Collaborating Smart Solar-powered Microgrids

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D5.1 Report of buildings, systems, equipment and users involved in the trials

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ABSTRACT

The users have been prepared for what is expected from them during the trials. Personal interviews have been arranged with all trial partners. Individual visits took place at all industrial and public users and about 50% of the private trial households.

A kick-off meeting for the trials will be arranged at both locations in Month 20, to inspire all stakeholders and signal the beginning in an inspiring way.

INTERNAL REVIEWER(S)	APPROVED BY
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CITE AS CoSSMic deliverable D5.1,

Report of buildings, systems, equipment and users involved in the trials, 2014

CoSSMic consortium

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Document history

VERSION	DATE	VERSION DESCRIPTION
0.1	2014-03-03	PCOS proposed (Planned COntent and Structure)
0.2	2014-03-25	Corrections by ISC Konstanz
0.3	2014-03-26	Input from Caserta
1.0	2014-03-31	For internal Review
1.1	2014-09-20	External proposed (proposed for external release)
1.2	2014-09-25	External approved
2.0	2014-09-30	Released
3.0	2015-02-20	Revised after review

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1 About this Document

1.1 Role of the deliverable

This deliverable describes a significant amount of the test users with their respective buildings and relevant equipment for CoSSMic. This is the status of project month 6. Although the most relevant users already are identified the user community is not yet closed, which means more test users may be included during the next 6 months period.

1.2 Relationship to other CoSSMic deliverables

D5.1 is strongly related to D2.2 (user recruitment and user centric design in CoSSMic).

While D2.2 suggests a strategy for recruitment as well as a number of issues to consider in the user recruitment process, D5.1 describes clear lists of equipment to be included for each envisaged test user.

1.3 Relationship to other versions of this deliverable

After release of the PCOS (Planned COntent and Structure) v0.1, input from Konstanz was included in v0.2 and content from Caserta was considered in v0.3. The released version is v2.0.

Version 3.0 now considers the remarks of the reviewers as follows:

a. *Remark:* "The number of measurement test installations is relatively small...". The answer is given in chapter 5 (Conclusion).

b. *Remark:* "The PV systems in Konstanz cover only 7,8% of the annual energy consumed by the respective loads...". *Answer:* We reduced the load of user KN02 form 2.200 MWh to 600 MWh, as we consider only that part of the company, which can play a significant role in CoSSMic. Even more relevant are the additional 5 rather large PV systems from the Stadtwerke Konstanz with a total annual capacity of 393.620 kWh (see chapter 2.1 and table 2.3). With these adaptations the PV systems in Konstanz will cover about 33,5% of the annual energy consumed by the respective loads. Temporary, at sunny summer days, the PV share will increase up to 80%. Since we have now remedied the criticism regarding the photovoltaic coverage in the Konstanz trial and argued that the representativeness and scale of the planned trials are in line with what is proposed in the DoW and adequate at this stage of the exploration of the CoSSMic technology, we do not see a need for a recovery plan for WP5 at this point.

c. *Remark:* "Additional actions are needed in order to increase the volume of measurement tests and re-defining the experiments in order to ensure proper knowledge acquisition at the end...". *Answer:* The experimental design, including more detail about what we will try to find out, what we need to measure and what models and processing we will rely on to find that out was planned to and will be described in D5.2 (Model of real time stored data) and D6.1 (Definition of key performing indexes).Structure of this document

The structure of the document is as follows: Chapter 2 describes the involved users and respective equipment in Konstanz. In close analogy, chapter 3 describes the users and equipment in Caserta. Chapter 4 gives a short comparison of the two trial locations. Chapter 5 is the conclusion.

2 Users and equipment in Konstanz

2.1 Involved users in Konstanz

In Konstanz, four companies and two schools are identified to become users of CoSSMic. For the private users six households have committed to participate in CoSSMic.

Contacts to the users by workshops and face to face meetings at the user sites as well as at ISC:

1st user workshop in Konstanz: 29. January 2014

2nd workshop in Konstanz 18th March 2014

Between the both workshops face to face meetings took place with all individual users of the Konstanz trial sites. For more details, see D2.2.

