HUBER+SUHNER IONITY ROCSYS

Whitepaper

Business cases for robotic charging at a public fast charging station

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Management summary

Rapid growth and mass market adoption of e-mobility require a timely roll-out of supporting charging infrastructure and superior user friendliness. In today's practice, both elements are often suboptimal or lacking.

This whitepaper describes a new approach based on robotic charging. In a robotic charging station plugging in and -out is performed by a robot. This gives a superior user experience, as the consumer ideally does not have to do anything in order to receive a charge. Parking in the right spot is only needed until autonomous driving takes over. Furthermore, robotic charging avoids the necessity for the driver to handle the often stiff and heavy charging cables.

A typical plug-in process can take several minutes when it is performed by humans, because they do not only plug in. For example, drivers put on their coat, step out, try to make sense of the functionality of the charger, etc. before actual power flows into the vehicles. At the end of the charge session cars often remain connected while charging has already stopped, or the charging session enters a phase with a very slow charging rate. This typically happens when a battery is being charged over 80%, while drivers finish their meal, coffee or phone call. In other words, leaving the car connected results in unnecessary queues, which reduces the maximum capacity of a charger. Automation of the plug-in and plug-out process prevents these losses.

For charge point operators it is beneficial to automate the process, because at high traffic locations more customers can be served with the same amount of charge points. It improves their service capacity and accelerates their return on investment. This whitepaper provides a business case to demonstrate that the service capacity of a high-traffic fast-charging location can be improved by 15%, and that an additional 12-14k€ of yearly revenue can be generated by introducing a robotic charging process. Therefore, a larger market can be served with the same level of infrastructure investment, while a superior user experience is obtained for the drivers. Lastly robotic charging stations are well prepared or even required to serve the future vehicle generations capable of self-driving and self-parking.

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1. Introduction

A massive and rapid shift to EVs or other decarbonized means of transport is essential to decarbonize mobility. This requires equally massive investments in charging infrastructure. The entire charging ecosystem, including EV-only brands like Tesla with a well-developed charging infrastructure, struggle to meet fast charging / High Power Charging (HPC) demand at peak moments and prime locations, leading to extensive queuing. This effect is the strongest in countries with rapid EV adoption, like Norway and The Netherlands. However, this will emerge in other European countries where the adoption of EV is stronger than the required charging infrastructure. Images of long queues en route to fast-charging locations, and reports of charge rage fuel the doubts and EV anxiety of prospective EV-drivers. This fear hampers EV adoption, which leads to longer acceptance time of zero emission cars as the standard. Furthermore, self-driving cars will be introduced in the near future. Fully automated charging points with standardized connectors are essential for unoccupied self-driving EVs to remain operational, as there is no driver present to connect the charger.

To substantiate this need, in this white paper we first elaborate on the problem and second analyse the requirements for a solution based on a stakeholder analysis. Next, we present our solution, summarize its benefits for the different stakeholders and compare it to the alternatives: manual charging and proprietary automation. To quantify the benefits, we analyse the market, present an introduction strategy and quantify the business cases along the EV value chain. Finally, we present our conclusions.

2. Problem definition

To stimulate adoption of EV by the general public, charging time and the overall charging experience of EV should become more comparable to filling up at a gas station. In order to achieve this, car manufacturers and Charge Point Operators invest in cars and infrastructures that can charge at higher power. As charging power increases, so does station throughput.

However, charge sites that are typified by queuing have at least 3 hours a day that are inefficient: the rush hours and lunch time. During these hours, charger availability severely constrains the number of charge operations **to less than 2 cars per hour, while average charge time is only 25 minutes[1].** Main reason for charging inefficiency is suboptimal human behaviour.

1. Before connecting the charger, drivers tend to spend time on other things, like answering phone messages, putting on a jacket, searching the wallet and going to the toilet.
2. During charging drivers often tend to leave the car or engage in other activities like making phone calls or enjoy some food. Therefore drivers are practically always unaware of the optimal moment to disconnect the charger and drive away (when battery > 80% full, charge speeds drop rapidly), but rather wait until they have finished their conference call or lunch.
3. The increase of the charging power has enlarged the weight of the charging equipment. This results in more challenging (and therefore time-consuming) manual connection of the almost 10 kg charging cable. This effect is even more problematic if the car is not positioned or aligned correctly. Manually connecting a charger is particularly challenging for people with less physical strength.
4. The position of the charge inlet on the EV is not standardised among different models. This makes correct car positioning in front of the manual charger challenging, resulting in suboptimal car placement and time-consuming delays e.g. people turning the car, parking in two spots, etc.

