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# Behaviour research report Flexpower

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# EXECUTIVE SUMMARY

Through surveys and interviews, research has been conducted amongst EV drivers and taxi drivers with full electric vehicles, examining to what extent they are aware of the functioning of Flexpower charging points and which motivations they have to use or refrain from using Flexpower charging points.

Results show that EV drivers are aware of the concept and goal of the Flexpower charging profile and are motivated to use Flexpower, and smart charging in general, to charge on sustainable energy and contribute to the alleviation of congestion of the energy grid.

Taxi drivers on the other hand, are less aware of Flexpower, but do agree that Flexpower is a positive initiative. Although they do not expect any hassle when charging at a Flexpower charging point that provides a slower charging speed during peak-hours, a reason to refrain from charging at a Flexpower charging point is primarily because slow charging during work hours is not desirable.

We recommend that the EV driver should receive more information, primarily on the exact charging speed of the charging session. Further research should be undertaken to examine the implementation of this recommendation.

As the sample size for both groups were small, we recommend that further research should be undertaken with a larger sample size for both groups.



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# 1. Research questions and context



# Research questions and context

## Research questions:

- To what extent are EV drivers aware of the advantages and functionalities of Flexpower charging points?
- Which motivations do EV drivers have to make use or refrain from using Flexpower charging points?
- How do EV drivers experience the charging sessions of Flexpower charging points?

## Context:

- Flyer ban in Amsterdam, prohibiting survey invitations under windshield wipers
- No existing customer base or contact details of Flexpower users
- No opportunity to send out a survey via Nuon/Vattenfall
- The Corona-crisis made it impossible to conduct interviews at charging points
- Due to the Coronavirus, a workshop with taxi drivers was cancelled



## 2. Research methods



# Research approach

- Research into both (i) EV drivers (residents and work-related visitors) and (ii) EV taxi drivers (specific group with different charging needs and preferences regarding charging costs and charging speed).
1. Survey sent out to taxi drivers via the *municipality of Amsterdam* in November 2019
    - 17 EV drivers were approached for follow-up research in March 2020
    - 11 of these EV taxi drivers participated in this research
  2. National Charging survey sent out to EV drivers via various channels in March 2020, including the *Vereniging Elektrische Rijders, ElaadNL and RVO*
    - 16 private EV drivers were approached for follow-up research in March 2020
    - 5 of these private EV drivers participated in this research
- Research has been conducted by Lotte Gardien (ElaadNL – interviews and the National Charging survey) and Milan Tamis (Amsterdam University of Applied Sciences – interviews and Flexpower survey taxi drivers).



# Research design

## I. Interview format EV drivers (specifically targeted to Flexpower)

- Use of Flexpower charging points
- Experience with Flexpower charging points
- Attitude towards Flexpower
- Information about Flexpower

## II. Flexpower survey taxi drivers (specifically targeted to Flexpower)

- Use of Flexpower charging points
- Experience with Flexpower charging points
- Attitude towards Flexpower
- Information about Flexpower

## III. National Charging survey (more generic on smart charging )

- Use of the vehicle and charging behavior
- Attitude towards smart charging
- Demographics



# Research design

- I. 4 interviews and 1 mail conversation with EV drivers
- II. 11 responses by EV taxi drivers to the Flexpower survey
- III. 26 responses to the National Charging survey about smart charging

Questions about smart charging in the National Charging survey are generic and apply to the Flexpower concept: the starting point of the questions about smart charging is that smart charging refers to charging sessions in which a varying charging speed is applied based on the overall demand for energy and the supply of sustainable energy.



## 3. Results



# I. interviews EV drivers



# Results I: interviews EV drivers

## Respondent 1

- Makes use of various Flexpower charging stations as a visitor once or twice a week, but always arrives there with a reasonably full battery as he can also charge at home.
- He has been charging at Flexpower charge points since the beginning of Flexpower, mainly for the reason of contributing to net balancing. Knows the sticker on the charging station.
- Prefers to charge at Flexpower if possible and will not quickly avoid Flexpower charging stations due to home charging options.
- Notices not much of Flexpower, partly because the battery is already quite full when connecting his car.
- Understands the Flexpower concept: faster charging when a lot of energy is available, less charging capacity when there is a shortage of energy. Thinks that the primary goal of Flexpower is grid balancing.



