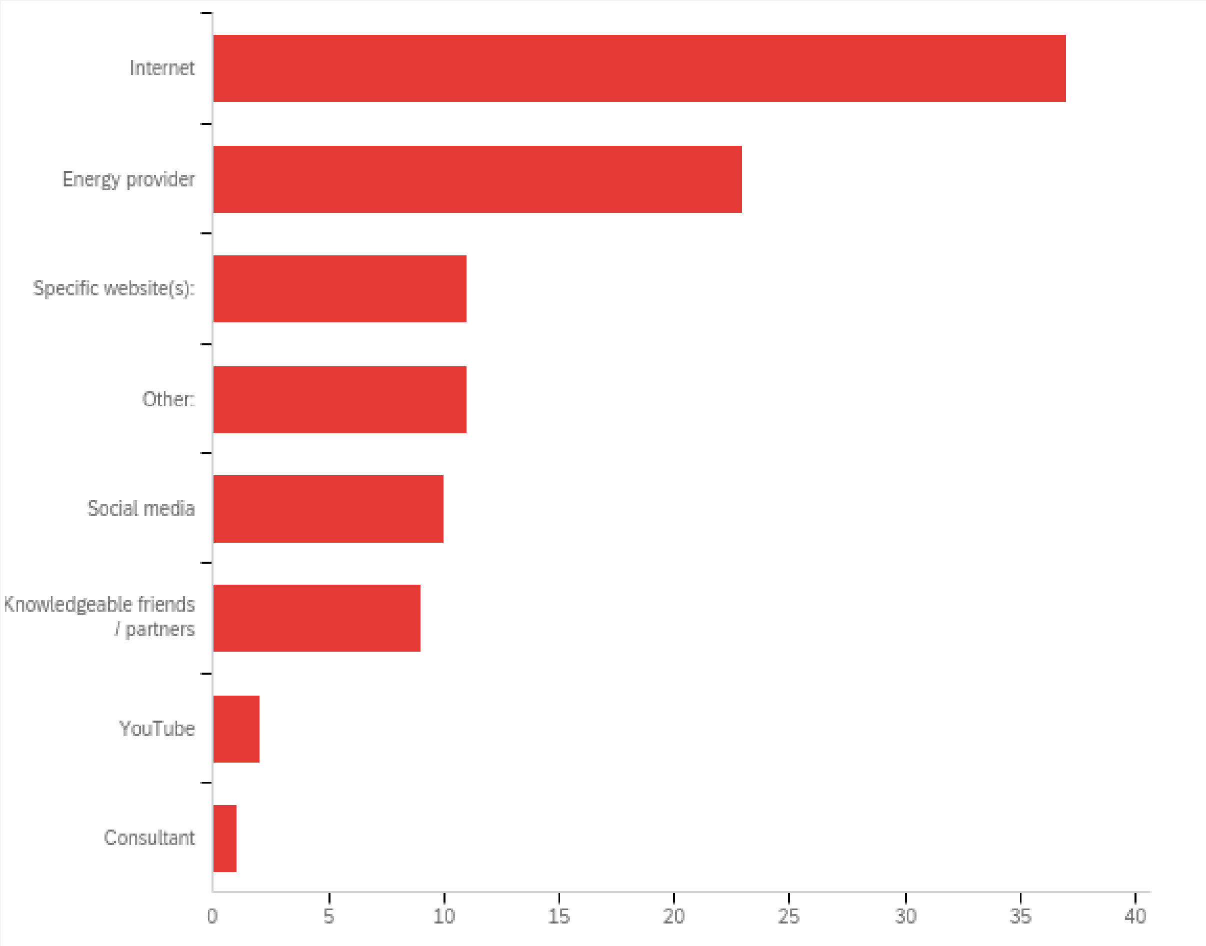
End of Block: Section 4 - toolbox

Start of Block: Section 5 - purchase decision process

Q19 - Which places would you search for information about DP? Multiple answers are possible

This is the first stage of the purchase decision process. What type of communication in this phase is important to include in an ICS roadmap?

Where respondents would search in their first phase of the PDP for information about DP: internet (35%), energy provider (22.1%), specific website(s): (van der bron, entsoe.eu, laadpastop10.nl, ANWB), social media, knowledgeable friends, YouTube, consultant. This indicates focus on the communication type: internet.



#	Answer	%	Count
1	Internet	35.58%	37
2	Social media	9.62%	10
3	Specific website(s):	10.58%	11
4	Knowledgeable friends / partners	8.65%	9
5	Consultant	0.96%	1
6	YouTube	1.92%	2

7	Other:	10.58%	11
9	Energy provider	22.12%	23
	Total	100%	104

Q19_3_TEXT - Specific website(s):

Specific website(s): - Text
laadpastop10.nl
ANWB
https://www.entsoe.eu/
LinkedIn

Q19_7_TEXT – Other:

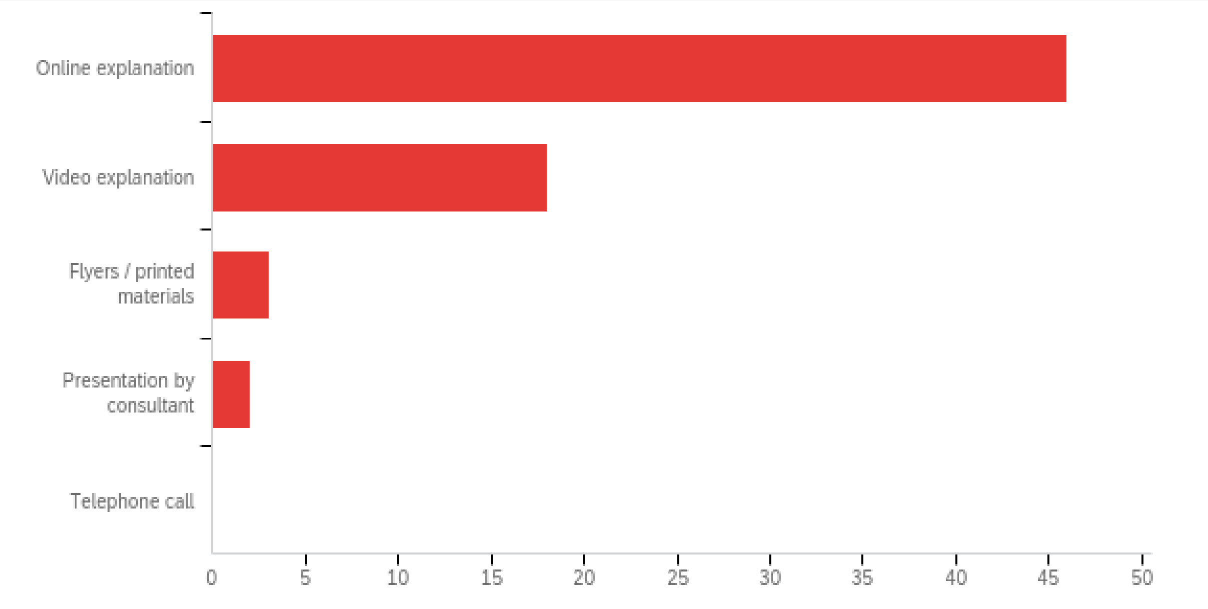
In scherm auto. Prijzen tesla naar moment
app
Twitter
Dagbladen
laadpaal
Energieleverancier 'Van de Bron'
Push messages on phone
Display of charing station
nergens nog
Nog nergens.
geen idee waar deze informatie te vinden is