These aspects do not only detract from a satisfying user experience, they also increase the time needed to charge, and decrease the charging station's throughput. IONITY has validated using on historical data that a charge session during peak hours takes on average 25 minutes, in which they consume 35 kWh (roughly 100 kWh per hour). Other CPOs came to similar conclusions. Analyses show that for high-power charging the **impact of human-factor induced inefficiencies is 15% of the entire charging time**.

[1] Ardan GmbH (December 2017) "*Charging Infrastructure In Europe - Status Quo & Market Development Needs*"

3. Stakeholder analysis

Manual charging is no future-proof solution with the current trend of electrification, the need for fast and effective charging, and the growing levels of autonomy in vehicles. Automating the plug-in process is the innovative break-through solution for this highly scalable business opportunity. A stakeholder analysis demonstrates the needs this technology addresses.

1. CPOs

Future proof: new charging products should be ready for autonomous parking and driving, otherwise they will be outpaced by new concepts.

Interoperability: one charger should be interoperable for all vehicles, otherwise cost and space constraints limit throughput and increase queuing.

Financial cost and benefits: the financial benefits should at least outweigh the cost.

Throughput cars: with rising queuing inefficiency, enhancing throughput during peak hours is an essential factor for charge hubs, which improves their business case.

Ease of installation: the installation of the charge points should be feasible at differing charge sites, independent of size and layout.

2. OEMs

User Experience: optimal user experience by unburdening the EV-owners where possible, including accessibility for people with physical disadvantages.

Future proof: supports the roadmap of all OEMs towards autonomous parking and driving

3. End users

User Experience: optimal user experience by unburdening the EV-owners where possible, including accessibility for people with physical disadvantages.

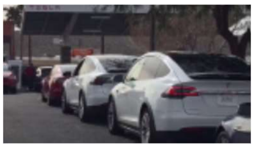
Charge assurance: the users primarily want their vehicles charged at the requested time. Hence, assuring that the connection is made when a charger is available, and charging can commence is the primary requirement.

Time benefits: faster charging and optimization of the process mitigates queues, which saves time for the end user.

4. Automating the connection of a standard connector

We propose to reduce charging times and improve customer experience by automating the charging process of already-standardized connectors. This primarily requires automation of the connection process, and the benefits can be fully exploited using the autonomous features of vehicles. The benefits of automating charging are listed in this section. They contain benefits for all stakeholders, i.e. CPOs, EV OEMs and end users. They are categorized and summarized in Table 4.1.

1. Reduction of charger down time



Eliminating the inefficiencies of human interaction with the charging cable will increase potential occupancy of an HPC point from around 2 vehicles per hour to 2,3 vehicles per hour, a ~15% increase in occupancy. The automated connection solution eliminates the down-time of the HPC, i.e. the time people take to accurately position the car, to handle and connect the cable to the car, and to leave the cable plugged-in when there is no/very slow charging (the charge rate slows down as the battery fills, especially at around 80% state of charge). HPC networks typically have several prime stations that handle up to 20% of traffic of the entire network. In these stations, queues occur during rush hours and around noon. Serving 15% more cars in these peak hours saves clients waiting time and increases turnover and margin for CPOs. This can reduce charging anxiety[2] in prospective EV adopters, leading to more rapid EV adoption.

2. Improved user experience and safety

Liquid cooled HPC cables are heavy and quite rigid, making them hard to handle for people with reduced physical strength (older people, physically disadvantaged people). Automating the handling of the charging cable therefore improves the user experience of EV charging.

3. More efficient use of charge site

As EVs do not have standardized locations for the charge ports, EV drivers may park in various ways to have the cable reach the port. This reduces the potential for placing additional chargers, leading to suboptimal use of charging stations. From a user perspective, it can be confusing and dangerous to see fellow drivers coming headlong into a one-way situation.