# Results I: interviews EV drivers

- Suggestions given by the respondent:
  - Financial settlement for EV drivers, for example paying more during peak hours, paying less during off-peak hours.
  - Display of the price on the charging station, which he finds particularly relevant if variable rates were to be used.



# Results I: interviews EV drivers

## Respondent 2

- Uses a Flexpower charging station at his office once a week. Start of the charging session is in the morning or after lunch.
- Knows about the sticker on the charging station, but because it does not provide information about the charging speed, it is not clear to him what the effect of Flexpower is on EV charging.
- Drives an old Nissan Leaf, with a sufficient battery capacity to bridge the commuting distance. He has to charge during customer visits. Drove a PHEV before buying his Nissan Leaf.
- The charge point he uses at work is also the only charge point available at work: this irritates the respondent because he now has to charge longer than when he drove a PHEV and the battery is sometimes not charged enough.
- Does not notice much of Flexpower, but he does sometimes wonder whether the battery should be charged more.
- Understands the Flexpower concept: during the evening peak, charging speed is reduced, outside evening peak charging speed is increased. Thinks that the goal is primarily solving the congestion problem.



# Results I: interviews EV drivers

- Not positive about Flexpower:
  - Finds that as an EV owner, he gives away flexibility and others earn money with it. Based on his principles, he is not ok with that. Would like to have a financial contribution.
  - He finds it not clear whether congestion problems are present at all the different locations where Flexpower is applied to charging stations.
- Suggestions given by the respondent:
  - Communicate that a charge point is in a congestion area and that therefore Flexpower is active.
  - Provide information about the charging speed.
- It is not clear to the respondent whether his car supports Flexpower, because it can only charge 1 phase. It is not clear to him whether the car can only charge slower, or if the car is also able to charge faster.
- Can only charge for a maximum of 1.5 hours at the charging point at his office, otherwise he will receive a €110,- fine. He finds that policy not useful if Flexpower will throttle charging speeds at certain times.
- Respondent thinks it is good to experiment with Flexpower.



# Results I: interviews EV drivers

## Respondent 3 (the interview was more about smart charging in general than Flexpower in particular)

- Presumably only charged at a Flexpower charging station once, as a visitor. Noticed that the car was not full after being connected to the charging station for 8 hours.
- Believes that smart charging is primarily used for "peak shaving" and is used so that network operators do not have to invest in heavier cables.
- He finds it problematic that it is not clear what you pay for a charging session.
- He thinks cheaper charging can be an incentive to use smart charging, but that this could also encourage charging point sticking (*laadpaalkleven*).
- Not entirely positive about smart charging:
  - Charging rates are unclear, thinks that charging stations will be occupied longer if costs are lower at certain times. Also thinks that the advantage lies mainly with the network operator and less with EV drivers.
  - Privacy is a concern.



# Results I: interviews EV drivers

- Suggestions given by the respondent:
  - Entering a departure time at a smart charging station.
  - Would like to have a financial allowance for the flexibility he is providing.



# Results I: interviews EV drivers

## Respondent 4

- Uses a Flexpower charging station at his home twice a week: once during the week at 6:00 PM and once during the weekend during the day.
- Does not consciously choose a Flexpower charging station, he charges there because this charging station is nearby and he would like to fully charge the car.
- Has noticed very little of Flexpower: his Nissan Leaf is connected all night and in the morning it is fully charged. If he requires a full battery quickly, he will drive to a fast charger.
- Knows about Flexpower because of the sticker on the charging station. He finds it informative that the different times of day are linked to the varying charging speeds. He understands that the charging speeds are not directly specified, as this depends on the number of phases and the type of car. He also does not think that an exact charging speed should be given.
- Understands the Flexpower concept: flexible charging speeds that depend on the capacity on the grid. Balancing energy.



