MAtchUP

D4.16: High Performance District and Smart Homes in Antalya
Final version

WP 4, T 4.3

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MAtchUP - SCC-1-2016-2017

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Technical References

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Abbreviations and Acronyms

Acronym	Description
GHG	Greenhouse Gas
ICT	Information and Communications Technology
DHW	Domestic Hot Water
KPI	Key Performance Indicator
PV	Photovoltaic
B(E)MS	Building (Energy) Management System
WP	Work Package
SCC	Smart Cities and Communication
SEAP	Sustainable Energy Action Plan
RES	Renewable Energy Sources
DH	District Heating
IPMVP	International Performance Measurement and Verification Protocol
D	Deliverable
TS	Turkish Standard
LED	Light Emitting Diot
DC	Direct Current
AC	Alternating Current
PV	Photo Voltaic
EPBD	Energy Performance of Building Directive
BEP	Building Energy Performance
CoAP	Constrained Application Protocol
XMPP	Extensible Messaging and Presence Protocol
MEP	Multipurpose Expansion Port
OSGP	Open Smart Grid Protocol

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0 Abstract

This report constitutes Deliverable “D4.16 High Performance District and Smart Homes in Antalya” is the final version of Deliverable D4.4, submitted in September 2019 (Project Month M24). One of the core objectives of this document is to provide information on actions and interventions linked with high performance buildings including building level renewable energy integration and smart home interventions to be implemented in Antalya demo site.

The deliverable is related to Task 4.3 (High Performance District and Smart Homes) under WP4. The generic aim is to provide a definition of a new concept of interventions related to the extensive retrofitting, new construction programmes and smart building developments for Antalya. These interventions aim at leading to a highly energy efficient buildings that create a new concept of high-performance district in Antalya. The task includes several sub-tasks; sub-task 4.3.1 where the focus lies within Kepez Santral for new Residential blocks and municipality building. Sub-task 4.3.2 will focus on the design of smart building automation solutions integrating energy, heating and cooling metering data of the interventions leading to the concept of Smart Building at residential buildings and Antalya Municipality Building. Sub-task 4.3.3 aims at providing technical specifications and technical documents defining the interventions to the clean energy generation at building level, including renewables like PV for public buildings and solar collectors for residential buildings. Finally, sub-task 4.3.4; RES, Storage and management at building level (at residential buildings and Antalya Municipality Building). This sub-task will carry out the design of a system to deliver energy on a continuous basis to smooth the electric load curve. More precisely, the design of a demand side management and monitoring and power management systems to manage the storage batteries integrated in the district described in 4.3.3 is the focus of this subtask.

Antalya will implement high-performance districts through improvements in buildings (towards high energy-efficiency, low energy demand), high integration of RES in the energy supply (increased local renewable energy generation), implementation of advanced energy management systems (smart controllers, domotics, smart power management systems, BEM) combined with innovative storage systems to achieve an intensive building interaction maximizing their potential synergies through the different energy grids and mobility infrastructures.

A brief technical definition of related interventions is explained in section 3. In section 4; the execution of the works namely the management structure, time plan, health, safety and waste management and risk mitigation are explained for each action. Section 5 explains the status of the interventions, business models and citizens’ engagement.

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1 Introduction

1.1 Purpose and target group

This report constitutes Deliverable "D4.16 New Concept of high-performance district in Antalya", which is one of the main outcomes of "Task 4.3 High-Performance District and Smart Homes" with the Subtasks "Subtask 4.3.1 New construction", "Subtask 4.3.2 Smart Controls and BEMS", "Subtask 4.3.3 Clean Energy" and "Subtask 4.3.4 Smart Energy Integration". One of the core objectives of this document is to define the innovative approach of Antalya to retrofitting, new constructions and smart energy management at building level in Antalya. 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 from partners

Partner	Contribution
ANT	WP Leader. Leading definition of the actions. ANT is the task leader for T4.3 and the deliverable D4.4
SAM	Define financial part and the accompanying business models of interventions. Also involved in monitoring activities.
DEM	DEM is coordinating the efforts in developing the deliverable D4.4. DEM will support the municipality in the definition of the intervention design DEM will support all energy actions and involved in monitoring activities.
ANP	Will support the municipality in the definition of the intervention design. Will be involved in monitoring activities.
AKD	Will support the municipality in the definition of the intervention design. Will support all energy actions and will involve in monitoring activities

1.3 Relation to other project activities

Deliverable	Relation to other project activities
D4.14	D4.14 describes the design of the interventions to be implemented in the city of Antalya in a general perspective and is the basis for all further tasks under WP4. D4.4 gives a more detailed description of the design and the status of the interventions.
D5.x	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, D4.16 is linked to WP5 deliverables.
D6.x	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 General overview

Antalya is the 5th biggest city with 2.3 million population and one of the main tourist attraction points in the region with a significant number of tourists visiting the city each year quadrupling the number of people specifically during summer times. Together with its characteristic climate, this has a huge impact on its energy demand and consumption scheme. In accordance with the calculations based on the latest available data (2017), the total amount of energy consumed in the city reaches 25,819,959 MWh[1]. This value includes all sources' energy consumption in MWh equivalent excluding energy consumption of electrical power plants[2] and energy consumption of aviation activities[3] (due from fuel consumption). The breakdown of the energy consumption based on sectors is shown in the next figure:

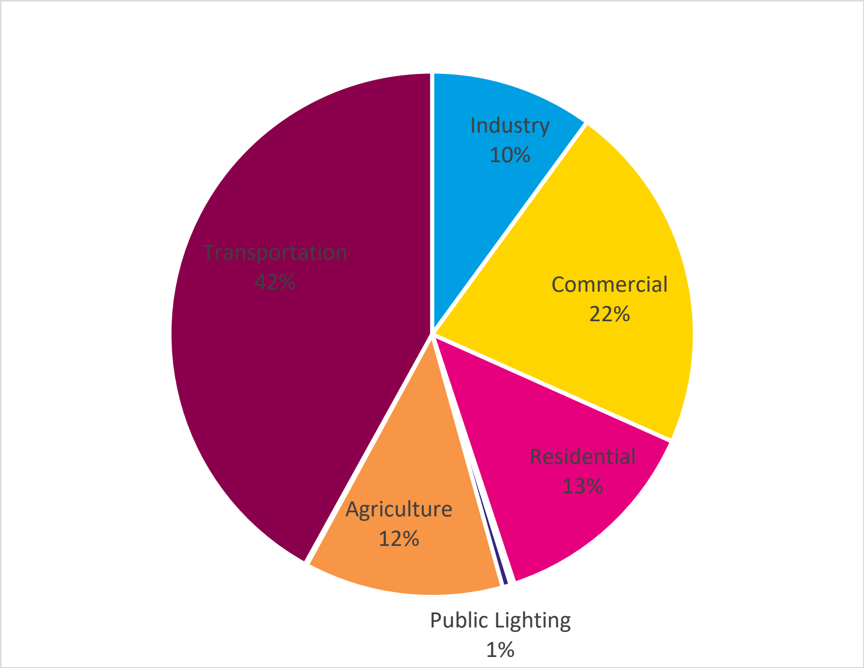

Figure 1 Antalya energy consumption

The building sector (Commercial and Residential consumption) reaches to 9,086,710 MWh/year representing approximately 35% of the total consumption within the city. Within the building sector the tertiary buildings have a share of approximately 62.8% of consumption.

[1] EMRA (Energy Market Regulatory Authority), which is the regulatory authority for all energy segments including Electricity, Natural Gas, Fuel Oil and Petroleum Sectors

[2] A significant amount of fuel consumption under electricity generation is related with a single 1150 MW capacity Natural Gas Power Plant which results in approximately 8,176,859 MWh/year equivalent energy consumption. This is not included in the city level energy consumption since the electricity generated is not only consumed within Antalya but is delivered to the interconnected national grid system.

[3] Antalya is one of the busiest touristic attraction sites of Turkey which is also reflected in aviation activities. 92,228 ton of aviation fuel has been consumed in 2017. This is not included in the city level energy consumption.

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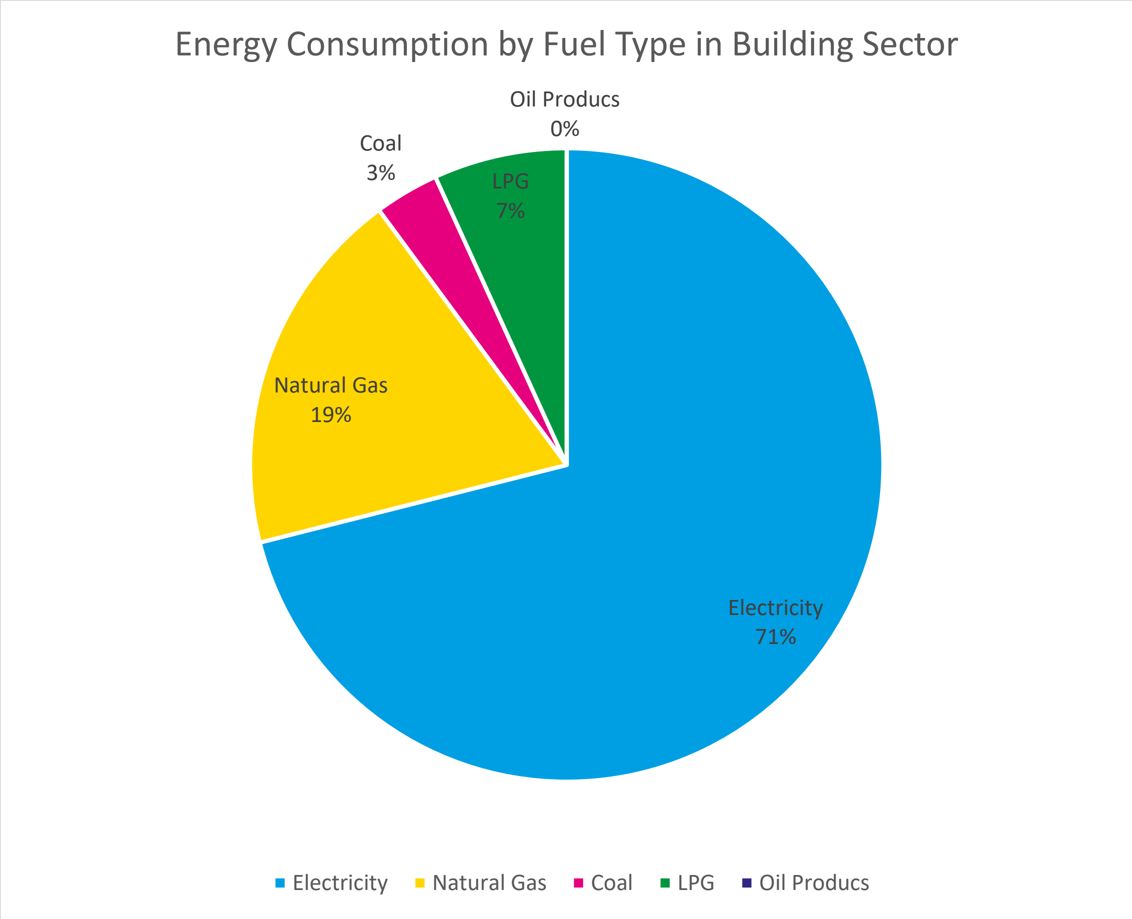

Figure 2 Energy consumption by fuel type in building sector in Antalya

As shown on figure above, a significant amount of energy is consumed in the form of electricity. Total electricity consumption within buildings sum up to 6,392,982 MWh/year with 71% of the share.

