Navigating the Sustainable Mobility Transition: Designing a Data-Driven Decision Support System for Planning and Operating Electric Vehicle Workplace Charging Infrastructure

A. Reference to data sets and further information

A.1. Mathematical formulation of optimisation model

Table 4: Complete model formulation including objective functions and constraints

Model type		PM-VF	CCM	CEM	eq.
Obj. function	*min.*	$z = \sum_{t \in T} (P_t + y_t - C)^2$	$z = \sum_{t \in T} y_t \, \lambda_t$	$z = \sum_{t \in T} y_t \, \gamma_t$	(1)
Constraints	*s.t.*	$y_t = \sum_{m \in M} x_{mt} \, f_{mt}$		$\forall t \in T$	(2)
		$0 \leq E_m^{ini} + \sum_{k \in T \,:\, k \leq t} \tau \, x_{mk} \, f_{mk} \leq E_m^{cap}$		$\forall t \in T;\ m \in M$	(3)
		$E_m^{fin} = E_m^{ini} + \sum_{k \in T \,:\, k \leq t} \tau \, x_{mk} \, f_{mk} \geq E_{T+1}$		$\forall t \in T;\ m \in M$	(4)
		$0 = x_{mt} \, (1 - f_{mt})$		$\forall t \in T;\ m \in M$	(5)
		$0 \leq x_{mt} \leq p_{max}$		$\forall t \in T;\ m \in M$	(6)
where,		$C = \frac{\max(P_t) + \min(P_t)}{2}$			(7)
and		$f_{mt} = \begin{cases} 1, & \text{if EV } m \in M \text{ is parked at the workplace at time } t \in T, \\ 0, & \text{otherwise.} \end{cases}$			(8)

Source: Adapted from Zheng et al. [1] and Ioakimidis et al. [2].

Table 5: Nomenclature

Sets	
$M = \{m\}$	Set of EVs, where m represents a single EV
$T = \{t\}$	Set of time slots, with fixed duration for each t
Parameters	
P_t	Electricity demand curve of industrial site at time step t [kWh]
λ_t	Time-of-Use (ToU) electricity price tariff at time step t [p/kWh]
γ_t	Grid carbon intensity at time step t [gCO_2/kWh]
E_m^{cap}	Total battery capacity of EV m [kWh]
E_m^{ini}	Initial battery charge level of EV m upon arrival at workplace [kWh]
E_{T+1}	Minimum battery charge requirement after work shift (specified by EV user) [kWh]
p_{max}	Maximum charging power capacity of charge point [kW]
f_{mt}	Parking availability matrix (binary) of EV m indicating arrival and departure times
C	Average of daily max. and min. P_t [kWh]
τ	Length of each time interval t [15 min]
Auxiliary variables (AVs)	
y_t	Total electricity demand from EV charging at time step t [kWh]
E_m^{fin}	Final battery charge level of EV m upon departure from workplace [kWh]
Decision variable (DV)	
x_{mt}	Charging electricity demand for EV m at time step t [kWh]

A.2. SUS scoring method

Let the responses to the ten statements of the SUS questionnaire be denoted as R_i, where $R_i \in \{1, 2, 3, 4, 5\}$ for all $i = 1, \ldots, 10$. The adjusted scores (A_i) for each response are computed as follows:

$$A_i = \begin{cases} R_i - 1, & \text{for odd-numbered items (positively worded) } (i = 1, 3, 5, 7, 9), \\ 5 - R_i, & \text{for even-numbered items (negatively worded) } (i = 2, 4, 6, 8, 10). \end{cases} \tag{9}$$

The sum of all adjusted scores is given by:

$$\text{SUS}_{\text{total}} = \sum_{i=1}^{10} A_i \tag{10}$$

The final SUS score, normalised to 0–100, is obtained by multiplying the total by 2.5:

$$\text{SUS Score} = 2.5 \times \text{SUS}_{\text{total}} = 2.5 \times \sum_{i=1}^{10} A_i \tag{11}$$

This yields a SUS score ranging from 0 to 100, with an average usability benchmark typically considered around 68.

A.3. Semi-structured interview guides

Table 6: Semi-structured interview guide (**round 1/2**): Exploring the decision context