# Results I: interviews EV drivers

- The respondent thinks Flexpower is a good concept, but also adds that he thinks more needs to be done, such as energy storage and allowing bidirectional charging (V2G) from the vehicle back into the grid.
- It does not matter to him what he pays at another charging station. He notes that many EV drivers drive a lease car, so that stimulating smart charging through the usage of financial benefits is only useful for EV drivers that do not have a lease car.
- He thinks privacy, as an objection to use smart charging, is not a valid reason, because other companies also collect information and, according to him, it makes little difference whether information is then also collected via your car.



# Results I: interviews EV drivers

## Respondent 5 (email only)

- Charged at Flexpower charging points three times: 1x normally, 2x the charging session ended after one minute and he only found out once he returned to his car (LED ring remained yellow)
- Respondent called the Vattenfall helpdesk, told them the problem and his location but noticed minimal interest.
- Respondent drives a Renault Zoë and acknowledges that this car has had many problems in general (such as charging below 12,5 A), but in his experience, when contacting a helpdesk, the helpdesks blame the car instead of the charging point or charging program.
- He normally does not experience any charging problems, except with EV-box charging points or hardware, such as the Vattenfall or Engie charging points.
- Considers himself not a fan of Smart Charging, because it does not work for a Renault Zoë.



## II. Survey taxi drivers



# Results II: Survey taxi drivers

- 4 taxi drivers do not charge at public charging points → no further data was collected.
- 4 taxi drivers indicate that they most likely charged at a Flexpower charging points, but do not know for sure. 1 taxi driver is certain that he charges at Flexpower charging points, but does not consciously make a decision to do so. 2 taxi drivers avoid Flexpower charging points.
- The 7 taxi drivers who (most likely) charge at Flexpower charging points, the choice for charging station is mainly based on charging speed (chosen 4 times) and distance to the destination (chosen 4 times) and less on price (chosen 2 times).
- Taxi drivers charge between 5 and 7 times a week at a public charging point. One driver answered to only charge between 1-3 times a month at a public charging point.
- Taxi drivers mainly charge between 00:00 and 08:00 (chosen 4 times) and between 08:00 and 12:00 (chosen 3 times). They charge less between 12:00 en 18:00 and 18:00 and 24:00 (both chosen 2 times).



# Results II: Survey taxi drivers

- 5 out of 7 taxi drivers think Flexpower is a good idea. One driver finds it suitable even, because the charges at a Flexpower charging point at night.
- Only 2 out of 7 taxi drivers are aware of how Flexpower works. One of these drivers came across the information in the Vattenfall app and on the website of the municipality of Amsterdam, the other driver came across the information on the website of the municipality of Amsterdam.
- Only two drivers noticed the sticker on the charging point. However, the information on the sticker, as shown in the survey, is clear according to all 7 drivers.
- Additional information that taxi drivers would like to have about Flexpower concerns charging speeds (mentioned twice), and price (mentioned once), for example via a display on the charging station or via an app/website.



# Results II: Survey taxi drivers

- Reason for two taxi drivers to avoid Flexpower charging points: they charge too slow for taxis during working hours.
- When asked whether taxi drivers think that they will be inconvenienced if a charging station only charges at 25% of the regular charging speed, the majority indicate that the car will then still be sufficiently charged (mentioned 3 times). The other respondents indicate that it will take longer to charge, that they will charge elsewhere, that they do not charge during peak hours or that the question does not apply to them.
- When asked whether taxi drivers expect to benefit from Flexpower charging stations offering more power during off-peak hours, the majority indicate that that the car will be charged faster (mentioned 3 times). Two drivers indicate that the extra power will compensate for slower charging during peak hours. The other two taxi drivers indicate that the car will be connected to the charging point long enough to be charged anyway or that the question does not apply to them.