Building level statistics and data (i.e. total number of buildings, building use, energy consumption, energy demand etc.) for Antalya is not complete and available in a systematic way. However, one available research[4] provides information on the energy demand for buildings both tertiary and residential in Antalya. The research provides results of average energy consumption of heating, cooling, DHW, lighting and ventilation. Results for Antalya are summarised as follows;

[4] Ref: http://dergipark.gov.tr/download/article-file/180587

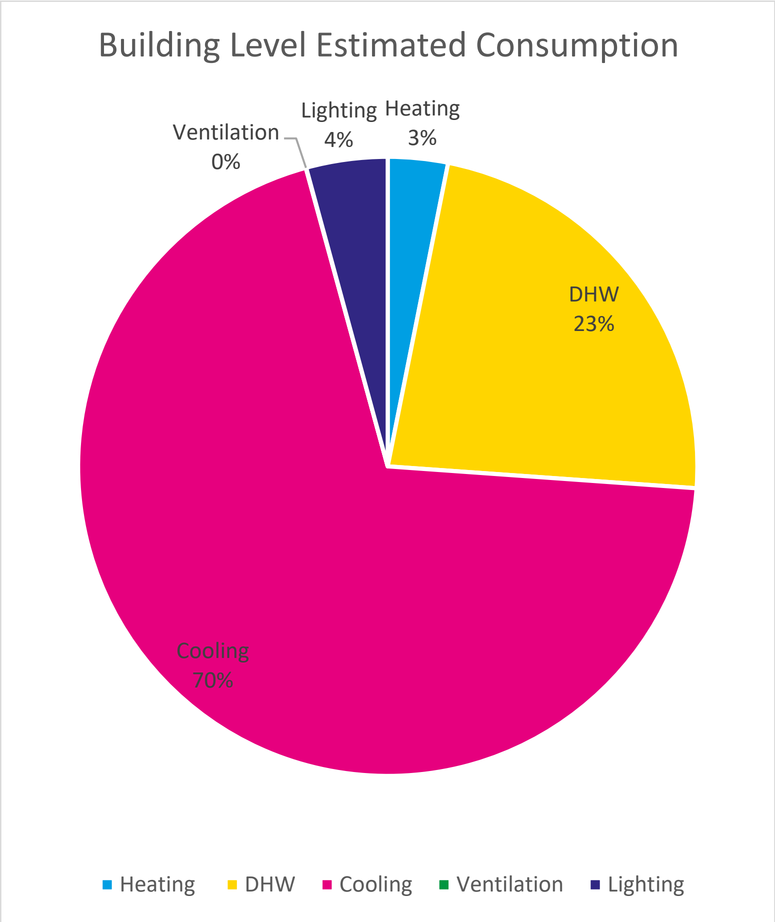

Figure 3 Breakdown of consumption at building level, Antalya

The search results highlight a high share of cooling within the total energy consumption at a building level with 70% of total demand. The second largest energy demand is for DHW demand with 23% of the total.

Based on analysis of statistical data available under the "Turkish Statistical Institute" (TUIK), there are approximately 295,000 buildings within Antalya. The majority of the building stock is for residential use with approximately 254,000 buildings. This is followed by commercial buildings with 26,600 buildings. There are 3,742 public buildings in Antalya.

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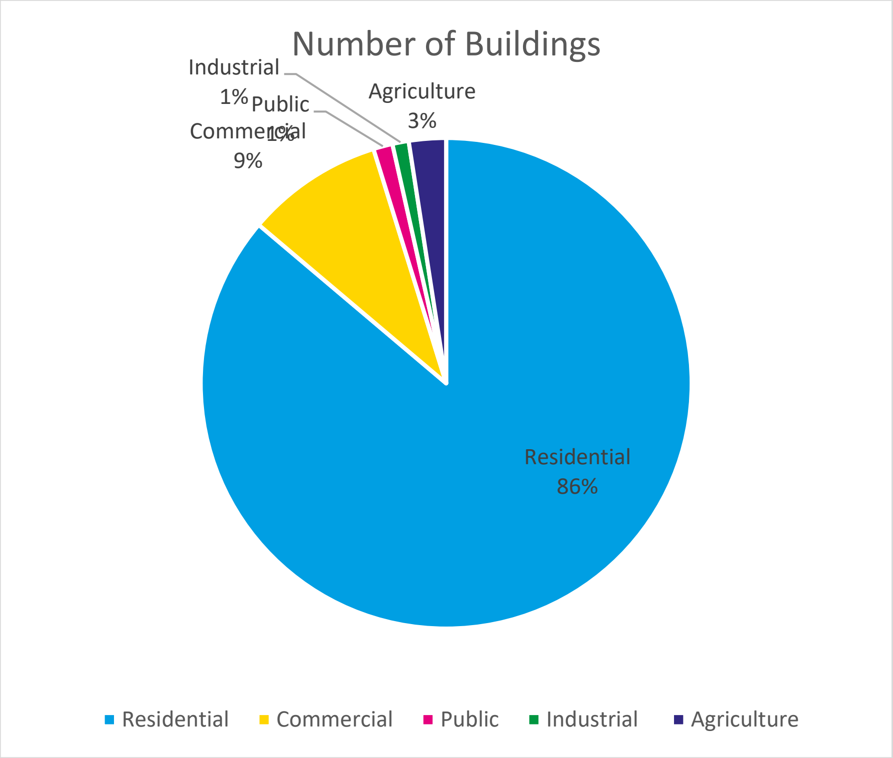

Figure 4 Share of buildings in accordance with their use

The gross floor area is 167,176,029 m^2 with residential area representing 91,869,931 m^2. The commercial gross floor area reaches to 52,286,711 m^2. The total gross floor area for public buildings is 9,008,993 m^2.

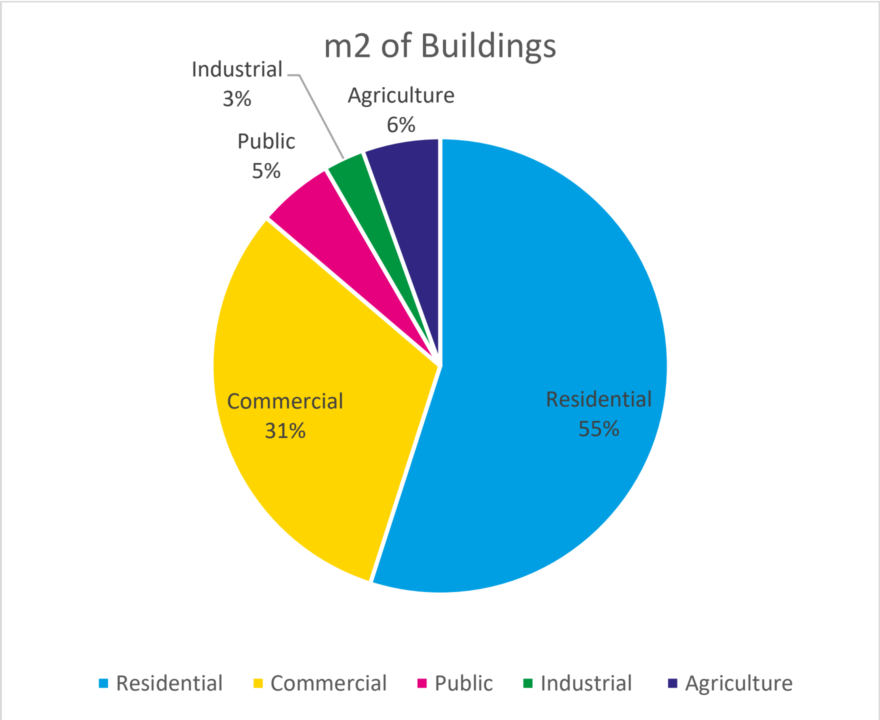

Figure 5 Share of gross floor area in accordance with their use

TS 825 Building Code

Turkey's building energy regulation focuses on thermal resistance. The National Standard of Thermal Insulation Requirements for Buildings TS 825 was first issued in 1999 and became mandatory in June 2000. This standard has been revised several times subsequently, latest version of which was published in 2013. More recently, Turkey has begun to align with the European legislation on buildings, including the Energy Performance of Buildings Directive (EPBD). A part of this process is adoption of Building Energy Performance (BEP) Regulation, which envisages the use of district heating and/or renewable energy for the buildings above a certain threshold. BEP (Building Energy Performance) is mandatory for all new buildings except for industrial buildings, temporary buildings used less than 2 years, buildings with a total useful floor area of less than 50 m^2, greenhouses, workshops as well as stand-alone buildings without heating or cooling requirements.

Residential Buildings	Scale (National, Regional, Local, etc…)	Building size threshold
New Buildings	National (Building Energy Performance Regulation)	Buildings with more than 2,000 m^2 of usable space will be equipped with a central heating system; for buildings more than 20,000 m^2, various ways to use renewable energy and cogeneration facilities are defined.
Existing Buildings	National (thermal regulation only): TS 825	All new buildings except buildings containing passive solar energy systems

Table 1 Regulations for buildings

The TS 825 is related with the rules of calculation methods of the heating and cooling energy requirements of the new and old buildings. It divides Turkey into five climatic zones (depending on average degree days) and limits heat loss from the building envelope.

According to TS 825, five different degree-day (DD) regions have been defined for Turkey, which are shown in figure below. Antalya is considered within Zone 1.