#	German	#	English
0	**Einführende Fragen** - Können Sie mir bitte einen kurzen Überblick über */Unternehmen/*'s Nachhaltigkeitsstrategie geben? Inwiefern spielt der Ausbau der E-Ladeinfrastruktur hierbei eine Rolle? - Wo steht */Unternehmen/* zum jetzigen Zeitpunkt? Sind bereits E-Ladesäulen in Betrieb und falls ja, wie viele, an welchen Standorten? Ladegeschwindigkeit? - Können Sie mir bitte mehr über den lokalen Kontext erzählen: (i) Wie viele Mitarbeitende pendeln täglich mit dem Auto zum Arbeitsplatz? (ii) Wie hoch ist der aktuelle Anteil von Elektrofahrzeugen am Gesamtfahrzeugbestand? (iii) Wie viele Parkplätze stehen vor Ort zur Verfügung?	**0**	**Introductory questions** - Could you please give me a brief overview of */Company/*'s sustainability strategy? To what extent does the expansion of EV charging infrastructure play a role in this strategy? - Where does */Company/* currently stand? Are there already EV charging stations in operation? If so, how many, at which locations, at what charging speed? - Could you please tell me more about the local context: (i) How many employees commute to work by car on a daily basis? (ii) What is the current proportion of EVs within the total vehicle fleet? (iii) How many parking spaces are available on-site?
1	**Entscheidungskontext und Umfang** - Können Sie den generellen Prozess beschreiben, den */Unternehmen/* bei der Entscheidung über E-Ladeinfrastruktur verfolgt? Was waren die Haupttreiber hinter dieser Entscheidung?	**1**	**Decision context and scope** - Could you describe the general process that */Company/* follows when deciding on EV charging infrastructure? What were the main drivers behind this decision?
2	**Identifizierung der Entscheidungskriterien** - Welche int. und ext. Kriterien berücksichtigen Sie typischerweise bei der Bewertung der Notwendigkeit und der Realisierbarkeit für E-Ladeinfrastruktur am Arbeitsplatz? (z.B. finanziell, ökologisch, regulatorisch, Mitarbeiterbedarf etc.) - Wie priorisieren oder gewichten Sie diese Kriterien?	**2**	**Identification of decision criteria** - Which internal and external criteria do you typically consider when evaluating the necessity and feasibility of EV charging infrastructure at the workplace? (e.g., financial, environmental, regulatory factors, employee demand, etc.) - How do you prioritise or weight these criteria?
3	**Stakeholder-Einbindung** - Wer sind die wichtigsten internen Stakeholder, die an diesem Entscheidungsprozess beteiligt sind? Welche Rollen spielen sie?	**3**	**Stakeholder involvement** - Who are the most important internal stakeholders involved in this decision-making process, and what roles do they play?
4	**Informationsbeschaffung und -bewertung** - Welche Art von Daten oder Informationen ziehen Sie bei der Entscheidungsfindung zum weiteren E-Ladeinfrastrukturausbau heran? (z.B. Kostenvoranschläge, Energiebedarfsprognosen, MA-Befragungen) - Bezogen auf die Energiebedarfsplanung: Inwiefern machen Sie hierbei bereits Bedarf von datengestützten Tools / von bestimmter Simulations-Software?	**4**	**Information acquisition and evaluation** - What type of data or information do you use when making decisions about the further expansion of EV charging infrastructure? (e.g., cost estimates, energy demand forecasts, employee surveys) - Regarding energy demand planning: To what extent do you already utilise data-driven tools or specific simulation software?
5	**Herausforderungen bei Entscheidungsfindung** - Hintergrundinformationen: (i) Wodurch kennzeichnet sich das bisherige Stromlastprofil? Zyklisch? Abhängig von welchen Faktoren? (ii) Welchen Einfluss haben die Ladevorgänge auf ihr Lastprofil zum jetzigen Zeitpunkt? (iii) Wie gestaltet sich ihr bisheriger Stromtarif (grob)? - Wie erfolgt die Steuerung der Ladesäulen zum jetzigen Stand? Wird nach gewissen Zielen optimiert? - Wie gehen Sie mit Zielkonflikten zwischen konkurrierenden Kriterien um?	**5**	**Challenges in decision-making** - Background information: (i) How would you characterise your current electricity load profile? Is it cyclical? Which factors influence it? (ii) What impact do charging processes currently have on your load profile? (iii) Could you briefly describe your current electricity tariff? - How are the charging stations currently controlled? Is the operation optimised acc. to specific objectives? - How do you address conflicts between competing criteria or objectives?
6	**Abschließende Frage(n)** - Glauben Sie, dass zusätzliche Werkzeuge, wie eine dedizierte entscheidungsunterstützende Software, Ihren Prozess verbessern könnten? Welche Kernfunktionen stellen Sie sich für eine Software vor?	**6**	**Concluding question(s)** - Do you think that additional tools, such as dedicated decision-support software, could improve your decision-making process? What key features would you envision for such software?