Q20 - What do you find most useful for learning about DP? Multiple answers possible

It is important to know where the respondent will look for information about DP in the PDP. Based on their preferences, the chosen platform should provide information about DP, which will inform the development of an ICS.

The communication channel which is most effective for information search to learn about DP is chosen by 66.67% of the respondents that online explanations (digital communication) are the most useful. Followed by video explanation (audio-visual media), flyers / printed (printed material) or presentation by consultant (face-to-face communication). Telephone calls score 0%.

Focus on digital communication with audio-visual media as support should be the focus in the second phase (information search) of the PDP from end-user perspective.

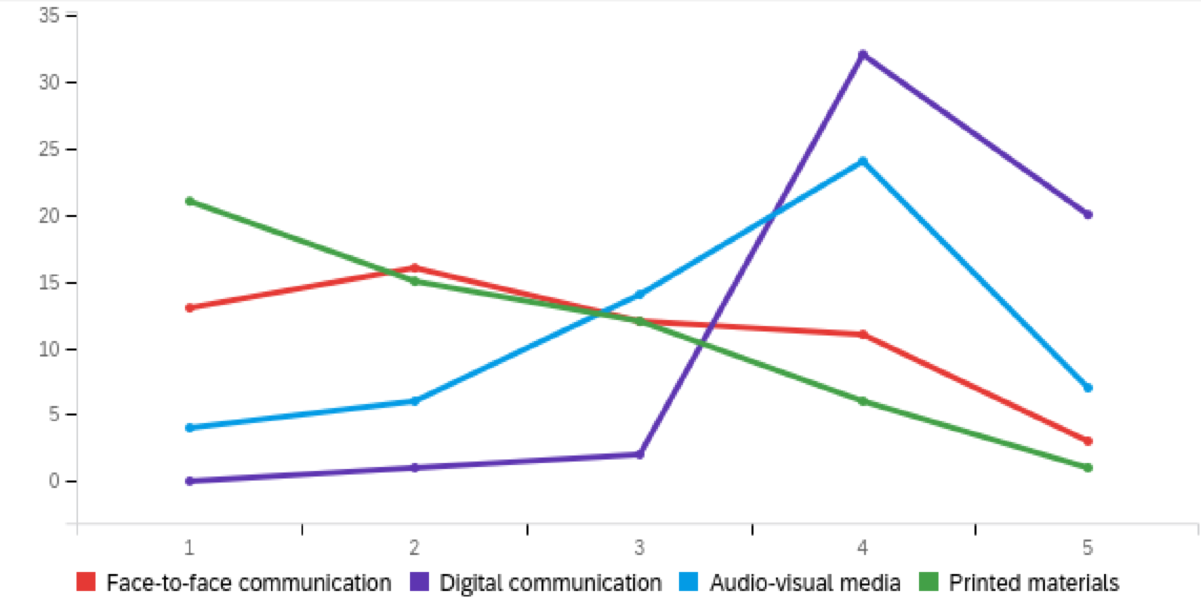


#	Answer	%	Count
1	Online explanation	66.67%	46
2	Video explanation	26.09%	18
3	Presentation by consultant	2.90%	2
4	Flyers / printed materials	4.35%	3
5	Telephone call	0.00%	0
	Total	100%	69

Q21 - Drag the slider to indicate how convenient you find the communication method for motivating your dynamic charging behaviour.

For each communication channel, the respondent is asked to rate its usefulness. From the TAM model, usefulness has an impact on the intention to use, which affects the purchase decision in the DPD. If respondents react positively, a particular communication channel is considered useful. This scales the influence of the intention to use from the TAM model to the purchase decision in the DPD. It assesses the perceived utility of different communication channels. This will inform an ICS to prioritise and enhance the effectiveness of specific channels in influencing the purchase decision.

Digital communication is found most useful for motivating charging behaviour, followed by audio-visual media, face-to-face communication, and printed material. In line with question 20. the prior focus on digital communication and audio-visual is important . This informs to prioritise and enhance of the perceived usefulness of digital communication and audio-visual media to influence the purchase decision.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Face-to-face communication	1.00	5.00	2.55	1.20	1.45	55
2	Digital communication	2.00	5.00	4.29	0.62	0.39	55
3	Audio-visual media	1.00	5.00	3.44	1.07	1.16	55
4	Printed materials	1.00	5.00	2.11	1.09	1.19	55

Q22 - When and where would you like to receive information about dynamic prices during to make it more convenient for you? Examples could be: In the car with QR-code glass-sticker Before entering / getting out of the car with a QR-code key chain   in the car with a mobile app At breakfast with an e-mail notification

Explore creative ways to integrate information output into EV-drivers' daily routines. This will inform an ICS to maximise interaction and user engagement with DP. This question allows respondents to provide open input regarding where and how they would like to be informed about DP. This input is valuable for developing an ICS, integrating information output into an EV-driver's daily routine, and considering the timing of direct stimuli interventions. The frequency will not be investigated as it can be given to end-users as optional.