4. Reduction of cable maintenance

The weight of the cable puts stress on the connectors that will fail prematurely (at busier stations, this can happen once a year), especially when users are not careful and drop them. This negatively impacts the uptime of the charge point and increases maintenance costs.

5. Readiness for autonomous vehicles

OEMs are close to introducing self-parking vehicles as an important step towards fully autonomous EVs. Having automated charging infrastructure is a *conditio sine qua non* for the rollout of self-driving EVs.

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[2] Charging anxiety is the fear that there will not be enough charge points to complete journeys Autovista, (2020), "*EV charging anxiety is the new range anxiety*"

Table 4.1 Stakeholder benefits

	End user benefit	CPO benefit	EV OEM benefit
Reduction of charger down time	Reduced queues during peak hours	Higher throughput means higher turnover/margin per charger	Less clients with charging anxiety means higher EV adoption
Improved user experience and safety	No heavy cable handling. Park and go	Less clients with physical disadvantages to forego HPC	Better user experience means increased EV adoption
More efficient use of charge site	Clear parking instructions save time	Improved land use = room to expand	-
Reduction of cable maintenance	More charge points open means less queuing	Decreased maintenance cost, and higher uptime means more turnover/margin.	-
Readiness for autonomous vehicles	Not concerned with charging process anymore.	-	Condition sine qua non fulfilled for self-driving EV deployment

5. Comparing alternatives

The proposed system has two alternatives: manual charging and proprietary solutions. This section compares these solutions to automating the plug-in process of a standardized connector. The result is summarized in Figure 5.1.

1. Manual charging vs. automated connection

Compared to manual charging, automating the process significantly reduces queuing, by eliminating 80% of the switch time the throughput can be enhanced by 15%. This directly enhances throughput, and delivers an annual revenue gain of 12-14k€ per charge point. This strongly outweighs the additional investment in the robot and infrastructure. In addition, the user experience is enhanced by 1) eliminating heavy cable lifting, 2) allowing to park and leave, 3) optimizing charge session time by ending the charge session at the requested state-of-charge.

2. Proprietary solutions vs automated connection

Despite current development efforts in automatic charging solutions, none of the proprietary solutions have been able to reach the market. One of the reason is that proprietary systems are dissatisfactory for Charge Point Operators. This is caused by the need to install multiple proprietary systems, which cannot be shared for optimal queuing (e.g. a charger is unused, but not suitable for anybody in the queue). This increases the number of needed chargers, thereby adding installation cost and complicating installation at space-constrained sites. In addition, this would not satisfy the customer, by limiting their ability to pick a station at their convenience. Automating the plug-in process of already standardized connectors makes it interoperable technology.

3. Comparison conclusion

The benefits of an automated charge site are both financial and intangible, and they accrue to both Charge Point Operators and Electric Vehicle owners. This creates a win-win situation, which means that automation of the plug-in process is capable of a genuine transformation of the charging market, as all sides of the market take advantages from the innovation and will stimulate each other to adopt it.