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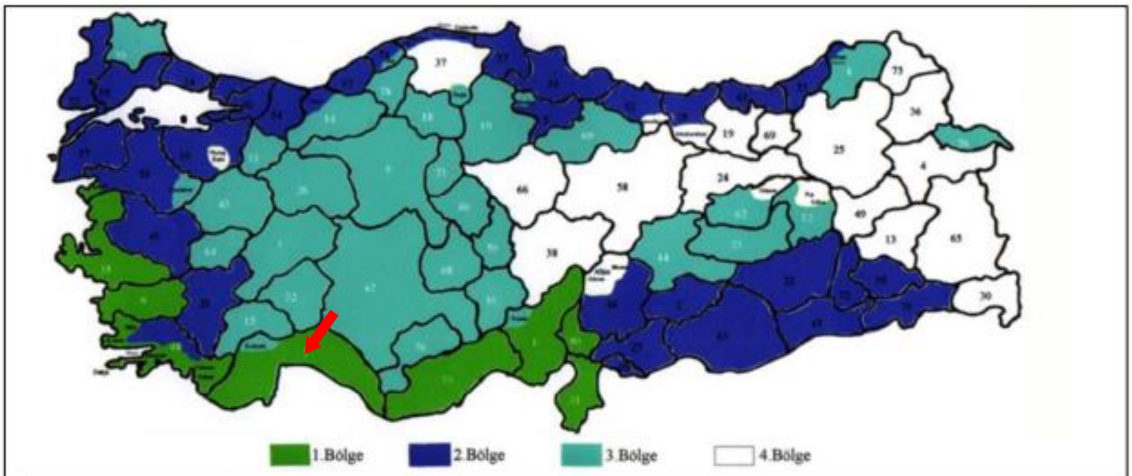

01- ADANA	10- BALIKESİR	19- ÇORUM	28- GİRESUN	37- KASTAMONU	46- K.MARAŞ	55- SAMSUN	64- UŞAK	73- ŞIRNAK
02- ADIYAMAN	11- BİLECİK	20- DENİZLİ	29- GÜMÜŞHANE	38- KAYSERİ	47- MARDİN	56- SİİRT	65- VAN	74- BARTIN
03- AFYON	12- BİNGÖL	21- DİYARBAKIR	30- HAKKARİ	39- KIRKLARELİ	48- MUĞLA	57- SİNOP	66- YOZGAT	75- ARDAHAN
04- AĞRI	13- BİTLİS	22- EDİRNE	31- HATAY	40- KIRŞEHİR	49- MUŞ	58- SİVAS	67- ZONGULDAK	76- IĞDIR
05- AMASYA	14- BOLU	23- ELAZIĞ	32- ISPARTA	41- KOCAELİ	50- NEVŞEHİR	59- TEKİRDAĞ	68- AKSARAY	77- YALOVA
06- ANKARA	15- BURDUR	24- ERZİNCAN	33- İÇEL	42- KONYA	51- NİĞDE	60- TOKAT	69- BAYBURT	78- KARABÜK
07- ANTALYA	16- BURSA	25- ERZURUM	34- İSTANBUL	43- KÜTAHYA	52- ORDU	61- TRABZON	70- KARAMAN	79- KİLİS
08- ARTVİN	17- ÇANAKKALE	26- ESKİŞEHİR	35- İZMİR	44- MALATYA	53- RİZE	62- TUNCELİ	71- KIRIKKALE	80- OSMANİYE
09- AYDIN	18- ÇANKIRI	27- GAZİANTEP	36- KARS	45- MANİSA	54- SAKARYA	63- ŞANLIURFA	72- BATMAN	81- DÜZCE

Figure 6 Turkey's provincial structure according to DD Zoning

Every new building constructed shall comply with at least C energy rating. In accordance with the minimum requirements of the code, the following table summarizes the minimum heat transfer coefficient values for buildings for Antalya (Zone 1). These values are also considered as the baseline for buildings in Antalya Intervention Area.

	U_D	U_T	U_t	U_p
Zone 1	0,7	0,45	0,7	2,4

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3 Technical definition of the interventions

One of the main objectives of the MAtchUP Project is to deploy innovative solutions in the energy, mobility and ICT sectors with a strong monitoring program to validate all of them. As being one of the three LightHouse Cities in MAtchUP Project, Antalya will address real pilot of transformation in Energy Sector including smart solutions towards integration of smart buildings and homes. These pilots will result in very ambitious energy savings, CO_2 emissions reductions, supported by ICT solutions as main enabler to collect relevant information, fostering open data use. This will be achieved through improvements in buildings towards higher energy-efficiency, integration of renewable energy systems as well as integration of advanced energy management systems to achieve intensive building interaction. These solutions will be combined with the new electromobility solutions.

MAtchUP will implement high share of renewable energy systems at building level integrated with a storage capacity to achieve peak shaving, helping the grid stability. This system will support smart lighting interventions as well as charging points which will be a part of smart electromobility solution of the district.

On the other hand, energy demand will be lowered with high performance building constructions on both residential and commercial usage. These buildings will be introduced with new technologies on smart displays and controls. Smart meters will be deployed to these sites to enable data gathering and upload to the Urban Platform with a standardized format.

Under Deliverable 5.1 “Technical Evaluation Procedure”, the interventions for new concept of high-performance districts have been identified as follows:

- Intervention 1: New construction of private residential buildings
    - [A1] Residential blocks (B Energy rating district)
    - [A4] Solar thermal collectors’ installation for residential buildings
    - [A6] Smart Controls and Domotics
    - [A7] Smart meters
- Intervention 2: Retrofitting of public tertiary buildings
    - [A2] Retrofitting of public tertiary buildings (B Energy rating)
    - [A3] PV installation for public buildings
    - [A5] Electrical storage for buildings and charging stations
    - [A6] Smart Controls and Domotics
    - [A7] Smart meters

The interventions in Antalya cover the new construction of high-performance buildings in the district of Kepez and retrofit of municipality building of Antalya, which will reach to at least B Energy rating. In this way the new efficient construction techniques will be used, as well as the integration of renewable energies such as PV, electrical storage and solar thermal.

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3.1 New Construction of Private Residential Buildings

The area that will be included in MAtchUP comprises a new Construction area, located in Kepez Santral District. From a total area of 46,000 m^2 (conditioned area) - 9 residential buildings - 606 flats that will be built beyond current standards for new construction will be the focus area. These buildings, whose constructive principles are high performance envelop through insulation, low u-value glazing, and energy efficient lighting. Demand for domestic hot water will be supplied mainly on renewables comprising Solar Thermal Collectors integrated in the buildings **[Action 4]**. This action also integrates other actions such as installation of home domotics and controls **[Action 6]** at apartment level as well as smart meters **[Action 7]**. This is part of a big area of intervention included in the Antalya plan for the city transformation.

3.2 Retrofitting of Public Tertiary Buildings

The action involves the high-performance Metropolitan Municipality Building of Antalya to reach at least B energy Rating;

- High performance building envelope (insulation and glazing),
- High performance HVAC systems,
- Heat recovery ventilation systems, and;
- Occupancy control.

The building will also benefit from use or Renewable Energy Systems integrated to the building.

These building(s) will also benefit from smart meters **[Action 6]** for a better energy management (such as advanced lighting, energy and comfort controls) and smart controls **[Action 7]**

3.3 Smart Controls and BEMS

There are two actions associated with Smart controls and BEMS. 1) Smart Controls and Domotics [Action 6] and 2) Smart Meter [Action 7]. Since smart meters Action 7 is also part of the “Improved Concept of Energy Infrastructures at City Level”, it has been detailed under D 4.17, therefore only action 6 “Smart Controls and Domotics” will be detailed under this deliverable.

<u>[A6] Smart Controls and Domotics</u>

The action involves the introduction of new technologies such as smart control calorimeters, sensors (humidity, heat, water leakage etc.), smart control domotics (home alarm, smart door locks, movement sensors, smart lighting and smart switches etc.) to residential and public buildings [Action 1 & Action 2]. It is estimated that 800 sensor panel (606 for residential, 194 for public), 650 smart control panel (606 for residential, 44 for public) and 606 domotics will be installed within the scope of the activity in the buildings.

<u>[A7] Smart Meters</u>

Within the scope of the MAtchUP, 606 smart meters (for residential) and 9 smart control power quality meters (for public buildings) will be deployed, enabling the development of

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Energy services to customers, like dynamic electricity data platform and provision of data sets from energy meters in a standardized format. This data will be aggregated at various scales, possibly from individual to building or district scales. To complement available data, supply of complementary standardized aggregated data, supply of contextual data and integration into the urban data platform.

3.4 Clean Energy, Building Renewables

There are two actions associated with building level renewable implementation. Antalya benefits from high rates of sunny days as well as irradiation levels, which makes the city favourable place for Solar Renewable Energy. The residential buildings will be integrated with a solar collector. These solar collectors will provide energy to cover DHW demand [A4]. A PV system will be installed to two buildings within the Antalya demo site at building level. 81 kWp capacity will be installed at the rooftop of the mobility building in the Kepez Santral District, while 260 kWp PV system will be installed at the rooftop of Metropolitan Municipality Building. A battery storage system [A5] will be integrated to both PV system and the generated electricity will be used for charging stations for e-mobility as well as building loads.

3.4.1 [A3] PV installation for public buildings

The action involves integration of PV system to two different locations. One is the rooftop of the Municipality Building of Antalya. This system will have a rated capacity of 260 kWp linked with a 250 kWh battery storage for electricity. The PV and battery system will provide renewable energy to various building loads such as lighting, air conditioning, elevators etc. Also, several car charging stations located in Municipality building will be covered by the PV and storage system specifically supporting 100% renewable e-mobility. This will increase the use rate of local renewables significantly.

80 kWp PV system linked with 150kWh battery storage will be installed at the rooftop of mobility hub at Kepez District. This system will support the charging stations in the mobility hub. Similar to the benefits achieved in municipality building, this system will support transformation to 100% renewable e-mobility.

Public tender for this activity is finalized in November 2020. Installation will start In December 2020 and commissioning is expected by March 2021.

3.4.2 [A4] Solar thermal collectors' installation for residential buildings

The action involves integration of solar thermal collectors for residential building **[Action 1]**. The aim is to install approximately 500m^2 solar collector systems which will have a potential to generate 696 MWh/yr equivalent hot water. The hot water will cover all or portion of the domestic hot water demand in the newly built residential buildings. The system is planned as a centralized system for each building block.

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3.5 Smart Energy Integration. RES, Storage and Management

[A5] Electrical storage for buildings and charging stations:

The action involves integration of battery groups for electricity storage. The PV capacity under [Action 3] will be integrated with a storage unit to achieve load shifting (to match demand and supply from RES) and peak shaving (reducing peak loads specifically due to charging peaks).

