MAtchUP

D3.4: New Concept of high performance district in Dresden – First Version

WP 3, T 3.3

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MAtchUP - SCC-1-2016-2017

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Technical References

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Project Coordinator	Ernesto Faubel Ayuntamiento de Valencia efaubel@valencia.es
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Version	Person	Partner	Date
0.1	Maximilian Breß	VON	31 Jul 2019
0.2	Maximilian Breß	VON	29 Aug 2019
1.0	Maximilian Breß	VON	25 Sep 2019

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Abbreviations and Acronyms

Acronym	Description
D	Deliverable
PV	Photovoltaic
VON	Vonovia
DRE	City of Dresden
TUD	University Dresden
FHG	Fraunhofer Gesellschaft
DWG	Drewag
KfW	Kreditanstalt für Wiederaufbau (Credit Institute for Reconstruction)
BSI	Bundesamt für Sicherheit in der Informationstechnik (Federal Office for Information Security)
SMGW	Smart Meter Gateway
ICT	Information and communications technology
kWp	Kilowatt Peak
EEG	Erneuerbare-Energien-Gesetz (German Renewable Energy Sources Act)
CBCC	Central Building Control Center
EASD	EA Systems Dresden

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Abstract

This deliverable focuses on the definition of a new concept of interventions focused on achieving high-energy efficiency rates in Johannstadt district in Dresden. The actions include extensive retrofitting and new construction programs as well as smart home developments for Dresden.

Led by VON, actions will be implemented in 10-storey buildings located in Pfotenhauer Str. as well as in Elisenstr. and will affect the windows, doors, façade, roof and the renovation of the heating system. Technical specifications and program of works (including energy, social and technical diagnosis) will be discussed with dwellers of the committed retrofitting programs.

Furthermore, these actions will include the integration of renewable energy systems as well as saving technologies.

The whole implementation process will be monitored and evaluated in order to develop a business model for energetic transformation leading to energy cost reduction.

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1 Introduction

1.1 Purpose and target group

This report constitutes Deliverable "*D3.4 New Concept of high performance district in Dresden– 1st version*", which is the main outcome of "Task 3.3 High-Performance District and Smart Homes" with the Subtasks "Subtask 3.3.1 Retrofitting actions", "Subtask 3.3.2 New construction", "Subtask 3.3.3 Smart Controls and BEMS", "Subtask 3.3.4 Clean Energy. Building Renewables" and "Subtask 3.3.5 Smart Energy Integration". The final version of this report (D3.16) will be delivered in September 2020 (project month M36). One of the core objectives of this document is to describe the detailed design of the interventions done by VON during the retrofitting and energetic restoration processes. Furthermore, the project should serve as a demonstration of the usage of sustainable technologies and future construction methods, the development of new business strategies and as a support for the urban transformation.

1.2 Contribution of partners

Table 1: Contribution of Partners

Participant	Contributions to
DRE	DRE is one of the lighthouse cities of the project and work package leader of WP3. Concerning Task T3.5, Subtask ST3.5.2 and Deliverable D3.8, DRE is the task and deliverable responsible party. Furthermore DRE is responsible for the topics urban mobility assistance (Action 25) and citizen's feedback mobility application (Action 65).
FHG	FHG is an ICT expert of the local team and thus involved in the monitoring activities and the Urban Platform developments in Dresden within WP3. It is also responsible for mobility actions in regard to electric vehicles, charging stations and new services on sustainable mobility. Concerning Task T3.5, Subtask ST3.5.2 and Deliverable D3.8, FHG is responsible for the topic optimal use of charging infrastructure (Action 23).
DWG	DWG is a main actor in the energy actions carried out in Dresden within WP3. It is also responsible for mobility actions in regard to electric vehicles, charging stations and new services on sustainable mobility. Concerning Task T3.5, Subtask ST3.5.2 and Deliverable D3.8, DWG is responsible for the topics smart management of electro mobility (Action 24) and smart meter gateway for electro mobility (Action 67).
VON	VON is a main actor in the energy actions carried out in Dresden within WP3. VON is responsible for all energetic restorations and retrofitting measurements done at the selected buildings in Dresden including the supply of 3 E-Vehicles to advert the concept of car sharing as well as the development of an overall strategy regarding energetic modernisation in the building sector.

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1.3 Relation to other activities in the project

Table 2: Relation to other activities in the project

Deliverable	Relation to D3.8
D3.14	D3.14 describes the detailed design of the interventions to be implemented in the city of Dresden and is the basis for all further tasks and deliverables in WP3. Therefore, D3.4 gives a more detailed description of the design and the status of the interventions about innovative mobility solutions and measures defined in the Dresden to boost the e-mobility in the city.
D3.7	D3.7 is the outcome of WP3 task 3.5.1 and describes the electrical vehicles and charging stations rollout in Dresden. Therefore, D3.7 and D3.8 together provide a complete overview on mobility interventions.
D5.5 – D5.7x	The objective of WP5 "Technical, social and economic evaluation" is to setup a strong evaluation framework to be deployed in each lighthouse city with the aim to assess the effectiveness of the proposed intervention, deployed in the associated individual actions. Therefore, D3.4 is linked to WP5 deliverables.
D6.5	The objective of WP6 "Exploitation and market deployment – innovative business models" is to design innovative business models and financial mechanisms to foster the implementation of smart city solutions, to identify exploitable results and to design an ad hoc strategy for their deployment and replication.

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2 State of the art and future vision related to New Concept of high performance district in Dresden

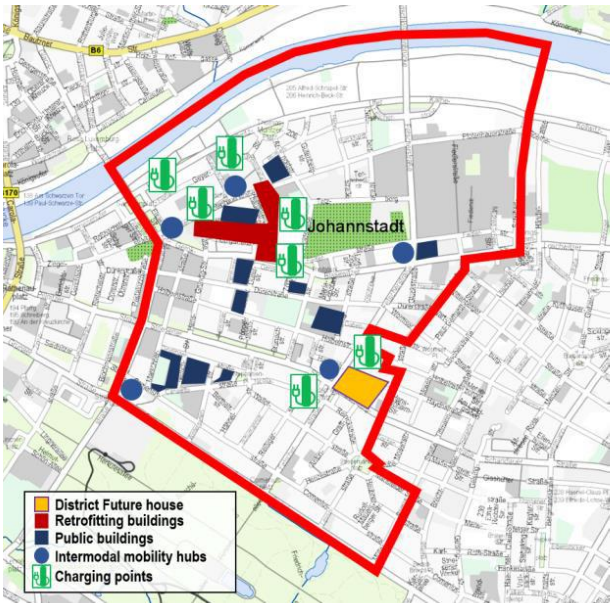
The existing buildings have been constructed between 1960-70. Their **54,838** m2 (living **35,650** m²) are distributed in 10-storey buildings in transverse wall construction with mainly north-facing staircases. There are 14 entrances to 560 residential units (about 1,200 inhabitants) divided in 2 and 3 room apartments (48 m² and 79 m² respectively). Until 2022, the referred buildings will receive comprehensive modernisations and retrofitting that involve the redesigning and replacement of various parts of the buildings as well as energetic insulation of facades and roofs. The planned structural measures do not just serve as external improvements but in the end should help to reduce emissions and to create a sustainable living space. In cooperation with DWG, tenant electricity models are promoted with the objective to increase the flexibility of the smart energy systems. Tenants are allowed to directly use the renewable electricity generated on their buildings:

Simulations regarding photovoltaic systems generation and tenant's demand of electricity are being performed. Additionally, the integration of storage is simulated.

A photovoltaic system is being installed on an existing building and the required metering systems are being installed. Furthermore, the effect of retrofitting existing buildings on energy demand is being monitored.

To support the mobility transformation within in this district and in Dresden in general, the selected building will receive 36 charging points including two fast-charge stations. FHG will equip the charging points with Smart Metering. In addition, VON employees will get access to 3 E-vehicles, which can be used as pool cars while doing the necessary maintenance within this district. This aims at reducing negative impacts on the environment as well as promoting the concepts of E-Mobility and car sharing.

Johannstadt District in Dresden



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3 Technical definition of the interventions

3.1 Action 07: Pfotenhauer Str. Retrofitting project

The existing buildings have been constructed between 1960-70. Their 54,838 m2 (living 35,650 m2) are distributed in 10-storey buildings in transverse wall construction with mainly north-facing staircases. There is 14 entrances to 560 residential units (about 1,200 inhabitants) divided in 2 and 3 room apartments (48 m² and 79 m² respectively).

The buildings will be retrofitted according to current energy consumption and saving standards. Existing windows and doors will be replaced with new elements meeting the standards of KfW program-151 and facades and roofs will be insulated using a thermal insulation system also according to the requirements of KfW program-151 (KfW-Effizienzhaus). Decreased energy consumption resulting from these retrofitting measures and energy produced by newly build PV-systems (Action 4) will be taken into account in the heating system design (Action 17). A charging pole (Action 22) will be placed for e-mobility. This will lead to a reduction of the heating systems dimension (compared to the status) in combination with lower energy consumption and thus a significant reduction of C02-emissions.

3.2 Action 09: District Future House

District Future House will be a housing cooperative with 2,287 m² (living space 1,191 m²) distributed in 14 dwellings. Its thermal demand will be covered through the DH while up to 40% of the electric one by the PV installed in the building (Action 41). Several "individual" technologies will be tested together in this new building. The Smart Meter/ Smart Meter Gateway-system (Action 43) will provide opportunities which need to be applied under real conditions to produce several benefits for the tenants.

The interaction between the classical supply concepts (district heating station), the technical building equipment (heating system, central domestic hot water preparation) and the additional technologies will be tested both technically and communicatively, and fully monitored among all the building. In addition to the energy-related part (consumption "house" and "housing" over all media, tenant electricity model, load-variable tariffs ...), other services and housing management should also be possible via the energy management system. Data transmission within the property and "outwards" (both for measuring point operation and for sub-meter) is to be carried out through the iMSys system as a modern communication infrastructure. Relating the energy management of this future house, it will be a smart building, which is managed by hierarchic management systems – one for the entire building and one for each single flat. The following functions are more possibilities needed to be finalized during the project.

Dwelling Energy Manager, will be the future central information and communication platform for tenants. It will provide information on demand of electricity, heat, water. The tenant will be able to choose ventilation, temperatures and times at this central service unit of for his apartment. There are different sensors for temperature and actors (floor heating valves). All the data are submitted to the Building Management and

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participate in optimizing the heat consumption. Information of the property management, weather forecast, contact data of housekeeper and others are given on the home display too. Also the consumption of the flat can be monitored by the tenant via his display.

Building Energy Manager: This collects and achieves all relevant data from the Dwelling Energy Manager. It regulates the central district heat feed-in and the central building ventilation.

3.3 Action 01: Smart Tenants

With the objective to increase the flexibility of the Smart Energy Systems, tenant electricity models will be promoted through this action. Through tenant electricity models, tenants are allowed to use the generated energy from renewable energies themselves in their quarters. The intelligent linkage of photovoltaics (Action 4) and storage (Actions 5 & 18) decouples on-site production and consumption and increases the autonomy of the district. This can increase the attractiveness of tenant flows and enable economic and ecological participation in the urban energy market for a large number of tenants. Integration of electro mobility (Action 23) in conjunction with the photovoltaic system, the indirect CO2 emissions from the electric vehicles can thus be further reduced and a positive contribution to the energy balance of the district can be achieved. As a result of the reduction in the feed-in into the public electricity grid, expected peaks in consumption and decentralized production will be reduced in the future (Action 54). The consumption-oriented and oriented expansion of renewable energies in the district is thus promoted.

For taken decisions among the different stakeholders involved in this action, providing information for tenants and power producers about their feed-in, consumption or efficiency is one of the main aspects to treat. For this, the buildings (Action 7) will have installed Intelligent metering systems (iMSys) that consists of modern measuring equipment (mME) and a smart meter gateway (SMGW), which collects, stores and transmits measured values to authorized market participants (AMT), taking into account the requirements of the BSI (high data protection and data security requirements). The implementation of iMsys provides the basis for the information and communication technology for linking the previously separate energy systems. IMsys are remotely communicable electricity meters that meet the high data protection and data security requirements. The iMSys are connected to the Urban Platform by gateway (SMGW-Smart Meter Gateway), which allows remote access via a communication link (based on the ICT infrastructure). The data from the gateway is then made available through the Urban Platform. The group of producers (CHP, PVA) is integrated into the iMSys via the control box. The active market partners (aAMP) form the authorized subscriber body who communicate the switching operations via the secure ICT infrastructure of the control box. Hence, iMsys allow only the previously sketched concepts as well as the provision of information to among other things on-site production, consumption, CO2 savings and efficiency for a "smart" tenant.

Additionally to the monitoring of the dwellings, simulation will be used for creating functional connections between modules like photovoltaics, storage batteries, controlled EV charging infrastructure as well as HVAC and district heating adds a lot of

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complexity to the energy system. Also to layout and test these systems regarding component sizing and functional interaction using dynamic systems simulation based on Modelica is state of the art. For the simulation, computational models of battery storages, buildings user behavior, etc. are connected in the proposed layout and functionality of the future district. The system is then valuated for typical usage scenarios, and afterwards the model gets adjusted until the system works as desired. Based on the results, the real world components are built. So, this process helps to reduce in site commissioning efforts and greatly improves quality. Currently these technologies are mainly used for high profile buildings.

3.4 Action 02: Building Control Center: 12 Public Buildings Energy Managed

Five schools, six children's day care facilities and one administrative building, all located in Dresden‘s high-performance district Johannstadt, will be connected to a Central Building Control Center (CBCC). Although currently being constructed in another Dresden district, it will allow an increase of the effective energy management of the selected 12 public buildings in Johannstadt district. The implementation of this Control Center builds on the energetic restorations done on the buildings (A07) and expands the efforts to a long rung monitoring tool regarding sustainability and energy efficiency. This increment will be obtained through the permanent timely adaptation of the building heating and ventilation systems with the current internal and external climatic conditions, exhausting the existing energy savings potential. All data acquired by the CBCC will be integrated into the Dresden Urban Platform and will be released as Open Data.

Main goal of Action A02 is to improve the energy efficiency of public buildings. Therefore, EASD models will be installed in one representative school building in the district using the A1 modelling approaches. Besides building performance analyzes and optimization, the models are used to implement and test predictive heat control algorithms, mainly regarding a permanent adaptation of heating and ventilation systems depending in outdoor and indoor conditions. Dresden wants to add the public buildings to its Central Building Control Center (CBCC), a platform for monitoring data evaluation and building energy management. To support a permanent high energetic standard of the connected buildings, EASD exemplary shows efficient measures of data evaluation and system optimization including models and monitoring data for the selected representative school building."

3.5 Action 43: Smart-Meter-Gateway in District Future House

In the District Future House (Action 9) one of the main project targets is to implement a joint metering concept for all media in the building – such as electricity, natural gas, (district) heat and (hot and cold) water. The energy management systems provide information to the tenants and the entire building. A reduction of the energy demand, hence resource saving by a control-system is going to be enabled by active involvement of the tenants. The expectations regarding District Future House project are a scalable and useful solution for other apartment buildings in the city of Dresden.

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All the flats are going to be integrated into a complete metering and management system by submeters. The projected configuration of electric submeters includes different shared electricity objects such as light, ventilation, circulation pumps, electronic information tables, elevators, smoke evacuator etc. Therefore, submetering systems are needed for heat cost allocation (for heating and domestic hot water) and will be additionally used for the management of drinking cold water. The entire building will be prepared for a future secure and reliable communications infrastructure. Additional equipment with empty conduits is designed for uncertain future communications requirements (wide-area-network – WAN) and future services. This smart-meter-gateway will provide data to Dresden Urban Platform.

3.6 Action 04: 226 kWp Photovoltaic System on existing Buildings

1st amendment version

A photovoltaic system will be installed on the existing buildings that were constructed between 1960-1970 and will be retrofitted inside the MAtchUP project (Action 7). In the 680 flats that comprise these buildings located on Pfotenhauer. Str. and Elisenstr. the total roof surface is about 4,500m². Given the architecture, about 226 kWp of PV generation can be installed. These will be included in the potential energy storage and total annual electricity generation should sum up at around 215,000 kWh. As the total electricity consumption of the building (its inhabitants) is around 750,000 kWh/a, the 100% of PV generation will be used in the building itself. Due to the planned storage (Action 5), the generation and demand mismatch can be covered. A CO2-reduction of around 25% can be reached due to PV generation.

2nd amendment version

A photovoltaic system will be installed on the existing buildings at Blasewitzer Str. 36 a-c that were constructed in 1990. Other apartment buildings at Pfotenhauer Str. will be retrofitted inside the MAtchUP project (Action 7).

3.7 Action 41: 8.7 kWp Photovoltaic System in District Future House

1st amendment version

In the District Future House that will be built inside the project (Action 9), PV energy will be produced and stored in the building itself. With a nominal power of 8.7 kWp and a generation of 950 kWh/kWp the solar panels installed will be able to provide the 75% of the energy demanded by the building. For the installation of the PV panels, two different concepts will be taking into consideration, aligning south and aligning east-west. Both concepts differ in the installable capacity and the time of production, so the decision will be made by taking into account statics of the roof, the costs and the benefit (maximum use of the RES in the building).

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2nd amendment version

In the District Future House that will be built inside the project (Action 9), PV energy will be produced and stored in the building itself. With a nominal power of 9.92 kWp and a generation of 920 kWh/kWp the solar panels installed will be able to provide the 40% of the energy demanded by the building. An own consumption rate of appr. 68% will be achieved and rised by the use of battery up to 76%. For the installation of the PV panels, two different concepts will be taken into consideration, aligning south and aligning east-west. Both concepts differ in the installable capacity and the time of production, so the decision will be made by taking into account statics of the roof, the costs and the benefit (maximum use of the RES in the building).