36 respondents want to be informed via a mobile app, from these people 12 people want to receive a push notification on when to charge and where (cheapest and fastest nearby). In line with question 16, showing again that the mobile application is a preferred technology from end-us perspective. But also, for Revolt is a strategy to maximise interaction and user engagement with DP.

Mobile app, preferably with outlook for coming few days also
In de auto
App
App
in de auto met een mobiele app
In de auto met een mobiele app en op digitaal in de navigatiesystemen (bijvoorbeeld Google Maps).
Bij voorkeur 24vuur tevoren via app zodat je laden en reizen op elkaar kan afstemmen
Qr code op paal
In auto net app
Allen bovenstaande, plus in de auto bij selectie of zoeken laadpunt
app
Mobiele app of laadpaal
Pop up app
Bij de laadpaal voorafgaand aan het laden
rick.tiemessen@gmail.com
App
Op mijn telefoon. Einde van de middag.
Mobiele app
email of sleutelhanger
Met een app

Met de mobiele app
Qrcode bij in- en uitstappen
Website
In de auto met een app, dashboard in huis
In app
Wat is een QR-code glassticker? Wat is een QR-code sleutelhanger? Vreemde vraag dit. Ik wil het gewoon of op het display op de laadpaal zien of in de app van de laadpaalexploitant
Mobiele app
Bij het in en uitstappen van de auto met een qr code
Via moniele app
Mobiele app
Via een app
Via de app
Via een app op telefoon
mobile app
Mobile app
Als ik thuis kom en de auto aan de paal koppel.
Niet, ben al op de hoogte
Push bericht via app op telefoon bij ontbijt
Met app en op basis van agenda/ planning en eventueel verweken van bijkomende kosten voor bijvoorbeeld parkeren
On the display if the charing station
op dashboard in de auto
in de auto met een mobiele app
geïntegreerd in mijn auto, zoek de laadpaal die het snelste laadt tegen de laagste prijs.
I would prefer to use a bookmarked website (Progressive Web Application) which I can consult at any time to look up the day-ahead prices.
push melding in de laadpas app
Als notificatie op m'n mobiele telefoon (wanneer er afwijkingen zijn) en uitgebreidere info in een app (liefst geïntegreerd in m'n Tesla app) op m'n telefoon.
dat een systeem dat op de achtergrond voor mij uitzoekt, ik wil er niet actief mee bezig zijn
mobiele app
als ik van plan ben te gaan laden, via een app. Of in de ochtend in een email./
display bij de laadpaal en in mobiele app

op het moment dat ik energie wil gaan verbruiken, in een app of op de paal zelf

End of Block: Section 5 - purchase decision process

Start of Block: Section 6 - Driver’s perception of the communication used

Q23 - Drag the slider to indicate how motivating these statements are for you to change your charging behaviour.

Evaluate the influence of "if-then" statements related to motivational objectives on EV-drivers' motivation to change their charging behaviour. This will help shape an ICS to emphasise key motivators and encourage prosocial behaviour. They form the correlation between willingness and the charging decision in the charging behaviour framework.

1 - Economical incentive - is found most motivating with a mean of 4.19.

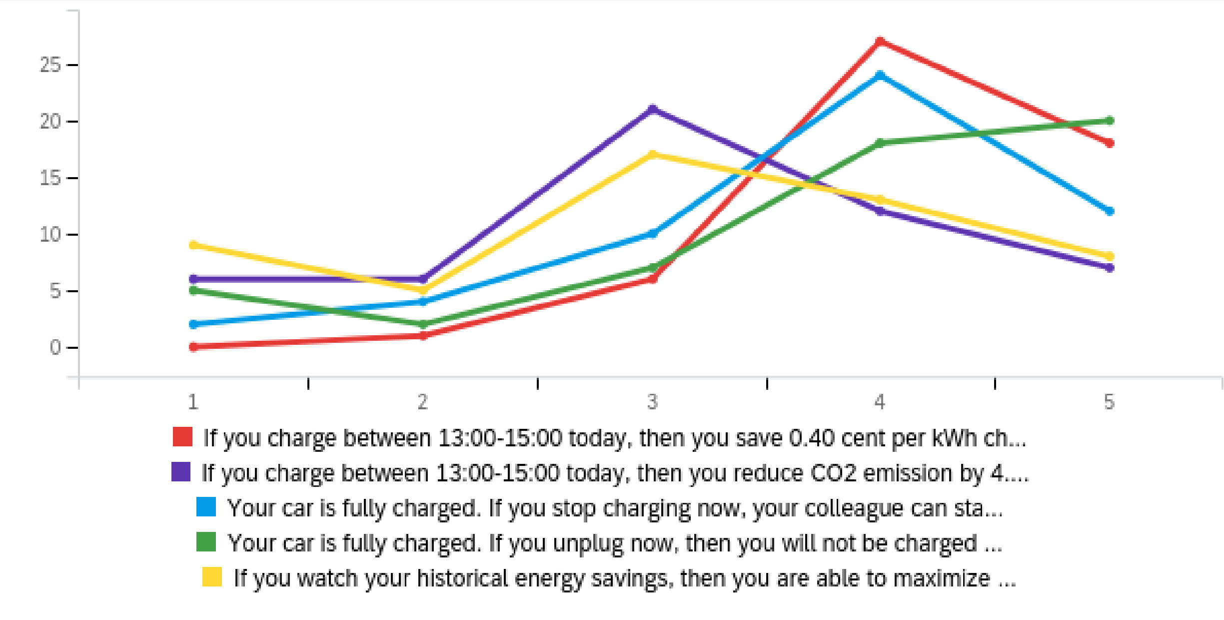
2 - Environmental incentive – is found to be motivating with a mean of 3.15.

3 - Technical incentive / Prosocial behaviour - is found most motivating with a mean of 3.77.

4 - Economic incentive / Prosocial behaviour - is found most motivating with a mean of 3.88.

5 - Personal feedback. If this provides high motivation, historical data insights should be provided to motivate the EV-driver to charge according to DP. - is found most motivating with a mean of 3.12.