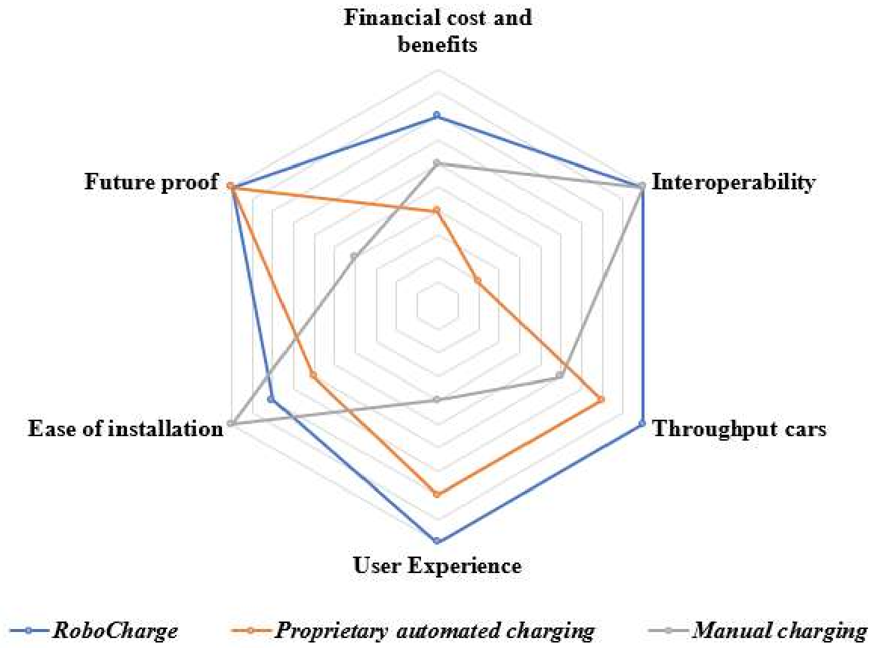

Figure 5.1 : Technology comparison

6. Market size, growth and trends

We target the growing EV charging stations market. Globally, this market is already sizeable: in 2019 the market equalled $2,5 billion. **The continuous annual growth rate (CAGR) equals 34,7%, leading to a rapid market growth to $27.7 billion in 2027**[3]. In this growing market we have identified the following market trends strengthening the need for automated charging:

1) The number of electric vehicles is rapidly increasing, between 2017 and 2019 an 89% increase of EVs has appeared. At the same time, the number of charge points have only grown by 32% absorbing the oversupply over chargers**Fout! Bladwijzer niet gedefinieerd.**. This trend will continue with the introduction of lower-priced EV models, which will service a lower-income market without access to private charging[4]. Since the EV growth outpaces the charger-point growth, IONITY estimates a tenfold occupancy growth at their charge points in the coming decade. This strongly increases queuing in peak hours, thereby growing the need for charger optimization. Automation of charge sites offers this optimization by efficiently handling queuing, **enlarging the number of charge sessions at peak hours from 2 to 2,3 (15%)**.
2) The increasing power ratings of charging points and vehicles will facilitate a higher throughput at the charge station by reducing the time of one charge session. This increases the effect of human-induced inefficiencies as more time-consuming vehicle switches appear. Automating the connection process potentially reduces the **switch time from 5 minutes to 1 minute (80%).**
3) The pathway towards autonomous driving has been paved over the recent years by the emergence of increasing autonomous abilities for cars. Especially the automated valet parking, a technology development currently ongoing at many car manufacturers (e.g. Ford, Mercedes, BMW, Daimler, Audi, Hyundai, Kia, Volkswagen)[5,6], will drive the need for automated charging systems.

Automation of the plug-in process is mainly interesting for public charging sites with multiple high-power chargers. These are mainly located at higher throughput corridors, like highway petrol stations, highway rest stops and city rings. This market is indicated by public high-power charging solutions (fast chargers >50kWh, and ultra-fast chargers >100kWh), representing an approximate 11.000 high power chargers at this moment. Automation is especially interesting for public charging sites at the highest throughput corridors, generally represented by ultra-fast charging hubs, often placed at corridors where space constraint are present and the highest throughput per charger is needed. **Currently, there are approximately 750 fast charging hubs, representing 2.000 high power charge points**[7]**. In the next couple of years a rapid surge of the market to 8.000 ultra-fast chargers is expected**Fout! Bladwijzer niet gedefinieerd.. Table 6.1 summarizes the total available market, and

	Total Available Market	Serviceable Available Market
	Fast chargers (>50kWh)	Ultra fast chargers (>100kWh)
2019	11.000	2.000
2020	14.800	2.700
2021	20.000	3.600
2022	26.900	4.900
2023	36.200	6.600
2024	48.800	8.900
2025	65.700	11.900
2026	88.500	16.100
2027	119.200	21.700
2028	160.600	29.200

[3] Markets and Markets, (2019), "*Electric Vehicle Charging Stations Market by Charging Level, Application, Charging Infrastructure, Electric Bus Charging, Installation, Charging Station type & Region - Global Forecast to 2027"*
[4] Fastned, (2015), *"Fastned Freedom Plan"*
[5] https://www.forbes.com/sites/edgarsten/2020/08/26/bosch-ford-unveil-automated-valet-parking-system/#14b0e5661008 – 26-10-2020
[6] https://www.cnet.com/roadshow/news/2021-mercedes-benz-s-class-automated-valet-parking-stuttgart/ – 26-10-2020
[7] Excluding Tesla superchargers (proprietary solution).

serviceable available market based on the Continuous Annual Growth Rate 34,7%.