3.8 Action 05: Integration of the Power Supply System on the retrofitted buildings with the District Storage System

1st amendment version

As larger energy storage systems are more efficient in terms of investment cost that individual ones, a District Storage System will be installed in the project (Action 18) for a better energy management of the PV energy generated by the Action 4. The connection of this District Storage System with the individual apartments and the demand management will be crucial to, ensuring the optimal service, achieve the most energy efficiency values. In this action housing needs, individual electric mobility needs and public-electric mobility (semi-public) mobility needs will be managed for ensuring the supply into the apartments.

2nd amendment version

For an integrated energy management of the PV energy generated by the Action 4 and a high level of sustainability in A1 a District Storage System is aimed to be analyzed in the project (Action 18). Therefore the variant analysis of decentralized and centralized District Storages will be developed to evaluate proper technical, economical and repeatable storage solutions. The variant analysis will be focused on two feasible possibilities. First option is a mix of virtual connected smaller local storages connected to the EMS. Second option is one larger district storage with interfaces to the EMS. As larger energy storage systems are more efficient in terms of investment cost than smaller units.

The connection of this district storage system to the individual apartments and demand management is crucial in order to guarantee optimum service and achieve the highest energy efficiency values. This action manages the housing demand, the individual electric mobility demand and the public electric mobility demand (semi-public) in order to ensure the supply of the housing.

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3.9 Action 42: Power Storage in District Future House

1st amendment version

For a better management of the PV power generated in the District Future House (Action 41), a Mercedes-Energy Storage system with a nominal capacity of 4.6 kWh will be installed (Action 9). The energy from this storage will be used for covering the building demand, but the possibility to be used for Electrical Vehicle charging will exist in the future.

2nd amendment version

For a better management of the PV power generated in the District Future House (Action 41), a Varta-Energy Storage system with a nominal capacity of 3,3 kWh will be installed (Action 9). The energy from this storage will be used for covering the building demand, but the possibility to be used for Electrical Vehicle charging will exist in the future.

3.10 Action 40: 5 E-Cars for Housing Sector

The housing sector employs different technical and non-technical staff (housekeeper, real estate agents, and property owners). Their mobility-scenarios differ but most of them take place in a rural area. Headquarters and service enters are located very close to their apartment buildings. Nonetheless, the referred employees might be excellent user cases for E-Mobility. As for now, there are very few or no electric vehicles in use. Because of that the project will put on service 5 new e-cars for monitoring their behavior through the urban platform, serving as starting point for a total electrification, studying the derivation of full-service- solutions with direct involvement of housing companies. Analyzing needs and application scenarios, mobility concepts for electric vehicles are developed for the use cases of housing companies. Based on these concepts, suitable mobility services, as defined by all-round services (consisting of electric vehicles, charging infrastructure, energy, authorization and payment), are created and implemented prototypically at the partner companies.

3.11 Action 38: Energy efficient design of the real estate

Development of a business model for energetic transformation of the real estate with guarantee of energy cost savings. The implementation will consist on the analysis of current energy state of existing buildings followed by the definition of actions and finally the large scale modernization of building energy technologies with energy-saving contracts, monitoring, controlling, energy consulting and performance optimization.

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4 Executive project description of each action

4.1 Action 07: Pfotenhauer Str. Retrofitting project

4.1.1 Management structure

The actions are led by VON in partnership with DWG (Planning and Consulting), DRE (City Government) and FHG (Research and Development)

4.1.2 Technical specification

Within the MAtchUP project, ~12 selected public buildings in the high-performance district Johannstadt will be retrofitted and modernised. With regard to energetic and ecological standards linked to KfW-fundigs, the buildings will receive an extensive energetic restoration, which includes the modern insulation of facades and roofs as well as the (partially) renewal of heating elements. The modernisation also includes the installation of balconies and the replacement of Windows and doors. Entrance areas, facades and stairways/elevators will be redesigned.

Figure 1: Referred Buildings in Johannstadt

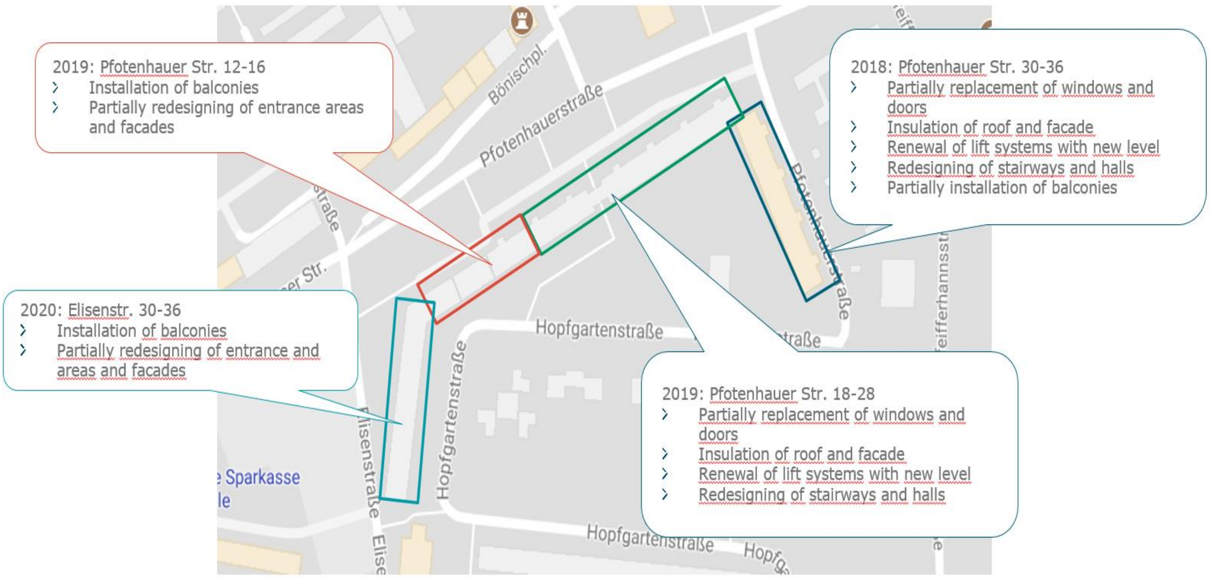

Figure 2: Planed Measurements for each building

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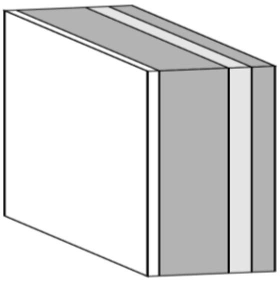
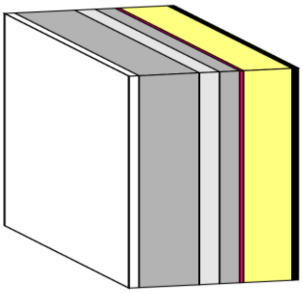
The technical improvements are described in the following.



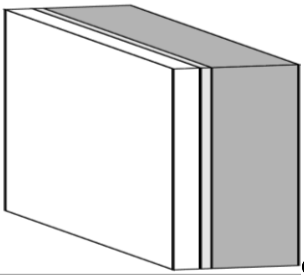
Outside Walls before



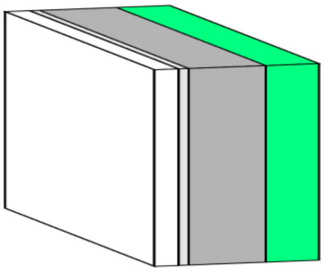
Outside Walls after

Currently the materials used for the outside walls include plaster mortar (limestone, 25mm), concrete (200mm), and expanded polystyrene foam (50mm) with a total thickness of 275mm. The thermal transmittance for the complete external surface is 0.63.

The constructional measures plan to add layers of mineral wool, lime-cement mortar as well as adhesive mortar. The restoration will increase the thickness about 125mm to a total of 420mm, resulting in an improved thermal transmittance of 0.20.

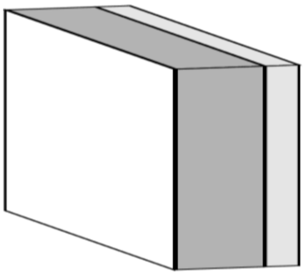


Cellar Ceiling before

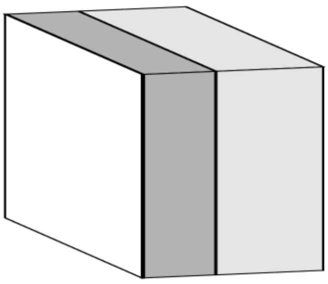


Cellar Ceiling after

The cellar ceiling consists of cement (50mm), climate membrane (KM Duplex UV, 1mm), polystyrene foam (20mm), and concrete (mm 160) with a total thickness of 231 mm and a thermal transmittance of 1.01, with regard to the overall surface of 1,073.5m². The future construction will also receive a layer of mineral wool increasing the thickness to a new total of 341mm and leading to a new thermal transmittance of 0.23.



Top Floor Ceiling before



Top Floor Ceiling after

The used materials regarding the top floor ceilings are mortar (limestone, 5mm), concrete (160mm), bitumen sheeting (3mm), climate membrane (KM Duplex UV, 1mm), and expanded polystyrene foam (60mm). The overall surface is 583.5 m², with a thickness of 229mm and a thermal transmittance of 0,56. To improve the thermal transmittance, the layer of expanded polystyrene will be extended to 240mm. The new transmittance is expected to be about 0.14.

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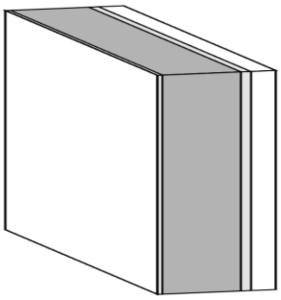
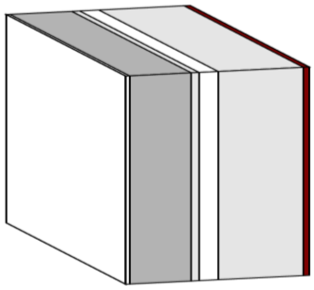

Ceiling against the attic before


Ceiling after

Currently the ceiling against the attic consist of plaster mortar (limestone, 10mm), cement (50mm), concrete (160mm), and expanded polystyrene foam (20mm) with a total thickness of 240 mm. The thermal transmittance for the complete external surface (490 m²) is 1.16.

After the restoration, the ceiling will have a new layer of expanded polystyrene foam (220mm) and a layer of OSB-panels (15mm). The thickness of the ceilings will be 475mm and the thermal transmittance will be around 0.14.

In combination the planned contractual measures and energetic restoration should lead to a reduction of monthly heating costs of 60% from 0.53 €/m³ to 0.32 €/m².

4.1.3 Planning of the tasks

Template for Gantt diagram:

Year 1				Year 2				Year 3	Year 4	Year 5
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
(1)	(1)									
	(2)	(2)	(2)							
				(3)	(3)					
						(4)				
						(5)	(5)	(5)	(5)	(5)
						M1	M2		M3	

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

(M) Next milestones (M1, M2, M3)

The first part of the retrofitting project (Pfotenhauer Str. 30) started on 23rd April 2018 and includes the installation of balconies but no energetic changes as these units have already been retrofitted a couple of years ago. Measures ended mid-December 2018 the latest, taking into account delays due to weather conditions or resource issues with external service providers.

The next part of the retrofitting project (Pfotenhauer Str. 32-36) started on 30th August 2018 and includes, besides fire protection measures and the additional elevator access, the following changes on the energetic side: Installation of a thermal insulation of facades with a so-called ―Wärmedämmverbundsystem‖ consisting of Sto-Mineral Wool Type 1/B with a thermal conductivity of 0.035 and 120mm thickness. Further measures include:

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- Insulation of top floor ceiling and cellar ceiling
- Hydraulic balancing of the heating system
- Substitution of the windows with triple glazing and a heat transition coefficient of 0,7 W/m²K
- Staircase vitrification

Measures ended mid-August 2019.

The third part of the project (Pfotenhauer Str. 12-16) started mid-2019 and only includes the installation of balconies but no energetic changes.

The fourth part of the project (Pfotenhauer Str. 18-28) started mid-2019 and includes, besides fire protection measures and the additional elevator access, the following changes on the energetic side:

- Installation of a thermal insulation of facades with a so-called ―Wärmedämmverbundsystem‖ consisting of Sto-Mineral Wool Type 1/B with a thermal conductivity of 0,035 and 120mm thickness
- Insulation of top floor ceiling and cellar ceiling
- Hydraulic balancing of the heating system
- Substitution of the windows with triple glazing and a heat transition coefficient of 0,7 W/m²K
- Staircase vitrification

Finally, in 2020, the last residential units in Elisenstraße will receive balconies. No energetic measures will be performed here.

4.1.4 Health, safety and waste management requirements

1. General requirements related to regular construction and renovation projects.
2. Extraction of asbestos probes as well as the analysation of possible hazardous substances or materials. Regular process that should be operated by professional companies.
   - ➔ Probes have been extracted and analysed by Ergo Umweltinstitut GmbH in July 2018.
   - ➔ Each finding is listed, documented and the necessary corrective actions were determined
3. Joint restructuring / large scale withdrawing of joints. A professional company should operate execution and disposal.
4.

4.1.5 Risks considered ex-ante and proposed risk-mitigation measures

Not applicable for this Action.

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4.2 Action 09: District Future House

4.2.1 Management structure

DREWAG is responsible for the planning, erection (by subcontractors) and construction supervision of the photovoltaic system, as well as calculation of the tenant electricity model and acquisition of the tenants. WGJ provides roof areas and access to the building. EASD simulates the data

4.2.2 Technical specification

The photovoltaic system has the following characteristics:

- Nominal output PV system 9.92 kWp
- High-performance modules from LG with 320 Wp each
- Power generation 9,200 kWh p.a.
- Varta storage system, usable capacity 3.3 kWh
- Expected own consumption rate of up to 80%.

Expected degree of self-sufficiency up to 40%.

4.2.3 Planning of the tasks

Template for Gantt diagram:

2018				2019				2020	2021	2022
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
(1)	(1)									
	(2)	(2)								
			(3)	(3)	(3)					
					(4)					
						(5)	(5)	(5)	(5)	(5)
							(M1)	(M2), (M3)		

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

The construction of the building and the implementation of all MAtchUP measures are carried out in close coordination with the apartment building owner (Vonovia). The construction of the building shell was carried out by the apartment building owner within the first MAtchUP months. Meanwhile, DREWAG carried out different preparations of the MAtchUP actions, such as:

- Design of PV generator (alignment, size, and roof statics)

- Redesign of the storage unit

- Final design of intelligent measuring system (iMSys)

- Final design of sub-metering and energy management systems of apartment and flat

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Figure 3: Unfinished construction in 02/2018

The energy management system and intelligent measuring systems are located in the basement. Sub-metering and flat energy management systems are installed in the flats. The energy management will provide a technical and communicative interaction of:

- PV generation/ storage within the tenant electricity model

- Smart Home Real Estate Industry ("RIECON" system) with displays for the apartment

building and each flat

- Intelligent metering systems

- Operating costs billing (heat, water)

- Heat supply (district heating)

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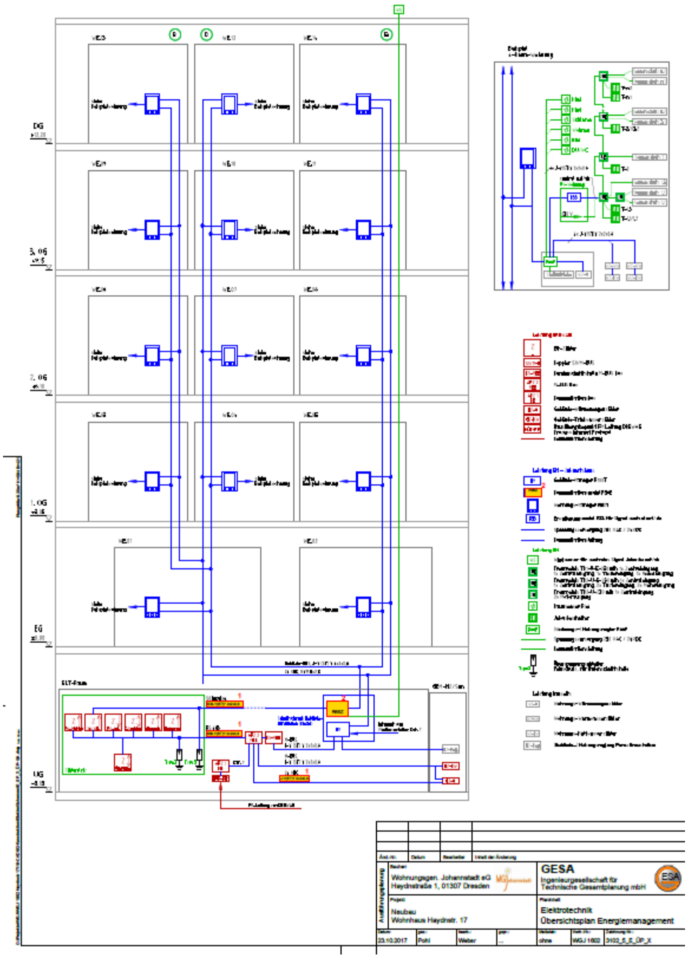

Figure 4: General layout plan energy management

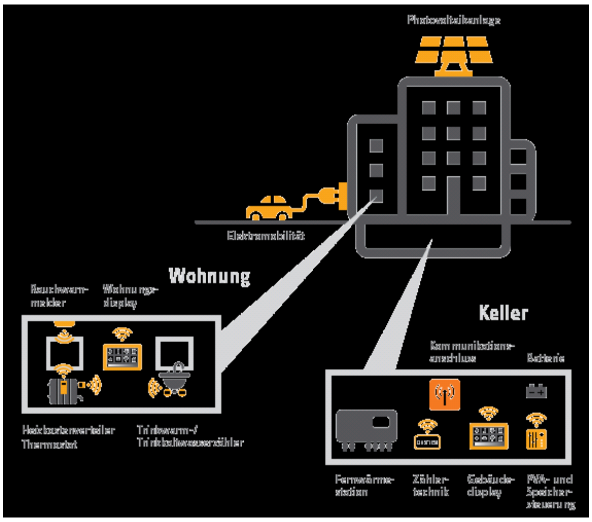

Figure 5: Scheme of energy management of building and flats

Within this action, we aim to analyze the connection of apartment building and flat energy systems to identify advantages in daily life. Therefore, we combine the energy balance of an apartment (electricity, heat, water) with flat energy systems. To reach this, we divided our efforts in 2 steps:

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1. The first step is to get comprehensive information about the energy status of flats and the apartment building.