Again, showing that economical statements are found to be most motivating to change charging behaviour, followed by environmental incentive.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	If you charge between 13:00-15:00 today, then you save 0.40 cent per kWh charged.	2.00	5.00	4.19	0.71	0.50	52
2	If you charge between 13:00-15:00 today, then you reduce CO2 emission by 4.3 kilograms.	1.00	5.00	3.15	1.15	1.32	52
3	Your car is fully charged. If you stop charging now, your colleague can start charging.	1.00	5.00	3.77	1.01	1.02	52
4	Your car is fully charged. If you unplug now, then you will not be charged a parking pricing.	1.00	5.00	3.88	1.23	1.53	52
5	If you watch your historical energy savings, then you can maximize your savings.	1.00	5.00	3.12	1.28	1.64	52

Q24 - Drag the slider on how much you agree with the statements.

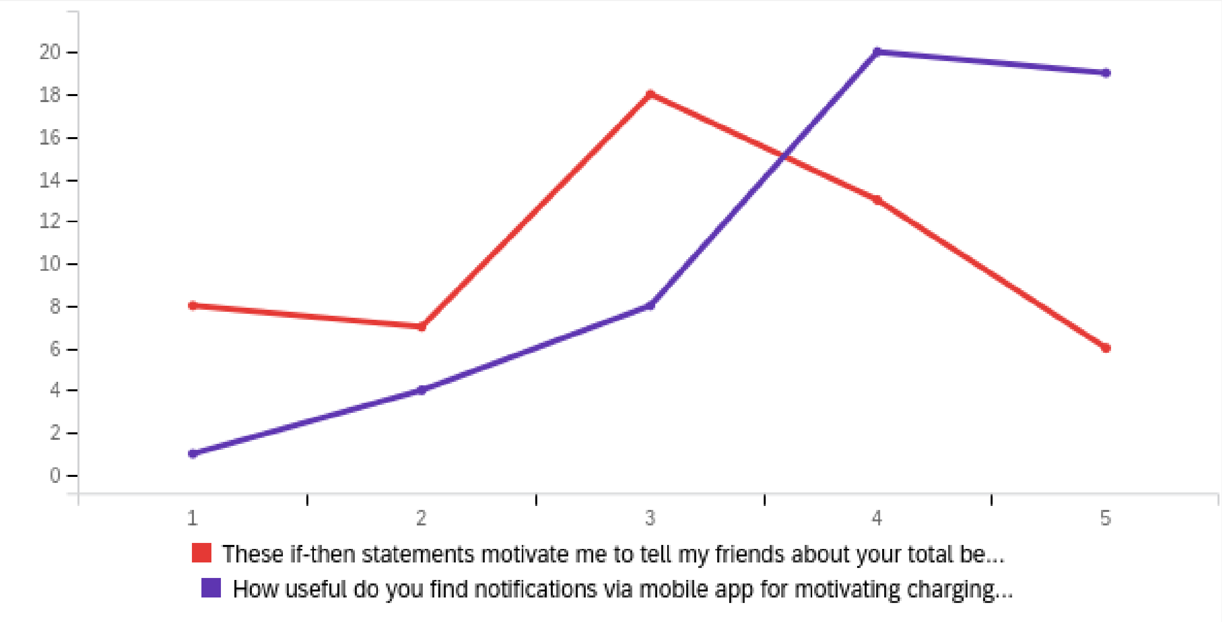
Assess the impact of "if-then" statements on the willingness of EV-drivers to use technology, specifically the influence of direct stimuli via notifications on mobile apps. This will inform an ICS to optimise user engagement and adoption.

1 - The influence of the willingness to engage in prosocial post-purchase behaviour. Prosocial behaviour should be encouraged to motivate the EV-driver positively. Disagreement with this statement indicates that these direct if-then statements do not encourage prosocial behaviour. In that case, Q28 should be considered to develop an ICS to stimulate pro-social behaviour in the post-purchase phase.

2 - Direct stimuli via notifications on a mobile app are found to be useful by a certain percentage of respondents and have an impact on the actual use of a certain technology based on the intention to use in the TAM model.

The if-then statements from question 23 are motivated to tell my friends about your total benefits is concluded to be neutral with mean of 3.04. Indicating if-then statements work on individual level to change behaviour, not stimulating pro-social behaviour. Thus, question 25, should be considered in develop an ICS to stimulate pro-social behaviour in the post-purchase phase to create pro-social behaviour within design of ICS.

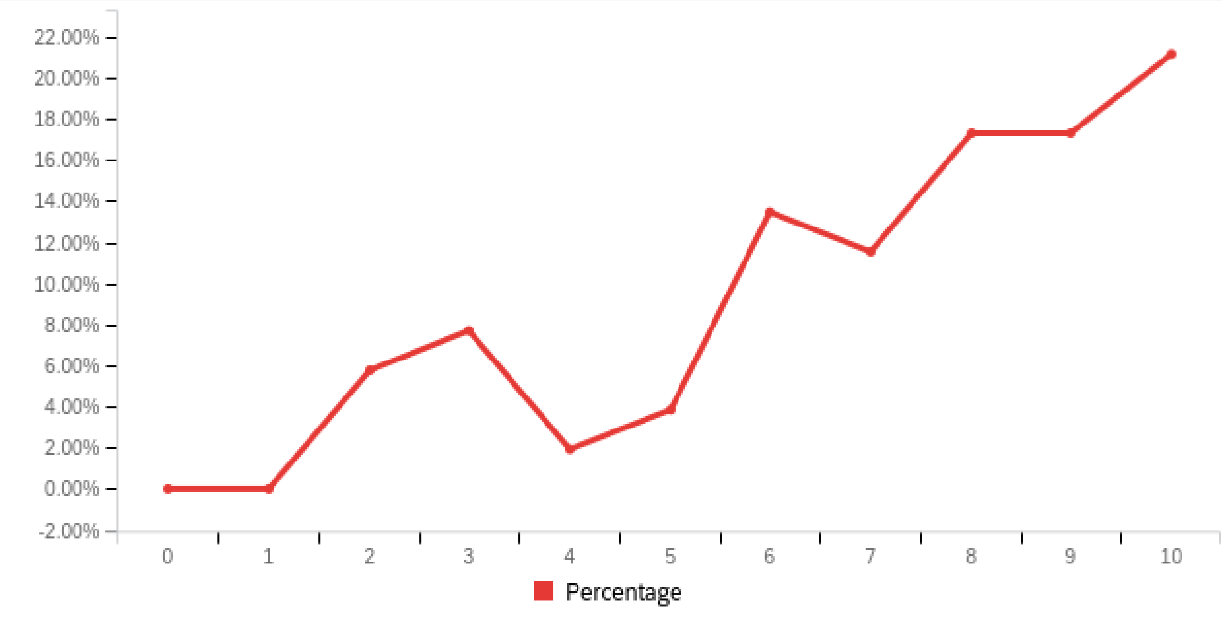
With a mean of 4.00 notifications via mobile app for motivating charging behaviour are found useful and impact the actual use of the technology according to the TAM model.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	These if-then statements motivate me to tell my friends about your total benefits.	1.00	5.00	3.04	1.21	1.46	52
2	How useful do you find notifications via mobile app for motivating charging behaviour.	1.00	5.00	4.00	1.00	1.00	52

