



DPC: 23 / 30435543 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 06 November 2023

Origin: International

Latest date for receipt of comments: 27 December 2023

Project No. 2021/00786

Responsible committee: PEL/69 Electric vehicles

Interested committees:

Title: BS EN IEC 63380-1 Local Charging station management systems and Local Energy Management Systems network connectivity and information exchange

Part 1: General Requirements, Use Cases and abstract Messages

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

**WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD.
THIS DRAFT IS NOT CURRENT BEYOND 27 December 2023**

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <http://standardsdevelopment.bsigroup.com>

Responsible Committee Secretary: **Ms Andreea Vieru (BSI)**
Direct tel: **0208 996 7432**
E-mail: **andreea.vieru@bsigroup.com**

 **Documents**
Document Sharing Hub

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



69/913/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:
IEC 63380-1 ED1

DATE OF CIRCULATION:
2023-11-03

CLOSING DATE FOR VOTING:
2024-01-26

SUPERSEDES DOCUMENTS:
69/751/RVN, 69/911/CC

IEC TC 69 : ELECTRICAL POWER/ENERGY TRANSFER SYSTEMS FOR ELECTRICALLY PROPELLED ROAD VEHICLES AND INDUSTRIAL TRUCKS

SECRETARIAT:

Belgium

SECRETARY:

Mr Peter Van den Bossche

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:

☒

Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING

☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

Local Charging station management systems and Local Energy Management Systems network connectivity and information exchange - Part -1 General Requirements, Use Cases and abstract Messages

PROPOSED STABILITY DATE: 2025

NOTE FROM TC/SC OFFICERS:

CONTENTS

1		
2		
3	FOREWORD.....	14
4	INTRODUCTION.....	16
5	1 Scope.....	17
6	2 Normative references	17
7	3 Terms, definitions, and abbreviated terms	18
8	3.1 Terms and definitions.....	18
9	3.2 Abbreviated terms.....	19
10	4 Scenarios and User Stories	19
11	4.1 Introduction.....	19
12	4.2 User Stories.....	20
13	4.3 Stakeholders.....	22
14	4.4 Use Case Actors.....	22
15	4.4.1 Charging Station.....	22
16	4.4.2 Energy Management System (EMS)	22
17	4.4.3 Electric Vehicle (EV).....	23
18	4.5 Mapping of User Stories to Use Cases.....	24
19	5 Technical Use Cases.....	24
20	5.1 Reader's guide.....	24
21	5.1.1 General	24
22	5.1.2 Requirements wording	24
23	5.1.3 Reading the graphics.....	25
24	5.2 Charging Station Commissioning and Configuration.....	25
25	5.2.1 Introduction	25
26	5.2.2 Scenario Overview.....	25
27	5.2.3 Scenario Support Requirements	26
28	5.2.4 Scenario flow.....	26
29	5.2.5 Scenario Details	26
30	5.2.6 Scenarios and Use Case Functions	27
31	5.2.7 Dependencies to other Use Cases.....	28
32	5.2.8 Additional Information	28
33	5.3 Coordinated EV Charging	28
34	5.3.1 Introduction	28
35	5.3.2 Scenario Overview.....	30
36	5.3.3 Scenario support requirements	30
37	5.3.4 Scenario flow.....	32
38	5.3.5 Scenario details.....	33
39	5.3.6 Scenarios and Use Case Functions	41
40	5.3.7 Dependencies to other Use Cases.....	41
41	5.3.8 Additional Information	42
42	5.4 EV Charging Electricity Measurement	42
43	5.4.1 Introduction	42
44	5.4.2 Scenario Overview.....	43
45	5.4.3 Scenario Support Requirements	43
46	5.4.4 Scenario flow.....	43
47	5.4.5 Scenario Details	43

48	5.4.6	Scenarios and Use Case Functions	45
49	5.4.7	Dependencies to other Use Cases	45
50	5.4.8	Additional Information	46
51	5.5	EV Charging Summary	46
52	5.5.1	Introduction	46
53	5.5.2	Scenario Overview	46
54	5.5.3	Scenario Support Requirements	46
55	5.5.4	Scenario flow	47
56	5.5.5	Scenario Details	47
57	5.5.6	Scenarios and Use Case Functions	48
58	5.5.7	Dependencies to other Use Cases	48
59	5.5.8	Additional Information	48
60	5.6	EV Commissioning and Configuration	48
61	5.6.1	Introduction	48
62	5.6.2	Scenario Overview	49
63	5.6.3	Scenario Support Requirements	49
64	5.6.4	Scenario flow	50
65	5.6.5	Scenario Details	50
66	5.6.6	Scenarios and Use Case Functions	55
67	5.6.7	Dependencies to other Use Cases	56
68	5.6.8	Additional Information	56
69	5.7	EV State of Charge	56
70	5.7.1	Introduction	56
71	5.7.2	Scenario Overview	56
72	5.7.3	Scenario Support Requirements	56
73	5.7.4	Scenario flow	57
74	5.7.5	Scenario Details	57
75	5.7.6	Scenarios and Use Case Functions	57
76	5.7.7	Dependencies to other Use Cases	57
77	5.7.8	Additional Information	57
78	5.8	Limitation of Active Power Consumption	57
79	5.8.1	Introduction	57
80	5.8.2	Detailed background information and rules	58
81	5.8.3	State machine	62
82	5.8.4	Scenario Overview	64
83	5.8.5	Scenario Support Requirements	64
84	5.8.6	Scenario flow	64
85	5.8.7	Scenario Details	64
86	5.8.8	Scenarios and Use Case Functions	68
87	5.8.9	Dependencies to other Use Cases	68
88	5.8.10	Further information and rules	69
89	5.8.11	Additional Information	69
90	5.9	Monitoring of Active Power Consumption	69
91	5.9.1	Introduction	69
92	5.9.2	Scenario Overview	70
93	5.9.3	Scenario Support Requirements	70
94	5.9.4	Scenario flow	71
95	5.9.5	Scenario Details	71
96	5.9.6	Scenarios and Use Case Functions	71

97	5.9.7	Dependencies to other Use Cases	74
98	5.9.8	Additional Information	74
99	5.10	Optimization of Self-Consumption during EV Charging	74
100	5.10.1	Introduction	74
101	5.10.2	Scenario Overview	75
102	5.10.3	Scenario Support Requirements	75
103	5.10.4	Scenario flow	75
104	5.10.5	Scenario Details	75
105	5.10.6	Dependencies to other Use Cases	77
106	5.10.7	Additional Information	78
107	5.11	Overload Protection by EV Charging Current Curtailment	78
108	5.11.1	Introduction	78
109	5.11.2	Derivation of the time limits for the involved units:	79
110	5.11.3	Further Information:	79
111	5.11.4	Scenario Overview	80
112	5.11.5	Scenario Support Requirements	80
113	5.11.6	Scenario flow	80
114	5.11.7	Scenario Details	80
115	5.11.8	Scenarios and Use Case Functions	83
116	5.11.9	Dependencies to other Use Cases	83
117	5.11.10	Additional Information	84
118	5.12	Basic EV Charging/Discharging	84
119	5.12.1	Introduction	84
120	5.12.2	Scenario Overview	84
121	5.12.3	Scenario Support Requirements	85
122	5.12.4	Scenario flow	85
123	5.12.5	Scenario Details	85
124	5.12.6	Scenarios and Use Case Functions	88
125	5.12.7	Dependencies to other Use Cases	89
126	5.12.8	Additional Information	89
127	5.13	Dynamic Bidirectional EV Charging	89
128	5.13.1	Introduction	89
129	5.13.2	Dynamic mode	90
130	5.13.3	Scenario Overview	91
131	5.13.4	Scenario Support Requirements	91
132	5.13.5	Scenario flow	91
133	5.13.6	Scenarios and Use Case Functions	92
134	5.13.7	Scenarios and Use Case Functions	96
135	5.13.8	Dependencies to other Use Cases	96
136	5.13.9	Further information and rules	97
137	5.13.10	Additional Information	97
138	6	Generic Use Case Functions (UCF)	97
139	6.1	Concepts	97
140	6.2	UCF_AC_Measurement	98
141	6.2.1	Generic Description	98
142	6.2.2	Additional Information	111
143	6.3	UCF_Characteristics	111
144	6.3.1	Generic Description	111
145	6.4	UCF_Charging_Power_Limits	113

146	6.4.1	Generic Description	113
147	6.4.2	Additional Information	114
148	6.5	UCF_Consumption_Curve	114
149	6.5.1	Generic Description	114
150	6.5.2	Additional Information	121
151	6.6	UCF_Device_Configuration	121
152	6.6.1	Generic Description	121
153	6.6.2	Additional information	124
154	6.7	UCF_Device_State	124
155	6.7.1	Generic Description	124
156	6.7.2	Additional Information	126
157	6.8	UCF_EV_Connected	126
158	6.8.1	Generic Description	126
159	6.8.2	Additional Information	126
160	6.9	UCF_Heartbeat	126
161	6.9.1	Generic Description	126
162	6.9.2	Additional Information	127
163	6.10	UCF_Identification	128
164	6.10.1	Generic Description	128
165	6.10.2	Additional Information	129
166	6.11	UCF_Incentive_Table	129
167	6.11.1	Generic Description	129
168	6.11.2	Additional Information	141
169	6.12	UCF_Load_Control	141
170	6.12.1	Generic Description	141
171	6.12.2	Additional Information	144
172	6.13	UCF_Manufacturer_Information	145
173	6.13.1	Generic Description	145
174	6.13.2	Additional Information	146
175	6.14	UCF_Maximum_Power_Limitation_Curve	146
176	6.14.1	Generic Description	146
177	6.14.2	Additional Information	150
178	6.15	UCF_Measurement	150
179	6.15.1	Generic Description	150
180	6.15.2	Additional Information	152
181	6.16	UCF_Power_Limit	152
182	6.16.1	Generic Description	152
183	6.16.2	Additional Information	155
184	6.17	UCF_Operation_Mode	155
185	6.17.1	Generic Description	155
186	6.17.2	Additional information	157
187	6.18	UCF_Session_Summary	157
188	6.18.1	Generic Description	157
189	6.18.2	Additional Information	161
190	6.19	UCF_Setpoint	161
191	6.19.1	Generic Description	161
192	6.19.2	Additional information	163
193		Bibliography	164

195	Figure 1 – Overview of the IEC 63380 series	20
196	Figure 2 – Communication scope of IEC 63380.....	20
197	Figure 3 – Sources of information for an EMS.....	23
198	Figure 4 – Charging Station Commissioning and Configuration – High-Level Use Case	
199	functionality overview.....	25
200	Figure 5 – Charging Station Commissioning and Configuration – Scenario overview.....	25
201	Figure 6 – Charging Station Commissioning and Configuration – Scenario 1 overview.....	26
202	Figure 7 – Charging Station Commissioning and Configuration – Scenario 2 overview.....	27
203	Figure 8 – Coordinated EV Charging – High-Level Use Case functionality overview.....	28
204	Figure 9 – Charging session example	29
205	Figure 10 – Coordinated EV Charging – Scenario overview	30
206	Figure 11 – Coordinated EV Charging – Scenario flow.....	32
207	Figure 12 – Energy demand example	33
208	Figure 13 – Maximum power limitation curve example.....	34
209	Figure 14 – Incentive table example with consideration of the $P_{\max}$ curve from	
210	Scenario 2	36
211	Figure 15 – Incentive Table example (single incentive slot) for different tiers	37
212	Figure 16 – Charging plan curve example	38
213	Figure 17 – EV Charging Electricity Measurement – High-Level Use Case functionality	
214	overview	42
215	Figure 18 – EV Charging Electricity Measurement – Scenario overview	43
216	Figure 19 – EV Charging Current overview	44
217	Figure 20 – EV Charging Power overview	44
218	Figure 21 – EV Charged Energy overview.....	45
219	Figure 22 – EV Charging Summary – High-Level Use Case functionality overview	46
220	Figure 23 – EV Charging Summary – Scenario overview.....	46
221	Figure 24 – Charging Session Summary	47
222	Figure 25 – EV Commissioning and Configuration – High-Level Use Case functionality	
223	overview	49
224	Figure 26 – EV Commissioning and Configuration – Scenario overview	49
225	Figure 27 – EV Commissioning and Configuration – Scenario 1 overview	50
226	Figure 28 – EV Commissioning and Configuration – Scenario 2 overview	51
227	Figure 29 – EV Commissioning and Configuration – Scenario 3 overview	52
228	Figure 30 – EV Commissioning and Configuration – Scenario 4 overview	52
229	Figure 31 – EV Commissioning and Configuration – Scenario 5 overview	53
230	Figure 32 – EV Commissioning and Configuration – Scenario 6 overview	54
231	Figure 33 – EV Commissioning and Configuration – Scenario 7 overview	54
232	Figure 34 – EV Commissioning and Configuration – Scenario 8 overview	55
233	Figure 35 – EV State of Charge – High-Level Use Case functionality overview	56
234	Figure 36 – EV State of Charge – Scenario overview	56
235	Figure 37 – Monitor EV's state of charge	57
236	Figure 38 – Limitation of Active Power Consumption – High-Level Use Case	
237	functionality overview.....	58
238	Figure 39 – LPC state machine after connection establishment.....	62

239	Figure 40 – Limitation of Active Power Consumption – Scenario overview	64
240	Figure 41 – Monitoring of Active Power Consumption – High-Level Use Case	
241	functionality overview	70
242	Figure 42 – Monitoring of active power consumption – Scenario overview	70
243	Figure 43 – Optimization of self-consumption during EV charging – High-Level Use	
244	Case functionality overview	75
245	Figure 44 – Optimization of Self-Consumption during EV Charging – Scenario overview	75
246	Figure 45 – Optimization of self-consumption during EV charging – Scenario 1	
247	overview	76
248	Figure 46 – Overload Protection by EV Charging Current Curtailment – High-Level Use	
249	Case functionality overview	79
250	Figure 47 – Overload Protection by EV Charging Current Curtailment – Scenario	
251	overview	80
252	Figure 48 – Overload Protection by EV Charging Current Curtailment – Scenario 1	
253	overview	81
254	Figure 49 – Example for asymmetric vs. symmetric charging curtailment	81
255	Figure 50 – Basic EV Charging/Discharging– High-Level Use Case functionality	
256	overview	84
257	Figure 51 – Basic EV Charging/Discharging – Scenario overview	85
258	Figure 52 – Basic EV Charging/Discharging – Scenario 1 overview	86
259	Figure 53 – EMS monitors EV's state of charge – Scenario 2 overview	86
260	Figure 54 – Basic EV Charging/Discharging – Scenario 3 overview	87
261	Figure 55 – Basic EV Charging/Discharging – Scenario 4 overview	87
262	Figure 56 – Basic EV Charging/Discharging – Scenario 5 overview	88
263	Figure 57 – Dynamic Bidirectional EV Charging – High-Level Use Case functionality	
264	overview	91
265	Figure 58 – Dynamic Bidirectional EV Charging – Scenario overview	91
266	Figure 59 – Example of energy request dependencies	94
267		
268	Table 1 – User Stories	21
269	Table 2 – Mapping of User Stories to Use Cases	24
270	Table 3 – Presence indication description	25
271	Table 4 – Charging Station Commissioning and Configuration – Scenario	
272	implementation requirements for Actors	26
273	Table 5 –Charging Station Commissioning and Configuration – Scenarios and primary	
274	Use Case Functions (UCFs).....	27
275	Table 6 – Coordinated EV Charging – Scenario implementation requirements for	
276	Actors	30
277	Table 7 – Coordinated EV Charging – Scenarios and primary Use Case Functions	
278	(UCFs).....	41
279	Table 8 – EV Charging Electricity Measurement – Scenario implementation	
280	requirements for Actors.....	43
281	Table 9 – EV Charging Electricity Measurement – Scenarios and primary Use Case	
282	Functions (UCFs).....	45
283	Table 10 – EV Charging Summary – Scenario implementation requirements for Actors.....	46
284	Table 11 – EV Charging Summary – Scenarios and primary Use Case Functions	
285	(UCFs).....	48