7. Market Strategy

In Europe, there are approximately 500 Charge Point Operators, many of whom do not take a significant role in the current fast charging ecosystem. The main market players for fast charging are: IONITY, Allego, FastNed, E.ON, Enel, EnBW, CEUC, Instavolt, Total, BP Chargemaster, Gridserve/Chargepoint, and Shell, who collectively have an 80% market share. Automated charging is a major improvement over the inefficient manual plugin at fast charging sites. Operators all have a significant amount of charge sites. Figure 7.1 demonstrates IONITY's nearly 300 charge sites (+/- 1.800 chargers). However, **a typical fast charging network has a top 20% prime locations (i.e. busy city and highway corridors), which represent a significant revenue share of 80% of the entire network**. Simultaneous, these prime locations are often space constrained and on expensive land, strongly limiting the availability and profitability of charging systems. This creates the perfect niche for the market introduction of automated charging: **"space constrained prime charge sites".**

Figure 7.1 : IONITY HPC Network (2020)

After market introduction of automated charging at a demonstration site, rapid expansion opportunities are present by demonstrating the efficiency of automated charging. To facilitate market uptake, Charge Point Operators can be convinced by means of a solid and validated business case for their locations, which can be made based on results from the demonstration site.

The early adopting fast charging locations outfitted with automated charging will act as a reference point for Charge Point Operators. This allows them to validate the business case for every charge point. As many charging hubs have scarce physical space available, and permitting and grid connection processes are slow, charger point growth is strongly limited. Meanwhile, Electric Vehicle growth is surging to all-time highs, outpacing the growth of charge sites significantly. IONITY expects a tenfold increase in occupancy rates due to these factors, and other market trends. **As such, more and more charge points will be constrained by charger availability and queuing will appear, underlining the value of automated charging**. The constraining process is already ongoing in the early EV-adoption markets like the Nordic countries**. Once more stations adopt the automated charging process, end users will get used to the smooth and careless charging process, pushing adoption rates at all public charging hubs.** This process will be further accelerated once autonomous valet parking enters the market.

8. Example business models along the EV value chain

Everyone along the EV value chain will benefit strongly from the introduction of high-power automated connection systems. As the stakeholders are all situated in different parts of the electric-vehicle value chain, their revenue models differ. They do however have one thing in common: the expected growth potential in terms of turnover and margin is sizeable.

1. Charge Point Operators

As an example, we take the business model for IONITY. They have seen the market for electric vehicles emerging over the past years, which increased the demand for charging capacity at their charge point stations. At the moment, queuing issues are already present at prime charging locations (e.g. Ringdalskogen, Dombås). As these locations are space constrained the only cost-efficient option to alleviate these locations from queuing inefficiency is to improve the throughput. In order to realize this ambition, IONITY expects to automate their charge points, achieving the following financial benefits:

a. Additional charge sessions

At the prime locations, current charge sessions are limited by charger availability during peak hours. On average, every day 3 hours are known for being peak hours at gas stations, based on the pricing models[8]. IONITY expects to see queuing inefficiency at least during these hours. The main cause for queuing is human inefficiency, which severely limits the number of charge sessions to less than 2 sessions an hour, while a charge session takes 25 minutes on average[9]. Automated charging can reduce the average switch time from 5 minutes to 1 minutes, growing the charge sessions to an average 2,3 sessions an hour, subsequently **increasing the yearly charge sessions for each automated charger up to 15%**. The average charge session power is 100kW[10] at a sales price of €0,59/kWh[11], and thereby generates €24,60 revenue. **Overall resulting in an additional automated yearly charging revenue of €7.500 – 8.500 per charger.**

b. Price-premium for automated charging during peak hours

Automated charging has several benefits for the end-users, such as relief of queue time, relief of charging procedure, and a better customer experience (e.g. park and go to lunch, without requirement to plug in/unplug your vehicle in between). Meanwhile, automated charging offers the opportunity to eliminate blocking fees. Blocking fees 40-80 eurocents/minute are currently charged by Charge Point Operators when a vehicle charges unnecessarily occupies a charger at high-frequency infrastructure (e.g. Tesla)[12]. Which automatically happens when you charge over 80% at high frequency infrastructure[13], overcharging for 5-10 minutes, would already lead to a blocking fee of €2-8 euro. Due to the apparent benefits of the innovation for end-users, and the elimination of blocking fees a price-premium of at least €2 per session could be charged for an automated charge session at peak hours. This is dependend on user acceptance and market uptake. **Resulting in an additional yearly charging revenue of €4.500 - 5.500 per charger**.