Table 7: Semi-structured interview guide (**round 2/2**): Demonstrating and evaluating our DSS

#	**German**	#	**English**
0	**Live Demonstration der Web Applikation** - Detaillierte Einführung und Erklärung der Software-Lösung basierend auf unternehmensspezifischen Daten der Interview Partner	**0**	**Live demonstration of web application** - Detailed introduction and explanation of the software solution based on firm-specific data from the interview partners
1	**Erste Eindrücke** - Was sind Ihre ersten Gedanken zur Benutzeroberfläche und zur Funktionalität der Webanwendung? Ist das nützlich? (Wenn nicht, warum nicht?)	**1**	**First impressions** - What are your first impressions of the user interface and the functionality of the web application? Do you find it useful? If not, why not?
2	**Entscheidungsunterstützung** - Hilft die Anwendung, verschiedene Faktoren auf eine sinnvolle Weise zu priorisieren/zu gewichten?	**2**	**Decision support** - Does the application help you prioritise or weigh different factors in a meaningful way?
3	**Benutzerfreundlichkeit** - Wie benutzerfreundlich ist die Anwendung? Gibt es Bereiche, die verwirrend/schwierig zu navigieren sind? - Wie einfach oder schwierig ist es, relevante Daten einzugeben und nützliche Auswertungen für Ihren Entscheidungsprozess zu erhalten?	**3**	**Ease of use** - How easy is the application to use? Are there any areas that you find confusing or difficult to navigate? - How easy or difficult is it to enter relevant data and get useful analyses to support your decision-making process?
4	**'Cognitive Fit': Problemdarstellung** - Entspricht die Art, wie Informationen in der Web Applikation präsentiert werden (z.B. Diagramme, Auswahl der Kriterien etc), Ihren Vorstellungen?)	**4**	**'Cognitive Fit': Visualising the problem** - Does the way the information is presented in the web application (e.g., charts, selection of criteria, etc.) meet your expectations?)
5	**Praxisrelevanz** - Wie schätzen Sie die Praxistauglichkeit der Web Applikation ein? - Würde das Tool Ihnen helfen, tatsächliche Investitionsentscheidungen in Bezug auf den Ausbau von E-Ladeinfrastruktur in Ihrem Unternehmen zu treffen?	**5**	**Practical relevance** - How would you assess the practical usefulness of the web application? - Would this application help you make actual investment decisions regarding the expansion of EV workplace charging infrastructure in your company?
6	**Verbesserungsvorschläge und Feedback** - Gibt es Funktionen, die Sie gerne hinzugefügt oder verbessert sehen würden?	**6**	**Suggestions for improvement and feedback** - Are there any features you would like to see added or improved?

A.4. Screenshots of web application (design cycles 1-2)

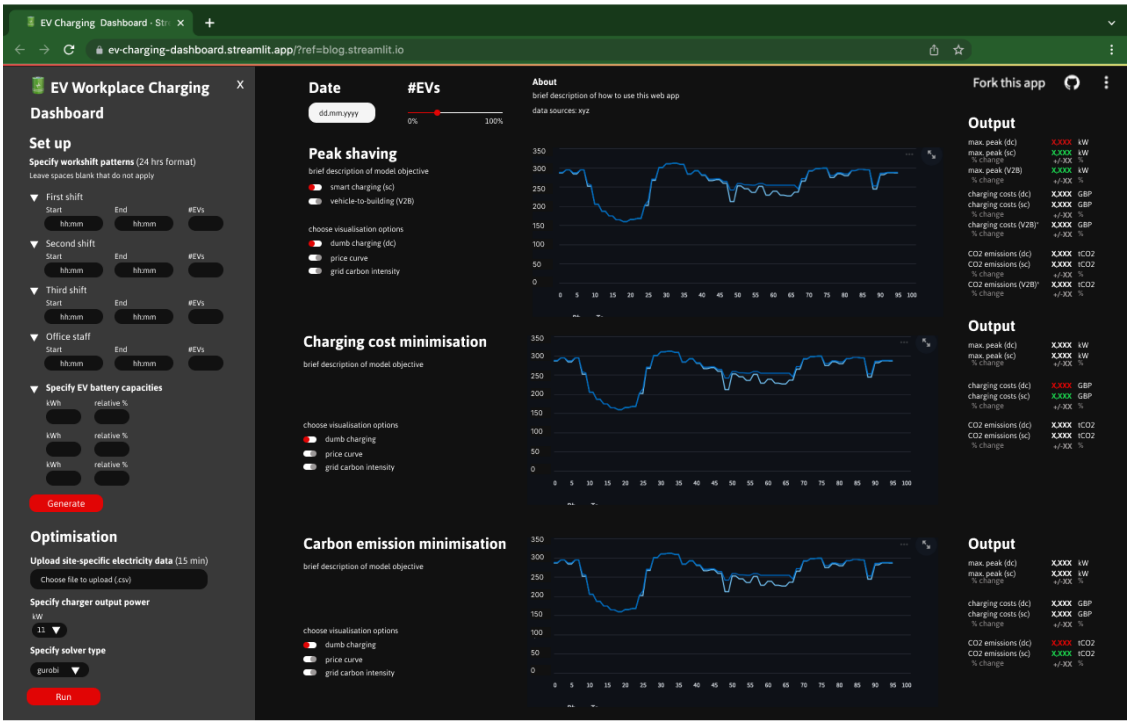

Figure 6: Static high-fidelity mock-up of our IT artefact using Figma's design suite (design cycle 1)