This will enable smooth load management as well as acting as a flexibility unit within the concept of smart grid. This will be controlled through intelligent energy management system.

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4 Executive project of the actions

4.1 A1 Residential blocks

4.1.1 Management structure

Contractor (SURYAPI) is the company responsible for financing and construction. The Antalya Greater Municipality is acting as the regulatory authority of the process on behalf of Ministry of Urbanization and Environment. The financing is based on the business model of "urban regeneration". The land value is increased through changing the allowed height of building blocks (compared to pre-intervention situation). This allows the investor/contractor to bare the risks and provide the necessary upfront investment (through bank loans and other financial tools) in return of owning property from the newly built buildings. The infrastructure and public areas / buildings /zones which fall under the responsibility of the Municipality are financed through "Ilbank" a specialized creditor bank in Urban Transformation area. Once the construction and transformation are finalized the new property re registered back to the pre-owners with respect to their contracts with the Investor. This model allows access to necessary financial tools and motivation for the private companies' involvement in such a large scale (thus high-risk) projects.

4.1.2 Technical specifications of the city infrastructure

The MAtchUP Actions on construction of new residential building of high performance is part of a larger project activity which is the "Kepez Santral Urban Regeneration". Kepez Santral is a district in Antalya was declared as "risky area" for earthquake hazard in 2014. The Ministry of Environment and Urban has assigned Antalya Greater Municipality for the Re-Urbanization task of Kepez Santralk District. The 1.3 million m^2 residential area has been decided to be re-constructed. Kepez project involves several residential building constructions as well as tertiary buildings and an integrated transportation solution. MAtchUP project activity covers actions that will be implemented within this larger project activity.

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Kepez Santral District before Kepez Regeneration Project

Kepez Santral Regeneration Project during construction

Figure 7 Pictures from Kepez District and Construction

[A1] covers 9 residential building blocks with 606 flats, a total area of 46,000 m2 conditioned area. These buildings are designed as high-performance buildings to reach at least an energy performance rating of B. B Energy rating is defined to have up to 40% better energy performance compared to the standard building of C rating.

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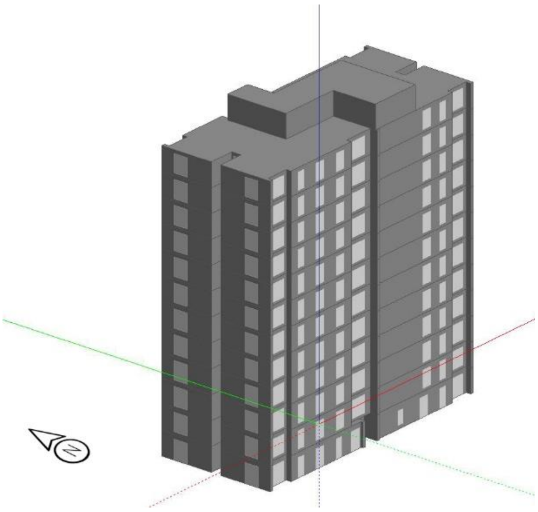
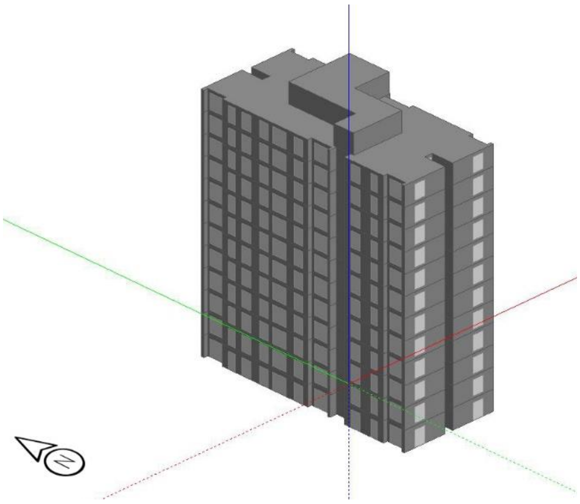
The following table summarizes the energy demands based on TS825 building code, which has been considered as the baseline value for these new residential buildings.





Block 1 – North-South Orientation		Block 2 – West -East Orientation	
	kWh/m^2 year		kWh/m^2 year
Heating	25.00	Heating	21.60
Cooling	41.30	Cooling	59.09
Lighting	23.70	Lighting	23.70
Domestic Hot Water	14.00	Domestic Hot Water	14.00
Fans&Pumps	4.6	Fans&Pumps	5.54
TOTAL	**108.60**	Sub TOTAL	**123.93**

Table 2 Simulated energy demands based on TS825

A better performance will be achieved with several measures including the following interventions:

- Insulation of building envelope
- Low-u value glazing
- Energy efficient lighting
- Gas fired condensing boiler of high efficiency
- Reference COP of chillers is 3.00
- Domestic hot water max 60°C
- Only natural ventilation is applied

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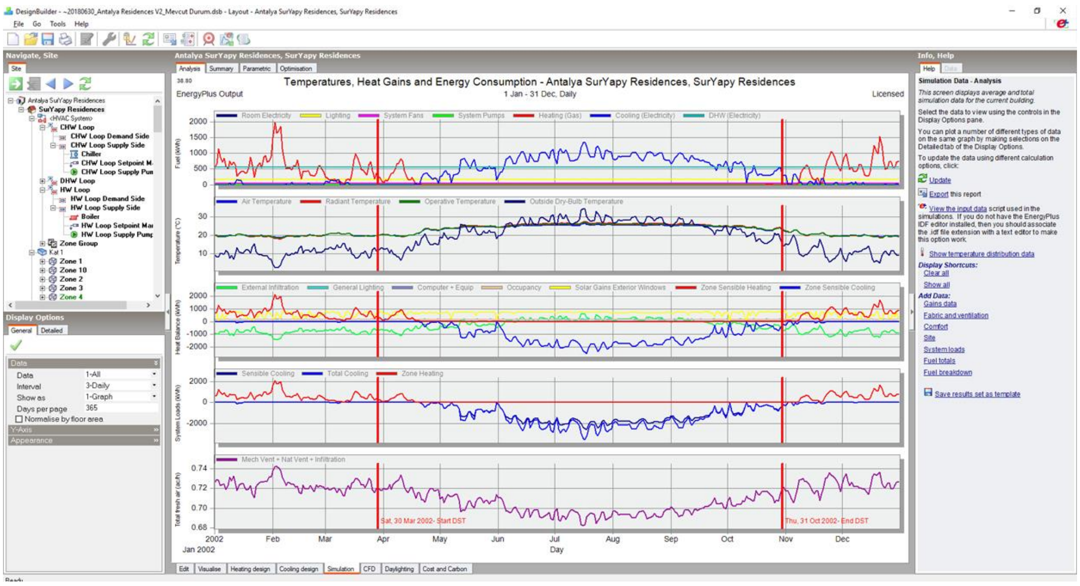
The outer walls that are open for weather conditions are designed to have a coefficient of heat permeability of 0.548 W/m^{2}K total (U value). The U value for roof insulations will be 0,428 W/m^{2}K and 0,730 W/m^{2}K for slabs. This is reached with an insulation material from mineral fibers with a thickness of 50 mm. Double glazed glass with a min U value of 1.8 W/m^{2}K will be used in the building. The lighting of interior will be also based on high-efficient LEDs. The LED lighting systems will not only result in lower installed capacities for lighting but will also lead to energy savings through lower heating effect of lighting in the interior. The energy demand for the interior lighting will be lowered to approximately 4 W/m^2 based on an average of 100 lx lighting demand in residential areas.

Based on the passive interventions designed for the high performance building the energy demand could be lowered to 84.10 kWh/m^2 per year for a building with north-south orientation. The same building would have had an energy demand of 123.93 kWh/m^2 based on requirements of TS825 building code. The same building would have had an energy performance of approximately 175 kWh/m^2 per year energy demand (G Rating) with no insulation. A significant portion of the building stock in Antalya has no insulation specifically for those buildings constructed before 2008.

The following table summarizes the energy demands based on design specifications new residential buildings.



Block 1 – North-South Orientation	kWh/m^2 year	Block 2 – West -East Orientation	kWh/m^2 year
Heating	21.00	Heating	20.60
Cooling	33.70	Cooling	47.56
Lighting	12.30	Lighting	12.30
Domestic Hot Water	13.00	Domestic Hot Water	13.00
Fans&Pumps	4.10	Fans&Pumps	5.25
Sub TOTAL	**84.10**	Sub TOTAL	**98.71**

Table 3 Simulated energy demands based on design specifications

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4.1.3 Planning of the tasks

The construction works of Kepez Santral has started in 2017. The construction works of Kepez Santral Urban Regeneration Project is divided into 6 zones. 9 residential building blocks under [A1] belong to A zone as shown in the figure below. The first zone to be completed is the A zone. All 9 buildling blocks of the A zone has been completed and registered to their flat owners within August 2020.

Figure 8 Site plan of Kepez District and Zone

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Figure 9 Construction of buildings

Figure 10 Buildings of zone A commissioned and registered

4.1.4 Health, safety and waste management requirements

In the scope of health, safety and waste management requirements, there is a regulation named as Regulation on Occupational Health and Safety in Construction published by Ministry of Labor and Social Security should be followed. This regulation published on

October 2013 (#28786)[5] contains rules for all specific topics listed in the title of this section. These rules are mainly related with following subtitles;

- Keeping the building area safe and clean
- In the selection of working places in the construction area; how to ensure access to these areas and identifying areas or roads for equipment, movements and transitions,
- Regulation of the conditions of use and transportation of the material,
- Performing technical maintenance and checks before and after the use of the facility and equipment,
- Allocating and limiting the appropriate storage areas for various materials, especially dangerous materials and substances,
- Regulation of the use of hazardous materials and their removal conditions,
- Storage, disposal or removal of waste and residues,
- Re-determination of the periods foreseen for the various works or stages of the work according to the status of the work in the construction area,
- Cooperation between subcontractors and self-employed persons,
- Consideration of interaction with industrial activities in or near the construction site

In terms of waste management, there are different types of wastes like scrap metal, form work, wood scrap, wood pallets, marble/ceramic tile, glass, cables, cardboard & paper wastes, plastic & nylon wastes etc. These are usually sent to waste facilities to reuse and recycle purposes. Also, a reporting procedure for waste management should be prepared to follow the information on waste composition, the amount of waste collected and sent to recycle or reuse facilities. After these steps waste reduction recommendations will be discussed.