# Results II: Survey taxi drivers

- 4 out of 7 taxi drivers would choose a Flexpower charging station faster if it had a cheaper charging rate than regular public charging points (both during peak and non-peak hours). On average, the rate should be 25% cheaper. The other 3 drivers indicate that price plays no role in their choice for a particular charging station.



## III. National charging survey



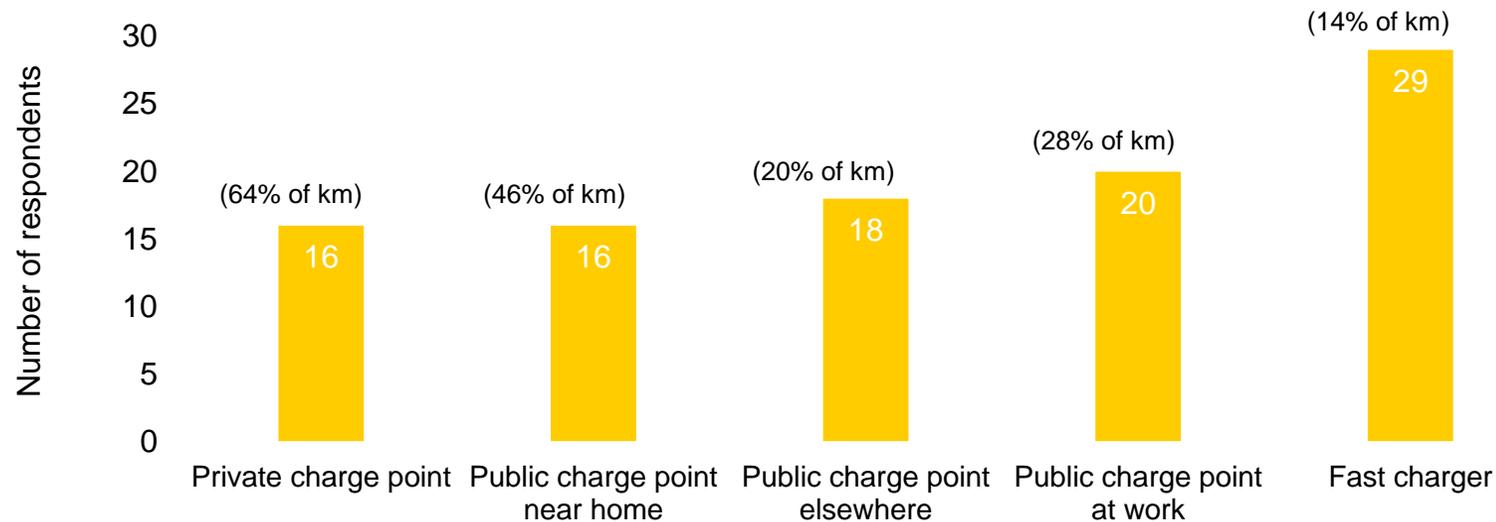
# Results III: National charging survey

- Respondents drive a PHEV (1), a FEV (30) or a not specified vehicle (1).
- 27 respondents have bought or currently lease their vehicle via a business construction (such as business lease) or a private construction (such as buying the car themselves, through private lease or carsharing).
- 3 vehicles are second hand.
- 11 respondents live in Amsterdam. None of them charge at a private charging point, but mostly at public charging points near their own home.



# Results III: National charging survey

While only 16 respondents charge at a private charge point, these charging sessions account for 64% of the electric kilometers driven by these 16 respondents. While 29 respondents charge at fast chargers, those charging sessions only account for 14% of the electric kilometers driven by these 29 respondents.



# Results III: National charging survey

- 16 respondents have a private charger, where on average 64% of the electric kilometers are charged. 3 respondents, who do not have a private chargers, occasionally use a regular wall socket.
- 16 respondents sometimes charge at a public charge point near their home, where an average of 46% of the electric kilometers are charged. 2 of these 16 respondents also have a private charging station. 7 respondents charge here for 68% or more of their electric kilometers.