- European legislation (RED2, Energy efficiency regulation) foresees direct information of tenants of their energy use in a monthly base. Our project is one preparation to this.

- We moreover want to identify energy losses and reduce energy demand (heat).

2. As a second step, we aim to identify the need for flexible tariffs. Useful business models are going to be developed. To achieve this, there is a cooperation between the owner of the apartment building and DWG/ DWNTZ.

The calculation of the tenant model is derived from the energy autarky ratio (see Action A 41). This ratio depends on the number of participants (tenants) which will take part. This is going to be monitored during the project. We calculated two variants with German RES-fee (EEG-Umlage). The current legislation leads us to use variant A below. It takes into account the estimated own consumption rate.

We will offer tenants energy model —"MeinMieterstrom" with a price line 0,5 Ct/kWh below the regular DREWAG product —"Dresdner Strom privat".

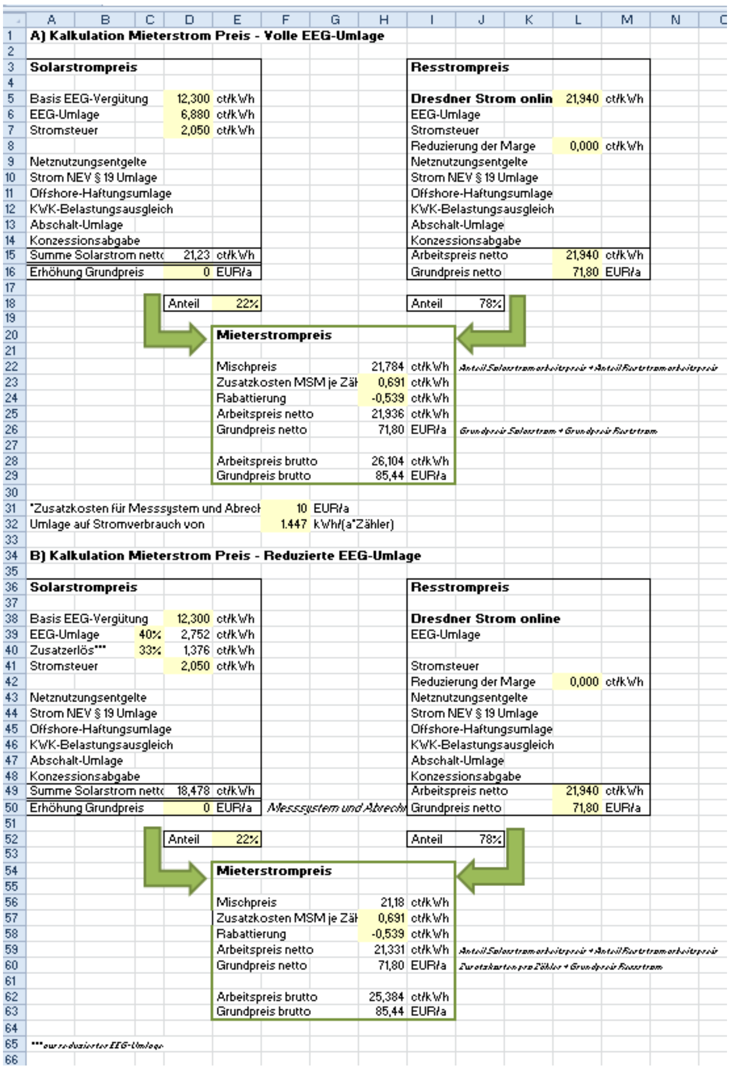

Figure 6: Calculation scheme of tenant electricity model (draft)

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Planning and construction of the photovoltaic system and the electricity storage system

The planning of the photovoltaic system and the storage system took place from 03/2018 to 06/2018. The heavily built-up roof (roof hatches, terraces etc.) proved to be particularly challenging. To ensure that sufficient electrical power could be installed, an individualised assembly system had to be planned, the purchase of which entailed considerable additional costs. In addition, high-performance photovoltaic modules were used. Another challenge was the interim replanning of the storage system, as the manufacturer of the already planned system unexpectedly stopped production. The photovoltaic system has the following characteristics:

- Nominal output PV system 9.92 kWp
- High-performance modules from LG with 320 Wp each
- Power generation 9,200 kWh p.a.
- Varta storage system, usable capacity 3.3 kWh
- Expected own consumption rate of up to 80%.
- Expected degree of self-sufficiency up to 40%.

Delivery and installation of the PV system and storage system started in 11/2018 and was completed in 05/2019 so that the system could be commissioned in 05/2019.

Figure 7: Photovoltaic system on the future house

RIECON Smart Home System

The RIECON Smart Home System was assembled and put into operation in 10/2018. Previously, the system was extensively tested on the DREWAG test stand. In addition to the functions of the Smart Home System shown in the two following illustrations, the owner can also import contact data for service providers, appointments (e.g. water cut-off) and messages into an apartment.

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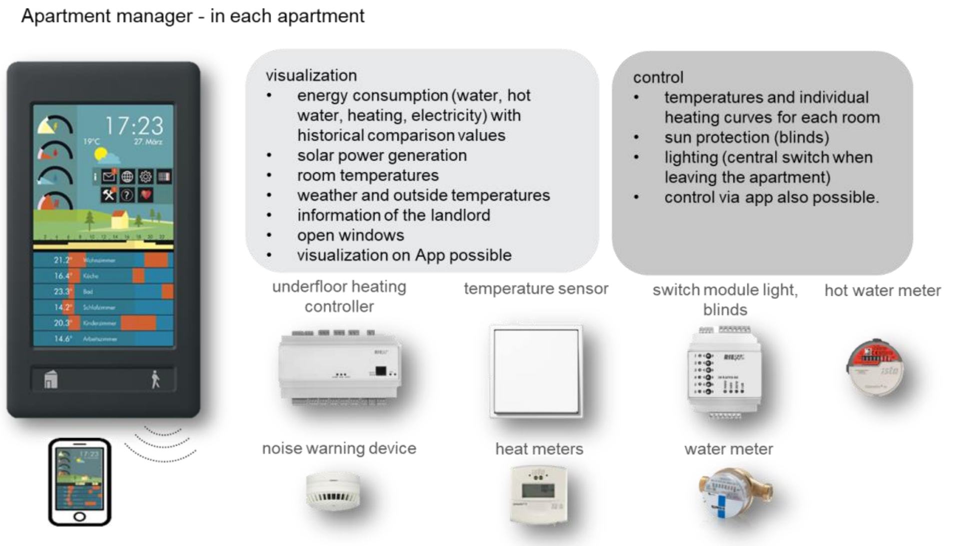

Figure 8: Functions of apartment manager

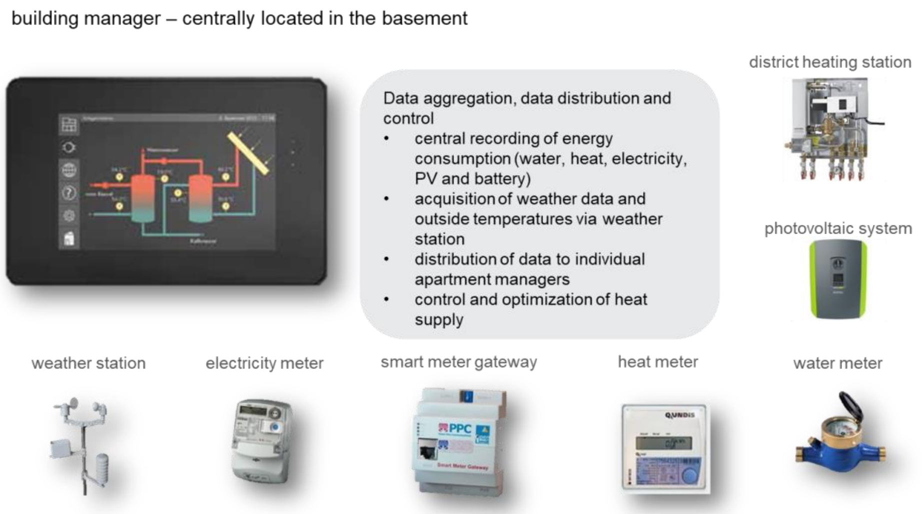

Figure 8: Functions of building manager

Tenant electricity model

The acquisition of the tenant electricity model started with the move of the tenants into the flats in 11/18. The tenants each received their tenant electricity contract (contract conclusion on a voluntary basis) and supplementary product information in the form of a flyer. Within very few days 12 of 14 tenants locked the tenant electricity contract and thereby exceeded the expectations. The following figure illustrates the function of the tenant electricity model.

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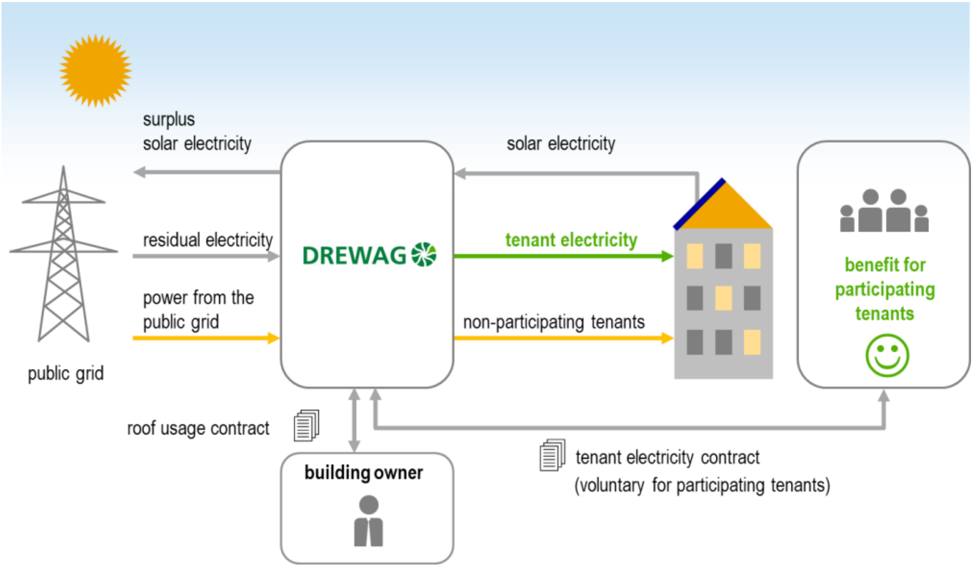

Figure 9: Scheme tenant electricity model

Irrespective of the provision of the technology, the tenants were billed at the more favourable tenant electricity tariff immediately after conclusion of the contract in 11/2018.

In the project future house, the tenant electricity has to become smart. Therefore, in addition to the technical implementation of the photovoltaic system and the storage system, a smart tenant electricity tariff was developed. What do we mean by a smart tenant electricity tariff? The solar power generation depends on the respective solar radiation and does not always match the current electricity consumption. This results in surplus feeds into the public power grid. With a storage system, we can already minimise these to some extent. However, we want to go one-step further and relieve the load on the electricity grids. In addition we discount the electricity price in phases of the surplus feed-in (load variable electricity tariff), thereby we animate the tenant to put the electricity consumption in low-priced times and to further reduce the feed-in into the electricity grid. The following chart illustrates this approach.

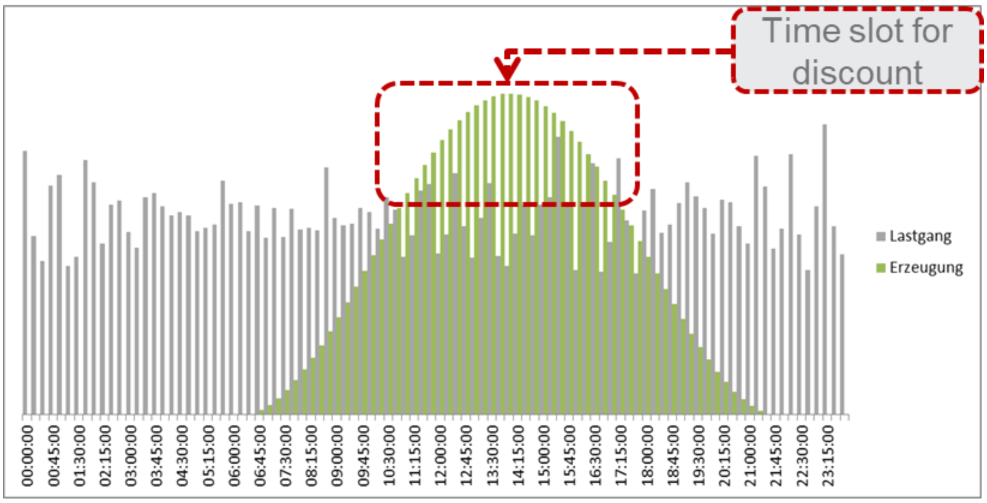

Figure 10: Generation curve photovoltaic system and electricity consumption for one day

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The tenants should be informed in each case about the display of their apartment manager to the favorable electricity tariff. We present the pricing of the future in three stages:

Table 2: Development stages of the load-variable electricity tariff in the project

Level	Load variable electricity tariff depending on	Period for discount	Discount
1	Fixed period	From 01.04. to 30.09. between 14:00 and 18:00 o'clock	2 ct/kWh gross
2	Time and Weather	Depending on locally recorded weather data	At least 2 ct/kWh gross
3	Time, weather and energy data	Depending on current energy data of the photovoltaic system and weather forecast data	At least 2 ct/kWh gross

We implemented the first stage of the load variable electricity tariff from 01/ to 04/2019. The following figure shows the underlying communication concept and the selection of the preferred solution.

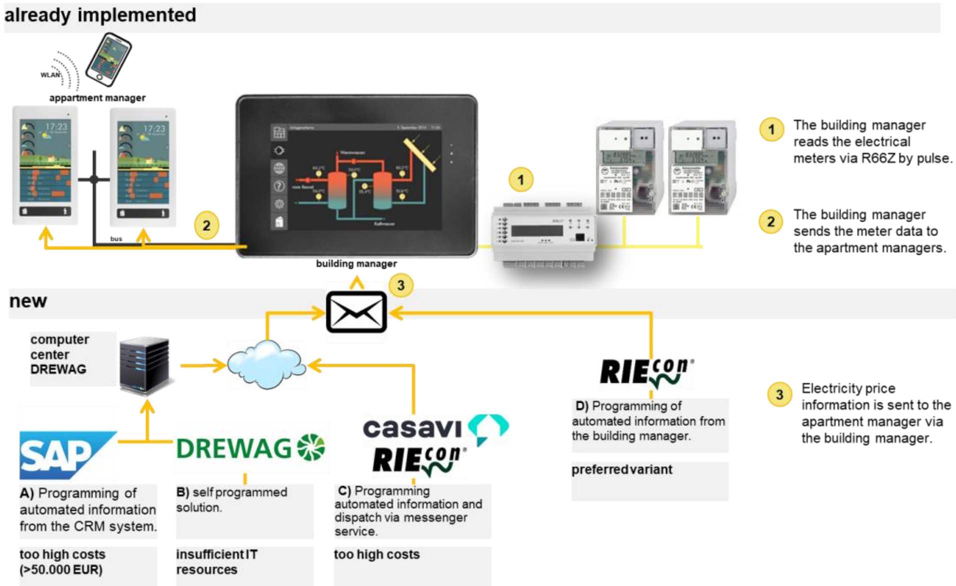

Figure 11: Communication concept for the load-variable electricity tariff Level 1

To visualize the smart tariff for the tenants, we decided to program a tariff bar on the apartment manager. The tenants were also informed in a separate letter about the start of the discount on 01.04.2019.

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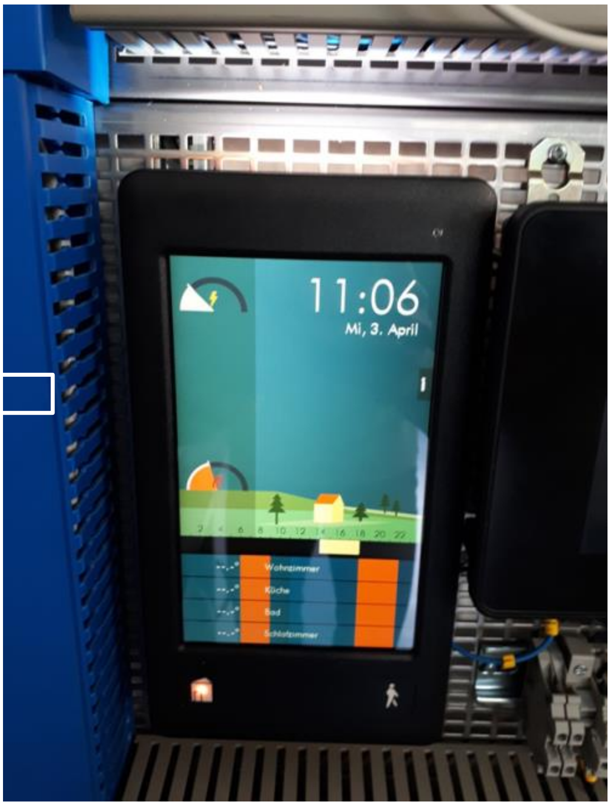

Figure 12: Realized visualization of the smart electricity tariff

Next Milestones:

M1: 4Q/19: Implementation of further use cases and levels of the load-variable electricity tariff

M2: 2Q/20: Controlling of first year

M3: 2Q/20: Feedback of apartment house owner to energy management and RES-generation

4.2.4 Health, safety and waste management requirements

Not applicable for this Action.

4.2.5 Risks considered ex-ante and proposed risk-mitigation measures

Not applicable for this Action.

