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Innovations in
charging infrastructure & management systems

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MCS – Megawatt Charging System

During the work on the MCS charger, we have selected the most-possibly efficient SiC power modules, designed the general hardware architecture and secured delivery of other components.

Charge planning and management tool

For the charge planning, we have identified an average of 50% peak power shaving capability of a standard depot-based operation of electric fleet with an assumption that every vehicle has unlimited access to the charger connector. With a limited availability scenario, charge planning system increases operability level instead of lowering the costs.

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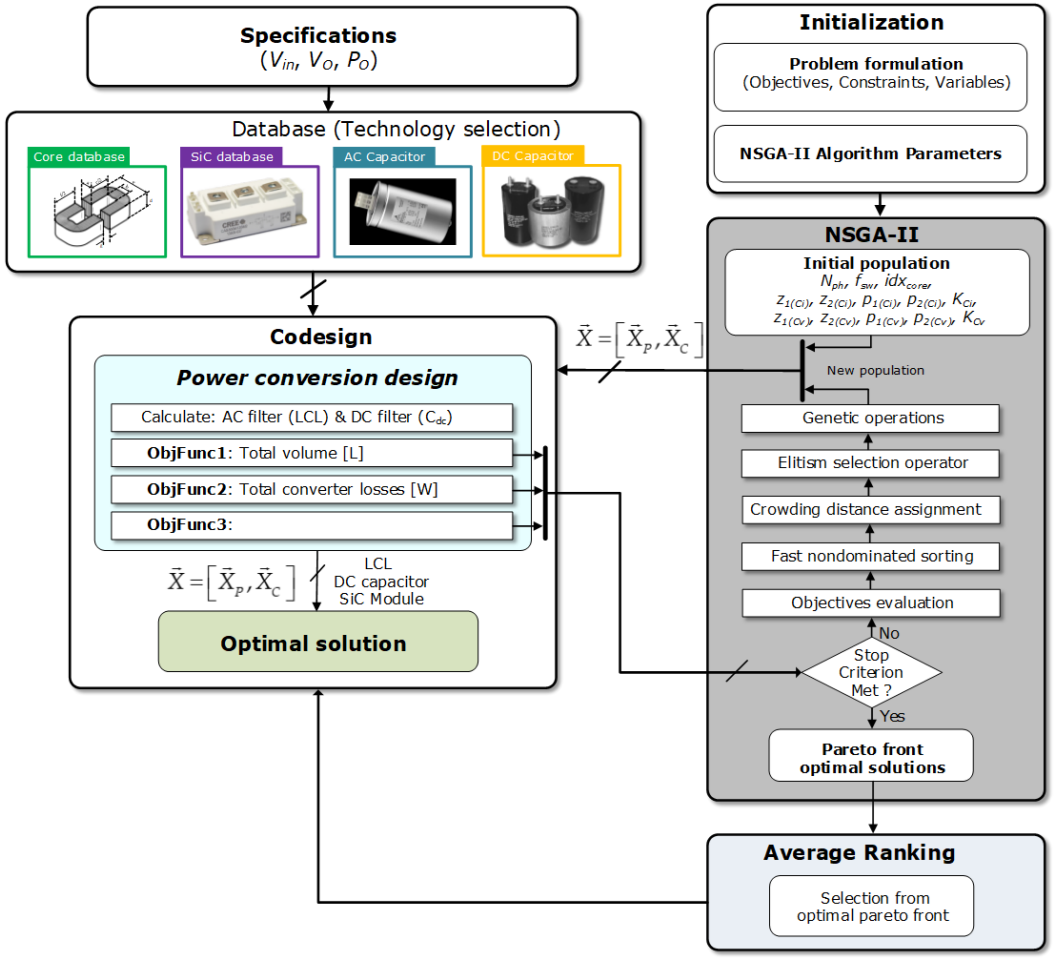
Design Optimization Framework - concept

For MCS – power modules selected for demonstration – with the SiC power modules to demonstrate the efficiency increase.

To select the most promising hardware, JEMA implemented the decision optimization algorithm. This study implements multi-objective optimization using the Non-Dominated Sorting Genetic Algorithm II (NSGA-II). With the algorytm described in the chart, optimal power module was selected.



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Main scientific and/or technological achievements

Design Optimization Framework - outcome

	5SFG0900X170100	CAB500M17HM3	CMH1200DC34S
	Hitachi	Wolfspeed	Mitshubishi
Efficiency (%)	98.1	98.25	96.32
Volume (L)	1600	1200	2100
Approximate Cost (k€)*	23.6	30.6	24.88