# Results III: National charging survey

- 18 respondents sometimes charge at a public charging station elsewhere, where on average 20% of the electric kilometers are charged. 1 respondent charges here often (>95% of the electric kilometers).
- 20 respondents use a charging station at work, where on average 28% of the electric kilometers are charged. 3 respondents charge here for 65% or more of their electric kilometers.
- 29 respondents use fast chargers, where on average 14% of the electric kilometers are charged. Only one respondent mainly uses fast charging to meet his/her charging needs (>89% of electric kilometers).

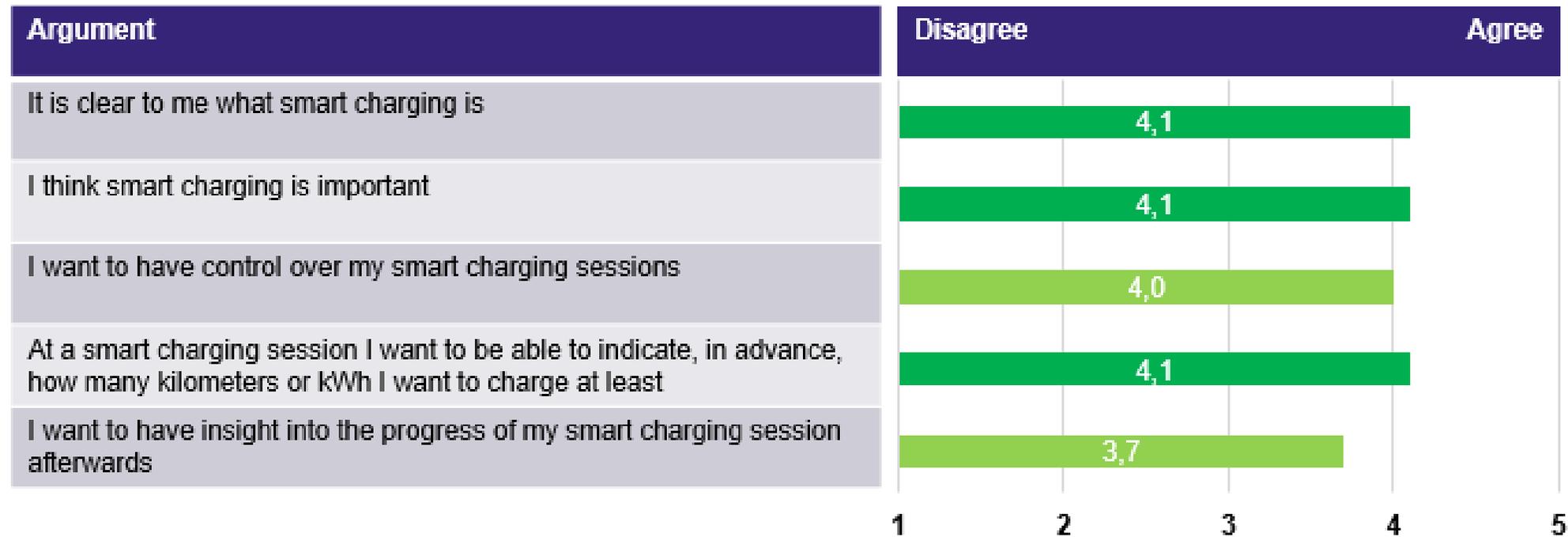


# Results III: National charging survey

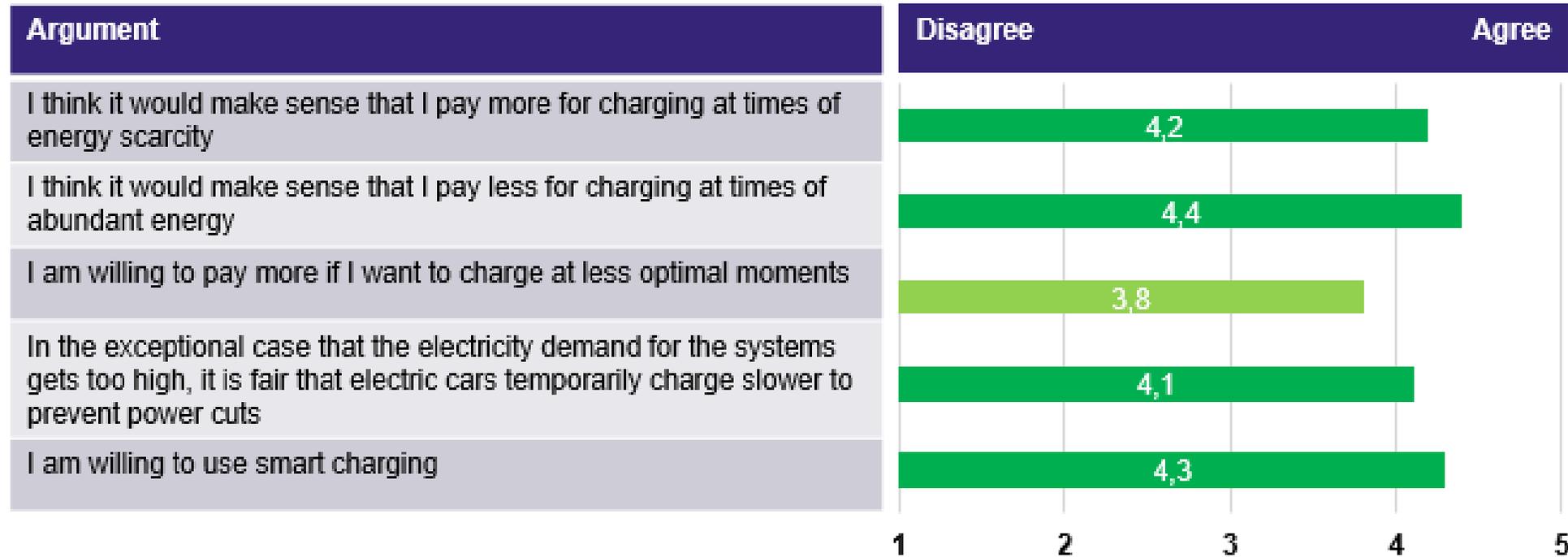
- All respondents are familiar with the term Smart Charging and make use of it to some degree.
- All respondents have made use of Flexpower charging points, but in addition also make use of other smart charging charge points, such as the charging points of EVnetNL (mentioned 9 times) and specific smart charging charge points in the provinces of Overijssel and Gelderland (mentioned 4 times).
- 17 respondents indicate that they hardly notice anything from smart charging.
- 5 respondents indicate to have experienced smart charging positively, for instance because smart charging contributes to a stable grid or because smart charging allows for charging on renewables.
- 8 respondents indicate to have experienced smart charging negatively, primarily because the charging speed of the smart charging point is not indicated.