4.3 Action 01: Smart Tenants

4.3.1 Management structure

This action is lead and executed by DWG in cooperation with VON (apartment and building owner) as well as EASD (simulation and technical evaluation).

DREWAG is responsible for the planning, erection (by subcontractors) and construction supervision of the photovoltaic system, as well as calculation of the tenant electricity model and acquisition of the tenants. VONOVIA provides roof areas and access to the building. EASD simulates the energy model data.

4.3.2 Technical specification

After the assimilation and collection of data, three different types of simulation models were developed.

1. The first model describes a representative floor of the building including all rooms as well as a high-resolution of the electrical power demand. This model enables the dynamic simulation of each individual room in minute steps. Thus, daily energy peaks can be detected and their position can be identified (See figure 13).

2. The second model describes a representative section of the building complex, which consists of a building entrance and the associated apartments. Within this model, all rooms of each floor are summarized into individual zones. This model enables the calculation and investigation of different user behaviors (electrical) and their influence on the energy system. Using the variant simulations, the impact of a storage system on the building‘s self-sufficiency in combination with the photovoltaic system is shown.

3. The third model describes the whole quarter with all building complexes. Each entrance with its associated apartments is attributed to a specific zone. All energy demands within the zone are summarized. This simulation model is important for the future development of the living quarter model (Action 18).

Based on these types of simulation models, the heat and electrical demand in these buildings can be easily simulated with high resolution. This will help to optimize e.g. the solar energy distribution with help of a well-sized battery storage system.

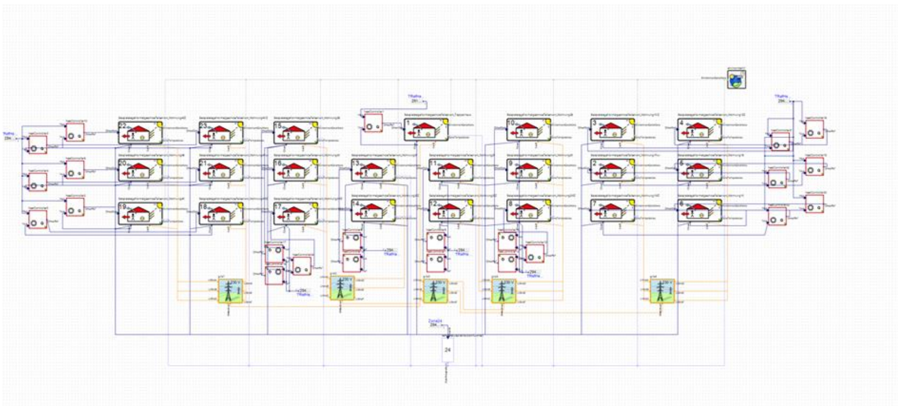

Figure 13: Energy Simulation Model - Architecture Floor

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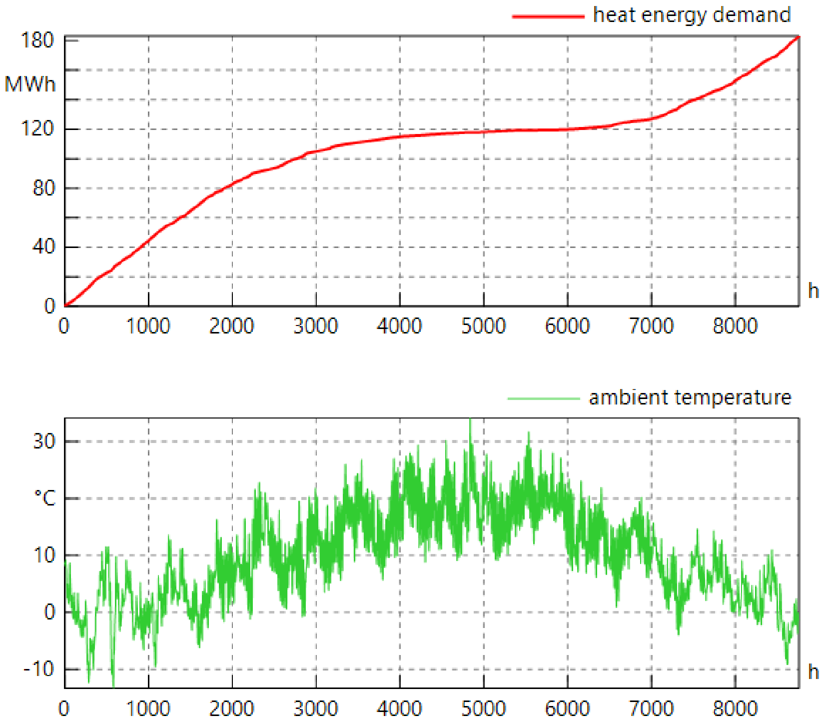

Figure 14: Simulation of Heat Demand at Pfotenhauer Straße

Due to the-static problems regarding the building's roof the residential buildings of this action had to be changed. We had to switch and realize the Smart-Tenant related actions in Blasewitzer Str. 36 a-c.

In the apartment building Blasewitzer Str. 36 a tenant electricity model is implemented. This includes both, an intelligent consumption and the participation of residents in local renewable energies. These renewable energies are generated by a photovoltaic system (PV) on the roof of the apartment building. The building comprises three entrances and 61 residential units. The resident structure of the building is to be regarded as mixed. The average electricity consumption per apartment is 1,400 kWh per year. For the entire property, this corresponds to an annual electricity consumption of appr. 85,000 kWh.

The roof area was equipped with PV by DWG. This consists of two roof areas with one inverter each. The first part comprises 80 PV modules, the second part 40 modules. The physical properties of the PV modules and the inverters of the real energy system were also used in the simulation model. This results in a total system output of 33 kWp for the entire roof area of the building. The modules were arranged at an angle of 5° to the east and west. Thus, the installed plant at the Dresden location generates an annual electricity yield of 30,000 kWh. (See Action 4)

In many building simulations and design calculations, the standard load profile (SLP) is used to determine the electrical energy demand. This corresponds to the average annual load profile of 10,000 residential units and is standardized to an annual energy requirement of Eel= 1,000 kWh/a. The averaging usually results in undesirable

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superimposition effects. Real load profiles are not subject to averaging and therefore show clear fluctuations in their course.

For simplicity's purposes, this model does not calculate heat loads and focuses on electrical simulation. For this purpose, an electrical load profile of the house tenants was generated with the help of a multi-agent simulation. This allows a realistic and minutely resolved simulation without the problems with the described mean values or privacy relevant measurement data (see figure 15).

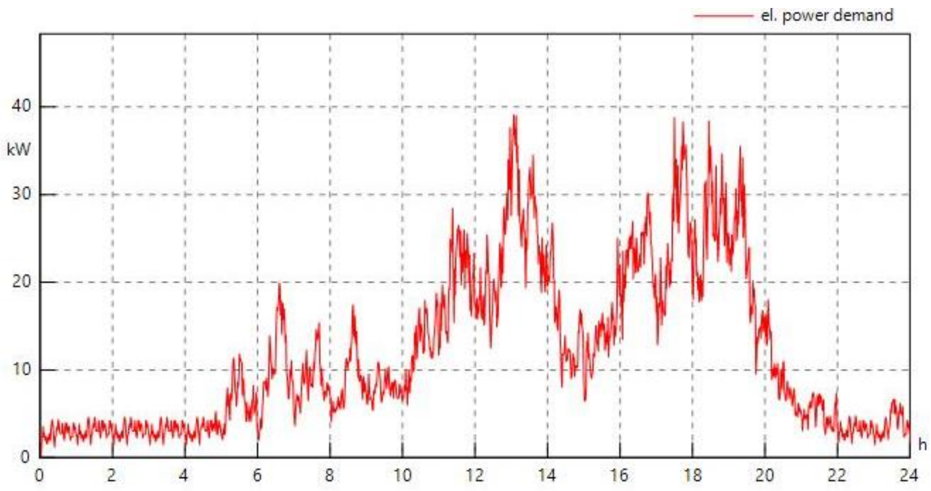

Figure 15: Daily Electrical Power Demand of Tenants

In addition to the electrical demand of the building, this model also simulates the proportion of solar power for the building based on regional weather data. Elements such as the PV, the inverter and the electrical storage are modeled with all physical conditions and thus enable a detailed and physically accurate simulation of different use case scenarios. These are described in more detail under Action 18. The model is shown schematically in the figure 16.

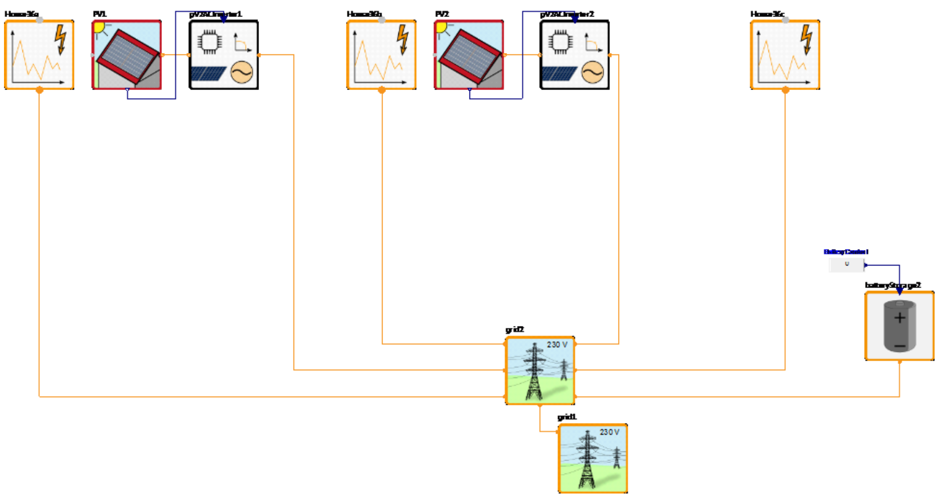

Figure 16: New Simulation Model – Scheme

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4.3.3 Planning of the tasks

2018				2019				2020	2021	2022
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
	(1)	(1)								
		(2)								
			(3)	(3)	(3)					
					(4)					
						(5)	(5)	(5)	(5)	(5)
						(M1)	(M2)	(M3)		

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

Milestones:

(M1) Info Screen for photovoltaic generation

(M2) Integration of electromobility

(M3) Monitoring of energy data and improvement of tenant flow simulation

The PV system part of this action started in month 03 and was finally accomplished in month 20 of the MAtchUP-project (see below).

During the first project year, we carried out a detailed planning of the initially planned apartment building at Pfotenhauer Str. We already

- developed and negotiated contracts concerning roof rent,
- adapted the DWG-contract for tenants energy model including the economic model
- calculated the tariff for the tenant energy model
- executed an energetic modeling specific demand ./. RES-generation in a minute-scale-resolution (MAtchUP-Partner EASD)
- developed variants of PV allocation on the rooftop,
- carried out planning of measuring system location in the floors and the cable layout,
- checked the fire protection of the new installations,
- prepared purchasing the PV- and roof mounting systems

Some of these progress statuses could be used in an adapted version for the new project site, i.e. Blasewitzer Str. 36 a-c.

The structure of integration of intelligent Measuring Systems (iMSys) which are connected to the Urban Platform via a gateway (SMGW – smart meter gateway) is designed in the associated Action A11.

Due to the insufficient load capacity reserve of the roof on Pfotenhauer Str., Vonovia identified a new building for the construction of a photovoltaic system. The tenant electricity model is now being implemented on Blasewitzer Strasse 36 a-c. For this purpose, DREWAG and VONOVIA have concluded a separate roof usage agreement in 07/2018, which regulates the planning, installation and operation of the system by DREWAG on the VONOVIA building.

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The aim is to supply the 61 apartments with proportionate solar power from the photovoltaic system and thus reduce the tenants' electricity costs. For this purpose, a photovoltaic system with a peak output of 33 kWp was installed.

The system generates almost 30,000 kWh p.a. and was completed in December 2018 following the start of construction in October 2018.

Figure 17: DREWAG photovoltaic system

With the photovoltaic system, the tenant has the opportunity to obtain solar power efficiently and ecologically directly from his own roof and to participate in the energy revolution. To this end, the tenant can conclude a solar power contract with DREWAG on a voluntary basis. Solar power generation and electricity consumption do not always coincide. This is why DREWAG also supplies green electricity from the public grid. In this way, the tenant is always reliably supplied with electricity, even when the sun is not shining. The tenant not only receives and uses the solar power generated directly on site, but also saves electricity costs. With an electricity consumption of 1,400 kWh per year, the electricity costs decrease by up to 10% compared to the previous electricity bill.

The following figure shows the simulated energy balance in the property and the expected solar power share in the tenant electricity tariff.

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Gebäude	Blasewitzer Straße 36 a-c; Version: 20.09.18
Anzahl Hauseingänge	3
Wohnungen je Hauseingang	20,33333333
Gesamtanzahl Wohnungen	61
Photovoltaikanlage	
Nennleistung PVA [kWp]	33
Spezifischer Ertrag [kWh/kWp]	900
Jahresenergieertrag [kWh]	29.700
Nennleistung PVA je Hauseingang [kWp]	11,00
Strombedarf	
ø Verbrauch je Wohnung p.a. [kWh]	1.400
Gesamtbedarf [kWh]	85.400
Abschätzung der teilnehmenden Mieter	
Auswahl: Neubau oder Bestand	Bestand
Teilnehmende Mieter	75%
Stromlieferung Mieterstrom [kWh]	64.050
Abschätzung Eigenverbrauchs- und Autarkiequote in der Mieterstrom-Bilanz	
Stromlieferung Mieterstrom [kWh]	64.050
Jahresenergieertrag PVA [kWh]	29.700
Eigenverbrauchsquote (EVQ)	75%
Solarer Anteil Mieterstrom im Objekt [kWh]	22.275
Autarkiequote (ATQ)	35%
Reststromlieferung Mieterstrom im Objekt [kWh]	41.775

Zusammensetzung der Wohnungen
Leerstand: 4%
- 3 Eingänge (a, b und c)
- 61 Wohnungen:
  - 23 WE in 36a (3 im EG, 4 je Etage, 5-Geschosser)
  - 12 WE in 36b (2 je Geschoss, 5-Geschosser)
  - 26 WE in 36c (2 im EG, 4 je Etage, 6-Geschosser)

Figure 18: Simulated energy balance in the tenant electricity tariff

The calculation of the tenant electricity tariff is based on the expected mix of the solar electricity supply from the photovoltaic system and the residual electricity supply from the public electricity grid. The mix is simulated and determined for the observation period of a calendar year. The following illustration shows the calculation of the tenant electricity tariff based on this.

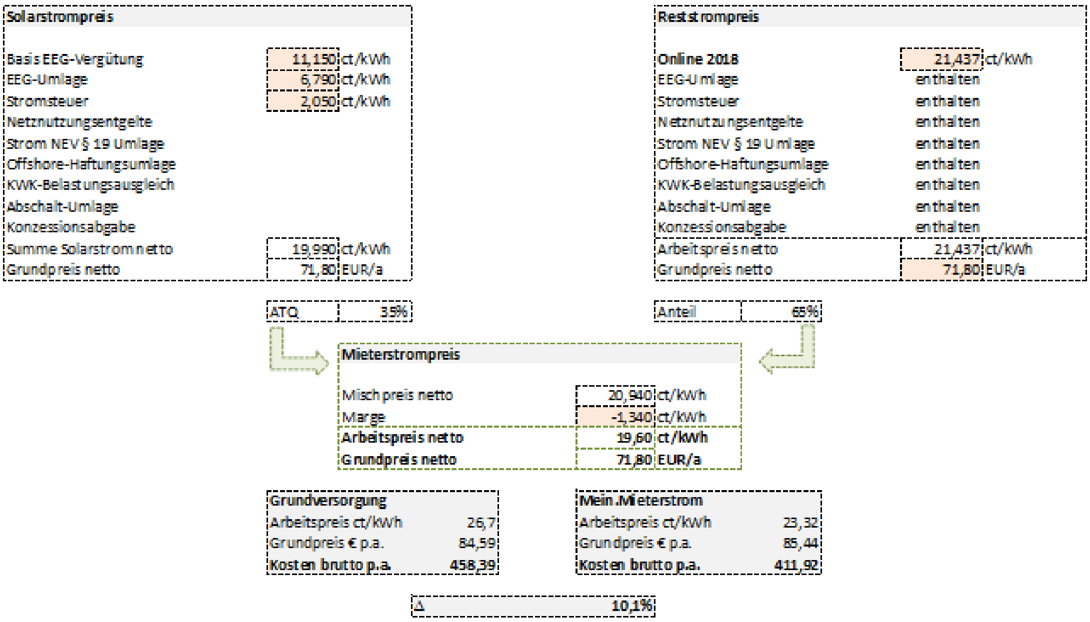

Figure 19: Calculation of the tenant electricity tariff

The basis for determining the solar electricity price is the EEG remuneration for solar electricity fed into the public grid that is valid in Germany. This secures the financing of the system regardless of the number of tenants participating in the tenant electricity model.

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In the course of the installation of the photovoltaic system, DREWAG NETZ determined that the meter systems no longer comply with the current valid technical regulations. In the course of this, the old meter systems were dismantled and new, regulation-compliant meter stations were erected at considerable additional expense. The new meter stations were put into operation on 15.05.2019.

In the same calendar week, DREWAG started selling the tenant electricity model. All 61 tenants received a cover letter and information sheet as well as their tenant electricity contract. In week 23, those tenants who have not yet returned their registration will receive a reminder letter in order to attract as many participants as possible to the model.

4.3.4 Health, safety and waste management requirements

Not applicable for this Action.

4.3.5 Risks considered ex-ante and proposed risk-mitigation measures

- Despite of our intensive research on mounting systems, the static engineer of VON identified insurmountable problems of the roof in a late stage of the planning phase. This led to a change of the apartment building to be used as within the MAtchUP-project and to adjust the energy model to the new building block.
- Interest rate of the tenant electricity model is poor.
- Depending on ongoing investigations on economic feasibility and partners for the Car sharing to tenant's milestone M2 is still vague.