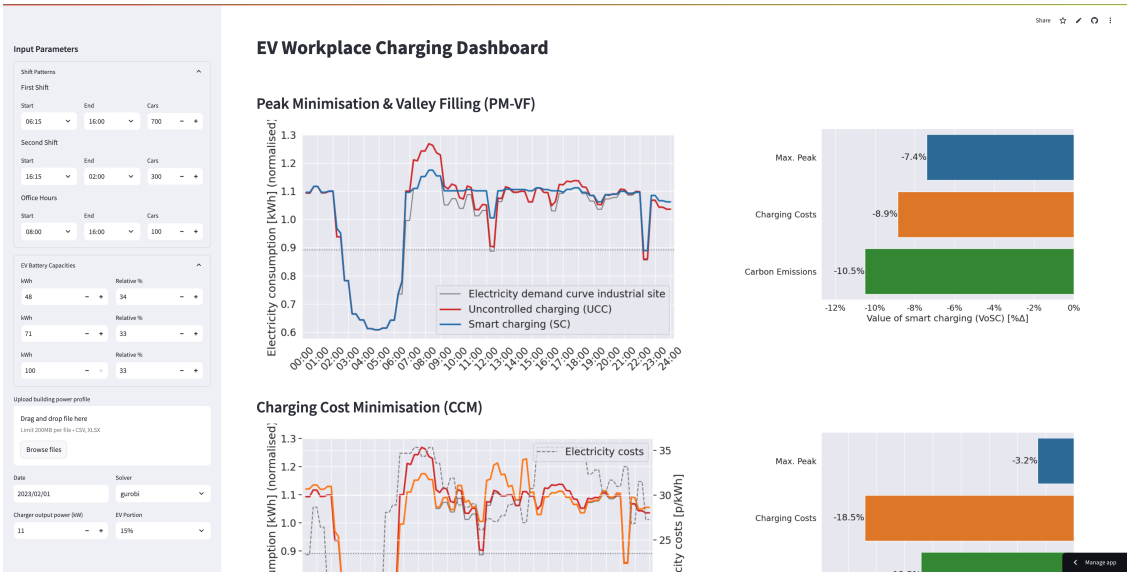

Figure 7: First functional version of our web application using Streamlit (design cycle 2)

A.5. In-depth qualitative data

Tables 8–12 list the complete direct interview quotes from design cycles 2 and 3, categorised by priority levels for feature development, which have been translated from German to English as accurately as possible without losing contextual information.

Table 8: Qualitative codes, categorised as *'high priority'* for feature development **(design cycle 2)**

DC [1]	**ID**	**Quote from interviews (round 2)**	**Timing** (mm:ss)	**Qualitative code(s)**	**Prio.**
2	1b	*"Something I might even wish for more is this: You've now (...) taken the load profile of a single day at our site and analysed it. As a complement or extension, one could perhaps create some kind of average."*	16:07	Aggregated analytics	High
2	1b	*"In Germany, we also have (. . .) a dynamic tariff. (. . .) You can basically take the numbers themselves and, in the end, go back to all time periods, even into the past. (. . .) [Then], of course, you can also retrieve the German prices from the website."*	18:10	Germany-specific market price data integration (entso-e)	High
2	1b	*"And regarding CO_2– specifically grid carbon intensity – I'm not sure if there are actually data available for download to display them properly here. But there is something called the Electricity Map. Do you happen to know it? (. . .) And there, of course, you can also specifically check for Germany what the electricity mix is on a given day."*	21:01	Germany-specific grid carbon intensity data integration (electricity maps)	High
2	2a	*"What would actually be interesting for me personally as a user would be to have a document to understand what the system is doing with the value I'm changing-just to have a sense of security. I don't like blindly trusting technical systems 100%, and even if they've proven themselves many times, I just like to know: what exactly is changing here? Maybe also what assumptions are being made when I change something-and does that also affect the validity of my result?"*	26:43	User guide	High
2	2a	*"What I always find quite practical is having an export function for the respective charts. (. . .) Maybe a CSV file, and possibly also an export version in high resolution that I can use in presentations or similar [outputs]. I also always like to look at the numbers in a CSV-just to get a feel for it myself."*	34:11	Export function of data/graphs	High
2	3a/b	*"As a next step, it might have been interesting, for example with the costs or other metrics, if the unit were simultaneously scaled up-what does that mean? For instance, with CO_2 emissions, if you want to use that for sustainability reports. What also would have been interesting is the absolute amount and what the reduction actually is."* [3a] *"To say: this is a fact, this is what we actually achieved."* [3b]	24:54	Quantification of absolute savings	High

[1] DC = Design cycle

Table 9: Qualitative codes, categorised as *'low- & medium prio.'* for feature development **(design cycle 2)**