4.1.5 Risks and proposed risk-mitigation measures

The construction is completed and the flats have been registered to their owners. No risks are identified.

4.2 A2 Retrofitting of public tertiary buildings

4.2.1 Management structure

Antalya Greater Municipality is the owner and operator of the Municipality Building. All interventions and actions are funded by either regional funds or Municipalities own budget. The procurement of required equipment as well as Construction design and work might be subcontracted to a third party through a tender process.

[5] http://www.resmigazete.gov.tr/eskiler/2013/10/20131005-2.htm

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4.2.2 Technical specifications of the city infrastructure

The following table summarizes the energy demands based on TS825 building code, which has been considered as the baseline value.

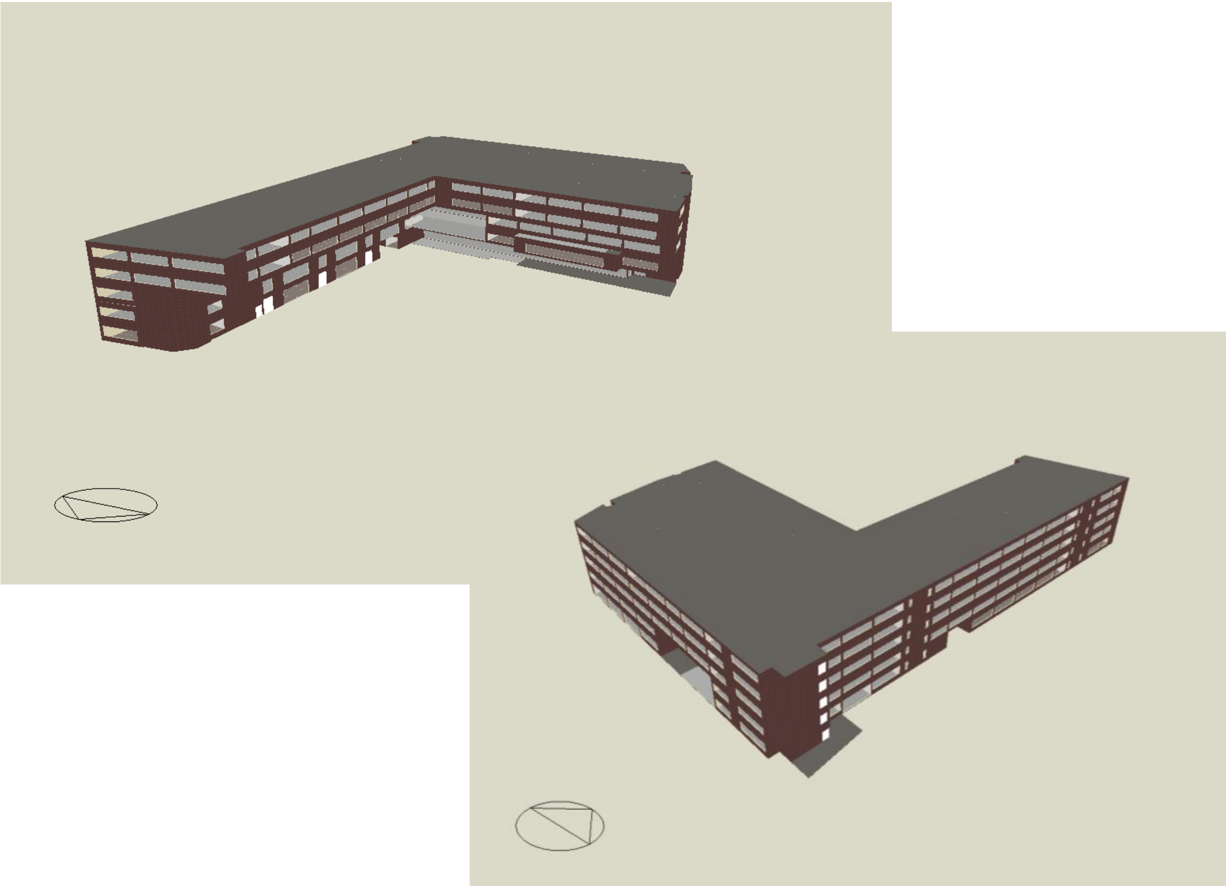

Figure 11 Simulated building model for Antalya Metropolitan Municipality Building

	kWh/m2 year	kWh/year
Heating	11,2	277.340
Cooling	34,9	867.460
Lighting	33,8	839.750
Fans	16,9	419.750
Total Thermal	11,2	277.340
Total Electricity	85,7	2.129.520
TOTAL	**96,9**	**2.406.860**

Figure 12 Simulated energy demands based on TS825 for Municipality Building

The action involves interventions and measures to verify a minimum B energy rating through utilization of;

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- High performance building envelope (insulation and glazing),
- Advanced lighting and control systems,
- High performance HVAC systems,
- Heat recovery ventilation systems, and;
- Occupancy control.

The outer walls that are open for weather conditions are designed to have a low coefficient of heat permeability. This will be reached with an insulation material from mineral fibers with a thickness of at least 50 mm. Double glazed glass with a min U value of approximately 1.8 W/m^{2}K will be used in the building. The lighting of interior will be also based on high-efficient LEDs. The LED lighting systems will not only result in lower installed capacities for lighting but will also lead to energy savings through lower heating effect of lighting in the interior. The aim is to achieve a maximum energy demand of approximately 4 W/m^2 for lighting.

Due to interventions on heat insulation on building envelope and windows, the building is becoming thermally efficient however becoming air tight having a negative impact on air quality with built moisture and pollution. At excessive levels, moisture will lead to mold, mildew, fungi, dust mites and bacteria, in worst cases. A common solution for this problem is to open windows and doors working against the efficiency of the building. However, a heat recovery ventilation system has the ability to refresh the air at the desired volumes while keeping the heat inside the conditioned space through a recovery system where the outgoing exhaust air is used to warm up the fresh air. System extracts inside warm air and draws outside fresh air. The warm air is passed through a heat exchanger to recover the heat before extracted. The cool fresh outside air is also passed through the heat exchanger; it is pre- heated before being supplied into the building. Systems typically run continually with an efficiency rate of 70-75%. Another energy efficient feature of Heat Recovery Ventilation system is cooling affect where outside air is used to cool down a building without using heat recovery system or cooling coil. Only fan power is needed to blow the fresh air directly inside when the outside temperature is cooler than the inside temperature. An outdoor air economy cycle can reduce cooling energy requirements by 20% to 30%.

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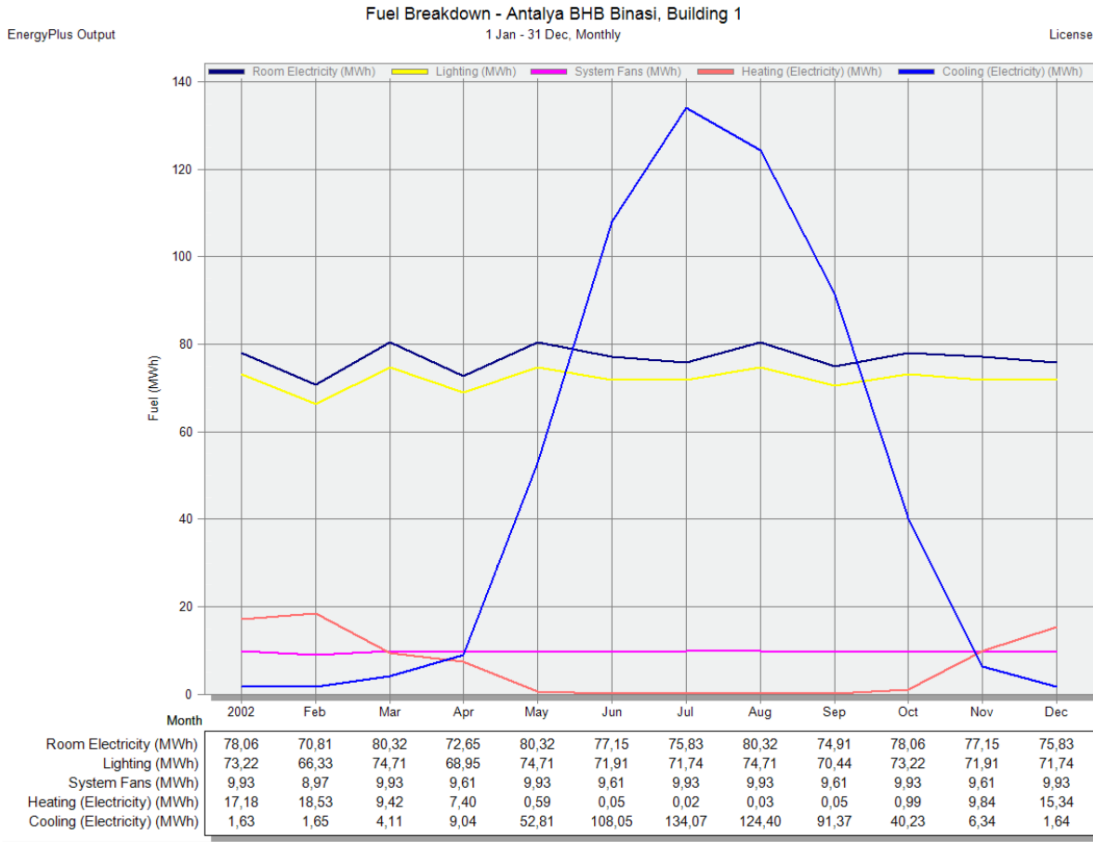

	kWh/m2 year	kWh/year
Heating	3,2	79.440
Cooling	23,2	575.340
Lighting	34,8	863.590
Fans	4,7	116.920
Total Thermal	3,2	79.440
Total Electricity	62,6	1.555.850
TOTAL	**65,8**	**1.635.290**

Table 4 Simulated energy demands based on design specifications

As a result of the interventions and actions, 32,2% savings from energy consumptions of baseline scenario are estimated ex-ante. A major saving is from cooling system with the use of high performance HVAC system. The cooling consumption is dropped from 34,9 kWh/m2 to 23,2 kWh/m2, a significant saving of 33%.

The total energy savings on an annual basis is estimated to reach 771.570 kWh/year.