4.4 Action 02: Building control center: 12 Public Buildings energy managed

4.4.1 Management structure

The action is led by and executed by DRE (building owner, operator of building control center) with technical and scientific support of EASD as a Third Party (simulation, monitoring concept and concept for technical equipment).

4.4.2 Technical specification

Within the MAtchUP project, ~12 selected public buildings in the high-performance district Johannstadt shall be equipped with intelligent metering devices (for the heating system) and connected to the Building Control Center, currently under construction. In the near-term, the initiative will be up scaled to public buildings across the city of Dresden.

To conduct a detailed simulation model and develop a measurement and monitoring concept, a pilot building has been selected. This school building is a standardized

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building type. Thus, results can be transferred to many other buildings in the city and beyond.

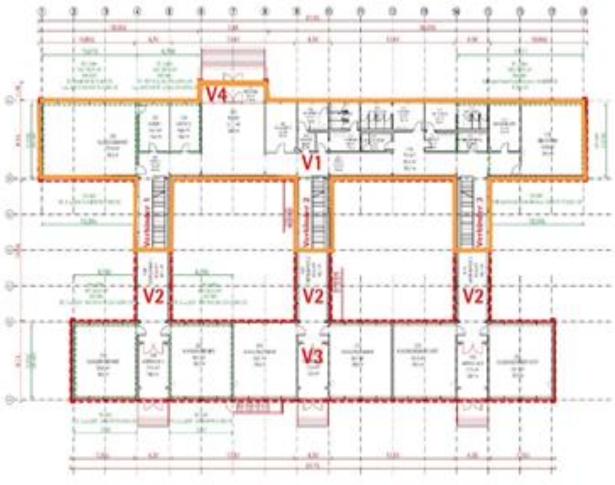

Figure 20: Floor plan pilot building (standardized school building type)

For this pilot building (102nd primary school, Pfotenhauer Str. 40), the following tasks have been finalized:

*1: Simulation Model for the pilot building:

The basis for the energy simulation is the building and energy system model. This is parameterized based on ground plans, the energy certificate and other data supplied by the executing agency. The model is implemented in SimulationX and the GreenCity library. In addition to the building-specific data, the model also integrates the local climate conditions. These include outside temperature, wind speed and direction, precipitation and solar radiation. Furthermore, a system technology is modeled according to the real model. The model is shown in Figure 21.

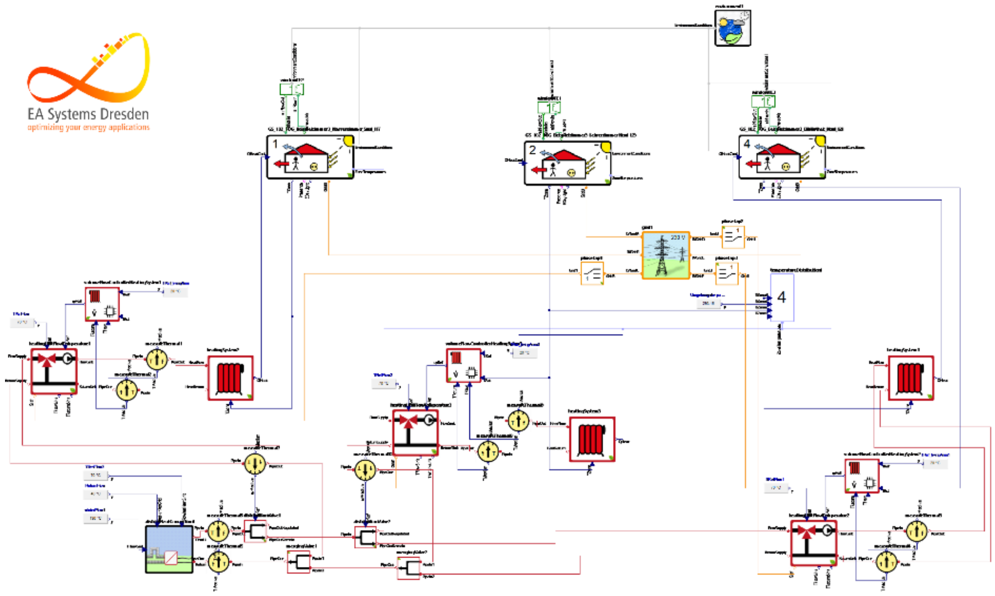

Figure 21: Simulation model of representative rooms

The simulation of the building model as a virtual twin makes it possible to quickly, easily and effectively determine the energy saving potential in different scenarios, with different variants and different focus points. For a correspondingly high resolution of the simulation results, an output step size of maximum one minute is used for the result profiles and a 15-minute output step size is used for the yearly sum results. In addition, the model is simulated over the entire reference year in order to estimate all seasons, the associated environmental conditions, and their influence on the energy system.

The following scenarios have already been examined with the help of this model:

- Influence of outdoor shading on room temperature
- Potentials of a ventilation system compared to the previous window ventilation in terms of room climate, comfort and energy savings for this object.
- Measures for improved heating control (e.g. heating curve control, reduction of the flow temperature at night, controllable thermostats for demand-oriented room temperature control)

In addition, the following further investigations are planned:

- Influence of a thermostat control with open windows on the energy demand
- Reaction of room temperature to window ventilation and comparison with measured values

**2: Monitoring concept*

In addition to the simulation model, real data will also be collected in the specific school building, monitored and stored on the urban platform. For this purpose, a monitoring concept was developed by EASD. This includes the measurement of the heat demand, which is covered by district heating. Furthermore, the electrical consumption in the building and the exact location-specific weather data. These data are stored digitally and sent via the Internet to a local server, which stores the data and allows them to be visualized as part of the monitoring process. Figure 22 shows the current status of the monitoring visualization.

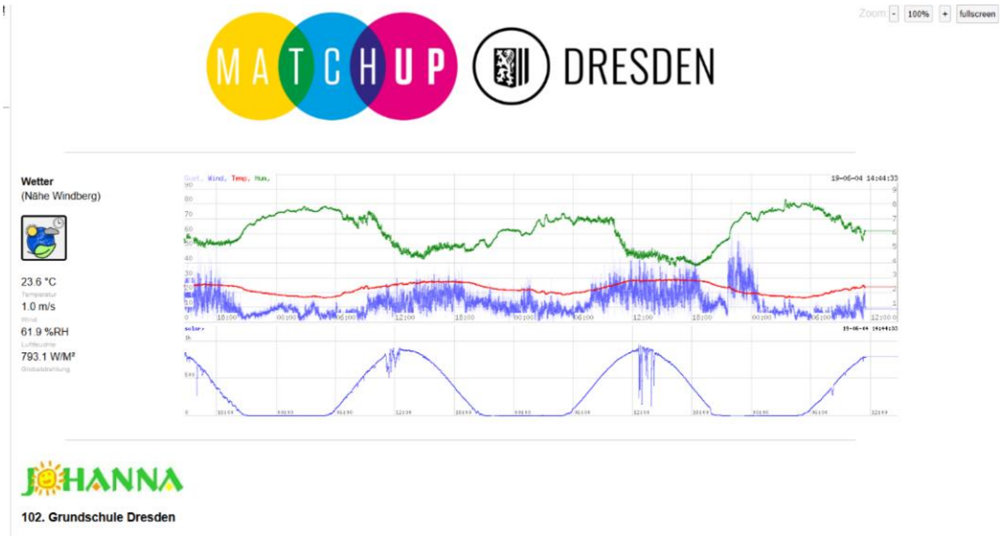

Figure 22: Current Monitoring Visualization

4.4.3 Planning of the tasks

During the first two MAtchUP project years [M1-M24], the following steps have been finalized:

- Selection of public buildings to be connected to the CBCC and selection of one representative public building for the simulation model.
- Simulation model for the pilot building
- Measurement and monitoring concept for the pilot building
- Tender for the supply of measurement, monitoring and control elements. Choice of specific technical components and respective order.

Next Milestones:

- Until 09/2020 [M36]: Launch of the CBCC with at least one connected public building
- Until 09/2020 [M36]: Material for —climate coaching (e.g. in schools) based on the simulation model and the evaluation with real data (monitoring concept by EASD) and data from the CBCC
- Until 09/2020 [M36]: Connection of all 12 pilot buildings to the CBCC
- Until 09/2022 [M60]: Continuous monitoring and evaluation

Gantt diagram:

2018				2019				2020	2021	2022
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
	(1)	(1)								
		(2)								
			(3)	(3)	(3)					
					(4)					
						(5)	(5)	(5)	(5)	(5)
						(M1)	(M2)	(M3)		

4.4.4 Health, safety and waste management requirements

Not applicable for this Action.

4.4.5 Risks considered ex-ante and proposed risk-mitigation measures

1. The initial list of buildings envisaged to be connected to the CBCC (i.e. 5 schools, 6 children's day care facilities and 1 administrative building) had to be updated. It now includes 5 schools, 2 profession schools, 1 gym, 3 children‘s day care facilities and 2 administrative buildings.

This deviation will neither cause any delays, nor will it have an impact on the project budget.

2. The permanent timely adaptation taking into account internal and external climatic conditions will target only the heating system for certain buildings, i.e. for the cases where no ventilation system is in place.

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This deviation will neither cause any delays, nor will it have an impact on the project budget.

3. Not all data will be integrated into the Dresden Urban Platform, but rather selected and useful data. Moreover, it still has to be decided, which (anonymized) datasets under which level of aggregation can be released as Open Data.

This deviation will neither cause any delays, nor will it have an impact on the project budget.

4.5 Action 43: Smart-Meter-Gateway in District Future House

4.5.1 Management structure

DWG has a managing and coordinating role in this action. Sales departments are in contact with tenants and employees from the network department. Together with IT-department, they develop the technical measuring station operation and oversee the exchange of information.

The meter data is then analyzed with the help of the service provider-engineering firm Last-and Energy Management (LEM) from Leipzig. WGJ provides roof areas and access to the building.

4.5.2 Technical specification

The District Future House has a variety of measurement and sub measuring issues. The evaluation is done via an implemented energy management system (housing manager), the RIECON-system. The housing manager serves as a platform for the energy demand in the flats, such as heating and ventilation control, consumption recording for heat, water and electricity as well as a terminal for operation, display and communication with the apartment manager or service providers. Communication to the actuators and sensors takes place via standardized interfaces and via a company-specific RIECON bus. The building manager collects and archives all consumption data from the connected building energy management system, analyzes the demand requirements for heating and ventilation. It determines the optimal control parameters for the heat generators and ventilation units. At the same time, the building manager is in communication via interfaces for connected service portals, such as the Urban City platform.

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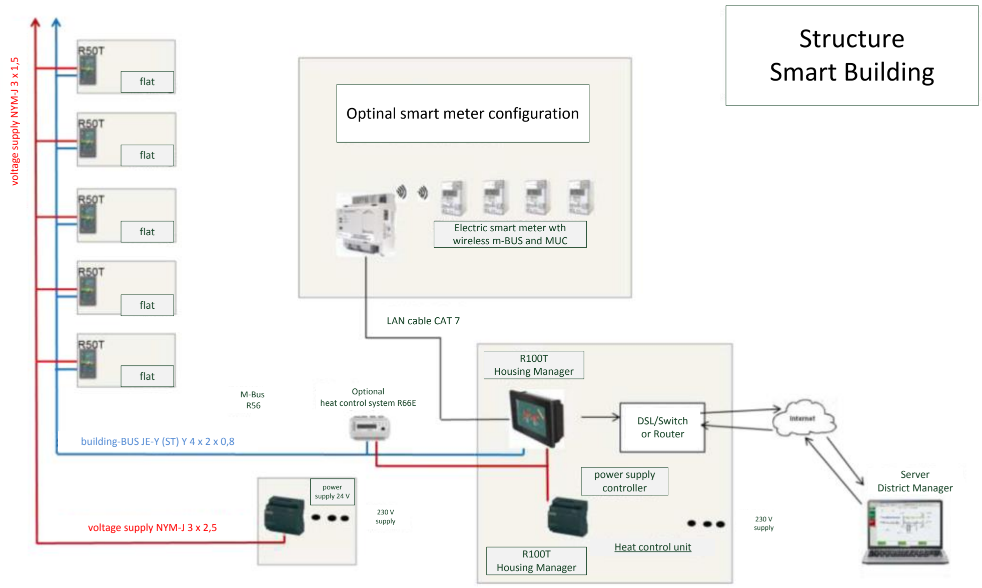

Figure 23: Scheme Measurement System RIECON (Source: Regelungskonzept RIEcon Smart Building, RIEDEL)

In addition to the data of the housing manager, data from the PV system (Action 4), the house lighting, the apartment meter system (Smart meter), the district heating system, the underground car park, the battery storage and other potential systems (e.g. electric storage systems,...) can be added to the building energy management system.

The partner LEM is in charge of the structured evaluation of the energy data. Daily meter data of the apartments, the PV system, the energy storage and the hot and cold water consumption are handed via LEM in a 15 minute granularity. As well as historical data, the high-resolution meter data is visualized on this base.

Based on a forecast, the user will be enabled to estimate his future consumption as an added value and assess his previous consumption. Figure 24 shows the system image of the data analysis.

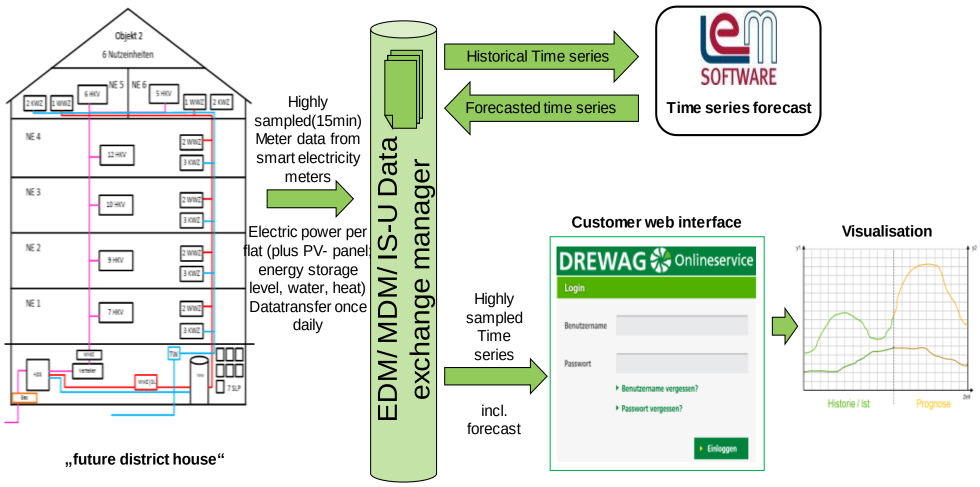

Figure 24: System image of data analysis and forecast

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This analysis based on metering data facilitates different services which are available for the user and other market participants. Together with the data of the PV feed-in, new flexible energy tariffs can be offered (Action 1).

4.5.3 Planning of the tasks

Action 43 is strongly linked to the progress of the District Future House (Action 9) and the PV system (Action 41) . The implementation of the RIECON system is up-to-date. For now it is not possible to implement intelligent measurement systems (in accordance with Section 2 (7) of the German regulation framework on Smart Meter), due to the currently pending certification. Furthermore, data analysis showed that compliance with data protection (according to EU GDPR) plays a very important role.

For the evaluation and forecast of the apartment meters, the data of 16 electricity meters (14 of residential units, 1 of PV system, 1 house light) have to be transmitted. Drinking water and district heating data are considered aggregated for the entire house. In addition, disturbance detection data should be incorporated. The exchange of data takes into account the current legislation regarding the transmission, processing and visualization of customer data.

Other topics include the development of the data interfaces on LEM and the visualization in the customer interface.

The development of functions for the presentation and prognosis of time series of an electricity meter based on intelligent measurement systems at the residential and connection level has already been completed.

Gantt diagram:

2018				2019				2020	2012	2022
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
		(1)	(1)	(1)						
				(2)	(2)					
					(3)	(3)				
						(4)	(4)			
						(5)	(5)	(5)	(5)	(5)
						M1	M2			

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

Next Milestones:
(M1) Completed function check forecasting tool
(M2) Development customer interface

The action started in month 07 and is expected to end in month 25 of MAtchUP.

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4.5.4 Health, safety and waste management requirements

Not applicable for this Action.

4.5.5 Risks considered ex-ante and proposed risk-mitigation measures

Still pending process of certification of Smart Meter System of federal office for information security. GDPR compliant data acquisition of measurement and sub-measurement systems is linked to the consent of end customers.

4.6 Action 04: 226 kWp photovoltaic system on existing buildings

4.6.1 Management structure

DREWAG is responsible for the planning, erection (by subcontractors) and construction supervision of the photovoltaic system, as well as calculation of the tenant electricity model and acquisition of the tenants. VONOVIA provides roof areas and access to the building. EASD simulates the energy model data.

4.6.2 Technical specification

Planning status of PV-system Blasewitzer Str. 36:

- Nominal power PVA 33 kWp (11 kWp for each stairway)
- Specific solar yield 900 kWh/kWp
- Annual PV-generation 30.000 kWh/a

The projected power consumption in the object is about 85,000 kWh/a and the own consumption has been determined to 22.275 kWh/a, if 75% of the tenants participate. This leads to an own consumption rate of 75% (without a storage system, see Action A42) and an autarky ratio of 35 % for the participating tenants. Using the CO2 intensity of the German electricity mix (471 g/kWh), this PV system will save approximately 14,1 tons of CO2 per year.

The photovoltaic system was planned in 08 and 09/2018.