286	Table 12 – EV Commissioning and Configuration – Scenario implementation	
287	requirements for Actors.....	49
288	Table 13 – EV Commissioning and Configuration – Scenarios and primary Use Case	
289	Functions (UCFs).....	55
290	Table 14 – EV State of Charge – Scenario implementation requirements for Actors	56
291	Table 15 – EV State of Charge – Scenarios and primary Use Case Functions (UCFs)	57
292	Table 16 – Charging station power limitation behaviour	59
293	Table 17 – Limitation of Active Power Consumption – Scenario implementation	
294	requirements for Actors.....	64
295	Table 18 – Scenario 1 – Control active power consumption limit – Data point list.....	65
296	Table 19 – Scenario 2 – Failsafe values – Data point list	66
297	Table 20 – Scenario 3 – Heartbeat – Data point list	67
298	Table 21 – Scenario 4 – Constraints – Data point list.....	68
299	Table 22 – Limitation of Active Power Consumption– Scenarios and primary Use Case	
300	Functions (UCFs).....	68
301	Table 23 – Monitoring of Active Power Consumption – Scenario implementation	
302	requirements for Actors.....	70
303	Table 24 – Scenario 1 – Monitor power consumption – Data point list.....	71
304	Table 25 – Scenario 2 – Monitor consumed energy – Data point list	72
305	Table 26 – Scenario 3 – Monitor current – Data point list	72
306	Table 27 – Scenario 4 – Monitor voltage – Data point list.....	73
307	Table 28 – Scenario 5 – Monitor frequency – Data point list.....	74
308	Table 29 – Monitoring of active power consumption – Scenarios and primary Use Case	
309	Functions (UCFs).....	74
310	Table 30 – Optimization of Self-Consumption during EV Charging – Scenario	
311	implementation requirements for Actors	75
312	Table 31 – Optimization of Self-Consumption during EV Charging – Scenarios and	
313	primary Use Case Functions (UCFs)	77
314	Table 32 – Overload Protection by EV Charging Current Curtailment – Scenario	
315	implementation requirements for Actors	80
316	Table 33 – Overload Protection by EV Charging Current Curtailment – Scenarios and	
317	primary Use Case Functions (UCFs)	83
318	Table 34 – Basic EV Charging/Discharging – Scenario implementation requirements	
319	for Actors.....	85
320	Table 35 – Basic EV Charging/Discharging – Scenarios and primary Use Case	
321	Functions (UCFs).....	88
322	Table 36 – Dynamic Bidirectional EV Charging – Scenario implementation	
323	requirements for Actors.....	91
324	Table 37 – Scenario 1 – Control active power setpoint – Data point list	92
325	Table 38 – Scenario 2 – Monitor energy requests – Data point list	95
326	Table 39 – Scenario 3 – Monitor constraints – Data point list	95
327	Table 40 – Scenario 4 – Configuration parameters – Data point list	96
328	Table 41 – Dynamic Bidirectional EV Charging – Scenarios and primary Use Case	
329	Functions (UCFs).....	96
330	Table 42 – Information content for Measurement Description at Actor charging station	
331	for Power (Use Case “Monitoring of active Power Consumption”).....	99
332	Table 43 – Information content for Measurement Description at Actor charging station	
333	for Power (Use Case “EV Charging Electricity Measurement”)	

334	Table 44 – Information content for Measurement Constraints at Actor charging station	
335	for Power (Use Cases “Monitoring of active Power Consumption” and “EV Charging	
336	Electricity Measurement”)	100
337	Table 45 – Information content for Measurement Data at Actor charging station for	
338	Power (Use Case “Monitoring of active Power Consumption”)	100
339	Table 46 – Information content for Measurement Data at Actor charging station for	
340	Power (Use Case “EV Charging Electricity Measurement”)	101
341	Table 47 – Information content for Measurement Description at Actor charging station	
342	for Energy (Use Case “Monitoring of active Power Consumption”)	101
343	Table 48 – Information content for Measurement Description at Actor charging station	
344	for Energy (Use Case “EV Charging Electricity Measurement”)	101
345	Table 49 – Information content for Measurement Constraints at Actor charging station	
346	for Energy (Use Cases “Monitoring of active Power Consumption” and “EV Charging	
347	Electricity Measurement”)	101
348	Table 50 – Information content for Measurement Data at Actor charging station for	
349	Energy (Use Case “Monitoring of active Power Consumption”)	102
350	Table 51 – Information content for Measurement Data at Actor charging station for	
351	Energy (Use Case “EV Charging Electricity Measurement”)	102
352	Table 52 – Information content for Measurement Description at Actor charging station	
353	for Current (Use Cases “Monitoring of active Power Consumption” and “EV Charging	
354	Electricity Measurement”)	103
355	Table 53 – Information content for Measurement Constraints at Actor charging station	
356	for Current (Use Cases “Monitoring of active Power Consumption” and “EV Charging	
357	Electricity Measurement”)	103
358	Table 54 – Information content for Measurement Data at Actor charging station for	
359	Current (Use Case “Monitoring of active Power Consumption”)	103
360	Table 55 – Information content for Measurement Data at Actor charging station for	
361	Power (Use Case “EV Charging Electricity Measurement”)	104
362	Table 56 – Information content for Measurement Description at Actor charging station	
363	for Current (Use Case “Monitoring of active Power Consumption”)	104
364	Table 57 – Information content for Measurement Constraints at Actor charging station	
365	for Current (Use Case “Monitoring of active Power Consumption”)	104
366	Table 58 – Information content for Measurement Data at Actor charging station for	
367	Current (Use Case “Monitoring of active Power Consumption”)	104
368	Table 59 – Information content for Measurement Description at Actor charging station	
369	for Frequency (Use Case “Monitoring of active Power Consumption”)	105
370	Table 60 – Information content for Measurement Constraints at Actor charging station	
371	for Frequency (Use Case “Monitoring of active Power Consumption”)	105
372	Table 61 – Information content for Measurement Data at Actor charging station for	
373	Frequency (Use Case “Monitoring of active Power Consumption”)	106
374	Table 62 – Information content for Electrical Connection Description at Actor charging	
375	station for Power (Use Cases “Monitoring of active Power Consumption” and “EV	
376	Charging Electricity Measurement”)	106
377	Table 63 – Information content for Electrical Connection Parameters at Actor charging	
378	station for Power (Use Case “Monitoring of active Power Consumption”) – phase	
379	specific	107
380	Table 64 – Information content for Electrical Connection Parameters at Actor charging	
381	station for Power (Use Case “Monitoring of active Power Consumption”) – non phase	
382	specific	107
383	Table 65 – Information content for Electrical Connection Parameters at Actor charging	
384	station for Power (Use Case “EV Charging Electricity Measurement”) – phase specific	107

385	Table 66 – Information content for Electrical Connection Description at Actor charging	
386	station for Energy (Use Cases “Monitoring of active Power Consumption” and “EV	
387	Charging Electricity Measurement”)	108
388	Table 67 – Information content for Electrical Connection Parameters at Actor charging	
389	station for Energy (Use Case “Monitoring of active Power Consumption”)	108
390	Table 68 – Information content for Electrical Connection Parameters at Actor charging	
391	station for Energy (Use Case “EV Charging Electricity Measurement”)	108
392	Table 69 – Information content for Electrical Connection Description at Actor charging	
393	station for Current (Use Cases “Monitoring of active Power Consumption” and “EV	
394	Charging Electricity Measurement”)	109
395	Table 70 – Information content for Electrical Connection Parameters at Actor charging	
396	station for Current (Use Case “Monitoring of active Power Consumption”)	109
397	Table 71 – Information content for Electrical Connection Parameters at Actor charging	
398	station for Current (Use Case “EV Charging Electricity Measurement”)	109
399	Table 72 – Information content for Electrical Connection Description at Actor charging	
400	station for Voltage (Use Case “Monitoring of active Power Consumption”)	110
401	Table 73 – Information content for Electrical Connection Parameters at Actor charging	
402	station for Current (Use Case “Monitoring of active Power Consumption”)	110
403	Table 74 – Information content for Electrical Connection Description at Actor charging	
404	station for Frequency (Use Case “Monitoring of active Power Consumption”)	111
405	Table 75 – Information content for Electrical Connection Parameters at Actor charging	
406	station for Frequency (Use Case “Monitoring of active Power Consumption”)	111
407	Table 76 – Information content for Characteristics at Actor charging station (“Use Case	
408	Limitation of Active Power Consumption”, Scenario 4) and (Use Case “ Dynamic	
409	Bidirectional EV Charging”, Scenario 3)	112
410	Table 77 – Information content for Electrical Connection Parameters at Actor charging	
411	station (“Use Case EV Commissioning and Configuration”, Scenario 6)	114
412	Table 78 – Information content for Electrical Connection Permitted Values at Actor	
413	charging station (“Use Case EV Commissioning and Configuration”, Scenario 6)	114
414	Table 79 – Information content for Time Series Description at Actor charging station	
415	(Use Case “Coordinated EV Charging”, Scenario 1) and (Use Case “Dynamic	
416	Bidirectional EV Charging”, Scenario 2)	116
417	Table 80 – Information content for Time Series Description at Actor charging station	
418	(Use Case “Coordinated EV Charging”, Scenario 4)	116
419	Table 81 – Information content for Time Series Constraints at Actor charging station	
420	(Use Case “Coordinated EV Charging”, Scenario 1,4)	117
421	Table 82 – Information content for Time Series Data at Actor charging station (Use	
422	Case “Coordinated EV Charging”, Scenario 1)	117
423	Table 83 – Information content for Time Series Data at Actor charging station (Use	
424	Case “Coordinated EV Charging”, Scenario 4)	119
425	Table 84 – Information content for Time Series Data at Actor charging station (Use	
426	Case “Dynamic Bidirectional EV Charging”, Scenario 2)	120
427	Table 85 – Information content for Key Value Description at Actor charging station	
428	(Use Case “EV Commissioning and Configuration” Scenario 2, and 3)	122
429	Table 86 – Information content for Key Value Description at Actor charging station	
430	(Use Case “Limitation of active power consumption” Scenario 2)	122
431	Table 87 – Information content for Key Value Description at Actor charging station	
432	(Use Case “Dynamic Bidirectional EV Charging” Scenario 4)	122
433	Table 88 – Information content for Device Configuration at Actor charging station (Use	
434	Case “Limitation of active power consumption”)	122
435	Table 89 – Information content for Device Configuration at Actor Charging (Use Case	
436	“Dynamic Bidirectional EV Charging” Scenario 4)	123

437	Table 90 – Information content for Device Configuration at Actor charging station (Use	
438	Case "EV Commissioning and Configuration" Scenario 2)	123
439	Table 91 – Information content for Device Configuration at Actor charging station (Use	
440	Case "EV Commissioning and Configuration" Scenario 3)	123
441	Table 92 – Information content for Key Value Description at Actor EMS (Scenario 2,	
442	Failsafe Consumption Active Power Limit)	123
443	Table 93 – Information content for Key Value Description at Actor EMS (Scenario 2,	
444	Failsafe Duration Minimum)	124
445	Table 94 – Information content for Device State at Actor EMS (Use Cases "Overload	
446	Protection by EV Charging Current Curtailment", "Charging Station Commissioning and	
447	Configuration" and "Optimization of Self-Consumption during EV Charging")	125
448	Table 95 – Information content for Device State at Actor EMS (Use Cases	
449	"Coordinated EV Charging", Scenario 7,8)	125
450	Table 96 – Information content for Device State at Actor charging station (Use Case	
451	"EV Commissioning and Configuration")	125
452	Table 97 – Information content for Device State at Actor charging station (Use Case	
453	"Basic EV Charging/Discharging")	125
454	Table 98 – Information content for Heartbeat at Actor EMS	127
455	Table 99 – Information content for Identification at Actor charging station (Use Case	
456	"EV Commissioning and Configuration")	128
457	Table 100 – Information content for Incentive Table Description at Actor charging	
458	station (Use Case "Coordinated EV Charging")	130
459	Table 101 – Information content for Incentive Table Constraints at Actor charging	
460	station (Use Case "Coordinated EV Charging")	133
461	Table 102 – Information content for Incentive Table Data at Actor charging station (Use	
462	Case "Coordinated EV Charging")	134
463	Table 103 – Information content for Incentive Table Description at Actor EMS (Use	
464	Case "Coordinated EV Charging")	136
465	Table 104 – Information content for Incentive Table Data at Actor EMS (Use Case	
466	"Coordinated EV Charging")	139
467	Table 105 – Information content for Load Control Limit Description at Actor charging	
468	station (Use Case "Overload Protection during EV Charging")	142
469	Table 106 – Information content for Load Control Limit Description at Actor charging	
470	station (Use Case "Optimization of Self-Consumption during EV Charging")	142
471	Table 107 – Information content for Load Power Limit Data at Actor charging station	143
472	Table 108 – Information content for Electrical Connection Description at Actor charging	
473	station	143
474	Table 109 – Information content for Electrical Connection Permitted Values at Actor	
475	charging station	143
476	Table 110 – Information content for Load Power Limit Data at Actor EMS	144
477	Table 111 – Information content for Manufacturer Data at Actor charging station (Use	
478	Case "EV Commissioning and Configuration", Use Case "Charging Station	
479	Commissioning and Configuration")	146
480	Table 112 – Information content for Time Series Description at Actor charging station	148
481	Table 113 – Information content for Time Series Constraints at Actor charging station	148
482	Table 114 – Information content for Time Series Data at Actor charging station	149
483	Table 115 – Information content for Time Series Data at Actor EMS	150
484	Table 116 – Information content for Measurement Description at Actor charging station	
485	(Use Case "EV State of Charge") – State of Charge	151

486	Table 117 – Information content for Measurement Constraints at Actor charging station	
487	(Use Case "EV State of Charge")	152
488	Table 118 – Information content for Measurement Data at Actor charging station (Use	
489	Case "EV State of Charge")	152
490	Table 119 – Information content for Active Power Limit Description at Actor charging	
491	station (Use Case "Limitation of Active Power Consumption")	153
492	Table 120 – Information content for Active Power Limit Data at Actor charging station	
493	(Use Case "Limitation of Active Power Consumption")	154
494	Table 121 – Information content for Active Power Limit Data at Actor EMS (Use Case	
495	"Limitation of Active Power Consumption")	155
496	Table 122 – Information content for Operation Mode Description at Actor charging	
497	station (Use Case "Basic EV Charging/Discharging")	156
498	Table 123 – Information content for Operation Mode Description at Actor EMS (Use	
499	Case "Basic EV Charging/Discharging")	156
500	Table 124 – Information content for Session Summary Description at Actor charging	
501	station	158
502	Table 125 – Information content for Session Summary Constraints at Actor charging	
503	station	159
504	Table 126 – Information content for Session Summary Data at Actor EMS	159
505	Table 127 – Information content for Setpoint Description at Actor charging station (Use	
506	Case "Dynamic EV Charging/Discharging")	162
507	Table 128 – Information content for Setpoint Constraints at Actor charging station (Use	
508	Cases "Dynamic EV Charging/Discharging")	162
509	Table 129: Information content for Setpoint Data at Actor charging station (Use Cases	
510	"Dynamic EV Charging/Discharging")	162
511		
512		
513		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

STANDARD INTERFACE FOR CONNECTING CHARGING POINTS AND/OR CHARGING STATIONS TO LOCAL ENERGY MANAGEMENT SYSTEMS

Part 1: General Requirements, Use Cases, and abstract Messages

For rules on the drafting of the title, refer to the ISO/IEC Directives, Part 2:2021, [Clause 11](#).