Q25 - I need to be able to choose when I leave and the minimum amount of energy I want to charge. The system will then automatically charge accordingly. Scale between 0 and 10.

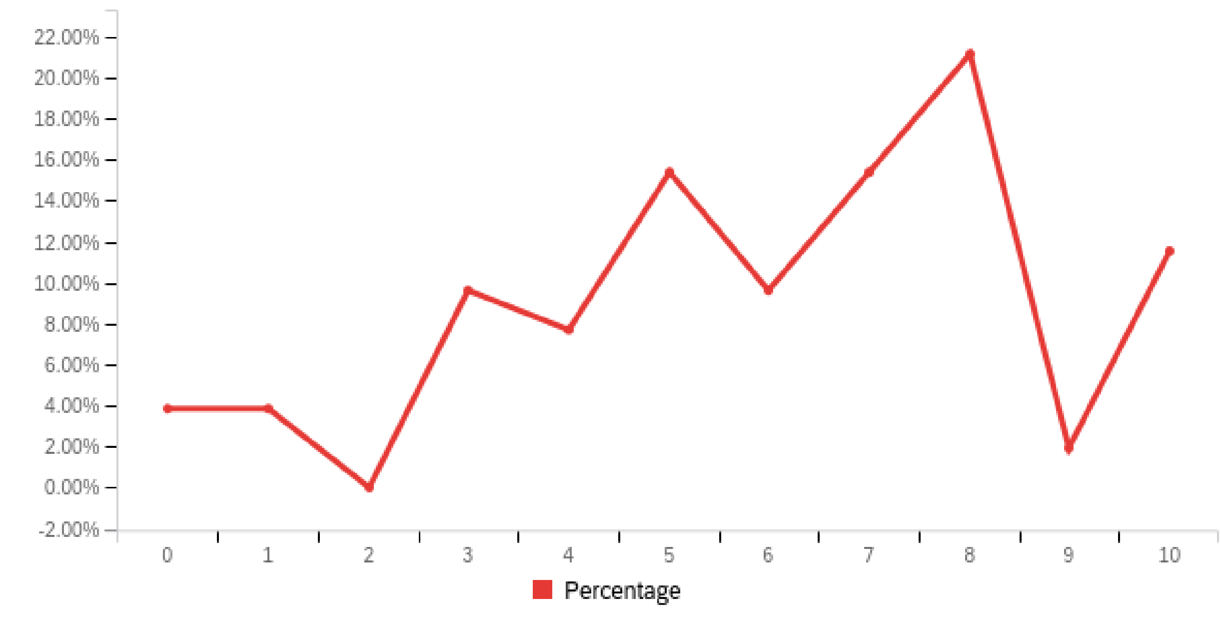
To what extent is the respondent willing to change their interaction with the charging point when more tasks are performed automatically? If the willingness to change is high, collaboration should be sought with Jedlix or Stekker.app, as developing this kind of algorithm is complex and requires resources.
With the mean of 7.29 respondents need to be able to choose when they leave and the minimum amount of energy I want to charge, where the system will then automatically charge accordingly. Showing the willingness to this type of technology is high, therefore collaboration should be sought with Jedlix or Stekker.app, as developing this kind of algorithm is complex and requires resources and to increase pro-social behaviour within this design of ICS in technology.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	I need to be able to choose when I leave and the minimum amount of energy I want to charge. The system will then automatically charge accordingly. Scale between 0 and 10.	2.00	10.00	7.29	2.41	5.82	52

Q26 - How likely would you share a negative experience with DP on charging points with those around you. Scale between 0 (not likely) and 10 (extremely likely).

What motivates the EV-driver to behave pro-socially regarding DP? These direct motivators of an EV-driver should be considered during the marketing of the product where Q26 researches the negative experience and Q27 the positive experience.
It is highly likely that people would share negative experiences with DP on charging points with those around you with a mean of 6.08. Analysing the graph, you see a high peek around 8. Chosen by 21.15% and another peak at 5(15.38%) and 7(15.38%).