DC [1]	ID	Quote from interviews (round 2)	Timing (mm:ss)	Qualitative code(s)	Prio.
2	1a/b	*"And maybe as an addition: Regarding CO_2 emissions, as a user, I would find it quite appealing if I could enter the CO_2 emissions caused by my specific electricity tariff myself, so that I can calculate it specifically for my company. (...) From a user perspective, I think that would be quite attractive to see exactly what savings I have actually achieved, specifically for my office building."* [1a] *"I think that's a very good point [referring to the previous comment], by the way. Because this CO_2 mix is not dynamic-it is provided to us once a year by our energy supplier. (...) It's simply fixed, not dynamic."* [1b]	22:13	Data input of tariff-specific CO_2 grid carbon intensity measures	Low
2	1b	*"What we haven't accounted for here-and this is actually a point you might want to consider-is what happens if we have fixed certain quantities or prices at a specific level? (...) That would be a very useful addition, for example. In other words, in the input parameters, you could include some kind of fixed price or fixed quantity."*	28:20	Data input of tariff-specific electricity prices (fixed/dynamic)	Low
2	1b	*"Of course, it would be great if this system could also provide some kind of forecast. What could the expected load be today, based on past average values? Naturally, not every day will be like the past, not even on average, but we do have a rough idea of how the day is likely to develop."*	30:49	Data-driven forecasting of expected load	Medium
2	1b	*"What just came to my mind is the topic of peaks. (...) There are grid usage fees (...) that are calculated based on two different components: One is the capacity charge, and peaks play a role in that. The higher the peak, the more expensive it gets. (...) And that's the key issue here-when it comes to deciding whether to avoid the peak and charge later, potentially saving on peak costs but increasing CO2 emissions or something else. (...) Also, the energy costs themselves-meaning what we actually draw from the grid in kilowatt-hours-but for peak minimisation, the first factor is what really matters. (...) It would be useful to add an aspect that shows what a peak actually costs us."*	34:17	Firm-specific peak pricing	Low
2	1a	*"I also think it's good that the CO2 emissions are ultimately included there (...). However, it would be necessary to differentiate between what the actual CO2 emissions are and what later appears as a calculated number, like the annual total."*	42:19	Analytical specification: CO2 emissions (accounted vs. actually emitted)	Low
2	2a	*"And what I would actually find really interesting: is that also dependent on the seasons, depending on what kind of strategy I might want to pursue at the time? And to actually simulate something like that?"*	23:02	Seasonal effects / aggregated analytics	Medium

[1] DC = Design cycle

Table 10: Qualitative codes, categorised as *'high priority'* for feature development **(design cycle 3)**

DC [1]	ID	Quote from interviews (round 2)	Timing (mm:ss)	Qualitative code(s)	Prio.
3	5b	*"I can't really do much with the indication 'energy consumption in kilowatt-hours' in the diagram. What I would actually need is a power value - in other words, what is the actual power draw, not the consumption. (...) For usability, it would actually make more sense to me to have a power value there rather than the consumption."*	17:00	Power (kW) on y-axis as additional visualisation output	High
3	5a/b	*"Tip: I think with Apple, for example, they have this kind of info button with just a very brief explanation behind it (...). I think something like that would help me a lot, especially if I don't deal with these terms on a daily basis: Why this graph? What does it show me? What is the added value? So I think if you could integrate something like that, really understandable for everyone (...), then you'd know what it means and you'd have the information readily accessible." [5a] "Or a small automatically generated summary text that says: if you had smart charging for peak minimisation, you could do xyz... And then in the end, you just have to link the elements from the diagram and the bar chart on the right, and then you basically already have what it's supposed to be telling you. That's already interpretation, and I think that would be helpful, because it would give us, in just one or two sentences, an explanation of what's already in the diagram. (...) That would also help people who are a bit less familiar with the subject or are a bit further removed from it." [5b]*	23:56	Auto-generated explanation text	High
3	5b	*"Yes, exactly, but I think something like absolute figures on an annual basis is good, because then I would immediately have something where I can say: OK, we've analysed one year - that would be roughly what we could save in a year with smart charging, which I could then also incorporate into my cost-effectiveness calculation for such a project. Because there's always some kind of economic viability assessment behind these things, and so far, aspects like the economic component of smart charging don't exist at all in this area for us. (...) And it doesn't have to be a diagram on an annual level - there just needs to be an absolute figure on a yearly basis."*	32:03	Aggregated analytics (annual)	High
3	8a	*"I'm not really that familiar with the whole topic, but I think it would've been kind of cool if the legend had been made a bit larger, and maybe if it had said something like 'What is smart charging?' - just a short definition, so I know exactly what it's about."*	20:00	Explanation text, larger legends	High

[1] DC = Design cycle

Table 11: Qualitative codes, categorised as *'low-'* and *'medium priority'* for feature development **(design cycle 3)** (1/2)