The foreword is a mandatory element of the text.

For rules on the drafting of the foreword, refer to the ISO/IEC Directives, Part 2:2021, [Clause 12](#).

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 63380 has been prepared by subcommittee PT63380: Interface for connecting Charging stations to local energy management systems, of IEC technical committee 69: Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
-------	------------------

69/849A/CD	CC_69_849A_CD
------------	---------------

566
567 Full information on the voting for its approval can be found in the report on voting indicated in
568 the above table.

569 The language used for the development of this International Standard is English.

570 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
571 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
572 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
573 described in greater detail at www.iec.ch/standardsdev/publications.

574 The committee has decided that the contents of this document will remain unchanged until the
575 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
576 specific document. At this date, the document will be

- 577 • reconfirmed,
578 • withdrawn,
579 • replaced by a revised edition, or
580 • amended.

581

582

INTRODUCTION

583 The expansion of renewable energy and the simultaneous reduction in conventional generation
584 result in new power flows and loads on the equipment in the grid and at the house connection
585 point. At the same time, electrical consumers with high power consumption are increasingly
586 being installed in low-voltage systems in private customer systems. These include charging
587 systems for electric vehicles and heat pumps. These two developments can temporarily lead to
588 peak loads and bottlenecks in the network. An expansion of the distribution grids for the
589 comparatively few hours of high simultaneous power consumption is not considered
590 economically sensible. The legislator has therefore introduced the concept of "network-friendly
591 control of controllable consumer devices".

592 It is crucial to define a standardized interface for the connected consumers and generating
593 facilities, which also includes the charging infrastructure for electric vehicles. When developing
594 a local, standardized interface, a fundamental distinction has to be made between the terms
595 power and energy management.

596 In order to avoid an overload and the associated emergency shutdown due to specified power
597 limits in the property while all consumers are drawing electricity at the same time - especially
598 heating and air conditioning technology as well as charging infrastructure - power management
599 is of great urgency. This allows the maximum load at the grid connection point to be reduced.
600 Accordingly, priority has to be given to local power management over, for example, optimization
601 of operations and tariffs or desired charging plans.

602 In addition to the above-described goal of power management, the further goal of procurement-
603 or tariff-optimized operation can be pursued within the performance limits specified by the
604 infrastructure – controlled by the energy management system. Accordingly, a charging
605 infrastructure should be able to transmit information about procurement and tariff-optimized
606 operation from the local energy management of the property to the electric vehicle so that it
607 can coordinate its charging plan according to local requirements. Such coordination is
608 particularly necessary if generating systems are used within the property in order to achieve
609 the highest possible self-consumption of electricity.

610 The long-term goal is to buffer power and energy bottlenecks within a property using the energy
611 stored in the vehicle, which also brings the topic of energy recovery into focus and should be
612 taken into account when developing a standardized interface for local power and energy
613 management.

614 The aim of this document is to define a standard interface for connecting charging points and/or
615 charging stations to local energy management systems.

STANDARD INTERFACE FOR CONNECTING CHARGING POINTS AND/OR CHARGING STATIONS TO LOCAL ENERGY MANAGEMENT SYSTEMS

Part 1: General Requirements, Use Cases, and abstract Messages

1 Scope

This IEC 63380 series defines the secure information exchange between local energy management systems and electric vehicle charging stations. The local energy management systems communicate to the charging station controllers via the resource manager.

This IEC 63380 series specifies use cases, the sequences of information exchange, the data models as well as the communication protocols to be used and shall cover all aspects of local energy management of charging stations.

This IEC 63380 series covers scenarios where the charging infrastructure is managed by the operator of the private electrical network, and local energy management systems are used for local load management.

This IEC 63380 series does not cover the secure information exchange between the charging station and the IT backend system(s), such as the management of energy transfer of the charge session, contractual and billing data, provided by the IT backend.

The IEC 63380 series consists of the following structure, describing the interface between charging stations and local energy management systems.

- Part -1 General Requirements, Use Cases and abstract Messages
- Part -2 Specific Data Model Mapping
- Part -3 Communication Protocol and Cybersecurity Specific Aspects
- Part -4 Test Specifications

This part of IEC 63380 specifies use cases, the sequences of information exchange and generic data models.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61851-1:2017: Electric vehicle conductive charging system - Part 1: General requirements

ISO 15118-2:2014: Road vehicles — Vehicle-to-Grid Communication Interface — Part 2: Network and application protocol requirements

ISO 15118-20:2022 Road vehicles — Vehicle to grid communication interface — Part 20: 2nd generation network layer and application layer requirements

IEC 63110-1:2022 Protocol for management of electric vehicles charging and discharging infrastructures - Part 1: Basic definitions, use cases and architectures

E DIN EN 61851-23 VDE 0122-2-3:2018-03 — Electric vehicle conductive charging system —
Part 23: DC electric vehicle charging station

3 Terms, definitions, and abbreviated terms

IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and definitions

3.1.1

actor

entity that communicates and interacts [1]

3.1.2

client

role that specifies that a node uses data from a "server" or can request for change

3.1.3

Energy Management System (EMS)

system used to monitor and control the energy consuming devices in a building. Within this document, "energy management system" always refers to a customer/facility energy management system and not a utility energy management system [2]. EMS may also be based on EN 50491-12-2 concept [3]

Note 1 to entry: For the purposes of this document, either a device located in a user's home or property, or a cloud application. The energy manager enables energy-optimized operation of the devices connected to it by harmonizing energy demand and availability

3.1.4

local EMS

see EMS.

Note 1 to entry: "Local" refers to the area of operation of the EMS, but not its location; the EMS can reside in an on-site device as well as in the cloud

3.1.5

resource manager

RM

logical component (typically implemented in software) that exclusively represents a group of devices or a single smart device, and is responsible for sending unambiguous instructions to a group of devices or to a single device, typically using a device-specific protocol

3.1.6

scenario

sequence of steps that are taken to change the state from that before the scenario to that immediately after the scenario [4]

Note 1 to entry: For the purposes of this document, part of a use case. Dividing a use case into scenarios helps the reader to understand the use case more quickly. Some scenarios are mandatory for a use case, while others may be recommended or optional

3.1.7**scope (Type)**

some data models define scope types for identifying specific functionalities unambiguously

3.1.8**server**

role that specifies that a node offers own data to be read or written by a node with role client. A server can notify its data to other nodes (with role client)

3.1.9**use case**

specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system

3.1.10**use case function**

function to represent communication steps from the described technical use cases in the form of reusable function

3.1.11**user story**

complete (but specific) business case described from the perspective of a user; can be separated into several use cases, e.g., "The user wants to simply charge her/his EV at home"

3.2 Abbreviated terms

BEV	Bidirectional Electric Vehicle
CEM	Customer Energy Manager
CP	Charging Point
CSC	Charging Station Controller
DSO	Distribution System Operator
EMS	Energy Management System
EP	Electricity Provider
EV	Electrical Vehicle
EVU	Electric Vehicle User
FO	Flexibility Operator
GCP	Grid Connection Point
MPO	Metering Point Operator
PV	Photovoltaic
PWM	Pulse Width Modulation
RES	Renewable Energy Supply
RM	Resource Manager
RMS	Root Mean Square
SoC	State of Charge
UCF	Use Case Function
US	User Story

4 Scenarios and User Stories**4.1 Introduction**

This document describes user stories, use cases, and common use case functions. Use case functions contain a set of information and instructions to be exchanged between two peers such as an EMS and a charging station. Figure 1 shows an overview of the IEC 63380 series.

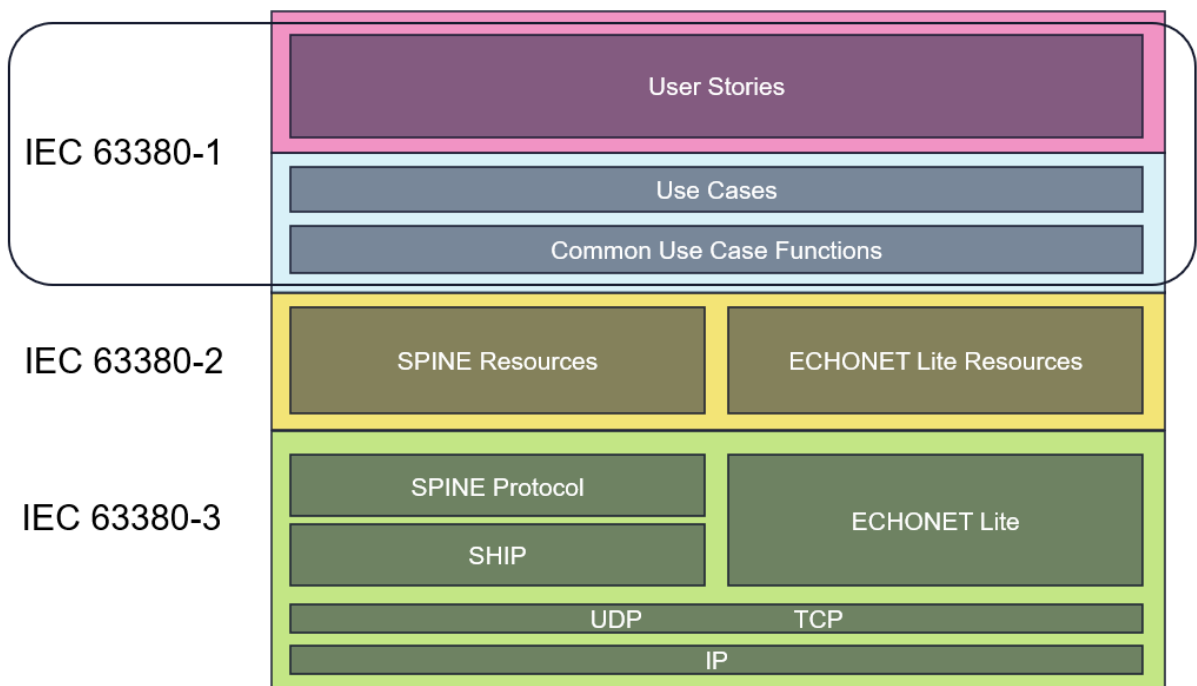


Figure 1 – Overview of the IEC 63380 series

Figure 2 represents the communication scope of the IEC 63380. As shown by the yellow arrow, the IEC 63380 describes the communication between the charging station and the EMS via a resource manager (the energy management for private charging inside the home). The management of the charging infrastructure is out of scope of this document.

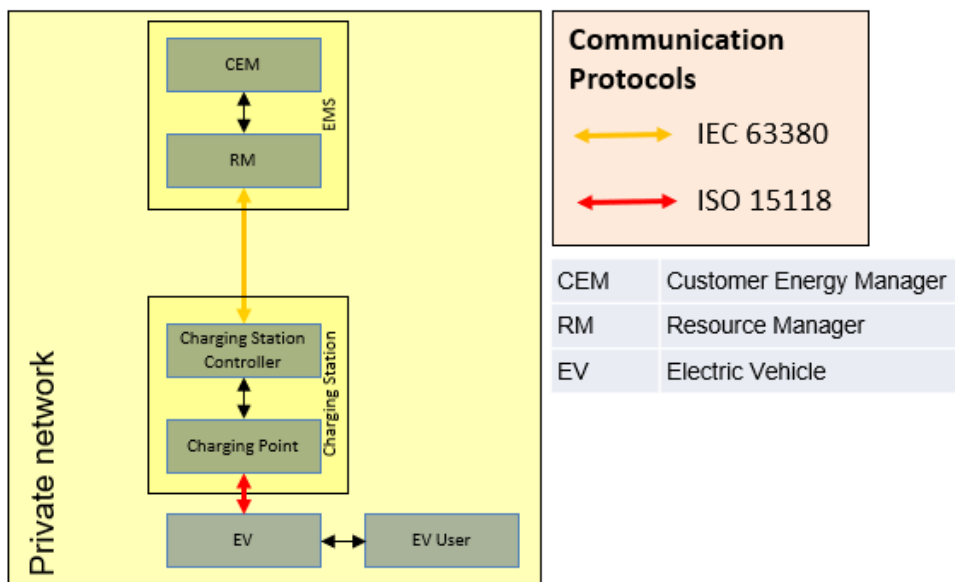


Figure 2 – Communication scope of IEC 63380

4.2 User Stories

The relevant User Stories (US) for the interface between charging station and local energy management are described in Table 1.