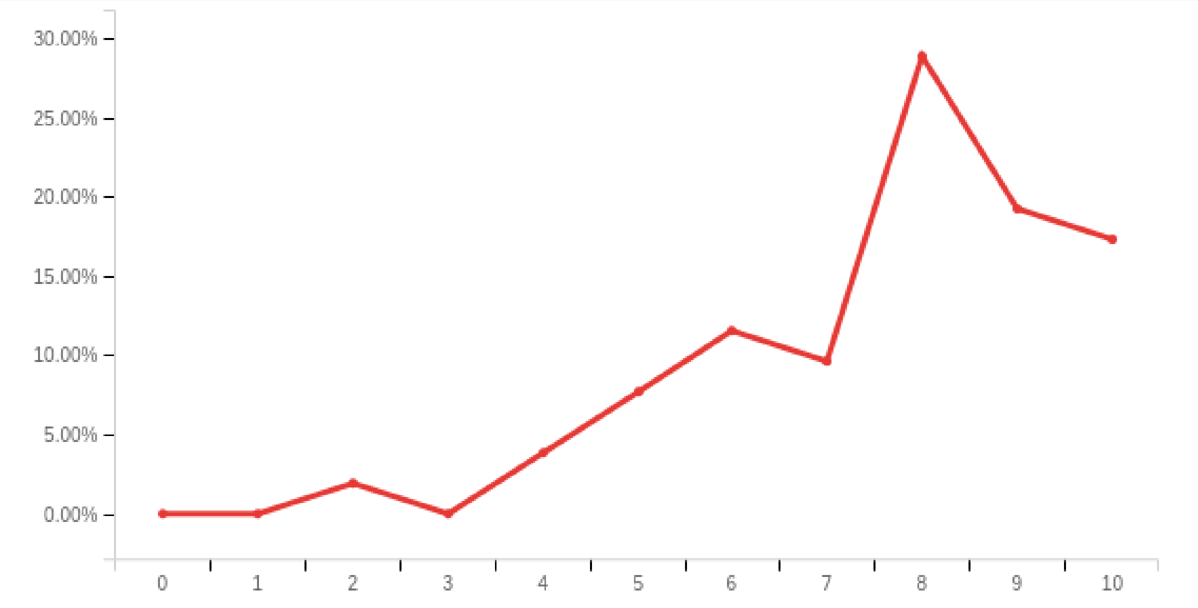


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How likely would you share a negative experience with DP on charging points with those around you. Scale between 0 (not likely) and 10 (extremely likely).	0.00	10.00	6.08	2.59	6.69	52

Q27 - How likely would you share a positive experience with DP on charging points with those around you. Scale between 0 (not likely) and 10 (extremely likely).

What motivates the EV-driver to behave pro-socially regarding DP? These direct motivators of an EV-driver should be considered during the marketing of the product where Q26 researches the negative experience and Q27 the positive experience.

It is highly likely that people would share positive experiences with DP on charging points with those around you with a mean of 7.71. Which is higher average than the negative experience. Where 8 was the most given score by 28.85% and 9 by 19.23%. Thus, when trying to influence pro-social behaviour. Positive experience are direct motivators. For Revolt Energy to be wanted by end-users a decent level of product quality to create satisfaction is crucial for pro-social behaviour.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How likely would you share a positive experience with DP on charging points with those around you. Scale between 0 (not likely) and 10 (extremely likely).	2.00	10.00	7.71	1.83	3.36	52

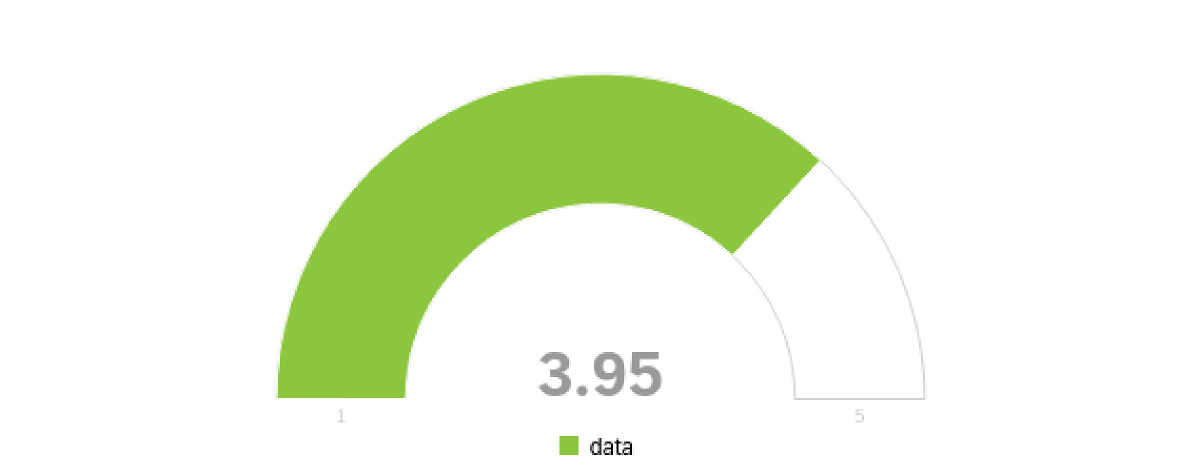
End of Block: Section 6 - Driver's perception of the communication used

Start of Block: Section 7 – Feedback

Q28 - How did you find this questionnaire?

48.65% rated the questionnaire as useful and 18 comments were left. These are evaluation point for the questionnaire to be considered from the end-user perspective and biases to be indicated.

- Thank you for taking the time for this questionnaire, you can leave feedback on how you received this questionnaire.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How did you find this questionnaire?	2.00	5.00	3.95	0.87	0.75	37

Q29 - Any other comments or ideas you want to share:

I do not want to know that i saved 40cents. Compared to what? I just want to know the rates i paid. I assume the rate is low when that is best for the network and for my finance. I already try to charge during low network load hours so i do not need stuimulation. But i do want low rates. 50c is by any standard too high. i pay 31 in my area for AC and DC at Tesla is even way lower..
Voor mij ontbreekt belangrijkse reden: bijdrage leveren aan vermindering van de pieken op her elektriciteisnet
Leuke enquete
Een beetje saai en niet echt concreet genoeg voor ervaren EV-rijders die pionieren met slim laden, V2G en dynamische energie contracten op een SAP.
Interessante materie, goed en duidelijk verwoord.
Succes!
Op naar blijvend negatieve prijzen voor opladen e autoos. Er moet wel aandacht zijn hoe om te gaan met de batterijen/accu's
Kunt je jouw is geen correct Nederlands, vreemde vragen en ik snapte ook niet overal wat de bedoeling was. In hoeverre ik het ermee eens ben?
Is de enquete gesponsord door Revolt? Verder zaten er af en toe rare vragen tussen. Wat zou je met een QR code in/op de auto moeten bijvoorbeeld?
https://vandebron.nl/energie/energiecontract/dynamisch en Jedlix
This targets current evdrivers but we should arrange charging according to what the 95% of the people that do not drive electric want.

Dynamische prijzen voor opladen thuis is prima. Onderweg opladen is er weinig keuze voor het tijdstip om te laden.