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4.2.3 Planning of the tasks

Antalya Metropolitan Municipality Building is a 4-story building with a total condition area of 25,000 m^2. The building is commissioned within 2017 with an Energy rating of B. Energy management system and high performing HVAC systems will be finalized by Q1 2021

Figure 13 Antalya Metropolitan Municipality Building

4.2.4 Health, safety and waste management requirements

In the scope of health, safety and waste management requirements, there is a regulation named as Regulation on Occupational Health and Safety in Construction published by

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Ministry of Labor and Social Security should be followed. This regulation published on October 2013 (#28786)[6] contains rules for all specific topics listed in the title of this section. These rules are mainly related to the following subtitles;

- Keeping the building area safe and clean
- In the selection of working places in the construction area; how to ensure access to these areas and identifying areas or roads for equipment, movements and transitions,
- Regulation of the conditions of use and transportation of the material,
- Performing technical maintenance and checks before and after the use of the facility and equipment,
- Allocating and limiting the appropriate storage areas for various materials, especially dangerous materials and substances,
- Regulation of the use of hazardous materials and their removal conditions,
- Storage, disposal or removal of waste and residues,
- Re-determination of the periods foreseen for the various works or stages of the work according to the status of the work in the construction area,
- Cooperation between subcontractors and self-employed persons,
- Consideration of interaction with industrial activities in or near the construction site

In terms of waste management, there are different types of wastes like scrap metal, form work, wood scrap, wood pallets, marble/ceramic tile, glass, cables, cardboard & paper wastes, plastic & nylon wastes etc. These are usually sent to waste facilities to reuse and recycle purposes. Also, a reporting procedure for waste management should be prepared to follow the information on waste composition, the amount of waste collected and sent to recycle or reuse facilities. After these steps waste reduction recommendations will be discussed.

4.2.5 Risks and proposed risk-mitigation measures

No risks are identified.

4.3 [A3] PV Installation for public buildings

Within the scope of MAtchUP, photovoltaic (PV) system will be implemented in two separate locations in Antalya. A 260 kWp capacity will be installed on top of the Antalya Municipality Building in Muratpaşa District and 81 kWp capacity will be installed at the rooftop of the mobility building in Kepez District. The total capacity will reach to 341 kWp with an estimated energy generation of 552 MWh/year. Both systems will be integrated with an electricity storage unit to establish flexibility and increase self-consumption rates.

[6] http://www.resmigazete.gov.tr/eskiler/2013/10/20131005-2.htm

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4.3.1 Management structure

The PV system integrated to the public building is under the responsibility of Antalya Greater Municipality. The PV systems will be financed through Municipality funds and / or regional funds. The design works, permit / licensing process and preparation for construction tender documents are subcontracted to a third-party consultant company experienced in his field. The construction works as well as commissioning will be subcontracted to a third party through a tender process. The operation and maintenance of the PV system will be under the responsibility of the associated department of Antalya Greater Municipality.

Public tender for this activity is finalized in October 2020. Installation will start In December 2020 and commissioning is expected by March 2021.

4.3.2 Technical specifications of the city infrastructure

Although Antalya has a very high potential for solar energy, PV integration at building level for decentralized electricity generation is very low. The total PV capacity is 16,140 kWp for local RES usage and only 1,150 kWp belongs to public buildings. Taking into account that this corresponds to a 0,17 kWh/m^2 electricity generation in public buildings. Since this is an insignificant amount the baseline generation from local PV is considered as “0”.

Within the scope of the MAtchUP Project activity, two separate PV systems will be installed in two separate locations -1) 260 kWp integrated to the Municipality Building of Antalya and 2) 81 kWp at mobility hub in Kepez Distrcit. Both PV systems share the same technical specifications. The total installed capacity is designed as 341 kWp. The intervention covers installation of mono-crystel PV modules with 320 W rated capacities with at least an efficiency of 19%. The system will incorporate Solar Inverters with a capacity of 50 kW and at least %97 efficiency each to transfer the energy to the DC bar of the Battery group [A5].

The main equipment of the system consists of:

- Solar Panels
- Mounting structure (Fixed Mount)
- On-Grid Inverter
- Monitoring equipment and system (including bidirectional electricity meter)
- AC Electric Panel
- Protective switch panels and circuit breakers
- DC & AC cabling
- Grounding

Antalya benefits from high solar radiation values. During June the solar radiation levels reach to an average of 6.93 kWh/m^2 per day, with 11.55 of hours of sunshine duration. This value drops to an average of 1.92 kWh/m^2 per day with 4.55 hours of sunshine duration during December Month when it is lowest. The annual average is 4.51 kWh/m^2 per day. This irradiation levels result in a potential of 27.6 kWh/m^2 over a year with 8.24

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hours of sunshine duration. Rainfall regime of the area is also an important factor in energy generation from PV systems. Antalya has a yearly average rainfall amount of 1066.9 Mm/year.

The PV system is south oriented with a 5^0 angle. The maximum generation curve (July) in Antalya weather conditions is as follows:

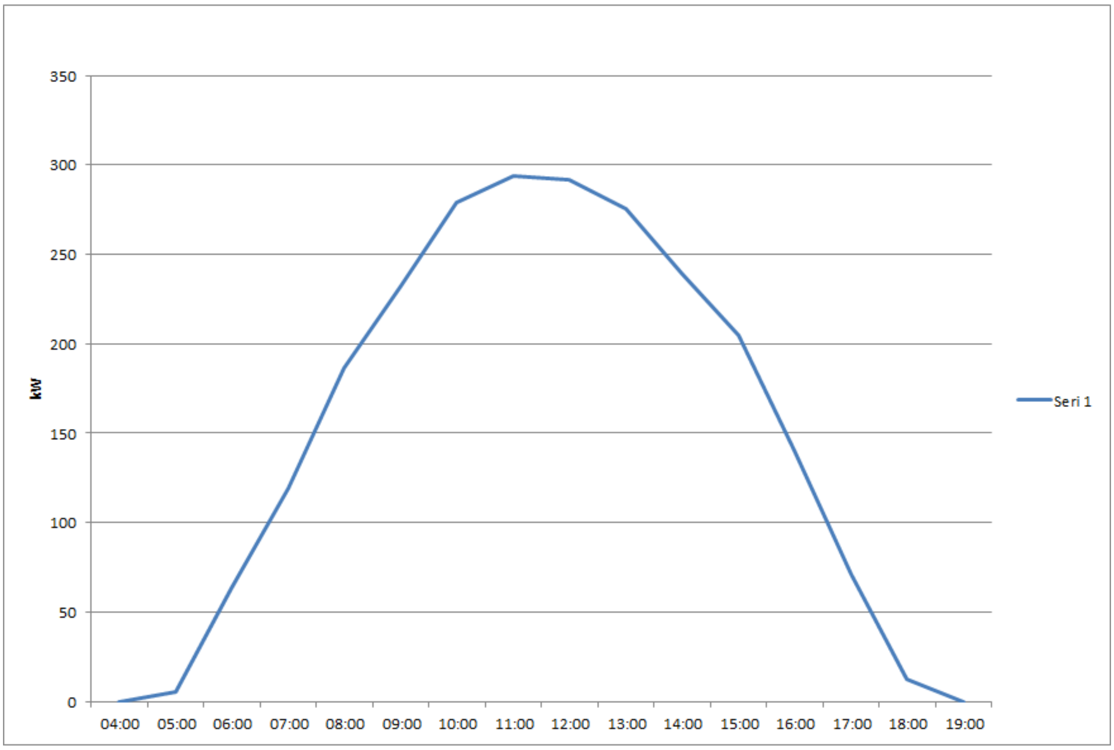

Figure 14 Maximum power output of the PV system (July)

The expected electricity generation throughout the year is 555.6 kWh/year. The highest estimated generation is within July with approximately 66 kWh and the least estimated generation is within December with approximately 27 kWh electricity generation. The generated electricity will be used mainly for the public lighting and charging stations in mobility solution. The PV system will be linked with a battery storage as well to provide flexibility to the system [A5].

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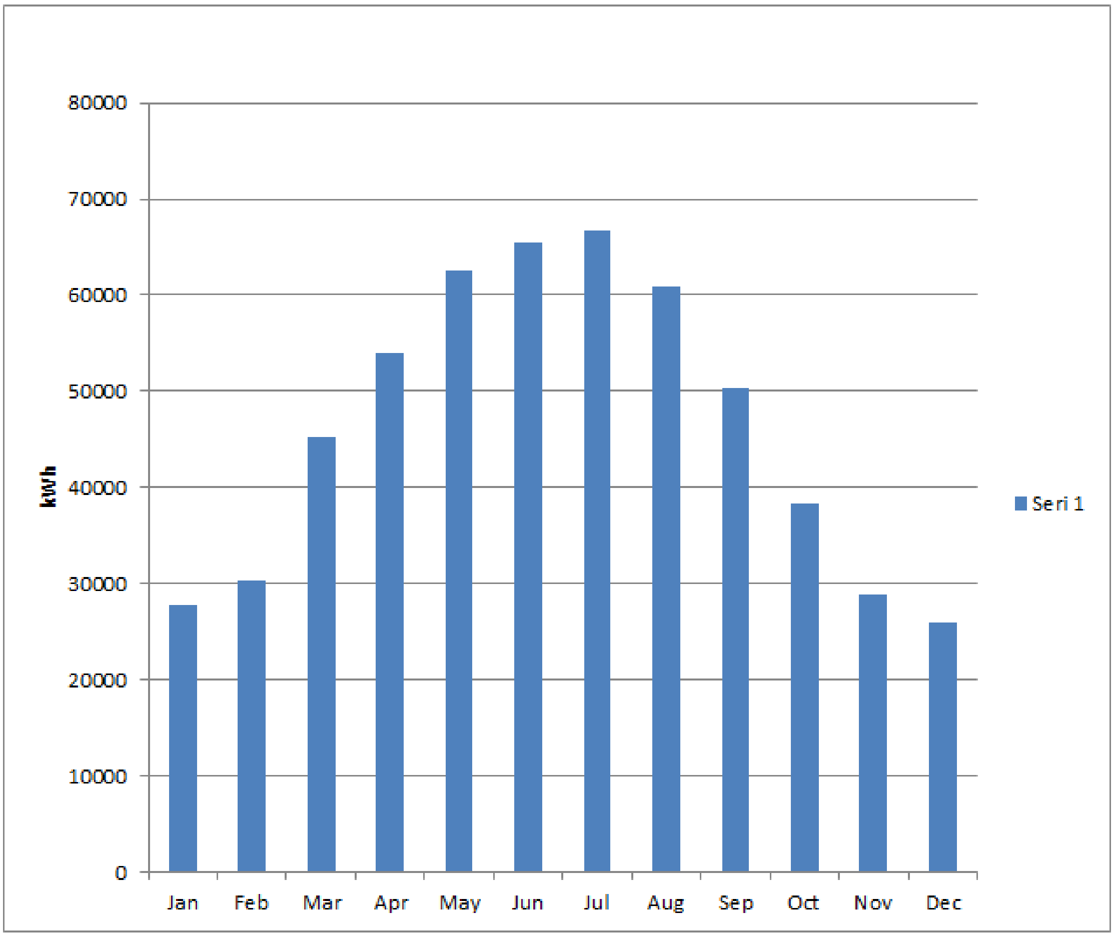

Figure 15 Estimated annual electricity generation of PV system in Antalya

4.3.3 Planning of the tasks

Action 3 will be implemented through a tendering process. The tender process cover design, procurement, management of permit processes, installation, testing and commissioning of several systems including PV System.