DC [1]	ID	Quote from interviews (round 2)	Timing (mm:ss)	Qualitative code(s)	Prio.
3	6c	*"So if I saw that correctly, when you switched from a day to a week view, the graph did change, but the bottom part (the x-axis) still ran from 00:00 to 24:00. (...) That wasn't immediately clear to me at first glance. (...) Yes, because honestly I would have expected - since you said we're now switching from a 24-hour view to a 7-day view -and while the graph did change, I still saw the labeling down there as 0 to 24:00, and so I instinctively switched back mentally to thinking it was only a single day again. (...) It was just that change in time frame from one day to one week: I had expected that the individual days would be displayed side by side, not layered on top of each other. That was my expectation - but it doesn't have to be decisive. Once you know it, you can adjust to it."*	10:15	Further explanation of weekly/monthly results related to timescale on x-axis	Medium
3	6a	*"In 2024, we didn't yet have a PV system, but now we do - so for us, it would make sense both from a CO emissions perspective and a cost perspective to make better use of that time window for charging. Do you have any way of visualising that?"*	14:52	Incorporating PV generation load	Medium
3	7a	*"I'd find it really cool if there were some kind of mix - like: 'How can I maybe reduce the peak?' But the actual magnitude of the peak doesn't really matter to me, as long as it stays below the threshold P, because the peak is what gets expensive for companies. At the beginning of the year, you're billed based on the peak rate, so it would be great if there were a fourth option [optimisation function] - the best of all of them. (...) And what would be interesting, perhaps, is to simply show that in the future you could also ask for the cost of the peak demand - like, what does the peak load cost per kilowatt?"*	12:17	Fourth objective function capping peaks	Medium
3	7a	*"What might be really cool is if the CSV or (...) the load profile that you import - it's just numerical data that you're displaying graphically here. Maybe a feature where you could add comments or set 'flags', so that you can briefly explain the peaks. Because as an energy manager, I look at it and it's crystal clear to me. (...) Decision-makers don't see it that way. And if I could take that from the export function and generate a small, simple visual report from it - that would be awesome. And if I could place 'flags' in those charts, so I could say: 'Hey, here's the first peak - employee clock-in, EV charging for the first shift, etc.' Then the decision-maker can take that and go to facility management and say: 'Look, here's an export - you can see something here you could act on.' "*	21:04	Annotation function within graphs	Medium

[1] DC = Design cycle

Table 12: Qualitative codes, categorised as *'low-'* and *'medium priority'* for feature development **(design cycle 3)** (2/2) (cont'd)

DC [1]	**ID**	**Quote from interviews (round 2)**	**Timing** (mm:ss)	**Qualitative code(s)**	**Prio.**
3	8a	*"This diagram on the right side - it shows charging cost, how much you save. I find it doesn't quite come across as convincing yet (. . .). Especially considering that - well, that's actually the benefit you get in the end, that's the outcome, and I think it could maybe be presented a bit more clearly. The reduced energy costs, the reduced carbon emissions - that kind of thing, so it's immediately visible. (. . .) I mean, of course, this is a very technical view - which is also important to me if I'm working as a Sustainability Manager and want to pitch this to the board. (. . .) And yes, that's what I mean with a different presentation: Maybe there are - I know it always sounds silly - but more 'fancy' ways to show it, like: this is how much cost you save, something that could also be exported into a presentation view that you can take into project meetings. But in general, this is the right kind of view, and I need it as well to do my calculations and to set up the project - so it is the right one."*	24:35	Presentation export function (PPT)	Low

[1] DC = Design cycle

From all interview sessions across design cycles 2 and 3, we derived 29 concrete suggestions for further feature development, as well as 25 more general comments concerning usability, ease of use, and practical relevance. Since the six *'high-priority'* feature requests identified in design cycle 2 have already been discussed earlier in Section §4.3, we focus here on the additional *'high-priority'* requests that emerged during design cycle 3 with firms ID 4–8.

As part of design cycle 3, four further *'high-priority'* feature enhancement requests were raised. First, interviewee 5b suggested a change in the way outputs are visualised: *"For usability, it would actually make more sense (...) to have a power value there rather than the consumption"* [ID: 5b]. This could be addressed by giving users the choice between two different visualisation types: power rate [kW] or electricity consumption [kWh]. Second, interviewee 5b proposed leveraging state-of-the-art *'generative Artificial Intelligence (genAI) Large-Language Models (LLMs)'* to improve users' understanding. Specifically, he suggested providing *"a small automatically generated summary text that says: 'If you had smart charging for peak minimisation you could do xyz' "* [ID: 5b]. He explained that such an auto-generated explanation text would especially *"help people who are a bit less familiar with the subject or are a bit further removed from it"* [ID: 5b]. Third, and closely related to a previous feedback point from interviewee 1b in design cycle 2 concerning aggregated analytics (cf. Table 8), interviewee 5b requested the computation of *"an absolute figure [of cost savings] on a yearly basis"* [ID: 5b] to improve understanding of the *"cost-effectiveness calculations for such a project"* [ID: 5b] involving smart charging. He justified this request by stating: *"Because there's always some kind of economic viability assessment behind these things, and so far, aspects like the economic component of smart charging don't exist at all in this area for us"* [ID: 5b]. This feedback underscores the practical importance of data-driven decision-support systems, such as our IT artefact, for simulating the economic outcomes of future smart charging investments. Fourth, and finally, interviewee 8a expressed the wish for more *'rudimentary'* explanatory texts, for instance related to *" 'What is smart charging?' - just a short definition, so I know exactly what it's about"* [ID: 8a].