Selected hardware

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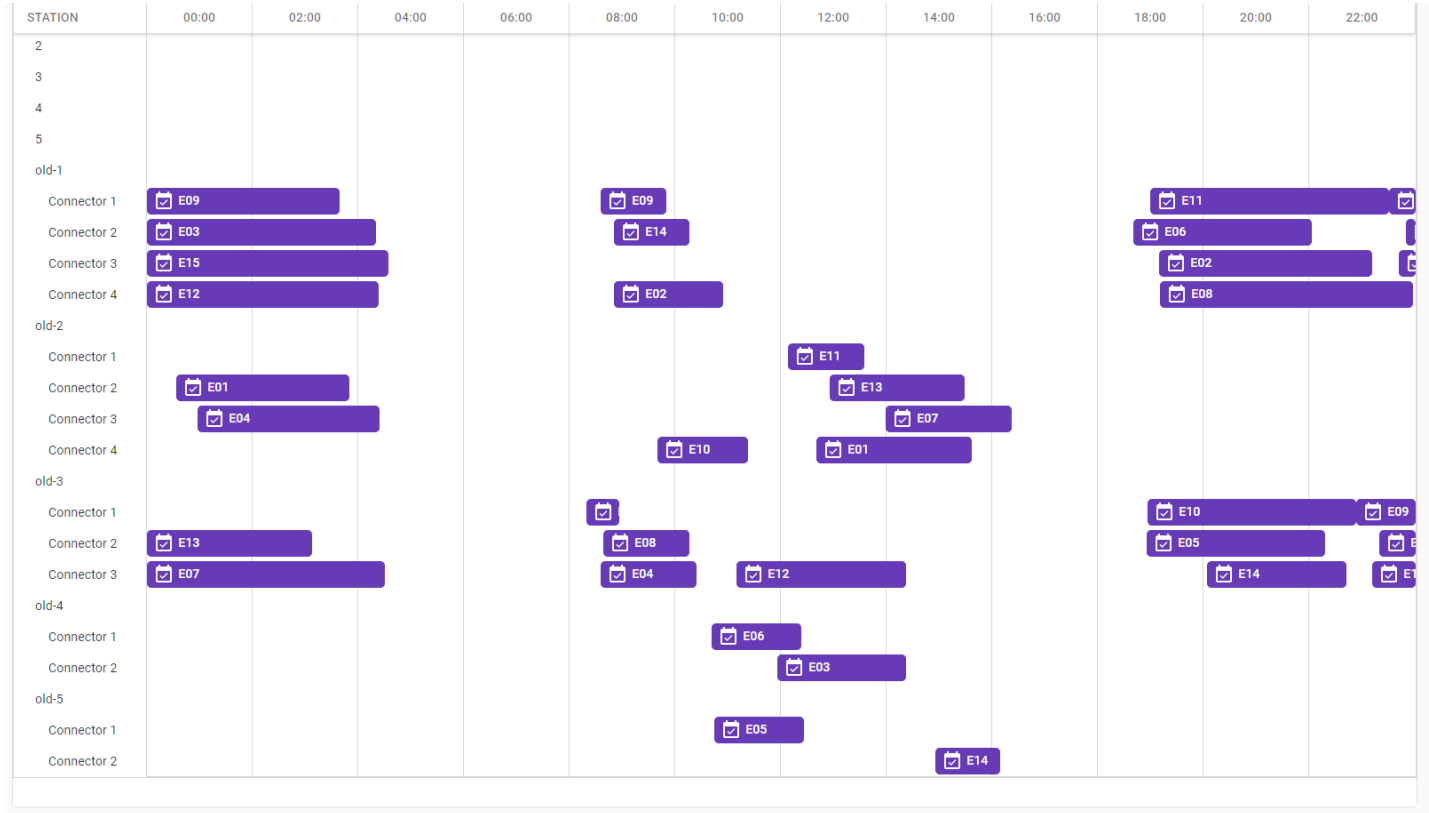
Charge management platform – operations optimization – Charge Opportunity Windows concept

With transportation plan from the customer, system identifies periods when the truck is stationary at the depo and is ready for charging. Those slots, called Charge Opportunity Windows (COW) are subject of charge planning.



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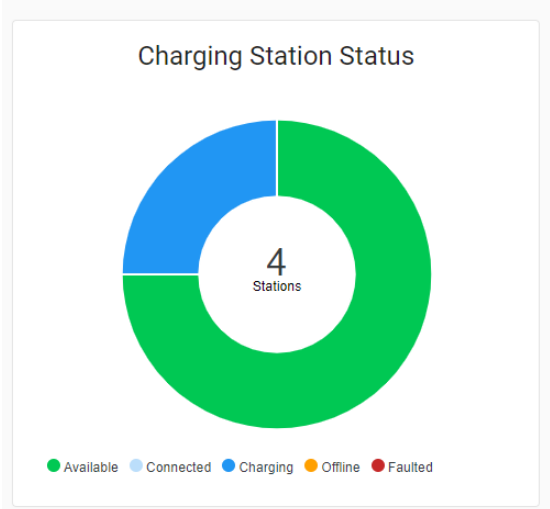
Charge planning details

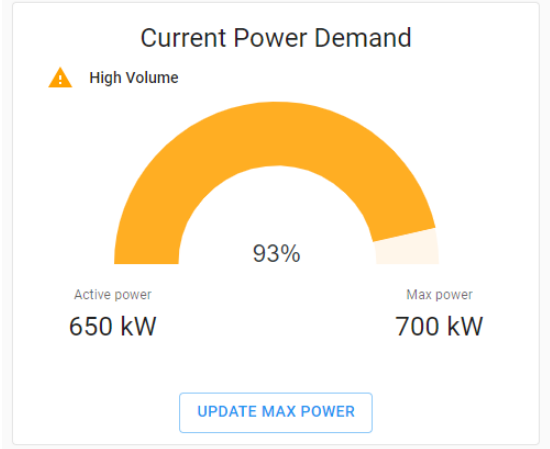
Charge planning is done per facility and is performer with one of two experimental version of planning algorithm:

1. „Greedy” algorithm – prioritizes most recent and shortest COWs. With this approach we assure that most urgent actions are best-possibly planned with opportunity to improve further operations with next iteration.

2. „Next-gen” algorithm – provides more balanced approach by identifying COWs with biggest „power required in unit of time” factor. This version provides more balanced plans, but without guarantee that nearest and most demanding changes will be handled with priority.

Notice: Every change in the transportation plan always triggers complete recalculation in given time window.





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Main innovation outputs

- Charge management platform – automatic peak shaving functionality

Both versions of the algorithm contains a set of constraints to support optimized charging. One of them is: respecting the assumed available peak power with ability to both:

1. Postpone charging operations within the COW
2. Lower charging limit with communication with the DC charger via OCPP protocol.
3. Minimizing the TCO by most optimal planning (high power charging during the day to allow multiple shifts, low porew during the night to lower the overal demand)