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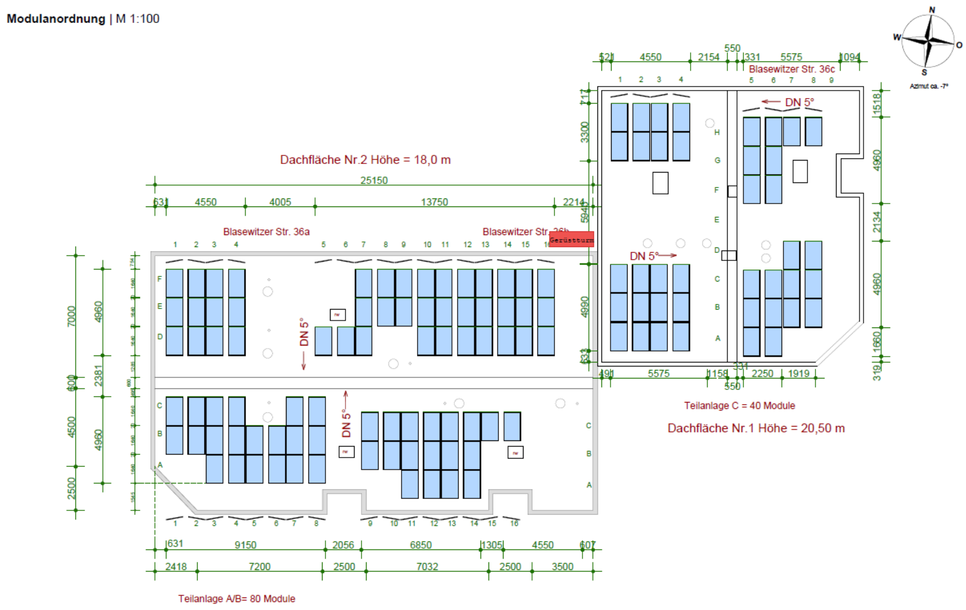

Figure 25: Module layout plan

4.6.3 Planning of the tasks

Gantt diagram:

2018				2019				2020	2021	2022
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
(1)	(1)	(1)								
		(2)								
			(3)	(3)	(3)					
					(4)					
						(5)	(5)	(5)	(5)	(5)
						(M1), (M2)	(M3)			

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

(M1) Info Screen for photovoltaic generation
(M2) Monitoring of energy data and improvement of tenant electricity simulation
(M3) Integration of electromobility

The action started in month 04 and ended in month 20 of MAtchUP.

As described in Action A9, there was a need for changing the apartment building due to static issues of the roof.

Status of PV-system Pfotenhauer Str.

To avoid any project delay, we already carried out a quite complete planning of the PV system (number and alignment, cabling, contracts). As there is no certified mounting system of PV panels at a height of >30m, we had to analyze the static roof situation in detail. In consequence, no additional roof load could be accepted. Thus, we had to cancel the approach for the originally envisaged apartment building.

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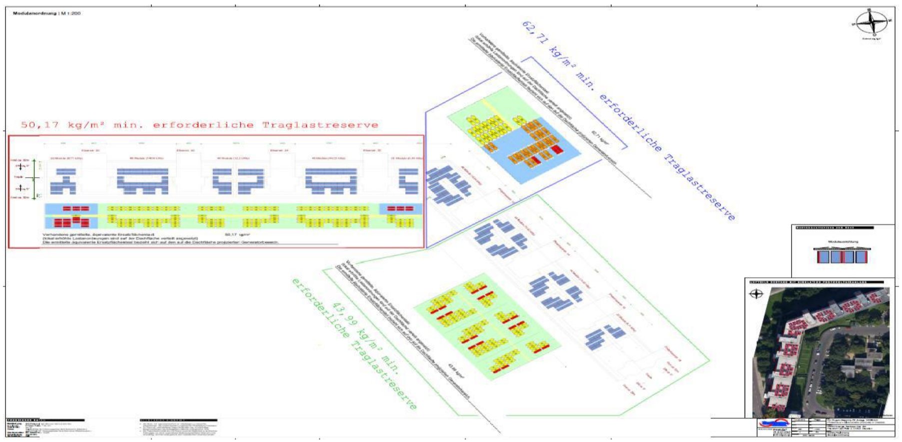

Figure 26: Planning status of PV-system Pfotenhauer Str.

Our project partner VON identified and put at disposal for the MAtchUP project an alternative building. That is where we started the planning again.

Status of PV-system Blasewitzer Str. 36

Gebäude	Blasewitzer Straße 36 a-c; Version: 20.09.18	
Anzahl Hauseingänge		3
Wohnungen je Hauseingang		20,33333333
Gesamtanzahl Wohnungen		61
Photovoltaikanlage		
Nennleistung PVA [kWp]		33
Spezifischer Ertrag [kWh/kWp]		900
Jahresenergieertrag [kWh]		29.700
Nennleistung PVA je Hauseingang [kWp]		11,00
Strombedarf		
ø Verbrauch je Wohnung p.a. [kWh]		1.400
Gesamtbedarf [kWh]		85.400
Abschätzung der teilnehmenden Mieter		
Auswahl: Neubau oder Bestand		Bestand
Teilnehmende Mieter		75%
Stromlieferung Mieterstrom [kWh]		64.050
Abschätzung Eigenverbrauchs- und Autarkiequote in der Mieterstrom-Bilanz		
Stromlieferung Mieterstrom [kWh]		64.050
Jahresenergieertrag PVA [kWh]		29.700
Eigenverbrauchsquote (EVQ)		75%
Solarer Anteil Mieterstrom im Objekt [kWh]		22.275
Autarkiequote (ATQ)		35%
Reststromlieferung Mieterstrom im Objekt [kWh]		41.775

Zusammensetzung der Wohnungen
Leerstand: 4%
- 3 Eingänge (a, b und c)
- 61 Wohnungen:
  - 23 WE in 36a (3 im EG, 4 je Etage, 5-Geschosser)
  - 12 WE in 36b (2 je Geschoss, 5-Geschosser)
  - 26 WE in 36c (2 im EG, 4 je Etage, 6-Geschosser)

Figure 27: Energy balance in the tenant electricity model

The plan of roof load, roof ballasting is currently under revision. Technical issues such as mounting method via crane and cabling plan have been solved already.

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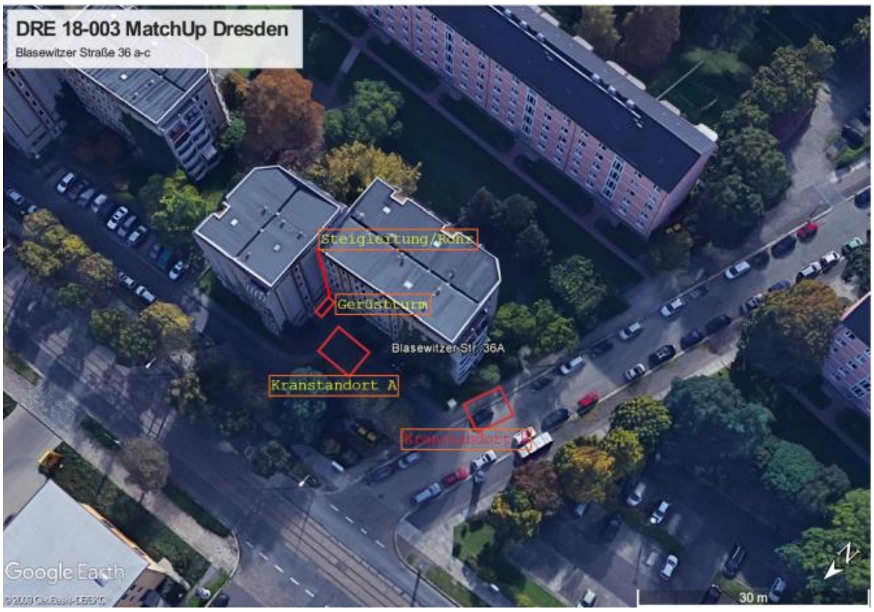

Figure 28: Construction plan (cable and crane)

For the construction of the photovoltaic system, DREWAG has concluded a separate roof usage agreement with VONOVIA in 07/2018, which regulates the planning, installation and operation of the system by DREWAG on the VONOVIA building. The photovoltaic system was planned in 08 and 09/2018 and completed in 12/2018 after the start of construction in 10/2018.

Figure 29: Illustration Mounting photovoltaic system

In course of the installation of the photovoltaic system, DREWAG NETZ determined that the meter systems no longer comply with the current valid technical regulations. In the course of this, the old meter systems were dismantled and new, regulation-compliant meter stations were erected at considerable additional expense. The new meter stations were put into operation on 15.05.2019.

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In the same calendar week, DREWAG started selling the tenant electricity model. All 61 tenants received a cover letter and information sheet as well as their tenant electricity contract. In week 23, those tenants who have not yet returned their registration will receive a reminder letter in order to attract as many participants as possible to the model.

Next Milestones

- Info Screen for photovoltaic generation

- Monitoring of energy data and improvement of tenant electricity simulation.

- Integration of electro mobility

4.6.4 Health, safety and waste management requirements

Not applicable for this Action.

4.6.5 Risks considered ex-ante and proposed risk-mitigation measures

The start of the construction and commissioning of the PV-system is delayed by approx. 6 months.

By changing the apartment building for this action,

- there is also a spatial separation of the actions for energetic renovation (Action A7) and PV/ tenant electricity model

Also:

- Milestone M1 stands under prerequisite of the pending decision of the housing company (VON). We are in an ongoing reconciliation process.

Depending on investigation results of economic feasibility and partners for the Car sharing to tenants milestone M2 is still vague.

4.7 Action 41: 8.7 kWp photovoltaic system in District Future House

4.7.1 Management structure

This action is led and executed by DWG. DREWAG is responsible for the planning, erection (by subcontractors) and construction supervision of the photovoltaic system, as well as calculation of the tenant electricity model and acquisition and customer-care of clients of the tenants' electricity model.

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4.7.2 Technical specification

Here are the main characteristics of the PV-system:

- Nominal output PV system 9.92 kWp
- High-performance modules from LG with 320 Wp each
- Power generation 9,200 kWh p.a.
- Varta storage system, usable capacity 3.3 kWh
- Expected own consumption rate of up to 80%.
- Expected degree of self-sufficiency up to 40%.

Figure A41-1 represents the results of the planning phase concerning the yield-optimized PV-module assignment on the rooftop. In the planning-phase, we also had to proof roof-statics which lead us to a system-choice of the mounting-system (Figure A41-2).

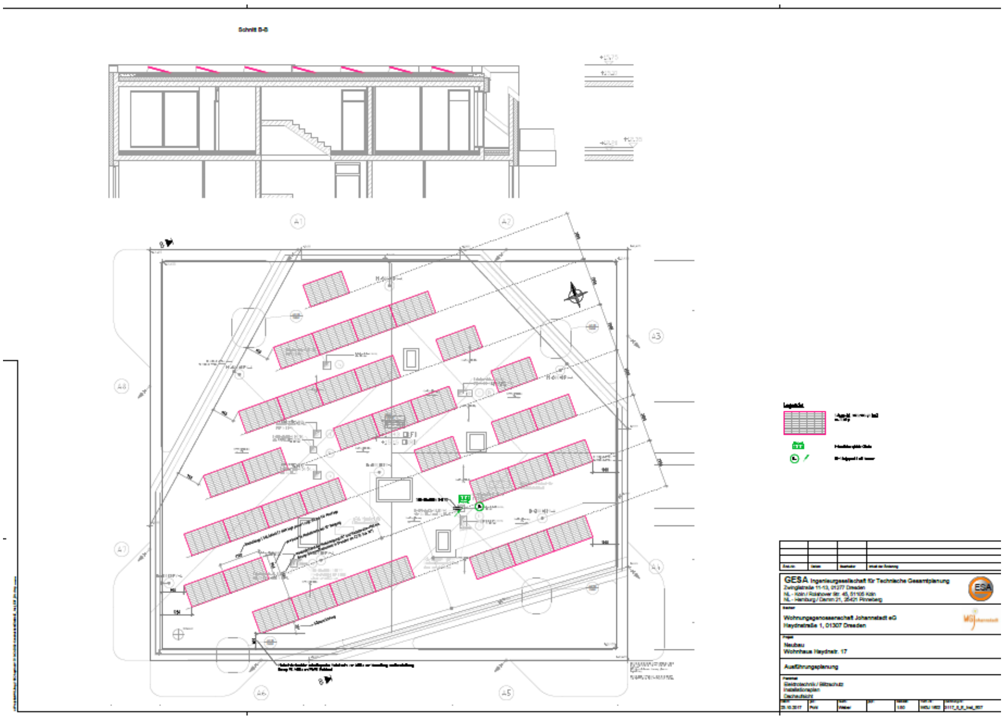

Figure 30: PV-module assignment plan at Haydnstr.

4.7.3 Planning of the tasks

Template for Gantt diagram:

2018				2019				2020	2021	2022
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4			
(1)	(1)									
	(2)	(2)								
			(3)	(3)	(3)					
					(4)					
						(5)	(5)	(5)	(5)	(5)

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(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

Implementing a PV-system into an apartment building aims to provide the tenants a maximum ratio of an energy, which is produced in the object with renewable energies. Within the planning process we calculated the autarky rate of the apartment building.

If a participant quota of 75% to the Tenant electricity model is assumed: The projected power consumption in the object is about 22,757 kWh/a and the own consumption has been determined to 28,350 kWh/a. This leads to an own consumption rate of 70 % and an autarky ration of 36 % of the entire apartment.

Hence, this PV will save appr. 3.8 tons/year of CO2.

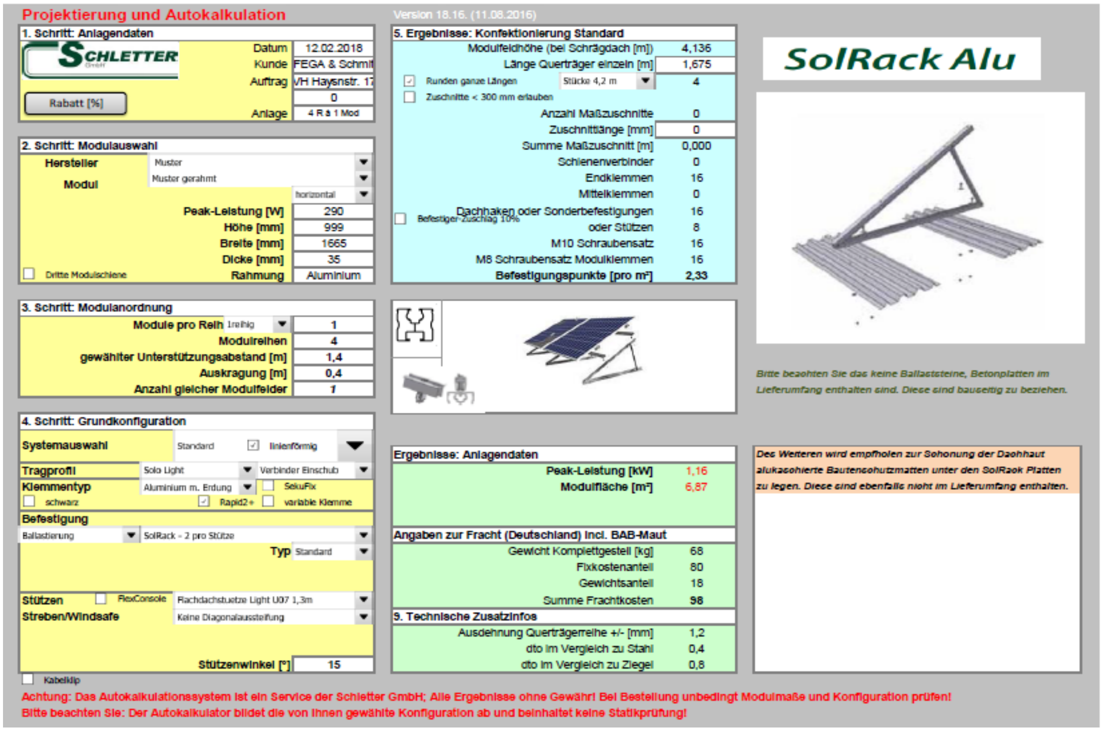

Figure 31: Static report on mounting systems at Haydnstr.

Planning and construction of the photovoltaic system and the electricity storage system

The planning of the photovoltaic system and the storage system took place from 03/2018 to 06/2018. The heavily built-up roof (roof hatches, terraces etc.) proved to be particularly challenging. To ensure that sufficient electrical power could be installed, an individualised assembly system had to be planned, the purchase of which entailed considerable additional costs. In addition, high-performance photovoltaic modules were used. Another challenge was the interim replanning of the storage system, as the manufacturer of the already planned system unexpectedly stopped production.

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Delivery and installation of the PV system and storage system started in 11/2018 and was completed in 05/2019 so that the system could be commissioned in 05/2019.

Figure 32: Figure 33: Photovoltaic system on the future house

4.7.4 Health, safety and waste management requirements

Not applicable for this Action.

4.7.5 Risks considered ex-ante and proposed risk-mitigation measures

Not applicable for this Action.

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4.8 Action 05: Integration of the power supply system of the retrofitted buildings with the District Storage System

4.8.1 Management structure

The action is led and executed by DWG in the cooperation of VON (apartment building owner), FHG and EASD (simulation models for energy).

4.8.2 Technical specification

First analyzes of renewable power availability as well as individual power demand of building and inhabitants (c.f. A1, A18) indicate that a district storage system does not well match with current economic, technic and regulatory boundaries. Renewable power surplus to be stored as well as corresponding sales revenue are too low to provide significant advantages for both the local utility as well as the inhabitants.

Thus, there will be no need to build up an advanced power supply system. (see Action A18)

However, future energy market developments as well as increasing requirements on grid stability will change this situation within the upcoming decade. To already meet these challenges, the considered retrofitted buildings will be analyzed with the developed simulation models (c.f. A1, A 18) to identify break-even conditions and future state of the market regarding suitable storage sizing and integration measures. However, there will not take place any physical integration measures of a real-world storage system in the considered buildings due to the above described situation, yet.

4.8.3 Planning of the tasks

Template for Gantt diagram:

Year 1				Year 2				Year 3	Year 4	Year 5
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
(1)	(1)	(1)	(1)							

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

Progress done from D3.1 (M12):

Within Action A18, a district storage was initially planned to construct¸ this Action A5 is based on this.