Realizing a **resulting total of €12.000 – 14.000 per charger** gives a positive return on investment in automation after less than two years of operation. Multiple studies demonstrate that automation of a charge site becomes rapidly more cost-efficient once the number of queuing hours increases.

As an example could be that IONITY rolls out this innovation at the space-constrained prime

[8] Bundeskartellamt, (2020), "Markttransparenzstelle füR Kraftstoffe (MTS-K) Jahresbericht 2019"
[9] Ultra-fast chargers allow to charge in 20-30 minutes, The Ardan GmbH, (2017), *"Charging Infrastructure In Europe"*
[10] Assuming 80% EVs with an higher range, and taking into account currently available EVs charge powers (https://www.elektroauto-news.net/wiki/elektroauto-vergleich)
[11] Based on 0,39 + 0,48 + 0,89/3 = € 0,59 (https://emobly.com/wp-media/2020/09/Ladekartenkompass_sept20_vertikal.png)
[12] https://electrek.co/2018/09/19/tesla-update-supercharger-idle-fees/
[13] https://www.cnet.com/roadshow/news/tesla-supercharger-80-percent-charge-limit/

charge sites (+/- 20% of their 400 charge sites), once it has been proven on a demonstration site. A typical IONITY charge site has six chargers. To facilitate adoption IONITY could start with partial site automation, by installing 2-3 automated chargers to enhance throughput. Initially, this would mean a conservative 10 automated chargers at 5 charge points. In subsequent years, as the growing EV market will increasingly reveal queuing inefficiency, and as more customers and partners get used to the new technology, IONITY could expand the automation to 400 automated chargers in 2028. **This generates an additional EBIT of €4-5million, while enhancing consumer experience.** As more customers and partners get used to the new technology, IONITY could ramp up faster, even up to today's complete existing network, if the market is asking for this.

Table 8.1: IONITY business estimate

Basic charge session parameters		
Charging power of a session (average)		100 kW
Charging time (average)		25 minutes
Power consumption charge session (average)		41 kWh
Sales price	€	0,59 per kWh
Charge session revenue	**€**	**24,19**
Charger capacity parameters		
Automated charging capacity at peak hours		2,3 cars/hour
Current average capacity at peak hours		2 cars/hour
Additional capacity during peak hours		0,3 cars/hour
Number of peak hours per day		3
Additional yearly charge sessions		**329**
Additional charge fee	€	2,00 /charge session
Total yearly charge session in peak hours		**2519**
Additional yearly revenue per charger due to efficiency gain	**€**	**7.946**
Additional yearly revenue per charger due to premium servic	**€**	**5.037**
Additional yearly revenue per charger	**€**	**12.983**

	2024	2025	2026	2027	2028
Number of automated chargers	10	30	100	180	400
Revenue automated charging (k€)	79	238	795	1.430	3.179
Number of charge sessions (k)	25	76	252	453	1.007
Additional charging fees (k€)	76	227	756	1.360	3.022
Total gross turnover (k€)	155	465	1.550	2.790	6.201
Total gross margin (k€)*	127	382	1.272	2.290	5.088
Maintenance automated charger (k€)	6	18	60	108	240
Depreciation automated charger (k€)	10	30	100	180	400
EBIT (k€)	**111**	**334**	**1.112**	**2.002**	**4.448**

* 65% margin based, on average electricy price in EU (https://strom-report.de/electricity-prices-europe/)

2. Charging automation companies

As an example for a charging automation company, we take ROCSYS. One option is to use a transaction model, selling the technology to Charge Point Operators. The charging technology is expected to be sold starting from €25.000, with the expected cost of goods starting at €15.000. Additionally, a yearly fee of €1.500 for servicing, checking and calibration is charged.