# Results III: National charging survey

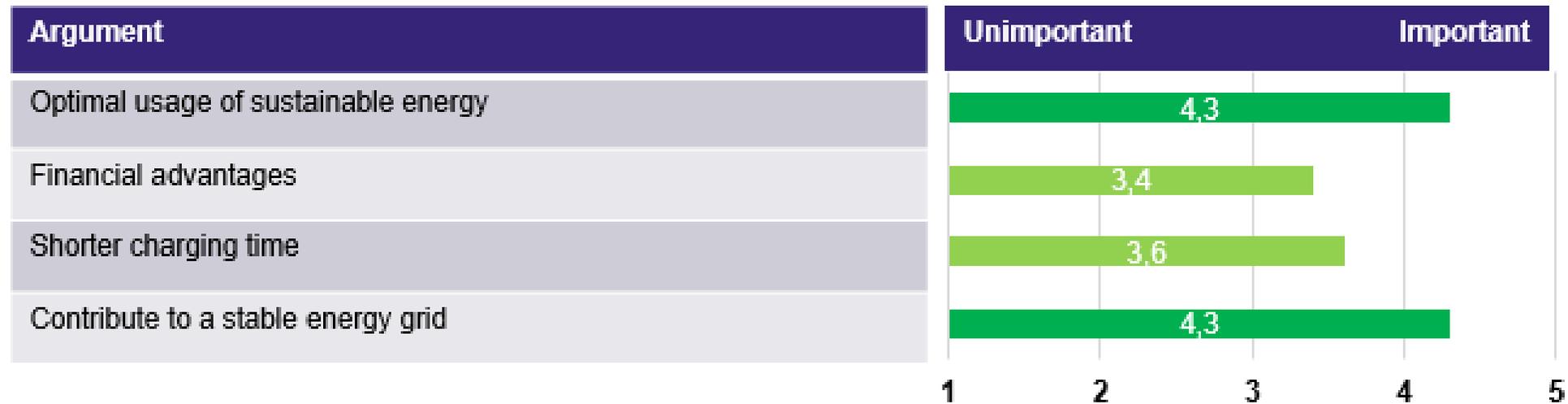


# Results III: National charging survey



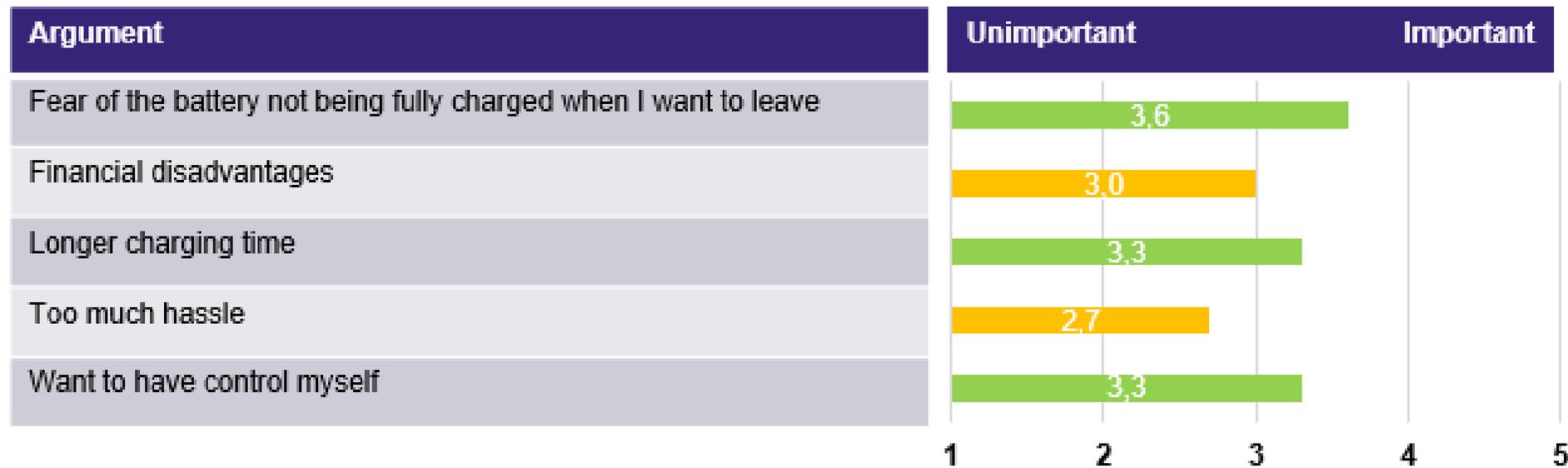
# Results III: National charging survey

How important are the following arguments to use smart charging for you?



# Results III: National charging survey

How important are the following arguments to not use smart charging for you?



Listed by respondents themselves: no information about the charging speed, not functioning charging points or not understanding the need for smart charging.



## IV. Preliminary Conclusions and recommendations



# Conclusions

## I. Interviews EV drivers

- Almost all of the respondent work in the energy and e-mobility sector, making this group not representative for the average EV driver.
- All respondent understand the concept and goal of Flexpower.
- Information about tariffs and charging speed are given as suggestions, so is the provision of information about whether or not a Flexpower charging point is situated in a net congestion area.
- Three EV drivers would find financial compensation justified when using Flexpower.
- In addition, one EV driver would find it useful if he could enter a departure time at smart charging charge points.
- One EV driver is explicitly concerned about privacy, another EV driver not at all.
- One EV driver chooses a Flexpower charging station to contribute to the prevention of network congestion, the other EV drivers charge at Flexpower charging stations as visitors or because the charging station is close to home or work.