We were redesigning this task, taking into consideration new projects to be implemented into the electric grid and to houses.

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Since there will be no feasible realization of a District storage system it is obsolete to step on and design a power supply system with this asset. Thus, no further project phases or milestones can be planned.

4.8.4 Health, safety and waste management requirements

Not applicable for this Action.

4.8.5 Risks considered ex-ante and proposed risk-mitigation measures

The risks of this action are derived from the decision to install of a district storage unit (Action 18).

4.9 Action 42 Power Storage in District Future House

4.9.1 Management structure

This action is lead and executed by DWG in partnership with WGJ. DREWAG is responsible for the planning, erection (by subcontractors) and construction supervision of the photovoltaic system, as well as calculation of the tenant electricity model and acquisition of the tenants. WGJ provides roof areas and access to the building. EASD simulates the energy model data.

4.9.2 Technical specification

Planning of the electric storage is an integral part of the project Future House.

We planned with a storage system with following parameters:

- Manufacturer / Type: Varta Element 3
- Technology: Lithium
- usable capacity [kWh]: 3,3
- Battery connection: AC
- Electrical power [kW]: 1,6

After the manufacturer was replaced, the originally planned storage-system from the market was re-chosen. The re-planning took place in the period from 03/2018 to 06/2018 resulting the use of the above-mentioned storage system.

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Figure 33: Information on the storage system

It was important to find a system that could be integrated on the AC side. This enabled us to set a bidirectional electricity meter in front of the storage in order to model and bill the system in the tenant electricity model.

The storage system will raise the own consumption rate of the PV-energy inside the building.

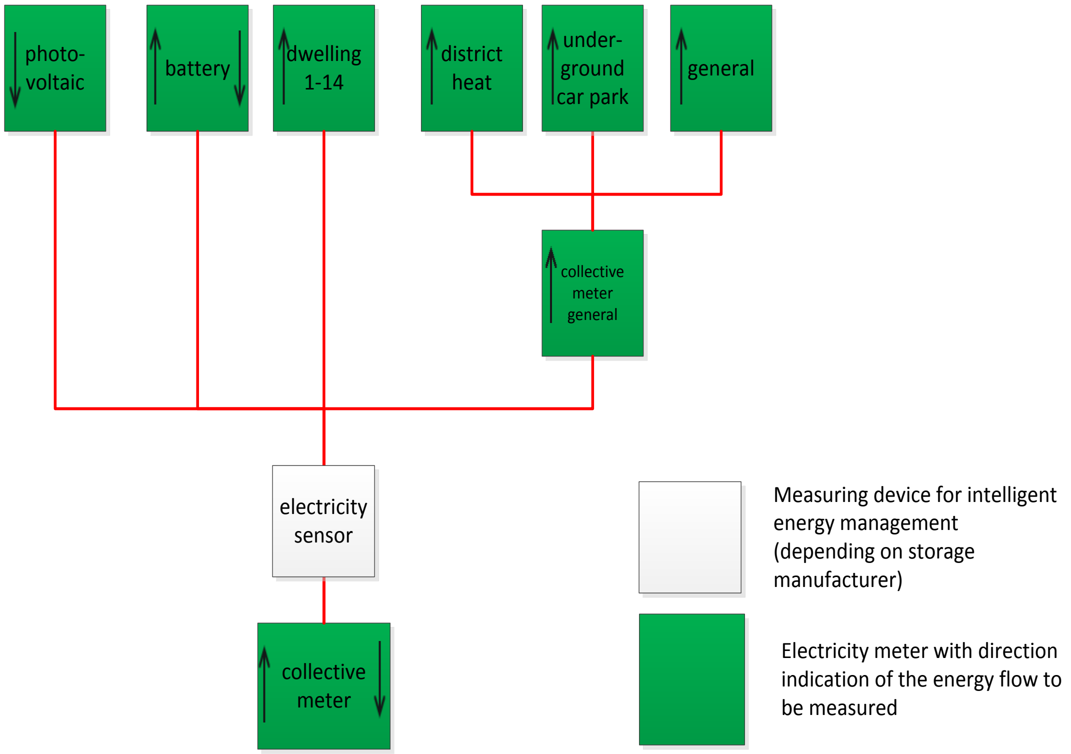

Figure 34: Electricity meter concept future house

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4.9.3 Planning of the tasks

Template for Gantt diagram:

Year 1				Year 2				Year 3	Year 4	Year 5
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
(1)	(1)									
	(2)	(2)	(2)							
				(3)	(3)					
						(4)				
						(5)	(5)	(5)	(5)	(5)
						M1	M2		M3	

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

08/18: Tendering and procurement

Q4/18: Construction and commissioning

Delivery and installation of the PV system and storage system started in 11/2018 and was completed in 05/2019 so that the system could be commissioned in 05/2019.

4.9.4 Health, safety and waste management requirements

Not applicable for this Action.

4.9.5 Risks considered ex-ante and proposed risk-mitigation measures

Not applicable for this Action.

4.10 Action 40: E-Cars for housing sector

4.10.1 Management structure

The action is led and executed by DWG in cooperation with VON (E-Car Supply) and FHG (Data-Evaluation). For the implementation, the following departments work together: Sales, marketing, business customers. VON will be responsible to coordinate the construction of the charging stations. The e-cars will be used by VON for their craftsmen. FHG is in charge of tracking the data from the cars and provide derived reports.

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4.10.2 Technical specification

With our project partner VONOVIA SE we are planning to use electric vehicles within the MAtchUP-project. The electric vehicles are to replace the Golfs currently in use with internal combustion engines.

For that, DWG ordered 5 VW E-Golfs which are going to be provided to VON.

The underlying vehicle rental contract DWG ./. VON has been drawn up and negotiated.

It is planned to use these electric cars in two focus groups:

- VONOVIA employees (e.g. housekeepers, service)
- Tenants

We are busy identifying utilization concepts for the electric cars which provide a high degree of utilization for employees and tenants within this action.

There will be one parking lot for electric cars and 8 charging points are available. 5 charging stations are to be used by VONOVIA and 3 by third parties. Because of the change of the apartment building (see Action 1) the charging points were relocated to a VON-parking at Blasewitzer Str. 53.

To evaluate the mobility-scenarios different data are needed. Mobility-data can be derived from cars onboard-unit and charging stations. Initial discussions were held to evaluate the mobility data of the vehicles.

DWG operates access and billing systems for electric mobility. The planned inclusion of tenants has not yet been realized. Therefore, different variants of role models are currently being discussed. This involves redefining all necessary service components, including the required partners.

4.10.3 Planning of the tasks

Year 1				Year 2				Year 3	Year 4	Year 5
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
			(1)	(1)						
				(2)	(2)					
					(3)	(3)				
						(4)				
						(5)	(5)	(5)	(5)	(5)
						M1	M2			

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

Milestones
(M1) Development vehicle booking system
(M2) Drawing up contracts for the rental of electric cars to VONOVIA tenants

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

For the construction of the charging infrastructure, the offer and planning are signed by VON. It is contracted that the construction will start as soon as the eGolfs are handed over to the craftsmen of VON. The final charging infrastructure will be available before the end of M24.

As the craftmens of VON have their working places at the Pfotenhauer Straße (2km from Blasewitzer Straße) it is planned to have two new charging sites (at Blasewitzer- and Pfotenhauer Straße) instead of only one at Blasewitzer Straße. The first site at Pfotenhauer Straße will be provided for the 3 eGolfs and the second site at Blasewitzer Straße will be provided for the car sharing service. Initially it was planned that all 5 e-cars should be charged with photovoltaic and used as car sharing with special conditions of the tenants of the “smart tenant house” at Blasewitzer Straße. The current situation is, that VON will provide 3 eGolfs (ordered by DWG), which will be used by their craftsmen, and 2 e-cars will be provided s by a car sharing service, which will be used by tenants.

Figure 35: Take-over of 3 eGolfs by VON-staff

Earlier as expected, the 3 eGolfs were handed over on 29 May 2019 after 4 vehicles (Corsa Gasoline) of VON were destroyed by arson on 19 May 2019. Resulting, currently there are no charging possibilities at the parking lot of VON. As a temporary interim solution, the eGolfs will be loaded on public charging stations.

Figure 36: VON vehicles destroyed by fire attack

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For the two e-cars provided by a car sharing service, the potentials for realization of different options were under discussion, resulting in the decision to cancel e-car sharing activities for tenants if no economic development path is found. Therefore tenants might receive a voucher to use an external car sharing offer. Content and extent are yet to be defined.

Carsharing service provider	Assessment
Deutsche Bahn Connect GmbH	The Deutsche Bahn Connect GmbH provides the hard-/software for the reservation and billing system for Flinkster and TeilAuto. We can also use these two components. Advantage: - use of existing hard-/Software (app) - own client with subclients - we could set up and charge our own prices - opening the platform to other users outside MAtchUP project - use for car sharing community Disadvantage: - Very high implementation and usage fees - manual care of the system
TeilAuto	- Label “TeilAuto” and not VON possible - Charging station at Bönischplatz (far away) - Profitability gap was indicated, funding requested by DWG Project risk: Lack of demand from e-cars in car sharing; Economic operation extremely difficult to implement
Flinkster (VON partner)	Flinkster opposes the provision of e-cars for economic reasons.

To evaluate the mobility-scenarios different data are needed. The evaluation will be done by FhG. Mobility-data can be derived from cars onboard-unit and charging stations. Initial discussions were held to evaluate the mobility data of the vehicles. FHG is already informed about the new e-cars. The tracking devices will be installed as soon as VW accept this.

Next Milestones (Q3/2019):

- Development vehicle booking system
- Drawing up contracts for the rental of electric cars to VONOVIA tenants.

4.10.4 Health, safety and waste management requirements

Not applicable for this Action.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement N°774477

4.10.5 Risks considered ex-ante and proposed risk-mitigation measures

Several issues concerning security of private data concerning mobility data were identified. Required data from planned onboard-units have to be redefined by FHG and to be approved by VON. Due to the high data protection guidelines of german car manufacturer VW, the project expenditure might be increase and effect the timeline for monitoring. Economic feasibility of eCarsharing to tenants is still under examination and might cause delays in the project. DWG entered in a discussion process with VON, DVB to find solutions for this issue.

4.11 Action 38: Energy efficient design of the real estate

4.11.1 Management structure

The actions are led by VON.

4.11.2 Technical specification

To analyse the efforts done in the previous actions and decrease future efforts regarding planning, profitability and timing, VON plans to develop a business model for energetic transformation of real estates. with guarantee of energy cost savings. The implementation will consist on the analysis of current energy state of existing buildings followed by the definition of actions and finally the large scale modernization of building energy technologies with energy-saving contracts, monitoring, controlling, energy consulting and performance optimization.

4.11.3 Planning of the tasks

Template for Gantt diagram:

Year 1				Year 2				Year 3	Year 4	Year 5
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8			
(1)	(1)									
	(2)	(2)	(2)							
				(3)	(3)					
						(4)				
						(5)	(5)	(5)	(5)	(5)
						M1	M2		M3	

(1) Design phase
(2) Selection of equipment and installers
(3) Installation of hard-/software
(4) Start of operation
(5) Monitoring

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(M) Next milestones:
2019: Interim meter reading in order to track changes in energy consumption

2019: Development of the business case underlying the business model

4.11.4 Health, safety and waste management requirements

Not applicable for this Action.

4.11.5 Risks considered ex-ante and proposed risk-mitigation measures

Not applicable for this Action.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

5 Status of the intervention

5.1 Action 07: Pfotenhauer Str. Retrofitting project

5.1.1 Status of the intervention

The first constructional measurers (Pfotenhauer Str. 30 /32-36) have started in 2018 and include the installation of balconies, energetic restorations and the insulation of facades. The modernisation measures are expected to end in 3Q 2019, currently with no expected delays.

5.1.2 Risks found and corrective actions performed

1. The installation of the PV-system is not possible on this building due to statics and will be built on Blasewitzer Str. 36a-c, c.f. Action A4.
   ➔ This deviation should not cause any delays, but might have an impact on budget and planning issues.

2. Animal welfare regulations regarding certain bird species and bats that nest within the building complex. Therefore, scaffolds may only be put up during March-April or August-September. Scaffolds should be covered with a net in order to keep birds from settling down.
   ➔ If ignored, these regulations could cause noticeable delays and may have a sensitive impact on planning and budget issues.

3. Partially resistance from tenants by not opening doors / refusing to give access to their apartments. Site manager takes care of the respective residents by talking to them. In the steps they will receive multiple letters and a possible lawsuit (happens very rarely).
   ➔ This resistance could cause minor delays and can have an impact on the budget, if disputes have to be sorted out in court.

5.1.3 Business model and financial scheme applied

- Retrofitting measures, such as the installation of balconies or new entrances, will not be financed by public funding and be fully covered by own investments. These investments may result in a raise of rent. The amount to which the rent will be raised is limited by legal registrations and will be calculated with regard to the savings resulting from energy savings per living unit/m².
- Energetic restorations are financed by KfW-Effizienzhaus credits (151/152). The amount of the subsidies is calculated separately for the affected building and depends on the ex post energy efficiency of the buildings modernised. Energetic restorations are planned and operated by VON and aim at reaching KfW-Effizienzhausstandard 100 for each eligible building.
   ➔ The calculated KfW-fundings provided for Pfotenhauer Str. 18-22 are € 4,430,000. Besides the restorations explained above, the buildings will receive a renewed warm water and ventilation system.
   ➔ Similar energetic retrofitting measures are planned for the Pfotenhauer Str. 24-28, financially supported by € 4,400,000 KfW-Credits.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

- ➔ Another € 3,730,000 are provided for energetic restorations in Pfotenhauer Str. 32-36.
- The combined credits provided by KfW result in a total KfW-funding of € 12,560,000.00

Meeting these KfW-Standards, the retrofitted buildings will show a significant reduction of annual energy consumption (sum of thermal (heating or cooling) energy consumption and electrical energy consumption). This will not just lead to lower energy costs for the inhabitants but also to reduced greenhouse gases and C02 emissions, contributing to the urban development on climate change. The estimated savings per m² are about €0.25/month. The non-energetic measures aim at embellishing the whole district and therefore increasing the general living standard for all inhabitants.

5.1.4 Citizen engagement strategy implemented

Citizens/tenants are being informed about the measures by mail as legally required. In case of resistance, site managers reach out to the tenants in order to talk about and clarify controversial issues. Smart Infoscreen at outer wall/or staircase of Blasewitzerstraße 36 to show results of PV-system.

5.2 Action 09: District future house

5.2.1 Status of the intervention

The planning of the photovoltaic system and the storage system took place from 03/2018 to 06/2018. The heavily built-up roof (roof hatches, terraces etc.) proved to be particularly challenging. To ensure that sufficient electrical power could be installed, an individualised assembly system had to be planned, the purchase of which entailed considerable additional costs. In addition, high-performance photovoltaic modules were used.

Delivery and installation of the PV system and storage system started in 11/2018 and was completed in 05/2019 so that the system could be commissioned in 05/2019.

The RIECON Smart Home System was assembled and put into operation in 10/2018. Previously, the system was extensively tested on the DREWAG test stand. In addition to the functions of the Smart Home Syste, the owner can also import contact data for service providers, appointments (e.g. water cut-off) and messages into an apartment.

5.2.2 Risks found and corrective actions performed

Additional costs for the individualization of the assembly system.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

5.2.3 Business model and financial scheme applied

For this action the total DWG-budget amounts to 189,869 €.

132,908 € of this amount will be financed by MAtchUP funds, the rest of 56,960 € will be funded by DWG.

- 109,395 € for 4 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for DWG in other projects.
- 12,000 € for subcontracting for commissioning of the construction management, implementation of the PV panels and the system connections storage integration.
- 24,900 € for equipment. 10,500 € depreciation of 1 smart meter/smart meter Gateway (total cost: 35 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%) and 14,400 € depreciation of 1 building control system (total cost: 48 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%).
- 8,000 € for other goods. Therefor 3,000 € for consumables for smart metering installation and office supplies and 5,000 € for audits.
- 35,573.75 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs [without subcontracting] (=0.25 x (109,395 €+24,900 €+8,000 €)).

In the case of the approval of the 2nd amendment the financial scheme will change in the following way:

For this action, a total DWG- budget of is 194,012.50 €.

135,808.75 € of this amount will be financed by MAtchUP funds, the rest of 58,203.75 € will be funded by DWG.

- 112,710 € for 4 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for DWG in other projects.
- 12,000 € for subcontracting for commissioning of the construction management, implementation of the PV panels and the system connections storage integration.
- 24,900 € for equipment. 10,500 € depreciation of 1 smart meter/smart meter Gateway (total cost: 35 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%) and 14,400 € depreciation of 1 building control system (total cost: 48 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%).
- 8,000 € for other goods. Therefor 3,000 € for consumables for smart metering installation and office supplies and 5,000 € for audits.
- 36,402.50 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs [without subcontracting] (=0.25 x (112,710 €+24,900 €+8,000 €)).Citizen engagement strategy implemented

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

5.2.4 Citizen engagement strategy implemented

By actively involving the tenants in the test cases, digital literacy will be increased within this group. Both DWG and tenants are going to learn about how to use properly advanced building infrastructures and integrate them into regular everyday operations.

5.3 Action 01: Smart tenants

5.3.1 Status of the intervention

So far the following achievements can be listed:

- Development and negotiation of contracts concerning roof rent,
- Adaption of the DWG-contract for tenants energy model including the economic model
- Calculation of tariffs for the tenant energy model
- Execution of an energetic modeling specific demand ./. RES-generation in a minute-scale-resolution (MAtchUP-Partner EASD)
- Development of variants of PV allocation on the rooftop,
- Planning of measuring system location in the floors and the cable layout,
- Checked the fire protection of the new installations,
- Purchasing the PV- and roof mounting systems

Some of these progress statuses could be used in an adapted version for the new project site, i.e. Blasewitzer Str. 36 a-c.