744

Table 1 – User Stories

ID	As a <ROLE>	I want to <GOAL>	so that <REASON>
US1-1	Electric Vehicle User EVU	simply charge my EV at home	my mobility needs are met, considering both constraints of the power grid and my individual objectives (costs, sustainability, independence, ...)
US1-2	Distribution System Operator DSO	call up grid management services (e.g., active power curtailment, voltage stabilization, Power Quality, ...) at the property's grid connection point using a unified interface	non-discriminatory access to the power grid and stable grid operation is ensured using cost-efficient decentralized grid management services of connected loads, storages and generators at the customer's premise
US1-3	Distribution System Operator DSO	get the current status, a forecast and impose target setpoints for parameters of the Grid Connection Point of the Private Power Network that are related to the operation of the Distribution System	non-discriminatory use of the capacity of the Distribution System is ensured and the installation of devices with high nominal power demand is facilitated, even if the maximum nominal power demand could exceed the planned capacity of the Distribution System
US1-4	Flexibility Operator FO	know and make use of the flexibility of connected components of the energy system at the customer's premise (both in terms of power and time)	- distributed generated energy is traded (e.g., direct selling) - the grid feed-in or grid power supply respectively can be adjusted for participation in frequency control or demand response markets
US1-5	Electricity Provider EP	know and make use of the flexibility of connected components of the energy system at the customer's premise (both in terms of power and time)	I can offer energy market orientated electricity supply products by including distributed generated energy in my portfolio or adopt the power consumption at the grid connection point according to my market-based energy trading processes
US1-6	Metering Point Operator MPO	collect and analyze the energy flows at the customer's premise using officially calibrated metering devices	Energy consumption, grid utilization (e.g., demand-based fees) and flexibility allocation can be captured and billed.
US1-7	Resident	be able to determine, how conflicting energy or power demands are resolved within the Private Power Network of my dwelling unit	I retain the authority about the use and distribution of energy within the Private Power Network of my dwelling unit (in contrast to letting a system make all decisions for me in an opaque way)
US1-8	Private Network Operator PNO	be able to determine, how conflicting energy or power demands are resolved within the Private Power Network (if applicable: between different dwelling units)	I retain the authority about the use and distribution of energy within the Private Power Network (in contrast to letting a system make all decisions for me in an opaque way)

745

4.3 Stakeholders

Within the Single- and Multi-Family home scenario, the following stakeholders have been identified:

- Electric Vehicle User – EVU
- Distribution System Operator – DSO
- Flexibility Operator – FO
- Electricity Provider – EP
- Metering Point Operator – MPO
- Private Network Operator – PNO
- Resident

4.4 Use Case Actors

In each of the following technical use cases, the interface between the charging station and the local energy management system is considered. In some cases, the EV may be included as an “auxiliary actor” in order to better elucidate the use case.

4.4.1 Charging Station

The charging station is used to charge/discharge an EV. It participates in energy management controlled by the EMS.

A charging station can provide one or more charging points; each charging point (CP) can charge exactly one EV.

Compared to a typical fuel pump where the refuelling process is manual, the typical charging station can usually communicate directly with the EV during the charging process, e.g., via ISO 15118 or IEC 61851-1, thus minimising manual interaction during longer charging processes.

4.4.2 Energy Management System (EMS)

The Actor EMS represents a local system for monitoring and control of energy resources and loads. It can manage the home's electrical systems to ensure energy optimized operation or visualize information. EMS may also be based on EN 50491-12-2 concept. More details about the customer energy manager (CEM) and the resource manager (RM) can be found in EN 50491-12-2 [3].

The Actor EMS has two logical roles. It protects against overload situations and/or delivers incentives. Multiple EVs may be connected to an EMS (through a charging station). However, only one EMS be connected to an EV within the Use Cases.

The EMS can receive information from several different sources, as described in Figure 3. The yellow arrow shows the focus of IEC 63380.

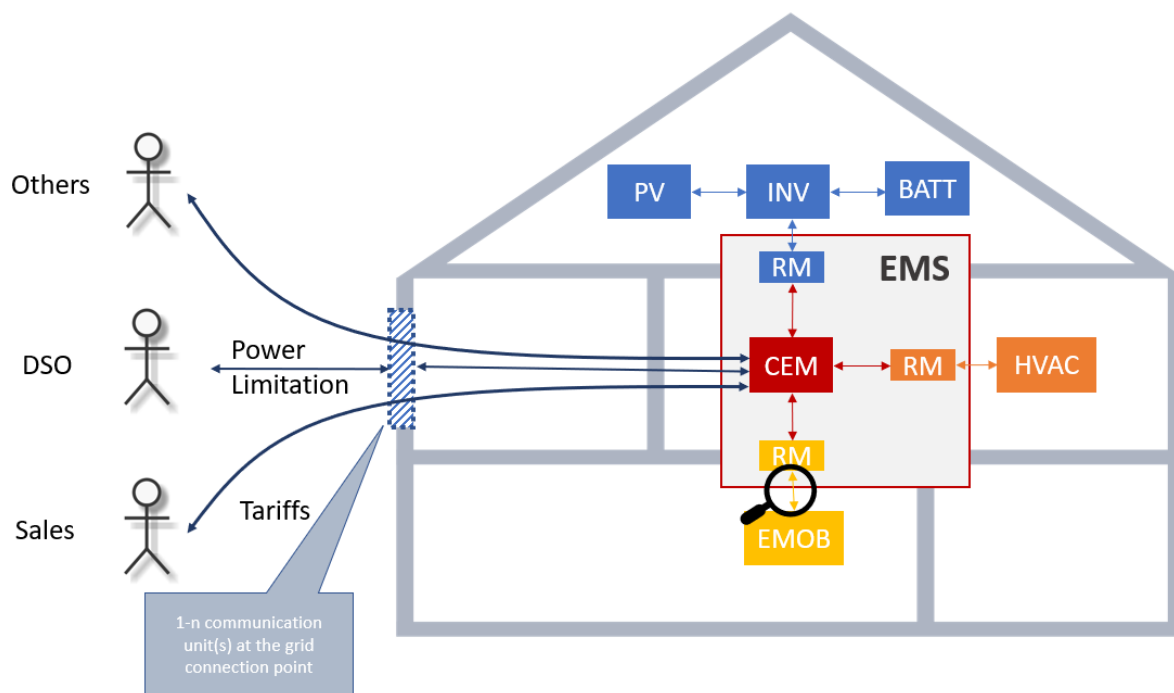


Figure 3 – Sources of information for an EMS

Legend

BATT	Battery
CEM	Customer Energy Manager
EMOB	Electromobility
EMS	Energy Management System
HVAC	Heating/Ventilation/Air Condition
INV	Inverter
PV	Photovoltaic
RM	Resource Manager

Based on this information, the EMS can make decisions that can lead, for example, to a limitation of the charging current for the charging device.

Example The user has prioritized the air conditioning in his EMS higher than the charging of the EV. With other high loads in the household, this can lead to a reduction of the available power for the charging station in the summer.

4.4.3 Electric Vehicle (EV)

The Actor EV is the electric vehicle that has one or more batteries and can exchange information with an EMS. Depending on the use case, only one EMS shall be connected to an EV (through a charging station), while multiple EVs may be connected to an EMS.

Note: All communication with the EV goes through the charging station, which will communicate with the EV using an appropriate standard such as ISO 15118 or PWM. This document will only specify communication between the EMS and the charging station, assuming that communication between the charging station and EV is covered appropriately.

4.5 Mapping of User Stories to Use Cases

Table 2 – Mapping of User Stories to Use Cases

User Story ID Use Case	US1-1	US1-2	US1-3	US1-4	US1-5	US1-6	US1-7	US1-8
Charging Station Commissioning and Configuration	x							
Coordinated EV Charging	x							x
EV Charging Electricity Measurement	x					x		
EV Charging Summary						x		
EV Commissioning and Configuration	x							
EV State of Charge	x							
Limitation of Active Power Consumption	x	x	x	x	x			
Monitoring of Active Power Consumption	x		x			x		
Optimization of Self-Consumption during EV Charging	x						x	
Overload Protection by EV Charging Current Curtailment	x	x	x	x	x			
Basic EV Charging/Discharging	x							
Dynamic Bidirectional EV Charging	x			x	x	x		

5 Technical Use Cases

5.1 Reader's guide

5.1.1 General

This section details the technical use cases mapped to the user stories in section 4.5.

In this document, it is assumed that the charging infrastructure offers either PWM according to IEC 61851-1, or ISO 15118-2/20. This document covered only the communication between the charging station and the EMS via the RM. The communication between the EV and the charging station is out of scope of this document.

This document also assumes that the charging station provides information about the actively used phases.

5.1.2 Requirements wording

The following keywords are used:

- Shall
- Shall not
- Should

• Should not

• May

Abbreviations for the presence indication of Elements listed in the tables are defined in Table 3:

Table 3 – Presence indication description

Abbreviation	Meaning	Link to requirement keywords
M	Mandatory	Shall
R	Recommended	Should
O	Optional	May
F	Forbidden	Shall not

5.1.3 Reading the graphics

In all figures of this document, it is assumed that the charging station via the charging station controller (CSC) is communicating to the energy management system through the resource manager.

5.2 Charging Station Commissioning and Configuration

5.2.1 Introduction

As the basis for other Use Cases related to the support of EV (electric vehicle) charging, this Use Case specifies the initial setup process between the Actor EMS and the charging station. For most related Use Cases, the Actor charging station serves as middle box that transmits the necessary information between the EMS and the EV.

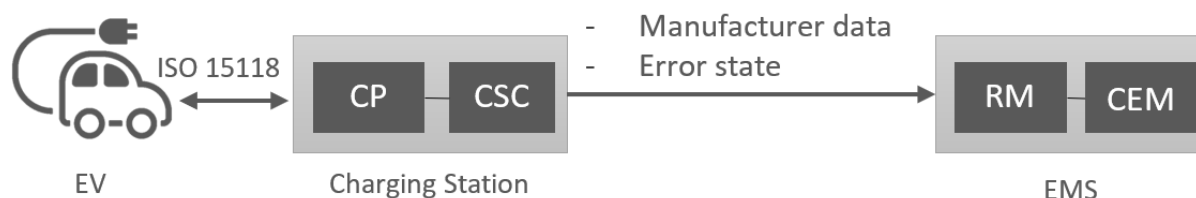


Figure 4 – Charging Station Commissioning and Configuration – High-Level Use Case functionality overview

The main part of the commissioning and configuration processes is to transmit information from the charging station to the EMS.

5.2.2 Scenario Overview

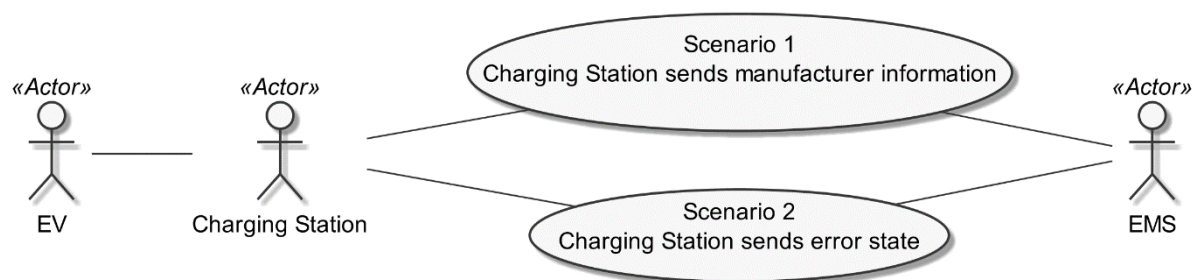


Figure 5 – Charging Station Commissioning and Configuration – Scenario overview

5.2.3 Scenario Support Requirements

Table 4 – Charging Station Commissioning and Configuration – Scenario implementation requirements for Actors

Scenario number	Scenario name	Charging station	EMS
1	Charging station sends manufacturer information	R	R
2	Charging station sends error state	M	M

5.2.4 Scenario flow

n/a

5.2.5 Scenario Details

5.2.5.1 Scenario 1 – Charging station sends manufacturer information

5.2.5.1.1 Description

The manufacturer data can hold different information of the corresponding charging station and the charging station manufacturer. This can be used to present the corresponding charging station to a user of the energy management application. E.g., based on the device name a corresponding icon could be used to represent the charging station.

It is recommended that; the following information should be available:

- device name
- device code
- vendor name
- vendor code
- brand name
- manufacturer label

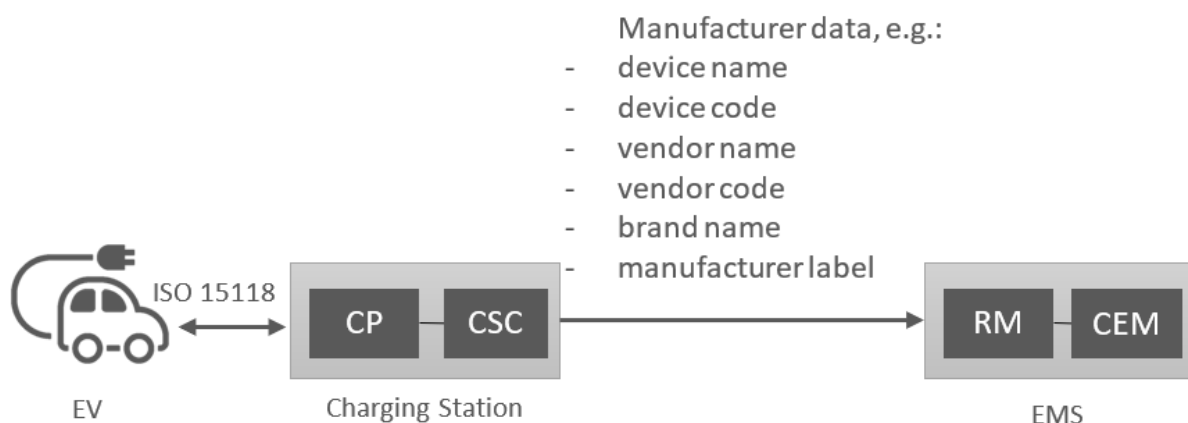


Figure 6 – Charging Station Commissioning and Configuration – Scenario 1 overview

Note: The manufacturer data in this use case are related to the charging station.

5.2.5.1.2 Conditions

Triggering Event:

868 The Scenario is typically triggered by establishing a communication link between the charging
869 station and the EMS.

870 **Pre-condition:**

871 The EMS has no manufacturer information of the charging station.

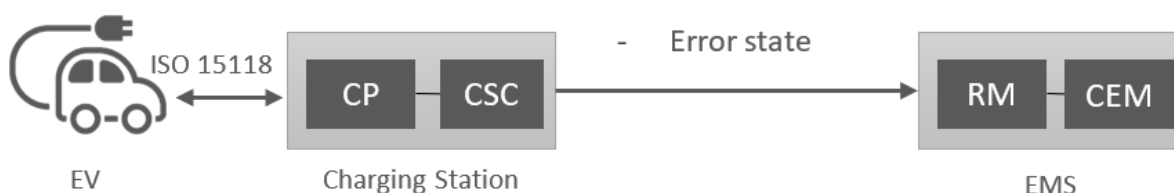
872 **Post-condition:**

873 The EMS has manufacturer information of the charging station and e.g., can show this
874 information to the customer.

875 **5.2.5.2 Scenario 2 - Charging station sends error state**

876 **5.2.5.2.1 Description**

877 Used to indicate errors of the charging station to the user. If the charging station has an error,
878 e.g., communication lost, the EV may no longer be able to follow the charging plan correctly
879 and updates from the EV may no longer contain valid data.



880

881 **Figure 7 – Charging Station Commissioning and Configuration – Scenario 2 overview**

882 **5.2.5.2.2 Conditions**

883 **Triggering Event:**

884 The Scenario is triggered as soon as the charging station is connected to the EMS.

885 **Pre-condition:**

886 The EMS has no error state information of the charging station.

887 **Post-condition:**

888 The EMS has error state information of the charging station.

889 **5.2.6 Scenarios and Use Case Functions**

890 For each scenario, the "primary" Use Case functions are given.

891 **Table 5 –Charging Station Commissioning and Configuration – Scenarios and primary**
892 **Use Case Functions (UCFs)**

Scenario		Primary Use Case functions
1	Charging station sends manufacturer information	UCF_Manufacturer_Information
2	Charging station sends error state	UCF_Device_State

5.2.7 Dependencies to other Use Cases

None.