All necessary permits from the distribution company for connection has been required.

Public tender for this activity has started in October 2020 and finalized in November 2020. Installation will start In December 2020 and commissioning is expected by March 2021.

4.3.4 Health, safety and waste management requirements

During the PV installation the same health and safety rules applied in construction will be followed. Apart from these there should be specific rules due to material in PV panels. The tips in the following list can be followed to complete the PV installation safely:

- Ensure only fully licensed electricians who have been inducted into an installer's safety program will be undertaking licensed work.

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- Prepare a risk assessment of possible hazards at the start of each installation especially when working at heights, working in ceiling spaces and installing and commissioning energy storage (battery) systems.
- For any high-risk activities (e.g. working on or near exposed live parts) develop a safe work method statement in consultation with your workers to be easily understood and followed.[7]

There is no specific legislation for PV waste in Turkey but the hazardous substances such as mercury, cadmium, lead, hexavalent chromium and polychlorinated biphenyls (PCBs) and ozone-depleting substances are present in the PV panels so there should be a waste management plan for those panels. DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE) can be followed during the preparation of waste management plan of PV panels.[8]

4.3.5 Risks and proposed risk-mitigation measures

As mentioned earlier the system is designed as an integrated system with PV and storage units to provide electricity to charging stations as well as public lighting systems. Although the generation curve could be estimated with a reasonable accuracy the load curves especially the charging station scenarios are also equally important for system configuration. A change in the e-mobility action (ex. Bus schedules, type of car, capacities etc.) will have an impact on the battery integrated PV system as well. Therefore, a synchronised effort together with mobility actions is important.

[7] http://neca.asn.au/sites/default/files//2018%20National/Safely%20Installing%20Solar%20Systems_1.1.pdf

[8] http://www.solarwaste.eu/wp-content/uploads/2014/04/WEEE-Recast-Dir-EN-20120704.pdf

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4.4 A4 Solar thermal collectors' installation for residential buildings

4.4.1 Management structure

[A4] Solar thermal collectors will be installed on top of the newly built residential buildings [A1] to provide Renewable Energy Solutions for DHW demand. Contractor (SURYAPI) is the company responsible for financing and construction of the buildings also including the necessary infrastructure (all systems excluding the thermal panels itself) of the solar thermal collectors. Currently, the construction of the buildings is finalized, the buildings are re-registered to their owners. In addition, the necessary infrastructure (circuit components, plumbing) are completed within the building and the roof. Once flat owners are re-registered, the solar collector panels will be installed.

Regarding the business model of the installation, operation and maintenance of the systems, two options are on the agenda:

1- The floor owners can collectively agree among themselves and contact a solar thermal collector company. The installation company can complete the system by connecting solar panels with the currently installed thermal collector infrastructure. Commissioning can be started by installing the meters belonging to the apartments.

2- The site management company of SURYAPI (homeowners association) can make an agreement with a solar thermal collector company on behalf of the flat owners. The company can complete solar panel installations on building roofs. Followed by, signing of the installation commitment to be made between the floor owners and the site management in return for the service. In line with this commitment, reflecting the panel investment cost to the invoices in addition to the monthly hot water usage expenses of the flat owners.

For both cases, the commissioning, monitoring and maintenance of the systems will be made by an installation company.

When evaluating the legal process in Turkey on the issue;

According to the provisions of Article 19 of the Property Ownership Law, each repairs, facilities and changes cannot be made in the common areas of the main real estate without the consent of all floor owners. As a rule, it is accepted that no facilities and changes can be made in common places unless the written approval of all floor owners is received, but it is concluded that it is an economical heating tool for all floor owners as well as an important contribution to the country's economy the Solar heating systems are allowed to be installed in roofs and similar common places.

Therefore, the principle of unanimity is not sought during the implementation of the decision, the principle of majority vote can be followed in decision making.

However, the two options given above are in the design phase, and SURYAPI continues to negotiate with flat owners and to determine the final operating model.

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4.4.2 Technical specifications of the city infrastructure

A solar collector is a device that collects the solar irradiation from the Sun for either space heating or domestic water heating. In MAtchUP case, the solar collectors will be used for DHW (Domestic Hot Water) demand in residential buildings [A1]. The main components of a solar thermal system could be summarized as follows:

- Collector solar collector panels and field piping together with support structure
- Heat transfer fluid (water of water glycol mixture)
- Storage tank system
- Pump for solar loop and pumps for other loops
- Heat exchangers to transfer heat from one loop to another
- Expansion and safety devices for each closed loop
- Sensors and monitoring devices

The system is designed as a centralized system for each building. Each building will have a solar collector located at the roof of the building connected to a shared centralized hot water storage tank where the heat is transferred to the DHW loop through a heat exchanger. The hot water storage tank is also connected to the natural gas fired boiler which is used as an auxiliary heater.

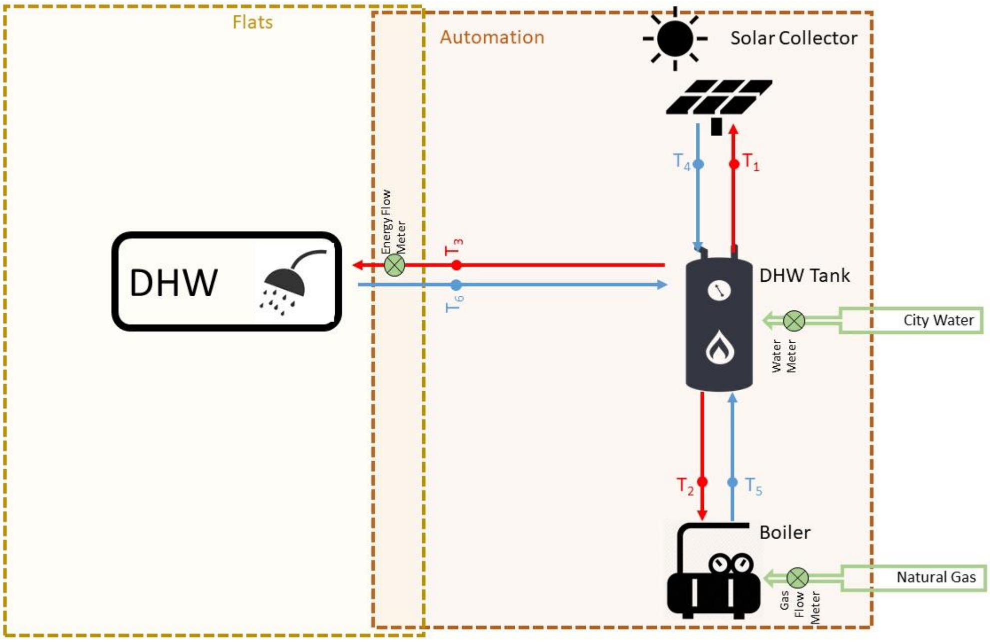

Figure 16 Solar collector system diagram

Each building can support approximately 125 m^2 application area for the solar collectors with an estimated energy generation equivalent to 175 MWh/year. Based on simulations run with Design Builder®, the use of solar collectors for DHW will contribute to overall energy performance of the building [A1] by 10%-12%.

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4.4.3 Planning of the tasks

The construction works of Kepez Santral has started in 2017. Buildings are finalized in August 2020 and flats are registered to their owners. Next steps include the installation of solar collectors and commissioning the solar collector system. The installation of solar collectors together with the supportive structures are expected to be finalized by 2nd Quarter of 2021.

4.4.4 Health, safety and waste management requirements

Occupational Health and Safety Law No: 6331 (OHS), which is based on the EU Directive No 89/391 was enacted in 2012. The construction and operation will be conducted in accordance with the provisions of this Law and related regulations. During periodic maintenance or repair, any waste such as cables, fuses, collectors etc. will be sorted depending on their toxicity and hazardous class and any waste considered as hazardous waste will be managed in accordance with the requirements of Hazardous Waste Management Regulation No29314.

4.4.5 Risks and proposed risk-mitigation measures

The construction of the buildings hence the constructions of the necessary infrastructure for the solar collectors are well advanced with minimum risk. However, the solar collectors have to be installed by the flat owners or tenants after re-registration of the flats once the building construction is finalized. There is a risk of delay for the integration of solar collectors to the infrastructure to allow monitoring of this action within the timelines of MAtchUP monitoring requirements. To mitigate the risks, MAtchUP team will work with the subcontractor (SURYAPI) to develop a package of “pre-fixed solution” for the property owners. This pre-fixed solution will cover ready to implement solar collectors and supportive structures design, equipment, installation and commissioning at a competitive price. This will allow property owners to act very quickly on their decision towards implementation.

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4.5 A5 Electrical storage for building and charging stations

4.5.1 Management structure

The storage system integrated to the public building is under the responsibility of Antalya Greater Municipality itself. The project will be co-financed by the Municipality. The design works, permit / licensing process and preparation for construction tender documents are subcontracted to a third-party consultant company experienced in his field. The construction works as well as commissioning will be subcontracted to a third party through a tender process. The operation and maintenance of the storage system will be under the responsibility of the associated department of Antalya Greater Municipality.

4.5.2 Technical specifications of the city infrastructure

The use of electricity storage at the building scale is not a diffused technology or action in Turkey. One significant reason for this is that the legislative structure allowed to benefit from the grid as a large storage network. Any excess energy from a RES was exported to the grid with no fee and the same amount of energy could be also imported from the grid any time in a calendar year with no fee. This allowed the RES systems to interact with the grid in a way the grid was used as a storage. Also, since there are no peak load fees/tariff applicable, the economic feasibility of a building or grid level electricity storage was negative since the DSO offered this service through the grid in a way free of charge. This was to support to RES development however suppressed the development of storage technologies and implementation in Turkey. However, in May 2019, the grid tariff regulation has amended to adopt a fee based on the exported and imported electricity for RES systems (and linked loads), changing the feasibility of a battery system.