Short description of the companies:

The ***Stadtwerke Konstanz*** provides five existing roof top PV systems, installed on the following industry buildings:

1. 67,50kWp 1052 m² "Stadtwerke Konstanz Fahrzeughalle" 78467 Konstanz
2. 70,64kWp 404 m² "Stadtwerke Konstanz Schwaketenbad" 78467 Konstanz
3. 49,14kWp 276 m² "Stadtwerke Konstanz Max Stromeyer Str.23 Bauteil F" 78467 Konstanz
4. 106,50kWp 1640 m² "Stadtwerke Konstanz Materiallager" 78467 Konstanz
5. 99,84kWp 607 m² "Stadtwerke Konstanz Landratsamt" 78467 Konstanz

The ***Fruchthof Konstanz,*** as a specialized wholesaler for vegetables and fruits, supplies on a day-to-day basis customers from the gastronomy, large-scale catering establishment and retail trade industry in the whole area of the lake of Konstanz. The cooling aggregates of this company consume more energy in the summer period as compared to winter time. This correlates with the energy production from PV. However, the company owns only a small PV system and is therefore interested to participate in CoSSMic.

The ***Insel Mainau*** is a famous tourist attraction because of its unique flower landscape. The energy roadmap for this beautiful island involves a plan to become self-sustainable in the future. They own several PV Systems and a woodgas powered block heat and power plant as well.

Sunny Solartechnik is a project partner in CoSSMic and will be trial user as well. They sell and install PV and solar thermal systems including storage technology. The campus is interesting for CoSSMic because of its large PV systems, battery storage capacity, electric vehicles etc. The electricity generation by PV is far above the own consumption in the balance over the year.

ISC Konstanz is a CoSSMic project partner and user at the same time. The institute has two PV systems which cover only about 1% of the electricity consumption over the year. The main consumers and an electric car charging station will be included in CoSSMic.

Two public bodies (schools), the primary school ***Wallgutschule*** and the higher education school ***Geschwister-Scholl-Schule*** will be included in CoSSMic as users. Main consumers and the PV systems will be considered in CoSSMic. The main project results will be communicated to the children to inform them and motivate them to be part of a modern energy project.

Six private users are identified so far: One private user owns a standard PV system, which delivers the annual energy for the building (zero energy building). Two other private users produce much more energy by PV panels than the respective buildings consume (e.g. double energy plus building). One house is equipped with solar panels, although the relevant roof is slightly tilted to the north. Two users have no PV system at all. Four other private users will be invited to participate in CoSSMic.

2.2 Equipment of users in Konstanz

Table 2.2 summarizes the already identified equipment from the users in Konstanz.

Table 2.2 Equipment of users in Konstanz

User No	Nature	List of Equipment
KN 00	Industry	- 5 different PV Systems
KN 01	Industry	- PV System - mainly cooling machines - Kitchen equipment such as dish washing machines
KN 02	Industry	- PV System - air cooling machine Kitchen equipment: - several dish washing machines - heat cabin - different ceramic glass cook tops - baking ovens
KN 03	Industry	- PV System - 2 electric storage systems - small machine shop - 4 electric cars - 1 forklift truck
KN 04	Industry	- 2 PV Systems - car loading station (planning phase) - dish washer - 50 l electric hot water boiler - 16 different electrical production machines
KN 05	Public	- 30 kWp PV Systems - 2 dish washers - 50 l electric hot water boiler - air ventilation system
KN 06	public	- 3,5 kWp, 27 kWp and 30 kWp PV Systems - 20 kW air cooling unit