Table 10 provides the complete set of interview quotes, linked to the respective qualitative code(s). While the *'high-priority'* feature requests from design cycle 2 (cf. Table 8) have already been implemented in the updated version of the web application (see Section §4.3, Figure 3), we deliberately decided to conclude the DSR process after three design cycles. This decision was based on the results of the quantitative evaluation with the SUS questionnaire, which did not improve further after the third cycle. These findings are analysed in detail in Section §5.3. All other *'low-'* and *'medium-priority'* feature requests can be accessed in Tables 11–12.

Table 13: Qualitative data pertaining to firms' decision context in the realm of energy management

DC [1]	ID	Characteristics of electricity load profile	Procurement strategy
2	1	- Production machineries as main demand sources (75%) - Cooling and compressed air (15%) - Remaining share attributable to facility management, incl EV charging	- Hourly time-of-use tariff - Certain share fixed via forward contracts - Remaining quantity sourced via spot market
2	2	- Small data centre with continuous load - EV charging, mainly during morning hours	- Variable fixed energy procurement (forward/spot)
2	3	- Facility operation	- Variable fixed energy procurement (forward/spot)
2	4	- Ventilation systems, cooling, production machineries	- Annual forward contracts (100% renewables)
3	5	- Production machineries	- Portfolio mix between short-, medium-, long-term products
3	6	- Compressed air generation, extraction, lighting, machineries	- Variable products (100% renewables)
3	7	- EV charging, AC during summer, canteen operations	- Variable products (100% renewables)
3	8	- Production machineries	- Variable products (100% renewables)
DC [1]	**ID**	**Outlook: Future electricity consumption**	**Expected challenges**
2	1	- Demand reduction through process optimisation and efficiency gains - No major uptake of EVs expected among employees	- Low-hanging fruits of process improvements have been realised already - Disproportionately high effort for further increase in energy efficiency
2	2	- Doubling of annual consumption due to electrification of heat production - Expansion of PV production on-site	- High investment costs due to the adaptation of building services - Sensible integration and use of PV system(s)
2	3	- Increase in annual demand by factor 2.5x	- Charging infrastructure - Reliability of electricity grid
2	4	- No future increase in demand from grid expected - Mainly due to expansion of on-site PV systems	- Flexible time-of-use tariff - Battery energy storage systems (BESS) for optimised load distribution
3	5	- +10-20% increase in demand due to electrification of processes	- Replacement of fossil-fuels (gas) remains challenging - Future technology remains uncertain (hydrogen vs. electrification vs. steam)
3	6	- More or less constant, possibly slight decrease	- Expansion of renewable energy production on-site - More efficient energy use, driven by ISO 50001
3	7	- +25% expected increase	- Managing higher peaks from increased EV charging demand
3	8	- Increased demand from expansion of production capacity	- Realising efficiency gains to lower overall electricity demand - Managing access to grid capacity

[1] DC = Design cycle

A.6. In-depth quantitative data

Table 14: Tabular overview of respondents' individual SUS scores and their adjective ratings, differentiated by design cycles 2 and 3.

No.	System Usability Scale (SUS) Item [1]	Design cycle 2						Design cycle 3					Rating
		1a	1b	2a	3a/b	4a	4b	5a	5b	6a	7a	8a	(Mean)
1	I think that I would like to use this system frequently.	4	4	4	4	5	4	4	4	4	4	3	**4.00**
2	I found the system unnecessarily complex.	1	1	1	2	1	1	3	2	1	1	2	**1.45**
3	I thought the system was easy to use.	5	5	4	5	4	4	4	4	4	4	3	**4.18**
4	I think that I would need the support of a technical person to be able to use this system.	2	1	2	2	2	1	1	2	1	2	3	**1.73**
5	I found the various functions in this system were well integrated.	4	4	4	5	5	4	4	5	4	5	4	**4.36**
6	I thought there was too much inconsistency in this system.	2	1	1	2	3	2	2	1	2	2	2	**1.82**
7	I would imagine that most people would learn to use this system very quickly.	5	5	5	4	5	5	3	3	4	5	2	**4.18**
8	I found the system very cumbersome to use.	4	4	4	4	5	4	4	4	4	4	3	**1.36**
9	I felt very confident using the system.	5	5	4	3	4	4	4	4	3	5	3	**4.00**
10	I needed to learn a lot of things before I could get going with this system.	1	1	1	3	1	1	4	1	2	1	2	**1.64**
	Final individual SUS Score	**90.0**	**95.0**	**85.0**	**77.5**	**87.5**	**87.5**	**70.0**	**82.5**	**80.0**	**87.5**	**57.5**	**81.8**
	Adjective rating [2]	(5*)	(5*)	(5*)	(3*)	(5*)	(5*)	(2*)	(4*)	(3*)	(5*)	(2*)	(4*)