Paar dingen. Huidige elektrische auto's hebben vaak een ondergrens van 6-4 kWh. Ze schakelen dus niet terug naar 0 kWh als er bijvoorbeeld hoge prijzen zijn of veel CO2 uitgestoten. Dat is slecht voor consument en milieu, en dus ook voor de businesscase voor dynamisch laden. Europa, RDW of ministerie I&W zouden autoindustrie hierop moeten aanspreken voor kleine technische aanpassing. Dit aspect blijft helaas onderbelicht in je questionnaire

Vergeet de invloed van zonnepanelen niet bij laden met dynamische prijzen. Ik zou thuis wel willen laden met dynamische prijzen, maa stap niet over voordat ik een thuisbatterij heb waar ik mijn zonne-energie kan opvangen. Anders verdien ik niks meer aan mijn zonne-energie.

Dynamic price can have usage risks. I will only use dynamic prices if there is a max price cap. Dont want to risk paying 10 euro per kWh when there is a problem on the grid for a couple of days.bthis has happend in the US

er zijn een aantal vragen die totaal onduidelijk zijn verwoord. Mischien kun je nog even kritisch naar de vragen (laten) kijken.

Ik denk dat het leaserijden hier ook een grote rol in speelt. Veel EV-rijders zijn nu leaserijders en de werkgever betaalt vaak de kosten. Dan ben je mogelijk minder prijsbewust

Leuke vragen, succes met uitwerken van de resultaten!

End of Block: Section 7 - feedback

Appendix G: Scores per CSF

Table 11; Scores per CSF, all respondents

CSF	*Question*	*Score*
2	10	(8.1)
3	13, 14-1	(8.0)
4	14-2	(8.0)
5	11	(8.3)
6	12	(5.9, 3.8) (Economical benefit, environmental benefit)
7	15-17&25	(5.0, 3.9, 3.5, 0.0) (10.0, 8.0, 2.7) (10, 10, 8.3) (7.3) (Hourly rates, peak rates, bonus-malus rates, flat rate) (Mobile app, QR-code on charging point, webpage) (€/kWh, kWh charged, current charging level of battery)
8	18	(7.8)
9	19-20	(8.7, 5.0) (7.6, 3.5) (Internet, energy provider) (Online explanation, video explanation)
10	22	(5.4) (Mobile app)
11	23-24	(8.4, 7.8, 6.3, 6.2) (6.1)
12	26-27	(6.1, 7.7)

Table 12; Score per CSF, lease drivers

CSF	*Score*
2	(7.92)
3	(4.28) (8.00)
4	(7.7)
5	(8.0)
6	(2.5, 1.8) (Economical benefit, environmental benefit)
7	(2.4, -4.7, -5.9) (10.0, 6.7, 4.8) (10.0, 9.1, 8.2) (7.1) (Hourly rates, bonus-malus, peak rates) (Mobile app, QR-code on charging point, webpage) (kWh charged, €/kWh, current charging level of battery)
8	(7.6, 7.5)
9	(10.0 ,4.6) (7.9, 3.9) (Internet, Energy provider) (Online explanation, video explanation)
10	(6.0) (Mobile app)
11	(8.2, 6.0, 7.4, 7.8) (6.5)
12	(6.1, 7.4)

Table 13; Score per CSF, private drivers

CSF	*Score*
2	(8.22)
3	(8.14)
4	(8.4)
5	(8.15)
6	(5.4, 1.0) (Economical benefit, environmental benefit)
7	(-0.7, -0.9, -2.7) (8.7, 6.1, 2.9) (10.0, 8.6, 5.0) (7.5) (Hourly rate, peak rates, bonus-malus rates) (Mobile app, QR-code on charging point, other: display) (€/kWh, kWh charged, current charging level of battery)
8	(7.9, 7.7)
9	(10.0, 9.2) (6.8, 3.2) (Internet, Energy provider) (Online explanation, video explanation)

CSF	*Score*
10	(6.0) (Mobile app)
11	(8.5, 6.6, 7.9, 7.7) (5.8)
12	(5.9, 8.3)

Appendix H: Examples for future research

Future research 1:
Developing an ROI model in which the charging profiles of customers are compared against dynamic prices (future Revolt) and the current price. The purchasing side is dynamic, while sales retain the current fixed price for the customer. It calculates the purchasing revenue, compares it with the cost difference, deducts technical costs (such as installation and energy supplier costs), and uses tools like PowerBI or Tableau. The model aims to determine how much cheaper the charging station price can be offered or if Revolt can recover the investment.

Input data includes charging profiles, current fixed prices, dynamic EPEX prices, margin, installation and energy supplier costs, and sales of HBEs (presumably electric vehicle charging stations).

Output data consists of the amount of cost savings, revenue generated, how much the charging station price can be lowered to maintain the same costs, and the annual revenue from the entire investment in dynamic pricing for this customer.

Future research 2:
How can you incorporate dynamic pricing into customer settlements within the Revolt systems, particularly within the AFAS system and the CPO environment of NRG? Assess the urgency of operational processing for price differentials and identify the operational adjustments required within the current systems to calculate dynamic prices with Revolt's 0.15 margin when customers acquire a charging station or charging card from Revolt.

Future research 3:
An A-B test where two user-interfaces are assessed on LinkedIn as add. One of them containing the most desired state of the ICS and other one with the most feasible or current state of Revolt’s ICS. By looking at the conversion rate of clicks on a certain as the total interaction of a certain interface can be assessed. Where you can evaluate if the research outcome ICS is indeed more desired and leading to increased interaction. If it indeed shows more response, it can be stated that the ICS is successful.

Appendix I: Research ethics

Research Ethics

My research must be in line with the principles of research integrity as different codes of conducts are implemented and need approval of the faculty's ethics committee as data collection is taking place. Firstly, as Revolt is part of PON, the research must alight with their code of conduct, focusing on data security and confidentiality. Secondly, the code of conduct of the University of Twente applies, focusing on research fraud or plagiarism. Lastly the Dutch code of Conduct for Research Integrity applies. The Dutch code of conduct for research integrity (2018) is based on five principles: honesty, scrupulousness, transparency, independence, and responsibility. These five principles should be included and outlined within my research.

Honesty should be maintained within my research. Therefore I ensure that the research is well-formulated and not be interpreted differently. Next to that, I will elaborate in a transparent and objective manner so that the research findings can be used by others. Here it is crucial to discover the truth in my data collection and analysis and validate the sources to prevent any bias to occur. With this I will inform all participants in full honesty about my research purpose beforehand, how data will be collected and how the data will be used. All in line with the Code of Conduct for Research Integrity (2018).