5.2.8 Additional Information

None.

5.3 Coordinated EV Charging

5.3.1 Introduction

This Use Case focuses on the adjustment of the charging process of an electric vehicle (EV) connected to a charging station such that limitations of the customer's local grid or optimization goals are met.

Examples for optimization goals are:

- the reduction of the electricity costs associated with a charging process
- the reduction of the CO₂-footprint associated with a charging process
- the compliance with constraints of the energy supplier or DSO
- the coordinated realization of demand response setpoints from grid-level aggregators

To achieve the goal, an Actor EMS with the role of delivering incentives can influence the consumption of an EV with incentives. For this the EMS sends an incentive table that defines different tiers with power levels and incentives. Different kinds of incentives are possible, like price, CO₂ emission or renewable energy percentage. Additionally, a maximum power limitation ($P_{\max}$) is provided by an Actor EMS (protects against overload) as a time-based curve, to avoid in advance overload situations during charging. To handle unexpected overload situations, please refer to the Use Case described in 5.11.

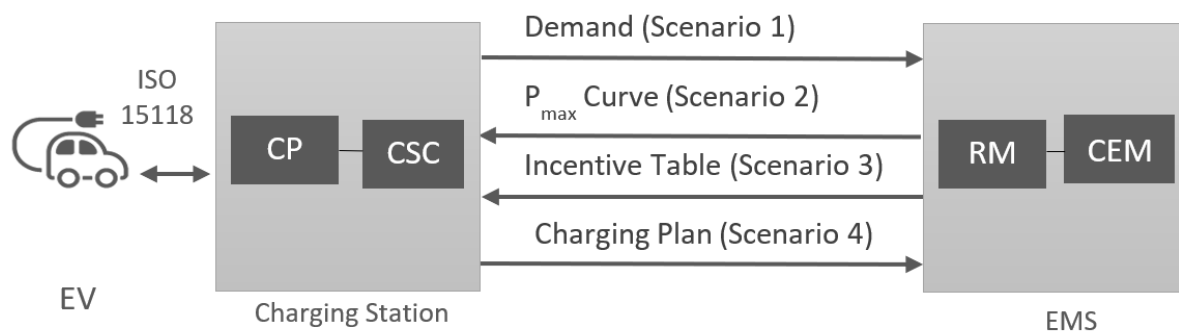


Figure 8 – Coordinated EV Charging – High-Level Use Case functionality overview

This Use Case mainly focuses on private charging infrastructure with a limited number of cars and other consumers. The incentive table and maximum power limitation ($P_{\max}$) curve can be mapped on the ISO 15118 tariff and $P_{\max}$ schedule information by the charging station to inform the EV over the charging cable. In case of PWM communication (IEC 61851-1) the charging station has to calculate the charging plan for the EV (as PWM can only be used to communicate the maximum charging current from charging station to EV). If PWM communication is used, the charging station may use additional input from the driver (for example a charging station user interface or customer app) to generate a charging energy demand.

The EMS with the roles of protection against overload and delivering incentives is a logical Actor and it is recommended to implement both roles on one device, as both roles need similar knowledge. To generate an incentive table, the EMS needs to have access to forecasts for the local electricity production, the electrical load, and the electricity costs. To generate the maximum power limitation ($P_{\max}$) curve, the EMS also needs to have access to forecasts for local electricity production and load.

Based on the incentive table from the EMS and the maximum power limitation ($P_{\max}$) curve from the EMS, the EV creates a charging plan, while considering its own constraints resulting from the user-configuration and other technical constraints. The charging plans contain a maximum charging power curve of the EV and is then sent through the charging station to the EMS, to reserve the necessary charging power for the EV.

The EV (through the charging station), the EMS can trigger a renegotiation by sending updates:

- a) The EV can send updates of its demand and trigger an update of the incentive table and the power limitation curve (e.g., if the EV departure time is shifted) through the charging station.
- b) The EMS with the role of overload protection can send an adjusted power limitation curve (e.g., if energy consumption or production has changed).

The EMS with the role of delivering incentives can send updated incentives (e.g., if a local photovoltaic system (PV) suddenly provides more energy as expected).

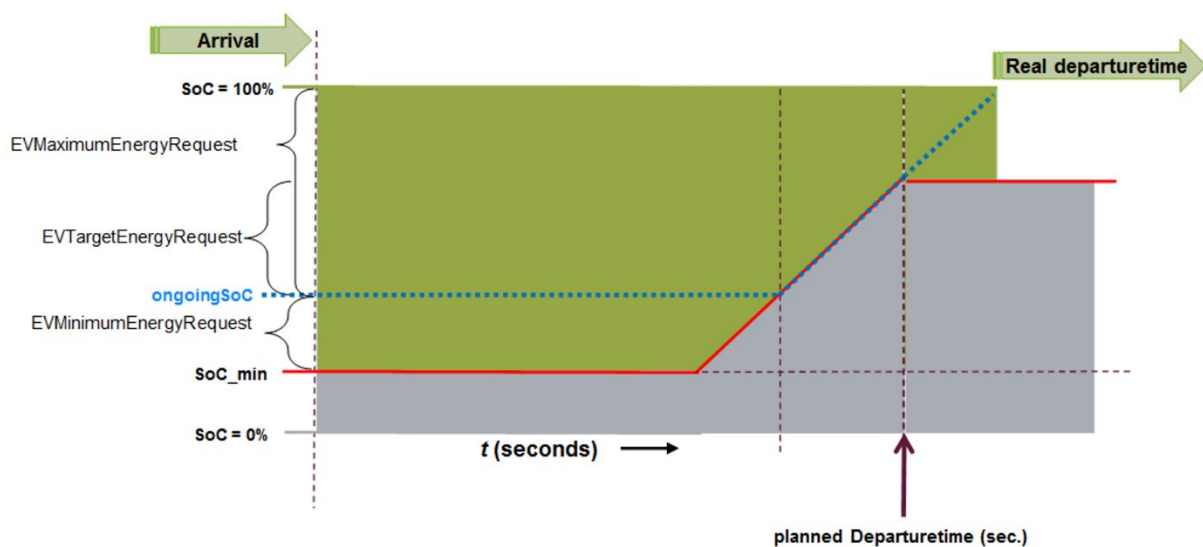


Figure 9 – Charging session example

Note: With coordinated charging, an EV knows when green, cheap or costless energy is available and can charge accordingly. In the special case of PV curtailment (energy that is not consumed but also cannot be fed into the grid), surplus costless energy can be used to charge the EV for free.

User Story as an example: The driver of the EV wants to charge his EV until the next morning with minimum costs.

5.3.2 Scenario Overview

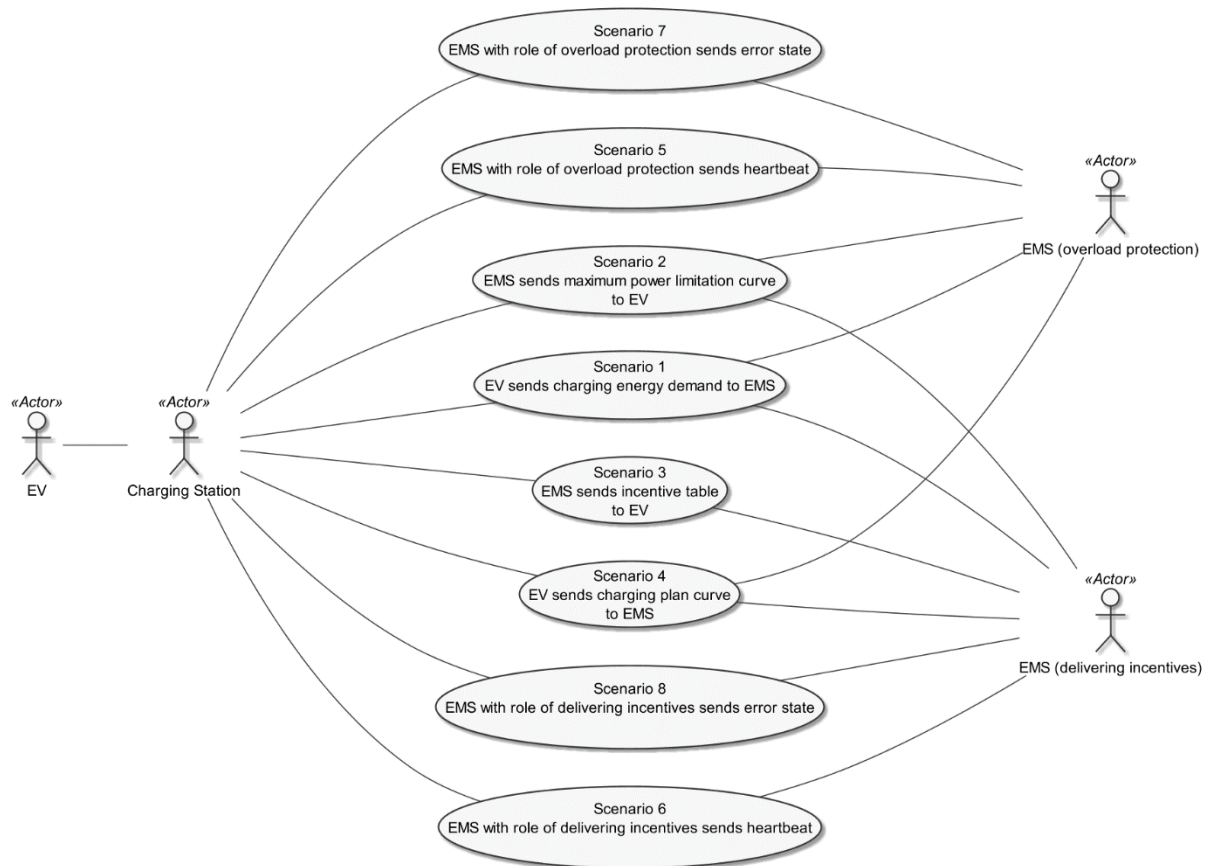


Figure 10 – Coordinated EV Charging – Scenario overview

5.3.3 Scenario support requirements

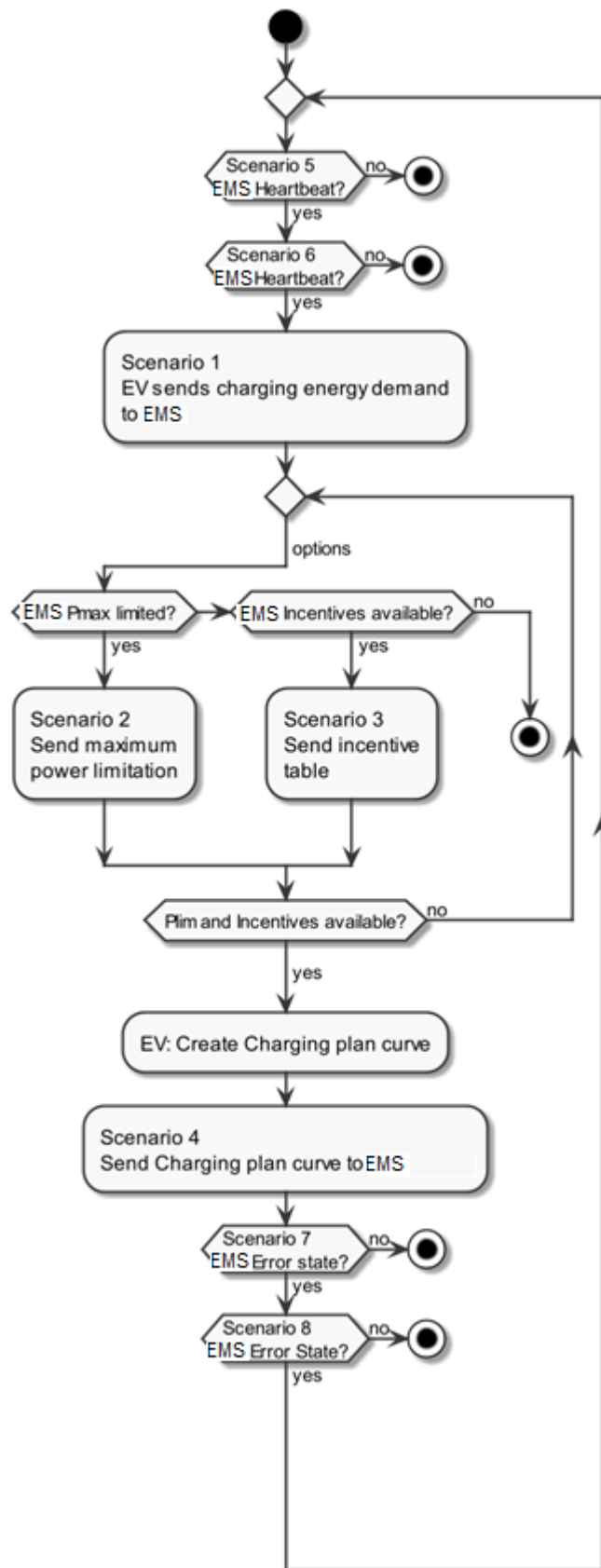
Table 6 – Coordinated EV Charging – Scenario implementation requirements for Actors

Scenario number	Scenario name	EV (through charging station)	EMS with the role of overload protection	EMS with the role of delivering incentives
1	EV via charging station sends charging energy demand to EMS	R	M	M
2	EMS sends maximum power limitation curve to EV	M	M	O
3	EMS sends incentive table to EV	M	-	M
4	EV via charging station sends charging plan curve to EMS	M	M	M
5	EMS with the role of overload protection send heartbeat	M	M	-
6	EMS with the role of delivering incentives send heartbeat	M	-	M

Scenario number	Scenario name	EV (through charging station)	EMS with the role of overload protection	EMS with the role of delivering incentives
7	EMS with the role of overload protection sends error state	M	M	-
8	EMS with the role of delivering incentives sends error state	M	-	M

952

953 The order in which the Scenarios occur is defined by triggering events specified in the Scenarios. For
954 some Scenarios data of other Scenarios is relevant, while other Scenarios can run in parallel.

955 **5.3.4 Scenario flow**956 **Figure 11 – Coordinated EV Charging – Scenario flow**

5.3.5 Scenario details

5.3.5.1 Scenario 1 - EV via charging station sends charging energy demand to EMS

5.3.5.1.1 Description

The EV via the charging station demands energy to charge the car of the customer. Within the demand the EV may specify an arrival time, a departure time, the minimum energy required $E_{\min}$, the recommended energy E_{opt} and the uncharged energy capacity $E_{\max}$ of the EV. The Scenario itself and all communicated values are optional and can depend on the implementation of the EV as well as the driver settings. Of course, at least one value should be communicated, though it is recommended to deliver as much information as possible to the EMS with the role of delivering incentives to achieve optimal energy management results.