[1] Likert scale: 1 = strongly disagree; 5 = strongly agree.
[2] Adjective ratings: (0*) = Worst imaginable (0–25); (1*) = Poor (25.1–51.6); (2*) = OK (51.7–71.0); (3*) = Good (71.1–80.7); (4*) = Excellent (80.8–84.0); (5*) = Best imaginable (84.1–100).

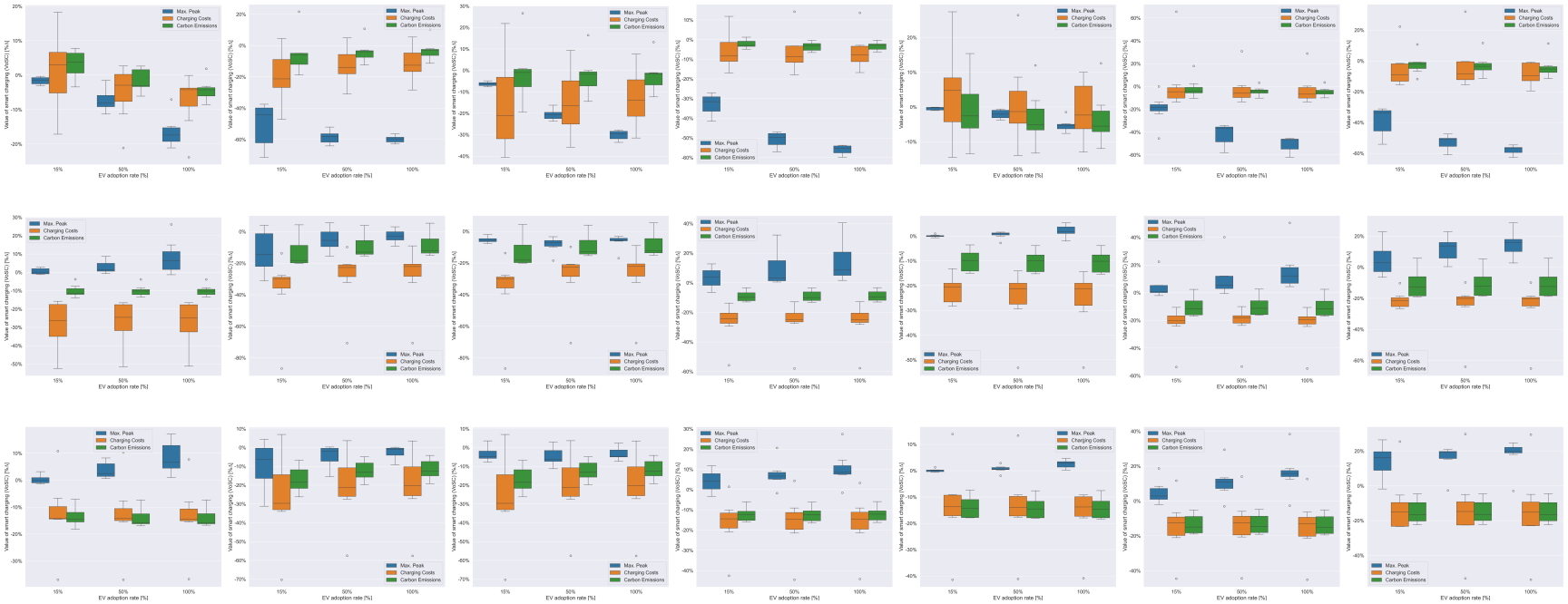

Figure 8: Visual summary of VoSC [%Δ] (y-axis) model results for increasing EV adoption rates of 15%, 50%, 100% (x-axis) w.r.t. each key metric *max. peak demand (blue)*, *charging costs (orange)*, and *carbon emissions (green)*, differentiated by charging strategies *PM-VF (top row)*, *CCM (middle row)*, *CEM (bottom row)* and each participating firm (columns 1–7). Note that lower %Δ numbers (y-axis) refer to higher saving potentials.

References

[1] Y. Zheng, S. Niu, Y. Shang, Z. Shao, L. Jian, Integrating plug-in electric vehicles into power grids: A comprehensive review on power interaction mode, scheduling methodology and mathematical foundation, Renew. Sustain. Energy Rev. 112 (2019) 424–439.

[2] C. S. Ioakimidis, D. Thomas, P. Rycerski, K. N. Genikomsakis, Peak shaving and valley filling of power consumption profile in non-residential buildings using an electric vehicle parking lot, Energy 148 (2018) 148–158.