Scrupulousness is used for my research outcome proposal towards Revolt and PON. My proposal must follow their code of conduct with ethical scrupulousness, as they intend to utilize the research outcome. Anonymizing the data is my responsibility to avoid ethical issues. Approval from the UT's ethics committee is a mandatory requirement for my data collection, and is provided in appendix A.

Transparency is a fundamental aspect in my research. It is implemented within the methods and processes. As a researcher, I prioritize the safety and well-being of all parties involved, while ensuring that data collected is accurate and reliable. The methods and processes are designed to prevent any harm and are closely supervised in line with the highest standards of the code of conducts. The structure of data collection is well thought to avoid any participations bias outlined and results are presented with complete accuracy and transparency. As transparency is of importance, the research outcome will include potential pitfalls and usage conditions to prevent any misinterpretation of the research outcome. Additionally, a thorough evaluation of these possible pitfalls and usage conditions is outline in the conclusion of the research.

Independence of the researcher is crucial to maintain. It is of importance to take full responsibility for all my statements made in the research. It is necessary to ensure effective communication with all parties involved.

Responsibility as a researcher is of high value. It is crucial to control and manage the whole project to avoid any bias occurring during the process. As stated in the assignment introduction with doing qualitative interviews, ethical issues of privacy are raised which is an issue of research ethics. When conducting my qualitative interview, I must ensure that ethical issues regarding privacy are addressed in accordance with the ethics. I understand in this case that the usage of personal information may raise privacy concerns, which is why I take measures to protect the content of the data collection used in my research. To this end, I use PON data services to store the data safely, use informed consent, inform my participant beforehand how data will be used, collect data anonymously and deliver my data anonymously. Sensitive personal data (e.g. names, regions, opinions) is to be well secured as this is classified data not to be shared or leaked in any potential way.

Social impact

Social impact is described in the assignment introduction as the ethical issues that are connected to the implications of my work for human being and society at large in the Ethics assignment description. There are three levels (micro, meso and macro) of context in society where my research could potentially impact. It is crucial to consider the implications at each level and communicate the research's objectives to stimulate the benefits and minimize the drawbacks for social impact.

At the *micro* level, the focus is on the individual user and the individual employee. As an ICS is focused on stimulation of interaction with the end-user. The end-user is directly impacted by my research's outcome, as they are to be interacted with according to my research question. My research outcome will enable interaction with a charging station. Which might make end-users more attracted to dynamic energy prices and potentially influence their charging behaviour towards a less volatile usage of electricity. Additionally, the use of new technology enables EV-drivers to be more and better informed before their charging decision. Influencing whether they want to charge at a specific time at a specific location for a specific price. This ensures higher accuracy and clarity of pricing information provided towards the EV-drivers, which nowadays is found to be the opposite of transparent.

At the *meso* level, the focus is on the organisation where I work. The direct impact of my research will be on the company: Revolt, and indirectly influencing their main stakeholder PON. It enables Revolt to increase interaction with their customers and end-users more effectively. While growth can increase their customer satisfaction and encourages greater use of their services, it can also put pressure on Revolt's employees due to increased customer interactions and customizable needs. Therefore, it is important to advise to handle that Revolt's workforce is equipped to handle any challenges that may arise with my research outcome. Further, the impact extends to the main stakeholder PON. As main stakeholder evaluation of the Return of Investment (ROI) integrated into the evaluation process and before implementation of the ICS is crucial, as the ICS is a new strategy which requires additional financial investment from the investors. Especially if the strategy fails to return any profits.

At the *macro* level, the focus is on society at large. The strategy potentially can influence the adaptation towards new technology for electric driving. Next to that, it addressed also a far larger issue, such as the climate crisis. As dynamic pricing adaptation will unburden the Dutch electricity grid, about Electric Vehicle charging. The energy transition requires a significant renovation of the energy systems, replacing fossil fuels for more sustainable energy. The rise in demand for electricity from households and businesses has implications on the Dutch electricity grid. Stating even that without additional measures, potential issues of electricity disruption will increase significantly by 2030. However, improved insight into energy usage and prevention on peak demand in corporation with smarter usage of energy will be able to prevent peak-demands to a more widespread energy usage over the days (Voorzienings- En Leveringszekerheid Energie, 2023). Where my research shows a huge contribution towards as the outcome might effectively reduce the impact of climate change, as less energy from coalmines is needed to support the already generated green energy throughout the day. Therefore, accurate communication of the strategy's intention is essential to ensure correct interpretation.

Professional Ethics

The professional ethics are related to my role as a professional. The most relevant responsibilities have in this project is that I am responsible for overseeing every aspect of the research process and taking my independency in this matter. Ensuring that the five above mentioned aspects of the Dutch Code of Conduct for Research Integrity (2018) (honesty, scrupulousness, transparency, independence, and responsibility) are implemented with professionalism. This includes effectively managing my project timeline, scheduling meetings, setting my deadlines, and delivering timely to my supervisors. Furthermore, I will guarantee that all parties involved with my research are fully informed and that my research objectives are in line with their expectations.

As being part of the team of Revolt, and at large in the PON organization, I am bound by the company's security and data protection rules as outlined in their Code of Conduct. These rules outline handling the customer data, showing significance of protecting data privacy and preventing data breaches to occur within the company. This is to maintain their customers' trust and confidence, where for me as a researcher it is important to follow these guidelines.

In case of any conflicts or uncertainties regarding data privacy and data protection decisions for my research, I will seek guidance from the security department of PON to ensure to be compliant with the company's security policies. Additionally, open communication and honest reporting of my research finding are necessary, even in unfavourable situations like no research outcome or a non-feasible outcome for the company. Even with ethical dilemmas that may arise during my research I seek guidance of my supervisors within the company and the university to uphold my responsibilities as a student doing engineering research.

Let's charge a better future.

Benthe Commissaris
b.d.m.c.commissaris@student.utwente.nl

University of Twente
Drienerlolaan 8
7622 NB Enschede

Revolt
Danzigerkade 8
(085) 016 3018

revolt