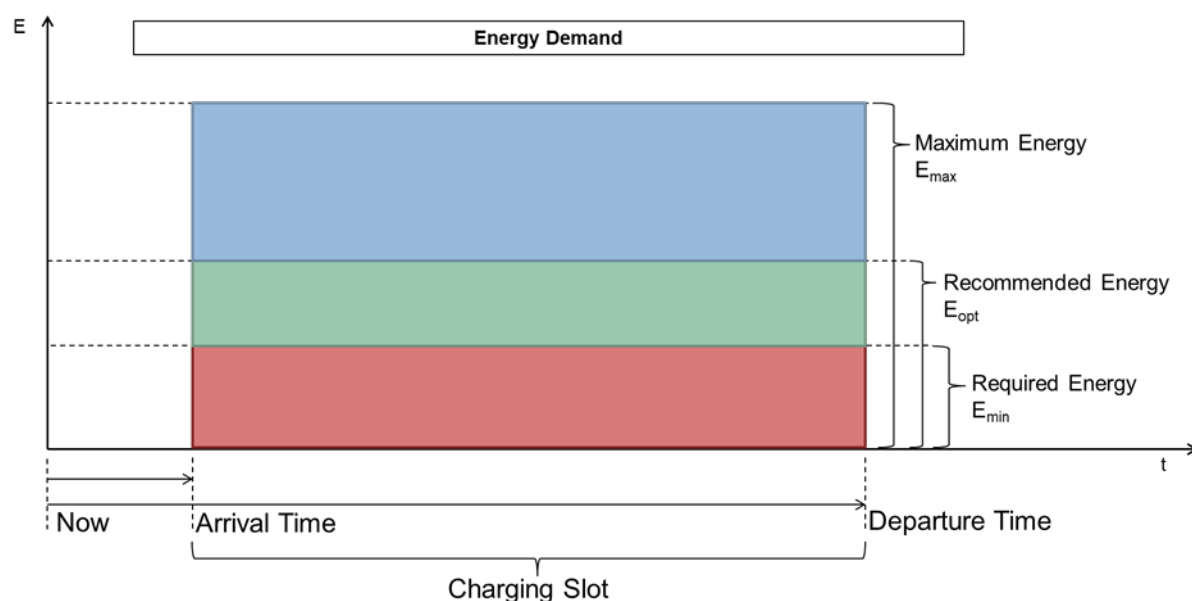


Figure 12 – Energy demand example

E.g., $E_{\min}$ could be set to an energy level sufficient to reach the next hospital, E_{opt} could be set to an energy level to reach the workplace and $E_{\max}$ should be set to the remaining battery capacity of the EV. $E_{\max}$ is especially valuable when e.g., a lot of costless PV surplus energy (energy above a certain curtailment factor) is available. In such a case the EV can be charged for free.

5.3.5.1.2 Conditions

Triggering Event:

The Scenario shall be triggered by connecting the EV to the charging station and the EV wants to charge. The Scenario may also be triggered later during the charging process if the charging demand changes. In this case the EV should also trigger Scenario 2 and 3 after the demand was updated.

Pre-condition:

The EMS do not know the current energy demand, arrival time and departure time of the EV.

Post-condition:

The EMS know the energy demand, arrival time and departure time of the EV that shall be used in the calculation of the maximum power limitation curve and incentive table later on, when triggered. After sending the energy demand, the EV shall request an update of Scenario 2 and 3.

5.3.5.2 Scenario 2 – EMS sends maximum power limitation curve to EV

5.3.5.2.1 Description

The EMS with the role of overload protection sends a maximum charging power limitation ($P_{\max}$) curve that serves as limit for the charging process. The EV charging consumption shall not surpass the maximum charging power limitation ($P_{\max}$) curve.

If a departure time was transmitted within Scenario 1, the EMS shall deliver a maximum power limitation curve that spans at least until the departure time. If the energy provided in the maximum charging power limitation ($P_{\max}$) curve is not high enough to fulfil the demand of the EV (also taking into account the maximum charge power of the EV, transmitted in the Use Case "EV Commissioning and Configuration"), the EMS shall deliver a longer maximum charging power limitation ($P_{\max}$) curve that may exceed the departure time but is able to fulfil the energy demand of the EV. If no departure time was delivered in Scenario 1, the EMS shall deliver a maximum charging power limitation curve for at least the next 48 hours.

The maximum charging power limitation ($P_{\max}$) curve should not be longer than 7 days (168h), also if the departure time is bigger than 168h. A maximum charging power limitation ($P_{\max}$) curve that covers a long time period may use a higher time resolution in the near future and a lower time resolution in the farer future. As soon as the time moves closer to the part of the curve with the lower time resolution, the curve should be updated.

In general, the maximum charging power limitation ($P_{\max}$) curve shall choose a time resolution that allows to express all considerable changes of $P_{\max}$.

E.g., if $P_{\max}$ does not change over the complete time span of the maximum charging power limitation ($P_{\max}$) curve, only a single time slot is needed.

Note: The charging station can request more than one $P_{\max}$ curve from the EMS.

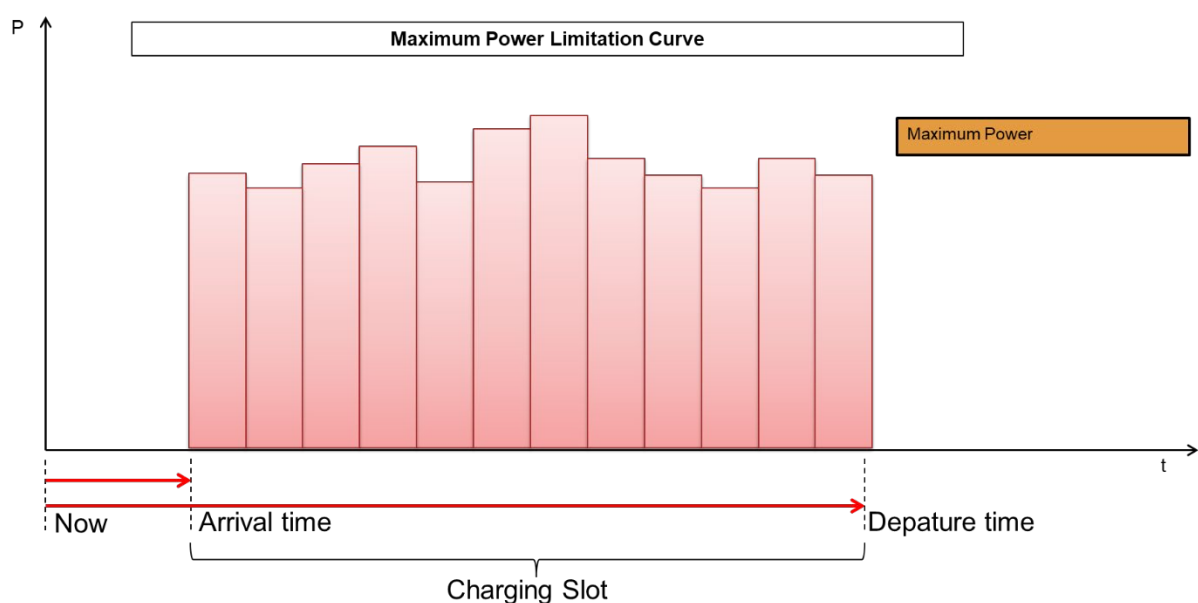


Figure 13 – Maximum power limitation curve example

5.3.5.2.2 Conditions**Triggering Event:**

The Scenario is triggered when the EV requests an update. The EV via the charging station shall request an update of the maximum charging power limitation ($P_{\max}$) curve after the EV has transmitted or updated its demand in Scenario 1. This means the EV has to ensure that the updated demand was received by the EMS before an update of the maximum charging power limitation ($P_{\max}$) curve is requested in this case. The EV via the charging station may also request an update without transmitting a demand. This Scenario may also be triggered by the EMS, e.g., if the maximum power limitation ($P_{\max}$) changes in critical ways, that may result in a changed charging plan of an EV. In this case the EMS shall send an update of the maximum power limitation ($P_{\max}$) curve to the corresponding EV, to trigger a new calculation of the charging plan.

After the EV has requested an update, the EMS with the role of overload protection shall send a maximum power limitation ($P_{\max}$) curve within 55 s, but ideally within 15 s. Otherwise, the EV may run into a timeout and the EV may start charging with initial parameters.

Pre-condition:

The EV has no current information on a maximum power limitation ($P_{\max}$) curve yet or the EV has no maximum power limitation ($P_{\max}$) curve for a changed demand and cannot adjust its charging plan accordingly.

Post-condition:

The EV knows the maximum power limitation curve and can adjust its charging plan accordingly.

5.3.5.3 Scenario 3 - EMS sends incentive table to EV**5.3.5.3.1 Description**

The EMS sends a table with incentives to the EV via the charging station that allows to create a cost optimized charging plan. The incentive table communicates up to 3 different power levels (tiers) over time. For each power level the EMS may communicate 3 different incentives over time:

- Price (either relative or absolute)
- Renewable energy percentage
- CO₂ emission

All power levels shall include the same combination of incentives. E.g., if a power level has a price incentive with a certain currency, the price incentive shall be used with the same currency for all power levels within the incentive table.

For each power level the EMS may include human readable descriptions. The human readable description can be freely chosen by the EMS or its user. The main goal is to enable the charging station to show and calculate the energy mix of a charging plan to a user. For this the human readable description should describe which producers are used in each power level. E.g., a simple description like "Grid" or "PV", or a more detailed description like "PV South Roof" or "Surplus 50% PV Roof 1 + 50% PV Roof 2" is feasible.

As the human readable strings may also be used by the charging station to allow a user to filter which power levels of an incentive table are preferred, the human readable description should not contain producers that do not belong to the corresponding power level like "Not PV Roof 2".

As the value range of the human readable data is not standardized in any way, the meaning of the human readable data should only be interpreted by human interaction and not by a device on itself.

If a departure time was transmitted within Scenario 1, the EMS shall deliver an incentive table that spans at least until the departure time. The EMS may wait until the maximum power limitation curve from the EMS (with the role of overload protection) is known and adjust the time span of the incentive table accordingly, if the maximum power limitation defines a timespan that exceeds the departure time.

If no departure time was delivered in Scenario 1, the EMS shall deliver an incentive table for at least the next 48 hours.

An incentive table should not be longer than 7 days (168h), even if the departure time is bigger than 168h. An incentive table that covers a longer time period may use a higher time resolution in the near future and a lower time resolution in the farer future. As soon as the time moves closer to the part of the incentive table with the lower time resolution, the incentive table should be updated.

In general, the incentive table shall have a time resolution that allows to express all considerable changes in the power levels. E.g., if the power levels and incentives do not change over the time span of the incentive table, only a single time slot is needed.

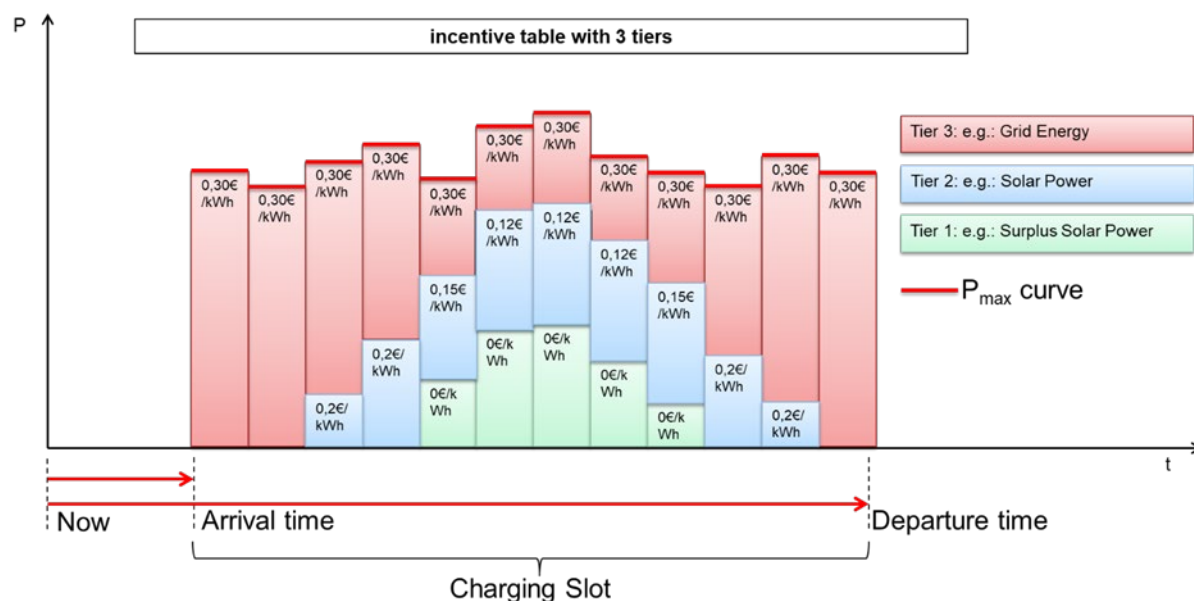


Figure 14 – Incentive table example with consideration of the P_{max} curve from Scenario 2

Each power level defines its supply (difference between a power level and the next higher power level) that can be consumed for the incentive(s) (e.g., price) given by the power level. The power levels within the incentive table shall provide a realistic picture of the physical installation (e.g., PV power is consumed before power from the grid can be consumed). This means the power of the lowest power level will be consumed first before the power of the next higher power level can be consumed. Even if the power of a higher power level may be cheaper, physically it is not possible to consume that cheap power without consuming the power of the lower power level first. Only if physically possible the power levels can be ordered after price.

The following figure and examples show how the supply of each power level can be consumed and how the incentives are applied.

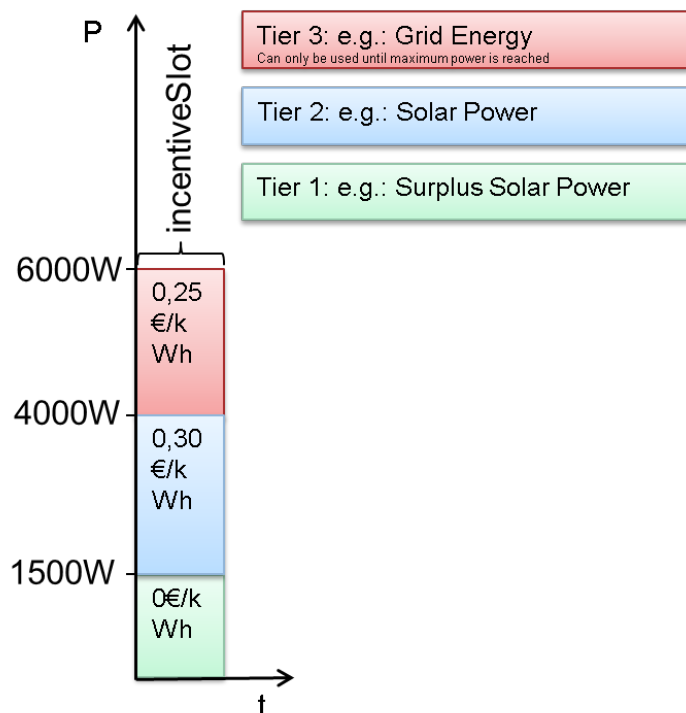


Figure 15 – Incentive Table example (single incentive slot) for different tiers

Example 1: If the actual power value is 5000 W:

- 1500 W are for free
- 2500 W cost 0,30 €/kWh
- and the last 1000W cost 0,25 €/kWh.