5.3.2 Risks found and corrective actions performed

As a result of the analysis of the roof, it was determined that the Pfotenhauer Str. building contained in the project application / GA does not allow any additional roof load at all. Therefore, our project partner VON offered the building in Blasewitzer Str. 36 a-c as a replacement object for use within the MAtchUP project. This change will reduce the PV capacity that can be installed to approx. 30 kWp and the number of flats to 61. In the course of the installation of the photovoltaic system, DREWAG NETZ determined that the meter systems no longer comply with the current valid technical regulations. In the course of this, the old meter systems were dismantled and new, regulation-compliant meter stations were erected at considerable additional expense. The new meter stations were put into operation on 15.05.2019.

5.3.3 Business model and financial scheme applied

For this action the total DWG-budget amounts to 217,200 €.

152,040 € of this amount will be financed by MAtchUP funds, the rest of 65,160 € will be funded by DREWAG.

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- 145,860 € for 4 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for DREWAG in other projects.
- 24,900 € for equipment. 10,500 € depreciation of 1 smart meter/smart meter gateway (total cost: 35 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%) and 14,400 € depreciation of 1 building control system (total cost: 48 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%).
- 3,000 € consumables for smart metering installation and office supplies.
- 43,440 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0.25 x (145,860 €+24,900 €+3,000 €)).

In the case of the approval of the 2nd amendment the financial scheme will change in the following way:

For this action, a total DWG- budget of 184,050 € is planned.

128,835 € of this amount will be financed by MAtchUP funds, the rest of 55,215 € will be funded by DREWAG.

- 119,340 € for 4 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for DREWAG in other projects.
- 24,900 € for equipment. 10,500 € depreciation of 1 smart meter/smart meter gateway (total cost: 35 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%) and 14,400 € depreciation of 1 building control system (total cost: 48 k€ - duration: 10 yr – use in the project 3 yr – depreciation ratio: 30%).
- 3,000 € consumables for smart metering installation and office supplies.
- 36,810 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0.25 x (119,340 €+24,900 €+3,000 €)).

EASD contributes to this action as linked third party of DRE. EASD has planned a total budget of 99.375 € which are 100% financed by DRE. Total budget is planned for engineering and scientific support (modelling, simulation and energy monitoring) of DRE within this action. 1 employee is funded for 12 month and will work for EASD afterwards in other EASD projects.

5.3.4 Citizen engagement strategy implemented

We assume low/intermediate monthly income of the tenants of Blasewitzer Str. 36, which has an impact on interest in new products and services. However, via the planned tenants electricity model we allow these characteristic tenants of a typical apartment building to participate on the local RES-generation in the district.

Tenants will be informed about the contribution of ‘their‘ building to generate electricity and to reduce CO2 emissions. Furthermore, they will have the opportunity to participate in the tenant energy model to achieve a lower price for their electricity consumption than the standard tariff. Besides this they will get the opportunity to use EV‘s more easy and comfortably.Next steps

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5.4 Action 02: Building control center: 12 Public Buildings energy managed

5.4.1 Status of the intervention

During the first two MAtchUP project years [M1-M24], the following steps could be finalized:

- Selection of public buildings to be connected to the CBCC and selection of one representative public building for the simulation model.
- Simulation model for the pilot building
- Measurement and monitoring concept for the pilot building
- Tender for the supply of measurement, monitoring and control elements. Choice of specific technical components and respective order.

5.4.2 Risks found and corrective actions performed

1. The initial list of buildings envisaged to be connected to the CBCC (i.e. 5 schools, 6 children's day care facilities and 1 administrative building) had to be updated. It now includes 5 schools, 2 profession schools, 1 gym, 3 children‘s day care facilities and 2 administrative buildings.

-> This deviation will neither cause any delays, nor will it have an impact on the project budget.

2. The permanent timely adaptation taking into account internal and external climatic conditions will target only the heating system for certain buildings, i.e. for the cases where no ventilation system is in place.

-> This deviation will neither cause any delays, nor will it have an impact on the project budget.

3. Not all data will be integrated into the Dresden Urban Platform, but rather selected and useful data. Moreover, it still has to be decided which (anonymized) datasets under which level of aggregation can be released as Open Data.

-> This deviation will neither cause any delays, nor will it have an impact on the project budget.

5.4.3 Business model and financial scheme applied

Via MAtchUP the following funds are available:

- 127.934 € for 1 employee (engineer CBCC) over two years. The funding of this engineer after this period will be secured via public city funds.
- 10.000 € for measurement & control equipment. Any additional equipment needs will be funded via public city funds.
- 240 € for information material for building users.

The CBCC shall be extended to the whole city of Dresden. It is planned to connect up to 200 public buildings during the coming five years. Without consideration of the

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project funds, an amortization of the technical equipment via energy savings is expected about 6 years after the connection of ~200 buildings.

5.4.4 Citizen engagement strategy implemented

First, an internal communication with the building users shall increase transparency, public acceptance of the remote control of the energy system, and awareness for energy saving potentials, ideally triggering further energy savings.

- Means: Flyer, dedicated events e.g. once a building is connected to the CBCC, link to teaching activities in schools, etc.

Second, an external communication shall support the upscaling of the Action within the city of Dresden, as well as the replication in other cities.

Means: Flyer, press releases, dedicated events, link to other city activities, use of social media, etc.

5.5 Action 43: Smart-Meter-Gateway in District Future House

5.5.1 Status of the intervention

Action 43 is strongly linked to the progress of the District Future House (Action 9) and the PV system (Action 41) .The implementation of the RIECON system is up-to-date. For now it is not possible to implement intelligent measurement systems (in accordance with Section 2 (7) of the German regulation framework on Smart Meter), due to the currently pending certification. Furthermore, data analysis showed that compliance with data protection (according to EU GDPR) plays a very important role.

5.5.2 Risks found and corrective actions performed

Problems with privacy agreement for tenants. Currently, there is no consent for data analysis. Also no access to existing “smart home devices” (Building Manager) for Data; Currently, only data access to the apartment counter data, as well as connection counters, is possible.

5.5.3 Business model and financial scheme applied

All measures of this action are financed by DREWAG without directly allocated MAtchUP funding to this action.

There are several interconnections within the Intervention consisting of A9; A41; A42; A53

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5.5.4 Citizen engagement strategy implemented

By actively involving the tenants in the test cases, digital literacy will be increased within this group. Both DWG and tenants are going to learn about how to use properly advanced building infrastructures and integrate them into regular everyday operations. Via the displays there is an information and interaction to the tenants.

5.6 Action 04: 226 kWp photovoltaic system on existing buildings

5.6.1 Status of the intervention

As described in Action A9, there was the need for changing the apartment building due to static issues of the roof.

Status of PV-system Pfotenhauer Str.

To avoid any project delay, we already carried out a quite complete planning of the PV system (number and alignment, cabling, contracts). As there is no certified mounting system of PV panels at a height of >30m, we had to analyze the static roof situation in detail. In consequence, no additional roof load could be accepted. Thus, we had to cancel the approach for the originally envisaged apartment building.

5.6.2 Risks found and corrective actions performed

Despite of all the issues reported, we estimate a significant decrease of person-months within this action. Reason for that is the much higher efficiency derived from one single partner (DWG) in realizing this action after the Amendment AMD 774477-68. On the other hand, within the bundle of actions of Smart Tenant an increased demand for modified project design is developing. We are going to suggest changes in the next amendment. The change affects the call objectives with minor changes due to changes of the PV-equipped building from Pfotenhauer Str. to Blasewitzer Str. there were different spatial conditions to construct a PV-system on the rooftop. Since no static analyses could have been conducted before the start of the project, the numbers can only be seen as target values, space had to be re-evaluated.

In the course of the installation of the photovoltaic system, DREWAG NETZ determined that the meter systems no longer comply with the current valid technical regulations. In the course of this, the old meter systems were dismantled and new, regulation-compliant meter stations were erected at considerable additional expense. The new meter stations were put into operation on 15.05.2019. There is a risk that only very few tenants will participate in the tenant electricity model.

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5.6.3 Business model and financial scheme applied

For this action, the total budget is 354,200 €.

247,940 € of this amount will be financed by MAtchUP funds, the rest of 106,260 € will be funded by DWG.

- 278,460 € for 5 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for DWG in other projects.
- 4,900 € for equipment. 4,900 € depreciation of 1 innovative monitoring system (total cost: 4.9 k€ - duration: 3 yr – use in the project 3 yr – depreciation ratio: 100%).
- 70,840 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0.25 x (278,460€+4,900€)).

In the case of the approval of the 2nd amendment the financial scheme will change in the following way:

For this action, a total DWG- budget of is 209,168.75 €.

146,418.13 € of this amount will be financed by MAtchUP funds, the rest of 62,750.62 € will be funded by DWG.

- 162,435 € for 5 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for DWG in other projects.
- 4,900 € for equipment. 4,900 € depreciation of 1 innovative monitoring system (total cost: 4.9 k€ - duration: 3 yr – use in the project 3 yr – depreciation ratio: 100%).
- 41,833.75 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0.25 x (162,435€+4,900€)).

5.6.4 Citizen engagement strategy implemented

- Via the planned tenants electricity model we allow tenants of a typical apartment building to participate on the local RES-generation in the district.
- Tenants will be informed about the contribution of ‘their‘ building to generate electricity and reduce CO2.
- Enabling tenants of an apartment building to use locally produced energy of the roof, improving the self-sufficiency level and saving of energy costs for tenants

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement N°774477

5.7 Action 41: 8.7 kWp photovoltaic system in District Future House

5.7.1 Status of the intervention

The planning of the photovoltaic system and the storage system took place from 03/2018 to 06/2018. The heavily built-up roof (roof hatches, terraces etc.) proved to be particularly challenging. To ensure that sufficient electrical power could be installed, an individualised assembly system had to be planned, the purchase of which entailed considerable additional costs. In addition, high-performance photovoltaic modules were used. Another challenge was the interim replanning of the storage system, as the manufacturer of the already planned system unexpectedly stopped production.

Delivery and installation of the PV system and storage system started in 11/2018 and was completed in 05/2019 so that the system could be commissioned in 05/2019.

5.7.2 Risks found and corrective actions performed

Not applicable for this Action.

5.7.3 Business model and financial scheme applied

All measures of this action are financed by DREWAG without any MAtchUP funding. There is no specific action funding, but there are overlapping tasks within the Intervention “Future District House” (A9, A42).

5.7.4 Citizen engagement strategy implemented

Via the planned tenants electricity model we allow tenants of a typical apartment building to participate on the local RES-generation in the district. Tenants will be informed about the contribution of ‘their‘ building to generate electricity and reduce CO2.

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5.8 Action 05: Integration of the power supply system of the retrofitted buildings with the District Storage System

5.8.1 Status of the intervention

Within Action A18, a district storage was initially planned to construct¸ this Action A5 is based on this. We were redesigning this Action, taking into consideration new projects to be implemented into the electric grid and to houses.

5.8.2 Risks found and corrective actions performed

We are planning to describe a redesigned Action taking into account the new technical situation and further developments (e.g. 5G). In order to ensure the efficient use of EU funding, variants that have the potential to be technically and economically viable have to be investigated first.

5.8.3 Business model and financial scheme applied

For DWG there is no funding of this action within Horizon 2020/ MAtchUP.

EASD contributes to this action as linked third party of DRE. EASD has planned a total budget of 57.188 € which are 100% financed by DRE. Total budget is planned for engineering and scientific support (modelling, simulation and energy monitoring) of DRE within this action. 1 employee is funded for 6 month and will work for EASD afterwards in other EASD projects. Additionally, 2 sets of testing equipment for system control and energy monitoring with a share of 7.500 € are added.

5.8.4 Citizen engagement strategy implemented

Based on the changes there is no further citizen information planned.

5.9 Action 42: Power Storage in District Future House

5.9.1 Status of the intervention

After the manufacturer was removed the the originally planned storage-system from the market, the replanning took place in the period from 03/2018 to 06/2018 resulting the use of the above-mentioned storage system. Delivery and installation of the PV system and storage system started in 11/2018 and was completed in 05/2019 so that the system could be commissioned in 05/2019.

5.9.2 Risks found and corrective actions performed

Not applicable for this Action.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

5.9.3 Business model and financial scheme applied

For this action, the total budget is 9,375 €.

6,562.50 € of this amount will be financed by MAtchUP funds, the rest of 2,812.50 € will be funded by DREWAG.

- 7,500 € for equipment. 7,500 € depreciation of 1 power storage (total cost: 12.5 k€ - duration: 5 yr – use in the project 3 yr – depreciation ratio: 60%).
- 1,875 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0.25 x 7,500€).

5.9.4 Citizen engagement strategy implemented

Tenants will rise the autarky ratio by using the storage system.

5.10 Action 40: E-Cars for housing sector

5.10.1 Status of the intervention

With our project partner VONOVIA SE we are planning to use electric vehicles within the MAtchUP-project. The electric vehicles are to replace the Golfs currently in use with internal combustion engines.

For that, DWG ordered 5 VW E-Golfs which are going to be provided to VON. The underlying vehicle rental contract DWG ./. VON has been drawn up and negotiated. The current situation is, that VON will provide 3 eGolfs (ordered by DWG), which will be used by their craftsmen, and 2 e-cars will be provided s by a car sharing service, which will be used by tenants. Earlier as expected, the 3 eGolfs were handed over on 29 May 2019 after 4 vehicles (Corsa Gasoline) of VON were destroyed by arson on 19 May 2019.

For the construction of the charging infrastructure, the offer and planning are signed by VON. It is contracted that the construction will start as soon as the eGolfs are handed over to the craftsmen of VON. The final charging infrastructure will be available in 3Q 2019

5.10.2 Risks found and corrective actions performed

4 vehicles (Corsa Gasoline) were destroyed by arson on 19 May 2019. The new e-cars needed to be provided earlier as well as the charging stations. Currently the cars are already provided to VON, but the charging stations not constructed. The interim solution is to use public stations.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

5.10.3 Business model and financial scheme applied

For this action the total DWG-budget amounts to 65,350 €. 45,745 € of this amount will be financed by MAtchUP funds, the rest of 19,605 € will be funded by DWG and ENSACH.

- 39,780 € for 2 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for ENSACH in other projects.
- 12,500 € for equipment. 7,500 € depreciation of 5 monitoring equipment (total cost: 7.5 k€ - duration: 3 yr – use in the project 3 yr – depreciation ratio: 100%) and 5,000 € depreciation of 1 test-hardware (total cost: 5 k€ - duration: 3 yr – use in the project 3 yr – depreciation ratio: 100%).
- 13,070 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0,25 x (39,780€+12,500€)).

In the case of the approval of the 2nd amendment the financial scheme will change in the following way:

For this action a total DWG- budget is 106,787.50 €. 74,751.25 € of this amount will be financed by MAtchUP funds, the rest of 32,036.25 € will be funded by DWG and ENSACH.

- 72,930 € for 2 employees pro rata temporis over three years. After the end of the MAtchUP-project in 2022 the employees will work for ENSACH in other projects.
- 12,500 € for equipment. 7,500 € depreciation of 5 monitoring equipment (total cost: 7.5 k€ - duration: 3 yr – use in the project 3 yr – depreciation ratio: 100%) and 5,000 € depreciation of 1 test-hardware (total cost: 5 k€ - duration: 3 yr – use in the project 3 yr – depreciation ratio: 100%).
- 21,357.50 € indirect costs declared on the basis of the flat-rate of 25% of the eligible direct costs (=0,25 x (72,930€+12,500€)).
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5.10.4 Citizen engagement strategy implemented

Within this action tenants of VON are enabled to use the electric cars.

5.11 Action 38: Energy efficient design of the real estate

5.11.1 Status of the intervention

The baseline data for the business case modeling has been collected, i.e. general electricity and district heating consumption of the respective buildings. This was done by meter reading and analysis of former electricity and heating bills in order to get the consumption prior to the energetic measures and the current meter data of the point in

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time just before starting the measures. Given this, actual consumption after energetic measures can be collected and compared to post-retrofitting consumption.

5.11.2 Risks found and corrective actions performed

Not applicable for this Action.

5.11.3 Business model and financial scheme applied

Planning and development of the demonstrated strategy as well as the required manpower will be fully covered by own investments.

5.11.4 Citizen engagement strategy implemented

Not applicable for this Action.

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6 Conclusions

This deliverable aims to give a broad overview on the specific technological, ecological and social measures and strategies to be applied regarding the implementation of a new concept of a high performance district in Dresden. The combined actions will be carried out through a strong cooperation between partners from various branches and with different competences. It is this variety of partners that makes it possible to connect energetic and retrofitting constructions with an innovative energy supply system and new service offers for all inhabitants within one project. Once realised, the outcome of this task will not just lead to outside beautifications or technical retrofitting, but also to a significant increase of living standards, involving cost reduction and further benefits.

The energetic restorations and modernisations done by Vonovia serve groundwork for the other actions involved in this task. The restorations are designed to update the referred buildings to state of the art standards regarding insulation and energy efficiency. In addition, the modernization measures contribute to improve the general state of the buildings.

The installation of PV systems will not just help to reduce energy costs for tenants, but also allow all inhabitants to become an active player in the energy market by using the new smart tenant service. Thus, inhabitants can at the same time provide an active contribution to the urban energy transmission and profit from the energy produced on their own very buildings.

To further promote the idea of a modern, energy autarkic district, the installation of a significant number of charging poles should offer an incentive for tenants to consider buying an e-vehicle, as the lack of charging poles still keeps many drivers from doing so. This incentive will be strengthened by the replacement of all Vonovia company cars by e-vehicles. By using e-vehicles, Vonovia employees advertise the concept of electric mobility as well as the idea of car sharing. Both concepts will be professionally operated and managed and therefore not just serving the district community, but also creating an example on how future mobility transition can be implemented.

All involved actions will be monitored and documented, involving the successes as well as the emerging problems and failures, which might come up. This monitoring should end up in a general strategy, on how future district modernization projects should be managed and realised and what risks and challenges should be taken into account.

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