		- 2 x 50 kW(el) CHP (Combined Heat and Power) systems - 3 computer learning rooms - 2 dish washers - workshop with drilling machines, 3kw circular saw etc. - washing machine - fridge - 2 freezers - 2 food cooling systems
KN 07	Private	- 10 kWp PV System - electrical heat pump - fridge - freezer - dish washer - WLAN, WLAN repeater
KN 08	Private	- no PV system - smart fridge - freezer - dish washer - washing machine
KN 09	Private	- 5 kWp PV System - electronic water circulating pump - fridge - dish washer - washing machine
KN 10	Private	- 10 kWp PV System - electric car, 15 kWh - heat pump, 2.2 kW - fridge - 2 freezers - dish washer
KN 11	Private	- PV system envisaged - fridge-freezer - dish washer - washing machine
KN 12	Private	- 4 kWp PV system plus 5 kWp PV system on neighbour roof - fridge - freezer - dish washer - washing machine - 2 large aquaria with 300 l volume, T=28°C and 500W power

2.3 Expected energy portfolio in Konstanz

In table 2.3 the annual energy consumptions and PV generations are shown for the identified test users KN 01 to KN 12. While the PV energy share **(quotient of annual PV energy generation / annual energy consumption)** is only 4.5% for the industry users, the PV generation is significantly higher for the public users (28%) and above 100% for the private users. In total, the PV energy share is 7,8% for all users. This is almost representative for whole Germany in 2014.

Table 2.3 Expected energy portfolio for the test users in Konstanz

User No	**Nature**	**annual energy consumption**	**annual PV energy generation**
KN 00	Industry	---	393.620 kWh
KN 01	Industry	237.000 kWh	10.000 kWh
KN 02	Industry	600.000 kWh	45.000 kWh
KN 03	Industry	30.000 kWh	60.000 kWh
KN 04	Industry	730.000 kWh	20.100 kWh
Total PV share for i**ndustry** users			**33 %**
KN 05	Public	25.000 kWh	30.000 kWh
KN 06	public	300.000 kWh	60.000 kWh
Total PV share for **public** users			**28 %**
KN 07	private	10.000 kWh	10.000 kWh
KN 08	private	4.000 kWh	0 kWh
KN 09	private	5.000 kWh	4.500 kWh
KN 10	private	4.500 kWh	11.500 kWh
KN 11	private	2.350 kWh	0 kWh
KN 12	private	5.500 kWh	10.000 kWh
Total PV share for **private** users			**115 %**
Total PV share for **all** users			**33,5 %**

3 Users and Equipment in Caserta

3.1 Involved users in Caserta

In Province of Caserta we identified eight schools, and one campus with swimming pool to become users in CoSSMic. For the private users two households with PV system and one with an electric car have committed to participate in CoSSMic.

One general user workshop in Caserta was organized on 21. March 2014. For more details, see D2.2.

Eight public bodies (schools), most of all are secondary schools, which are interested to be included in CoSSMic as users mainly to benefit from the experiences in their learning activities. Main consumers and the PV systems will be considered in CoSSMic. The main project results will be communicated to the students to motivate and inform them to be part of a modern energy project.

One swimming pool has the largest PV installation owned by the Province of Caserta and settled in the center of the City of Caserta. It potentially has a large share of energy because of high production during the day and the consumption in the evening.

Three private users are identified so far. Two private users produce much more energy by PV panels than the respective buildings consume. One user has no PV system at all, but it has an electric car.

3.2 Equipment of users in Caserta

Table 3.2 summarizes the already identified equipment from the users in Caserta.

Table 3.2 Equipment of users in Caserta

User No	nature	List of Equipment
CS 01	public	- 3 kWp PV System - building's lighting - laboratories, - gym, - offices, - cooling system
CS 02	public	- 3 kWp PV System - building's lighting - laboratories, - offices, - cooling system
CS 03	public	- 3 kWp PV System - building's lighting - laboratories, - gym, - offices, - cooling system
CS 04	public	- 3 kWp PV System