Example 2: If the actual power value is 1000 W:

- Only the lowest tier is used
- the 1000 W are for free.

Example 3: If the actual power value is 2000 W:

- 1500 W are for free
- and the last 500 W cost 0,30 €/kWh.

Note: Negative prices or incentives may be used if feasible. Negative power values are not relevant in this Use Case, as this Use Case only covers the EV charging consumption and not bi-directional charging or similar cases.

5.3.5.3.2 Conditions

Triggering Event:

The EV via the charging station shall request an update of the incentive table after the EV has transmitted or updated its demand in Scenario 1. This means the EV via the charging station has to ensure that the updated demand was received by the EMS before an update of the incentive table curve is requested in this case.

The EV via the charging station may also request an update without transmitting a demand, e.g., during charging to look for better power conditions.

This Scenario may also be triggered if the incentive table had changes in ways that would affect the charging costs of a charging plan of a certain EV. In this case the EMS shall send an update of the incentive table to the corresponding EV to trigger a new calculation of the charging plan.

1111 After the Scenario is triggered, the EMS shall send an incentive table within 55 s, but ideally
 1112 within 15 s. Otherwise, the EV may run into a timeout and the EV may start charging with initial
 1113 parameters.

1114 **Pre-condition:**

1115 The EV does not know the current incentive table and cannot create a cost optimized charging
 1116 plan.

1117 **Post-condition:**

1118 The EV knows the incentive table and can create a cost optimized charging plan.

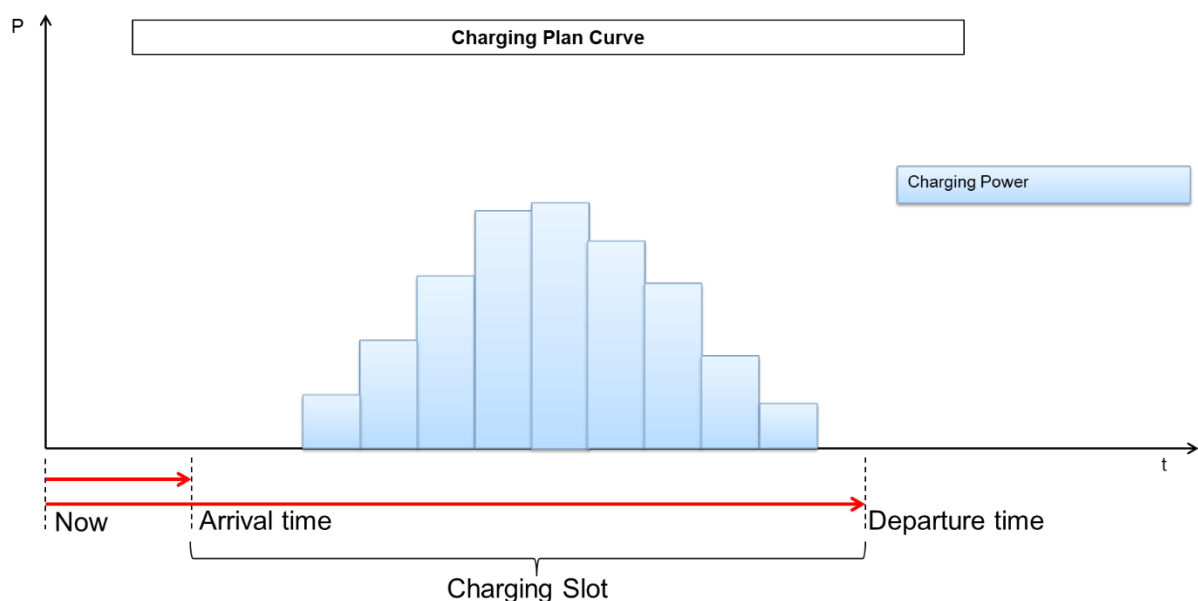
1119 **5.3.5.4 Scenario 4 - EV via charging station sends charging plan curve to EMS**

1120 **5.3.5.4.1 Description**

1121 If the EV has received the maximum power limitation curve and the incentive table via the
 1122 charging station, the EV can create a cost optimized charging plan to reach its charging demand.
 1123 The charging plan shall be a simple power curve, that communicates the planned charging
 1124 power over time. A minimum ($P_{\min}$) and expected charging power (P_{opt}) may be included into
 1125 the charging power curve. A maximum power ($P_{\max}$) shall always be set in the charging power
 1126 curve to allow the EMS and the EMS to calculate with the worst-case charging consumption of
 1127 the EV. The charging plan is then transmitted to the EMS and the EMS, so they can reserve the
 1128 necessary charging power for the EV. The EV shall charge according to its plan within its
 1129 reported minimum ($P_{\min}$) and maximum ($P_{\max}$) power.

1130 The charging plan represents all power needed by the EV. This includes charging the battery
 1131 and other loads of the EV, e.g., climatization and conditioning.

1132 Note: The EV chooses the best available power slots for its charging plan depending on its charging strategy. E.g.,
 1133 if the goal of the EV is to charge for the cheapest price, the EV will choose the power slots with the cheapest price.



1134
 1135 **Figure 16 – Charging plan curve example**

1136 **5.3.5.4.2 Conditions**

1137 **Triggering Event:**

1138 The Scenario shall initially be triggered by Scenario 2. An EV should wait until it has also
1139 received the incentive table via Scenario 3 or until the timeouts in Scenarios 2 or 3 occur, before
1140 it starts with the charging plan calculation, to avoid unnecessary re-calculation of the charging
1141 plan.

1142 If Scenarios 2 or 3 are used later on to send updates of either the incentive table or the
1143 maximum power limitation curve, this shall also trigger Scenario 4 to adjust the charging plan
1144 accordingly. If Scenario 2 or 3 sends an update, the EV should wait at least a short period (e.g.,
1145 5 s) of time, whether there is also an update provided from the other Scenario before charging
1146 plan calculation starts, to avoid unnecessary re-calculation of the charging plan. However, it is
1147 also possible that only one Scenario sends an update, in this case the EV just uses the old
1148 information of the other Scenario.

1149 After the Scenario is triggered, the EV shall send the charging plan within 55 s, but ideally within
1150 15 s.

1151 ***Pre-condition:***

1152 The charging plan is not known to the EMS. Therefore, the power used for charging cannot be
1153 reserved for the EV and it cannot be ensured that the needed power is available when the EV
1154 is planned to charge.

1155 ***Post-condition:***

1156 The charging plan is known to the EMS, so they can reserve the necessary charging power for
1157 the EV.

1158 **5.3.5.5 Scenario 5 - EMS with the role of overload protection send heartbeat**

1159 **5.3.5.5.1 Description**

1160 The EMS shall send a regular heartbeat signal, at least each 60 s, which allows to detect
1161 whether the EMS is available. In case of a heartbeat timeout, updates from the EMS may no
1162 longer be received. Therefore, the EV via the charging station should consider that the data
1163 from the EMS may no longer be up to date.

1164 **5.3.5.5.2 Conditions**

1165 ***Triggering Event:***

1166 The Scenario shall be triggered as soon as the EV is connected to the EMS via the charging
1167 station.

1168 ***Pre-condition:***

1169 The EV does not know if the EMS is currently available.

1170 ***Post-condition:***

1171 The EV does know if the EMS is currently available or not and can react as specified.

1172 **5.3.5.6 Scenario 6 – EMS with the role of delivering incentives send heartbeat**

1173 **5.3.5.6.1 Description**

1174 The EMS shall send a regular heartbeat signal, at least each 60 s, which allows to detect
1175 whether the EMS is available. In case of a heartbeat timeout, updates from the EMS may no

1176 longer be received. Therefore, the EV via the charging station should consider that the data
1177 from the EMS may no longer be up to date.

1178 **5.3.5.6.2 Conditions**

1179 ***Triggering Event:***

1180 The Scenario shall be triggered as soon as the EV is connected to the EMS via the charging
1181 station.

1182 ***Pre-condition:***

1183 The EV does not know if the EMS is currently available.

1184 ***Post-condition:***

1185 The EV does know if the EMS is currently available or not and can react as specified.

1186 **5.3.5.7 Scenario 7 - EMS with the role of overload protection sends error state**

1187 **5.3.5.7.1 Description**

1188 The EMS shall indicate errors, e.g., communication lost, so the EV via the charging station can
1189 visualize this to the user. If the EMS has an error, updates from the EMS may no longer contain
1190 valid data and the EMS may no longer be able to reserve the charging power for the EV correctly.

1191 Note: The definition of errors is out of scope of this document.

1192 **5.3.5.7.2 Conditions**

1193 ***Triggering Event:***

1194 The Scenario shall be triggered as soon as the EMS has an error, e.g., communication lost.

1195 ***Pre-condition:***

1196 The EV via the charging station does not know if the EMS has an error.

1197 ***Post-condition:***

1198 The EV does know if the EMS has an error and can react as specified.

1199 **5.3.5.8 Scenario 8 - EMS with the role of delivering incentives sends error state**

1200 **5.3.5.8.1 Description**

1201 The EMS shall indicate errors, e.g., communication lost, so the EV via the charging station can
1202 visualize this to the user. If the EMS has an error, updates from the EMS may no longer contain
1203 valid data and the EMS may no longer be able to reserve the charging power for the EV correctly.

1204 Note: The definition of errors is out of scope of this document.

1205 **5.3.5.8.2 Conditions**

1206 ***Triggering Event:***

1207 The Scenario shall be triggered as soon as the EMS has an error, e.g., communication lost.

Pre-condition:

The EV via the charging station does not know if the EMS has an error.

Post-condition:

The EV via the charging station does know if the EMS has an error and can react as specified.

5.3.6 Scenarios and Use Case Functions

For each scenario, the "primary" Use Case functions are given.

Table 7 – Coordinated EV Charging – Scenarios and primary Use Case Functions (UCFs)

Scenario		Primary Use Case functions
1	EV via charging station sends charging energy demand to EMS	UCF_Consumption_Curve
2	EMS sends maximum power limitation curve to EV	UCF_Maximum_Power_Limitation_Curve
3	EMS sends incentive table to EV	UCF_Incentive_Table
4	EV via charging station sends charging plan curve to EMS	UCF_Consumption_Curve
5	EMS with the role of overload protection send heartbeat	UCF_Heartbeat
6	EMS with the role of delivering incentives send heartbeat	UCF_Heartbeat
7	EMS with the role of overload protection sends error state	UCF_Device_State
8	EMS with the role of delivering incentives sends error state	UCF_Device_State

5.3.7 Dependencies to other Use Cases**5.3.7.1 "EV Commissioning and Configuration"****5.3.7.1.1 "Scenario 1 - EV connected"**

If this Use Case relates to connecting the EV to the charging station the referenced Scenario is meant. Therefore, this Scenario shall be supported by the Actors charging station, and EMS.

5.3.7.1.2 "Scenario 6 - EV via charging station sends charging power limits"

The Actor EMS can use the EV charging power limits during calculations for Scenario 2 and 3 of this Use Case. Therefore, the referenced Scenario should be supported by the Actor charging station and shall be supported by the Actor EMS.

5.3.7.1.3 "Scenario 7 - EV sleep mode"

If the Actor charging station is in sleep mode, the EV will not charge. To reduce the EV wake up cycles to a minimum, the EMS shall only send updates in case of significant changes. Therefore, the referenced Scenario shall be supported by the Actor charging station if it supports a sleep mode, and the Scenario shall be supported by the Actor EMS.

5.3.7.1.4 "Scenario 8 - EV disconnected"

If the EV gets disconnected the EV will no longer be charged. The EV can be removed from the power management calculations of the Actor EMS. Therefore, the referenced Scenario shall be supported by the Actor charging station and it shall be supported by the Actor EMS.

5.3.7.2 "EV Charging Electricity Measurement"

At least Scenario 1 or Scenario 2 or Scenario 3 of the Use Case "EV Charging Electricity Measurement" should be supported, otherwise the EMS cannot evaluate the progress of the charging process and divergences from the charging plan. This may be especially helpful in case PWM communication is used between EV and charging station. If the EV charges with less power than reserved by the EMS for the EV, this can lower the efficient use of power for all consumers within the installation.

5.3.7.3 "Overload Protection by EV Charging Current Curtailment"

Even if a power limitation curve is provided within this Use Case, the currents provided in the Use Case "Overload Protection by EV Charging Current Curtailment" are more significant especially in case of asymmetric charging with phase specific currents. In any case, the EV via the charging station shall neither consume more than the power limitation value provided by the "Overload Protection by EV Charging Current Curtailment" Use Case nor the power limitation curve provided by this Use Case.

5.3.8 Additional Information

None.

5.4 EV Charging Electricity Measurement

5.4.1 Introduction

This Use Case aims to continuously monitor the electricity that is consumed by the EV during charging to evaluate the charging process of the EV and react accordingly. The support of this Use Case may be valuable or necessary also in combination with other Use Cases, e.g., "Overload Protection by EV Charging Current Curtailment", "EV Charging Summary" or "Coordinated EV Charging". If a charging plan was negotiated based on the EV's demand, the EMS can evaluate how close the EV follows the charging plan and if the EV will be able to charge its demand until the scheduled departure time. The EMS may also present the measurement values to the customer, so the customer himself can evaluate the charging process.

To allow the EMS to calculate how much electricity is consumed during charging, the EV needs to deliver a measurement of the charging power, current or energy via the charging station. The EMS shall be able to use all 3 values within its calculation, e.g., for calculation of a new charging current value for overload protection. However, if asymmetric charging is supported, phase specific power or current measurements are needed. In general, it is recommended to support the measurement of the charging current. The current or power drawn by the EV consists of the current or power that is used for battery charging, for pre-conditioning of the EV (heating or cooling) and for the auxiliary consumers during charging.