The combination of a breakthrough innovation which contributes to a better EV adoption, has already proven to be interesting subject for public relations and rapidly draws media attention. During the development and demonstration of the automated charger, the charge point operators, industry stakeholders, and end users should be continuously involved. This is key in the strategy to assure a smooth market introduction.

ROCSYS will target Charge Point Operators such as IONITY, by showcasing the validated business case and extensive marketing & sales efforts. This will surge the market traction, facilitating a rapid growth of market share amongst Charge Point Operators. As a result, the sale of 900 systems in in 2028 will be realized, generating a EBIT of €14-16 million. Indicating a market share of 5% in the ultra-fast charging industry.

Table 8.2: ROCSYS business estimate

	2024	2025	2026	2027	2028
Automated charger sales	10	40	175	400	900
Revenue sales (k€)	250	1.000	4.375	10.000	22.500
Cumulative number of automated chargers	10	50	225	625	1.525
Service revenue	15	75	338	938	2.288
Total revenue	265	1.075	4.713	10.938	24.788
Gross margin (k€)	115	575	2.588	7.188	17.538
Selling, General and Admin. Expenses (k€)	250	350	500	600	650
R&D expenses (k€)	350	400	550	550	550
Other operational expenses (k€)	200	300	650	850	1.050
EBIT (k€)	**-685**	**-475**	**888**	**5.188**	**15.288**

3. Charging equipment manufacturers

As an example we take HUBER+SUHNER, who is already market leader in the EU and US high power charging cable market. They aim to sell the technology with a transaction business model, selling the charge cable system for automated charging solutions. In addition, direct sales to charge point providers for maintenance and replacement will be realized, because generally charge cables are in need of replacement every 1-2 years. An average replacement once every two years is assumed, as robotic handling is expected to create less wear and tear of the product. The charge cable system is expected to be sold for €1.700, the expected cost of goods is €1.100. The charging cable system can be standard in an automated charging solution, such as the ROCSYS robot, as a co-developed solution. Overall, HUBER + SUHNER expects to sell approximately 2.000 cables for automated charging solutions, with a revenue of €3-4 million in 2028.

Table 8.3: Huber + Suhner business estimate

	2024	2025	2026	2027	2028
Charge cables sales	10	85	350	1.035	2.675
Revenue (k€)	17	145	595	1.760	4.548
Gross margin (k€)	6	51	210	621	1.605
Selling, General and Admin. Expenses (k€)	20	40	40	40	40
R&D expenses (k€)	30	40	60	60	60
Other operational expenses (k€)	35	40	80	150	200
EBIT (k€)	**-79**	**-69**	**30**	**371**	**1.305**

9. Conclusion

Charge Point Operators cannot keep up with the growing EV market. Therefore, charging stations become more and more crowded. This leads, amongst others, to loss of revenue for CPO's, a poor user experience and reduced adoption of EVs. Increased charging powers help to combat this problem, but the stiffness and weight of the cables introduce new problems, and the cost for improved infrastructure is higher. Another option is automation of the plug-in and plug-out process. This reduces and potentially eliminates the human-factor, allowing for optimal use of chargers and of the charge site.

Our studies show that automation of charging can increase charge sessions during peak hours by 15%, potentially increasing the yearly revenue per charger by 12 to 14 k€. On top of that, using automated chargers reduces the maintenance cost on cables and connectors, reduces the space required for one charge point, increases the user experience and safety of a charge site, and, finally, it prepares the charge site for servicing (partially) autonomous vehicles.

Background of companies

IONITY is the leading European high-power Charge Point Operator, with over 300 currently operating charge sites and an expected growth to 400 in the coming years. Driven by the belief that powering an EV across Europe should be so carefree that soon you will never even think about it again.

ROCSYS is active in the field of fully automated charging of electric vehicles based on new principles used in soft robotics. The ROCSYS technology is a world's first, offering unique interoperable robotic charging.

HUBER+SUHNER offers its customers around the globe outstanding products and services for their electrical and optical connectivity needs. Within the automotive industry they are the world leader in high power cable supplies.