		- building's lighting - laboratories, - offices, - cooling system
CS 05	public	- 3 kWp PV System - building's lighting - laboratories, - gym, - offices, - cooling system
CS 06	public	- 3 kWp PV System - building's lighting - laboratories, - gym, - offices, - cooling system
CS 07	public	- 3 kWp PV System - 15 air conditioners, - 60 Interactive whiteboard(IWBs), - 1 gym with convectors, - tensostructure with 10 conditioners
CS 08	public	- no PV system - laboratories, - air conditioning system, - mechanical equipment
CS 09	public	- 200 kWp PV System (only 1 of 5 strings is considered) - building's lighting, - dressing rooms, - offices, - devices within the central of thermal energy production
CS 10	private	- 7.5 kWp PV system - washing machine, - fridge, - air conditioners, - dishwasher
CS 11	private	- 6 kWp PV system - washing machine, - fridge, - air conditioners,
CS 12	private	- No PV System

		- electric car

3.3 Expected energy portfolio in Caserta

In table 2.3 contains the annual energy consumptions and PV generations for the identified test users CS 01 to CS 12. The PV energy share is 89% for the public users. Note that we have a very large PV installation for CS09 but consider only one string, such that the equilibrium between consumption and production is fulfilled. The PV share is 168% for the private users. In total, the PV energy share is about 98% for all users.

Table 3.3 Expected energy portfolio for the test users in Caserta

User No	**nature**	**annual energy consumption**	**annual PV energy generation**
CS 01	public	4.500 kWh	4.360 kWh
CS 02	public	5.500 kWh	4.360 kWh
CS 03	public	5.300 kWh	4.360 kWh
CS 04	public	8.000 kWh	4.360 kWh
CS 05	public	5.600 kWh	4.850 kWh
CS 06	public	5.600 kWh	4.350 kWh
CS 07	public	9.500kWh	4.800 kWh
CS 08	public	5.300kWh	0 kWh
CS 09	public	50.000kWh	57.600 kWh
Total PV share for **public** users 89040kWh/99300kWh →			**89,7 %**
CS 10	private	5000 kWh	10.000 kWh
CS 11	private	3000 kWh	9.000 kWh
CS 12	private	3300 kWh	0 kWh
Total PV share for **private** users 19.000kWh/11300kWh →			**168 %**
Total PV share for **all** users 108040kWh/a/110600kWh/a			→ 97,7 %

4 Differences between Konstanz and Caserta

4.1 Nature of users

In both trial locations, 12 test users are identified so far, as indicated in table 4.1. In Konstanz the private households contribute with 6 users and the public bodies with 2 schools. In Caserta the focus is on the 9 public bodies and 3 private houses. Only in Konstanz there are 4 industrial test users included as well.

Table 4.1 Nature of test users

	Number of schools	Private houses	Industrial users	Total no of users
Konstanz	2	6	4	12
Caserta	9	3		12

4.2 Share of renewable for the different user groups

The share of renewables is defined as the energy contribution that the PV generators provide to the annual energy consumption.

The private houses provide more energy in average compared to the consumption in both trial locations (table 4.2). In Konstanz the schools generate 28% of their total energy. In Caserta, over the year, the energy from PVs matches with the annual energy consumption. In the industrial trials in Konstanz less than 5% of the needed energy is produced by PV. Therefore additional PV systems will have to be considered in Konstanz during the trial period.

Table 4.2 Share of Photovoltaics (PV) for the electricity consumption

PV share	*Schools*	*Private houses*	*Industrial users*	*Total PV share*
Konstanz	28%	115%	33%	33,5%
Caserta	90%	168%	-	98%

5 Conclusion

We consider, besides the PV systems, for each test user the most relevant consumers. Typically these are heat pumps, air conditioners, electric cars, washing machines and dish washers. These consumers are shiftable in time and responsible for about 80% of the electricity consumption. Thus we are confident to generate meaningful results and we emphasize the representativeness of our trials. They include a number of different kinds of buildings, office, small industry, schools etc. with differing consumption patterns.

The scale of the trial buildings and equipment we have designed are in line with what we have proposed in the DoW and budgeted for. Even better results could have been achievable with larger scale trials, but that is not possible within the budget and time constraints valid for this project. On the other hand we think that the small scale trials we have proposed is quite appropriate at this stage of development of the CoSSMic idea. More elaborate trials are more appropriate as a next step, building on the results from the limited scale trials carried out by CoSSMic.