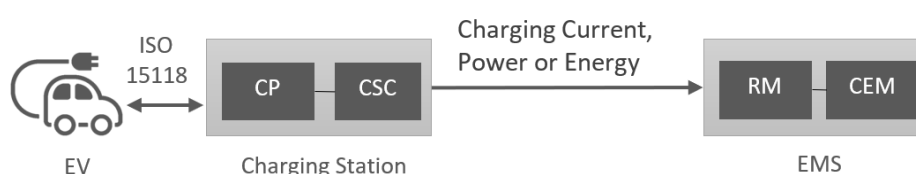
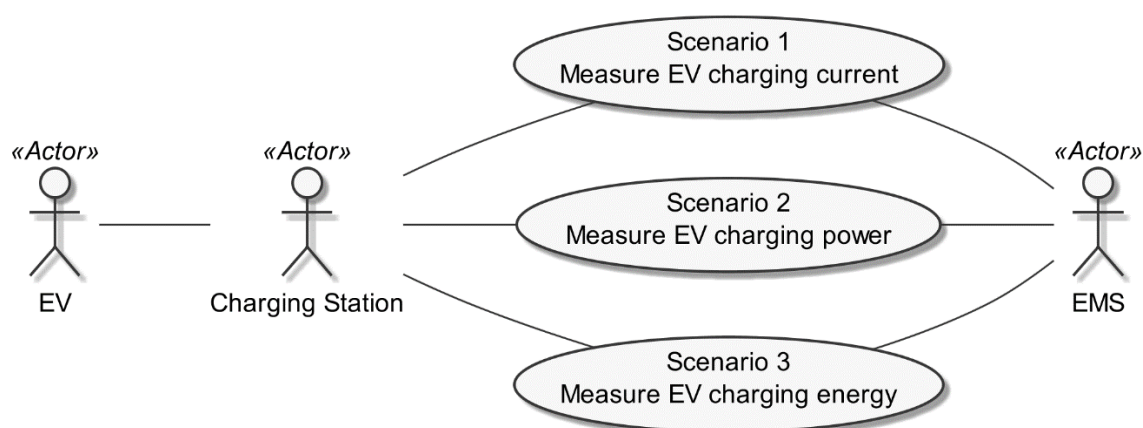


Figure 17 – EV Charging Electricity Measurement – High-Level Use Case functionality overview

1272 Note: The overall performance of the Use Cases depends on accuracy and sampling rate of measurement values.

1273 5.4.2 Scenario Overview



1274
1275 **Figure 18 – EV Charging Electricity Measurement – Scenario overview**

1276

1277 5.4.3 Scenario Support Requirements

1278 **Table 8 – EV Charging Electricity Measurement – Scenario implementation requirements**
1279 **for Actors**

Scenario number	Scenario name	EV (through charging station)	EMS
1	Measure EV charging current	R	M
2	Measure EV charging power	O	M
3	Measure EV charged energy	O	M

1280 To prevent disadvantages for other Use Cases that rely on the measurement values of this Use
1281 Case, Scenario 1 should be supported because this delivers the most reliable values. The EV
1282 via the charging station shall support at least one of Scenario 1, 2 or 3, as all 3 scenarios
1283 measure electricity and can be converted into each other. If asymmetric charging is supported,
1284 at least one of scenario 1 and 2 shall be supported as the energy cannot be converted into
1285 phase specific values.

1286 5.4.4 Scenario flow

1287 n/a

1288 5.4.5 Scenario Details

1289 5.4.5.1 Scenario 1 – Measure EV charging current

1290 5.4.5.1.1 Description

1291 The EMS with the role of overload protection monitors the RMS charging current of the EV per
1292 phase as provided by the charging station. Depending on the capabilities of the local grid, the
1293 EV and the charging station, one to three phases are measured.

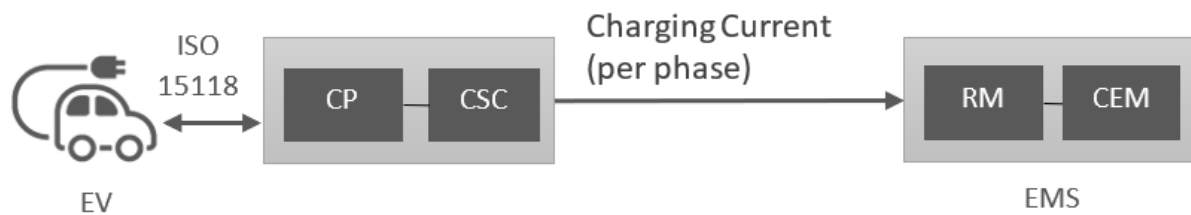


Figure 19 – EV Charging Current overview

5.4.5.1.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the charging station.

Pre-condition:

The EMS does not know how much electricity is consumed by the EV.

Post-condition:

The EMS does know how much electricity is consumed by the EV.

5.4.5.2 Scenario 2 – Measure EV charging power

5.4.5.2.1 Description

The EMS with the role of overload protection monitors the charging power of the EV as provided by the charging station. In case of asymmetric charging there shall be a measurement per phase. Depending on the capabilities of the local grid, the EV and the charging station, one to three phases are measured.

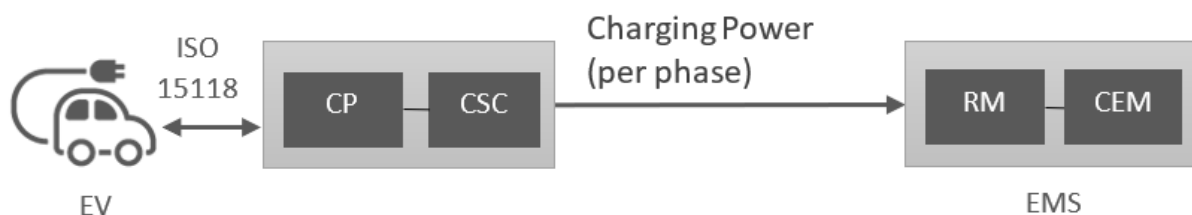


Figure 20 – EV Charging Power overview

5.4.5.2.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the charging station.

Pre-condition:

The EMS does not know how much electricity is consumed by the EV.

Post-condition:

The EMS does know how much electricity is consumed by the EV.

5.4.5.3 Scenario 3 – Measure EV charged energy

5.4.5.3.1 Description

The EMS monitors the energy charged into the EV as provided by the charging station.

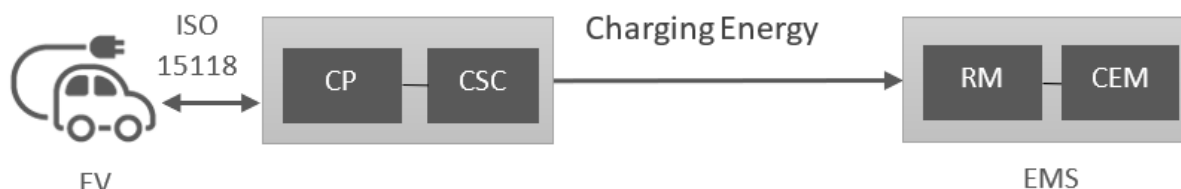


Figure 21 – EV Charged Energy overview

5.4.5.3.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the charging station.

Pre-condition:

The EMS via the charging station does not know how much electricity is consumed by the EV.

Post-condition:

The EMS via the charging station does know how much electricity is consumed by the EV.

5.4.6 Scenarios and Use Case Functions

For each scenario, the "primary" Use Case functions are given.

Table 9 – EV Charging Electricity Measurement – Scenarios and primary Use Case Functions (UCFs)

Scenario		Primary Use Case functions
1	Measure EV charging current	UCF_AC_Measurement
2	Measure EV charging power	
3	Measure EV charged energy	

5.4.7 Dependencies to other Use Cases

The following Scenarios of the Use Case "EV Commissioning and Configuration" are relevant in this Use Case.

5.4.7.1 "EV Commissioning and Configuration"

5.4.7.1.1 "Scenario 1 - EV connected"

If this Use Case relates to connecting the EV to the charging station the referenced Scenario is meant. Therefore, this Scenario shall be supported by the Actors EV and EMS.

5.4.7.1.2 "Scenario 3 - EV via charging station sends support of asymmetric charging"

The Actor EMS shall use the information for calculations for Scenario 1 and 2. This Scenario should be supported by the Actor charging station and this Scenario shall be supported by the Actor EMS.

5.4.8 Additional Information

None.

5.5 EV Charging Summary

5.5.1 Introduction

This Use Case aims to summarize the energy consumption and costs of an electric vehicle's (EV's) charging process. The charging summary allows a customer to evaluate if cost and energy optimization goals are met and may also be used for other purposes, e.g., creating a charging history. However, this information should not be used for billing purposes, as it may contain estimated values.

The EMS with the role of delivering incentives continuously logs the percentage of the energy source of the charged energy as well as the energy costs of the current charging session. During or at the end of charging the charging station can request a charging summary.

The charging summary may be linked to a session ID, retrieved from the charging station, in order to link the summarized energy consumption to a specific session and the session's measurement values retrieved during the session.

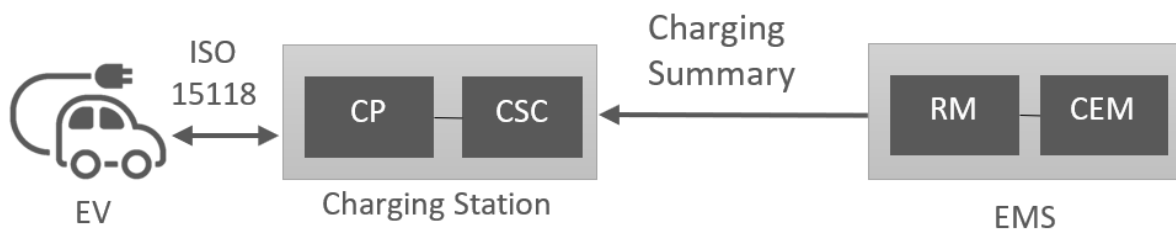


Figure 22 – EV Charging Summary – High-Level Use Case functionality overview

5.5.2 Scenario Overview



Figure 23 – EV Charging Summary – Scenario overview

5.5.3 Scenario Support Requirements

Table 10 – EV Charging Summary – Scenario implementation requirements for Actors

Scenario number	Scenario name	Charging station	EMS
1	EMS sends Charging Session Summary to charging station	M	M

5.5.4 Scenario flow

n/a

5.5.5 Scenario Details

5.5.5.1 Scenario 1 - EMS sends Charging Session Summary to charging station

5.5.5.1.1 Description

The EMS sends a charging summary to the charging station that contains the total costs and amount of the charged energy since the EV was connected to the charging station. The summary also contains the cost and amount of the self-produced energy as well as the cost and amount of the grid energy that was consumed during charging since the EV was connected to the charging station.

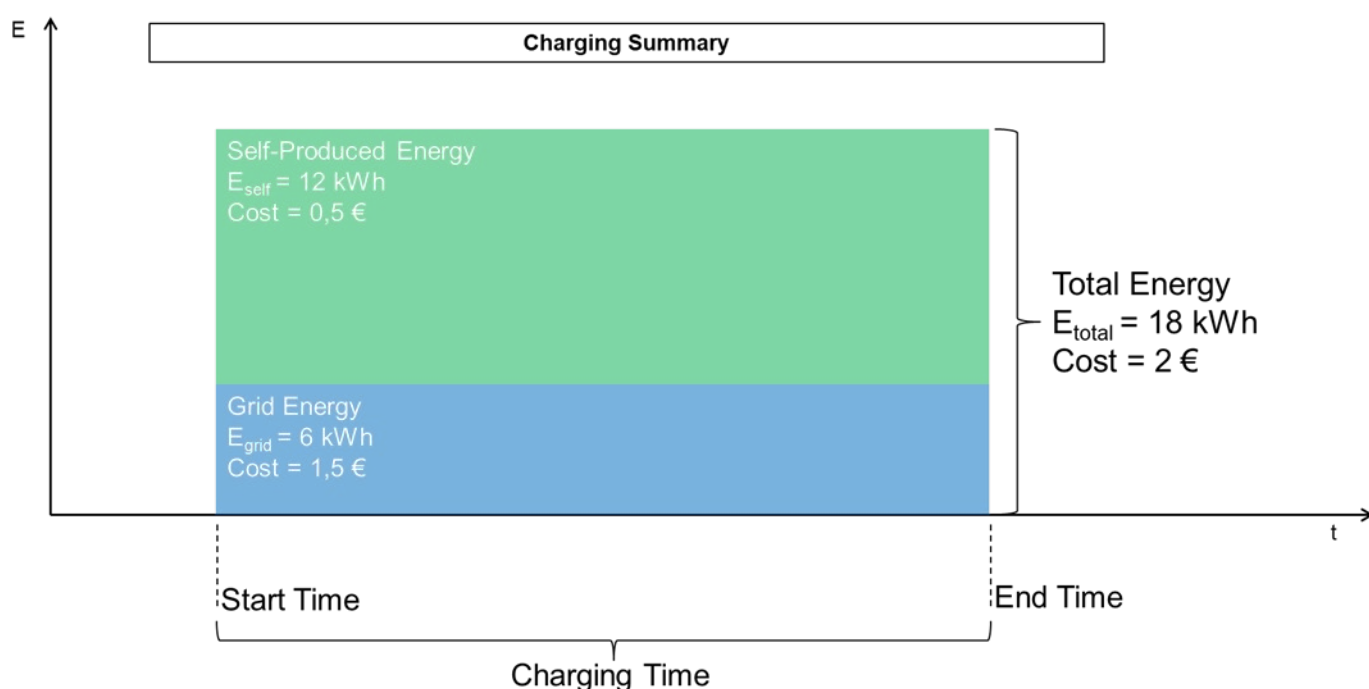


Figure 24 – Charging Session Summary

The EMS shall be able to deliver a charging summary as long as the EV is connected. Additionally, the EMS shall be able to deliver a charging summary even one minute after the EV was disconnected and if no EV was connected meanwhile.

5.5.5.1.2 Conditions

Triggering Event:

If the charging process is finished the charging station requests the charging session summary. The charging station also may already request updates of the charging session summary during charging, e.g., to visualize the charging process.

Pre-condition:

The charging station does not know the charging costs and the energy mix.

Post-condition:

The charging station does know the charging costs and the energy mix.

5.5.6 Scenarios and Use Case Functions

Table 11 – EV Charging Summary – Scenarios and primary Use Case Functions (UCFs)

Scenario		Primary Use Case functions
1	EMS sends Charging Session Summary to charging station	UCF_Session_Summary

5.5.7 Dependencies to other Use Cases

5.5.7.1 "EV Commissioning and Configuration"

The following Scenarios of "EV Commissioning and Configuration" are relevant in this Use Case.

5.5.7.1.1 "Scenario 1 - EV connected"

If this Use Case relates to connecting the EV to the charging station the referenced Scenario is meant. Therefore, this Scenario shall be supported by the Actors charging station and EMS.

5.5.7.1.2 "Scenario 8 - EV disconnected"

If this Use Case relates to disconnecting the EV to the charging station this Scenario is meant. Therefore, this Scenario shall be supported by the charging station and the EMS.

5.5.7.2 "Measurement of Electricity During EV Charging"

At least Scenario 1 or Scenario 2 or Scenario 3 of the Use Case "Measurement of Electricity During EV Charging" shall be supported, otherwise the EMS cannot evaluate how much Energy was charged by the EV, if there are no other means to measure the charging process, e.g., by a sub-meter that measures the electrical consumption of the charging station.

5.5.8 Additional Information

None.

5.6 EV Commissioning and Configuration

5.6.1 Introduction

This Use Case specifies commissioning and configuration processes between the Actor EMS and the Actor charging station (or the electric vehicle via the charging station) as the basis for other Use Cases related to the support of the EV charging process. The Actor charging station transmits the necessary information between the EMS and EV.