# Conclusions

## II. Flexpower survey taxi drivers

- Taxi drivers think positive about Flexpower, but are not well aware of how Flexpower exactly functions.
- Most taxi drivers were not familiar with the sticker on the charging point, but they do acknowledge it offers clear information.
- For the most part, taxi drivers do not expect to encounter much hassle when public charging points charge slower during peak hours, but they do think that they will experience the advantage of faster charging times during non-peak hours.
- Reason to avoid Flexpower charging points is slower charging during work hours.
- A cheaper charging price on Flexpower charging points would prove attractive for some taxi drivers.
- Suggestions given: provide information about the charging speed and the price.



# Conclusions

## III. National Charging survey

- In general, the EV-drivers in this sample know what smart charging is, have experienced smart charging on public charging points and consider smart charging important. Furthermore, they are willing to use smart charging.
- The EV-driver responses to the items show that they want to be in control of the smart charging sessions and want to have the option to indicate how many kilometers or kWh they would like to charge. This was valued more than gaining insight into the course of the charging sessions afterwards, although that too received favorable evaluations.
- The EV-drivers not only consider it logically that they pay more for charging at peak hours and less for charging at non-peak hours, they are also willing to pay more for charging at peak-hours.
- Lastly, most relevant for Flexpower, the EV-drivers from the sample consider it fair that, when the demand for electricity surges, EVs are charged slower to prevent power outages.



# Conclusions

- Reasons to use smart charging are mainly the optimal usage of sustainable energy and contributing to grid stability. Financial gains and shorter charging times were still positively, but less positively evaluated.
- Reasons to abstain from smart charging stem primarily from (1) the fear of the car not being sufficiently charged when the drivers wants to leave and (2) wanting to have some degree of control over the charging session.



# Conclusions

- **To what extent are EV drivers aware of the advantages and functioning of Flexpower charging points?**

The interviewed EV drivers are well aware of the advantages, functioning and goal of Flexpower. Taxi drivers were less aware of Flexpower nor with the sticker on the charging point.

- **Which motivations do EV drivers have to make use or refrain from using Flexpower charging points?**

The main motivation to use smart charging in general and Flexpower in particular is the usage of sustainable energy as well as the contribution to a stable energy grid. Reasons to refrain from using a Flexpower charging point are given by taxi drivers, who indicate that slower charging during work hours is not desirable.

- **How do EV drivers experience the charging sessions of Flexpower charging points?**

One interviewed EV driver experienced two unsuccessful Flexpower charging sessions whereby the vehicle was not charged and he noticed this upon return. Another EV driver noticed that his vehicle was not as fully charged as he had expected, considering the connection time. Three other interviewed EV drivers do not notice much of Flexpower.



# Recommendations

- Provide the EV driver with information on:
  1. **The charging point's or charging session's charging speed:** the lack of transparency regarding charging speed might provide a reason to abstain from using a Flexpower charging point.
  2. **The energy used in the charging session:** the main motivation for consumers to use smart charging is optimal use of sustainable energy.
  3. **Flexpower's contribution to grid stability:** explain that Flexpower charging points are in congested areas and hence Flexpower (and the adjustment of charging speed) is necessary to maintain a stable grid.
  4. **Which EV models can profit from Flexpower:** explain which vehicle models (current and/or number of phases) can benefit from faster charging speeds during non-peak hours.
- More research is required, with a higher number of respondents. Interesting avenues for research could include:
  - Actual experiences with Flexpower profile regarding negatively or positively affected charge volumes.
  - The control EV drivers want over their charging sessions.
  - The fear of the battery not being fully charged the next time the car is used.



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