There will be two battery groups within Antalya Demos Site. A 250 kWh battery capacity will be integrated with the PV system installed on top the Municipality Building while 150 kWh capacity will be integrated with the PV system installed at Kepez District. NMC type Li Ion batteries (Lithium Nickel Manganese Coblat Oxide) will be used at the site which is both suitable to serve as energy cell and power cell.

The 250 kWh capacity will mainly serve as load shift, to match the supply of the PV system to building demand, increasing the self supply rate from the renewable system for the Municipality building. The battery system will also support peak shaving specifically due to charging station for e-mobility.

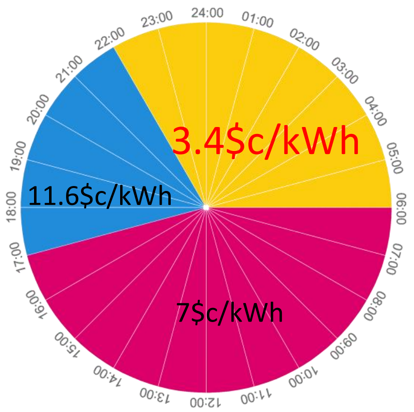

Figure 17 Smart tariff in Antalya

Electricity generation is mostly in day time while peak loads are mostly occur in peak times (17:00 – 21:00). Covering the demand from stored electricity will avoid using electricity from the grid which has the highest tariff. This will also increase the stability of the grid system.

A battery storage capacity will be integrated to the PV system [A3] through an inverter. The PV will generate electricity and provide electricity to the loads. The excess generation will be stored in the battery group. The electricity for the loads will be provided by the battery group when there is not enough electricity generation from the PV system or during peak demand. The integrated system will be connected to the grid through an inverter.

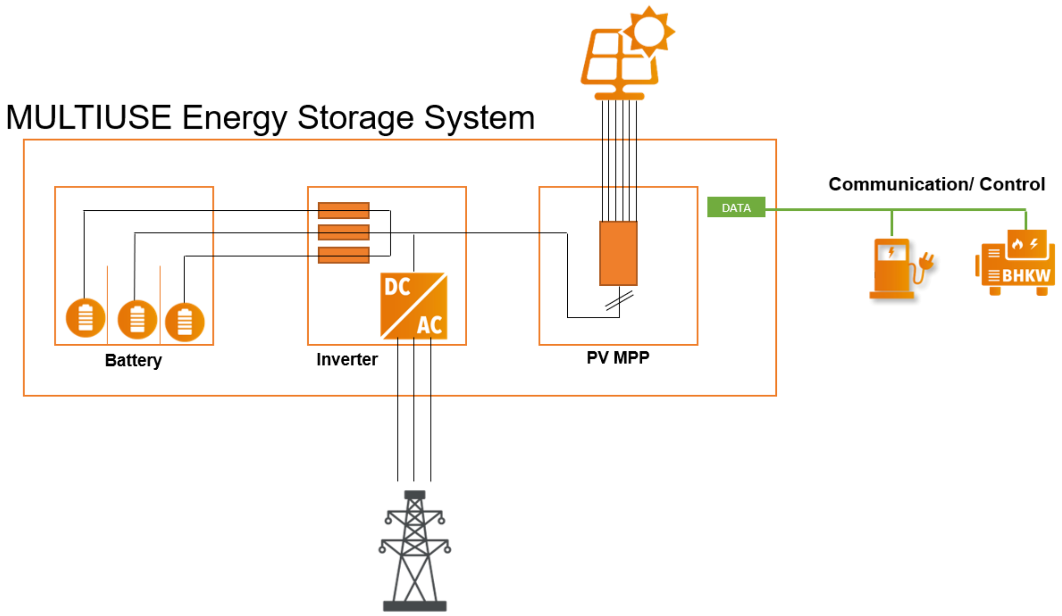

Figure 18 Functional block diagram for battery integrated PV system

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4.5.3 Planning of the tasks

Action 5 will be implemented through a tendering process. The tender process cover design, procurement, management of permit processes, installation, testing and commissioning of several systems including Battery Storage.

As of September 2020, all necessary permits from the distribution company for connection has been required. Public tender for this activity has started in October 2020 and finalized in November 2020. Installation will start In December 2020 and commissioning is expected by March 2021.

4.5.4 Health, safety and waste management requirements

Occupational Health and Safety Law No: 6331 (OHS), which is based on the EU Directive No 89/391 was enacted in 2012. The SPP construction and operation will be conducted in accordance with the provisions of this Law and related regulations.

During periodic maintenance or repair, any waste such as cables, fuses, collectors, solar cells etc. will be sorted depending on their toxicity and hazardous class and any waste considered as hazardous waste will be managed in accordance with the requirements of Hazardous Waste Management Regulation No29314.

4.5.5 Risks and proposed risk-mitigation measures

All necessary permits are obtained, hence there are no major risks associated with permits. The next steps include finalization of the tender process followed by construction and commissioning of the systems. As an administrative process, delays might occur in finalization of the tender and assigning a contract to a company as well as delays in project execution. The minimize the risk, the tender documents include requirements for companies that could enter into the tender process.

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4.6 A6 Smart control and domotics

4.6.1 Management structure

Implementation of A6 covers two building groups, residential buildings (9 blocks within Kepez Santral District [A1]) and the Municipality Building. Contractor (SURYAPI) is the company responsible for financing and construction in residential buildings while ANTEPE is the controller. The Municipality of Antalya is the sole responsible for both implementation and operation of the systems in the Municipality Building [A2].

4.6.2 Technical specifications of the city infrastructure

It contains a central unit to provide smart home technologies based on widely used CoAP (Constrained Application Protocol, XMPP (Extensible Messaging and Presence Protocol) protocols and bindings like KNX, ZWave, etc.

Through implementation of the action, Residents can control and monitor the connected energy systems (such as AC units). Also, the smart homes will be connected to the IoT platform (Antalya urban platform) and residents will be able to benefit from powerful and flexible rules, event and time-based triggers and notification systems.

In order to control and monitor all smart controllers, sensors and devices, an integrated platform (as one of the services at top of the Antalya urban platform) like OpenHAB will be provided. The aim will be to integrate all home automation systems and technologies into one single solution in the demosite. The reason for choosing OpenHAB like solutions is to support hundreds of different technologies and devices available in the market. All these are going to be integrated with the Urban ICT Platform via well-known and secure service integration patterns and protocols.

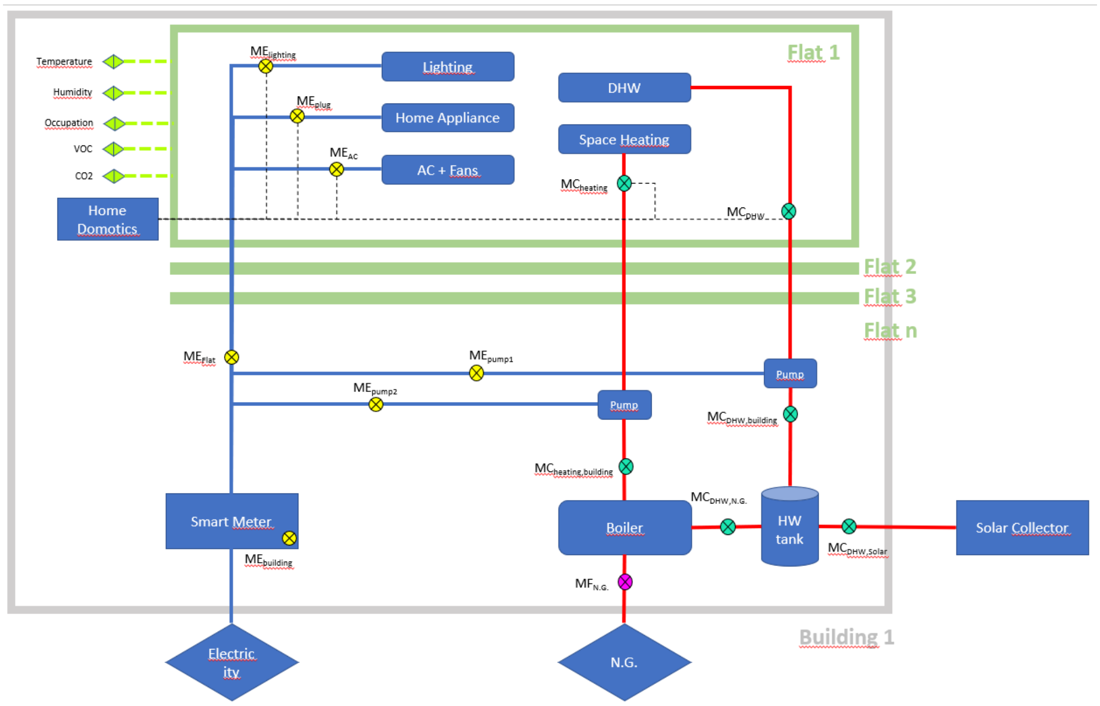

Figure 19 Monitoring and sensor layout for residential buildings

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Each flat will be equipped with temperature (in door), humidity, occupation, VOC and CO2 sensors. Also, a temperature sensor outside the building will monitor the air temperature at two opposite orientations of the building. These sensors are planned to be placed at a single point with wireless communication to minimize the implementation time and complexity. Sensors will communicate through LoRa/ LoRaWAN. Sufficient number of "LoRa / LoRaWAN" gateways will be installed inside the building so that the sensors can send the measurement data to the central software. The Contractor will determine the number of gateways to be installed, and the Contractor will be responsible for uninterrupted and healthy communication of the sensors at the points to be selected.

Figure 20 Ultrasonic heat meters

Heat energy consumptions will be monitored with calorimeters. These calorimeters will periodically monitor the energy consumption of each flat for space heating and DHW. The energy generated from Solar Collectors at each building block will be also monitored to identify the local RES usage. Each building has a natural gas fired boiler. The energy generated from this system will be also monitored. All calorimeters will be in accordance with EN 1434   standard, with a temperature measurement range: 5 ˚C - 90 ˚C.

Electricity consumptions will be monitored through energy analysers. Multi-channel energy analyzers will be used to measure the consumption of more than one flat.

Sensors will be externally powered or battery powered; In case the supply is from the battery, a battery life of at least 2 years will be guaranteed. IR controllers will be powered by an external adapter. IR controllers, will perform the operations of opening and closing of split air conditioners and changing the set values according to the commands from Energy Management Control System. At least one “LoRa / LoRaWAN gateway” will be installed on each floor in the blocks so that the sensors and IR controllers can send the measurement data to the central software.

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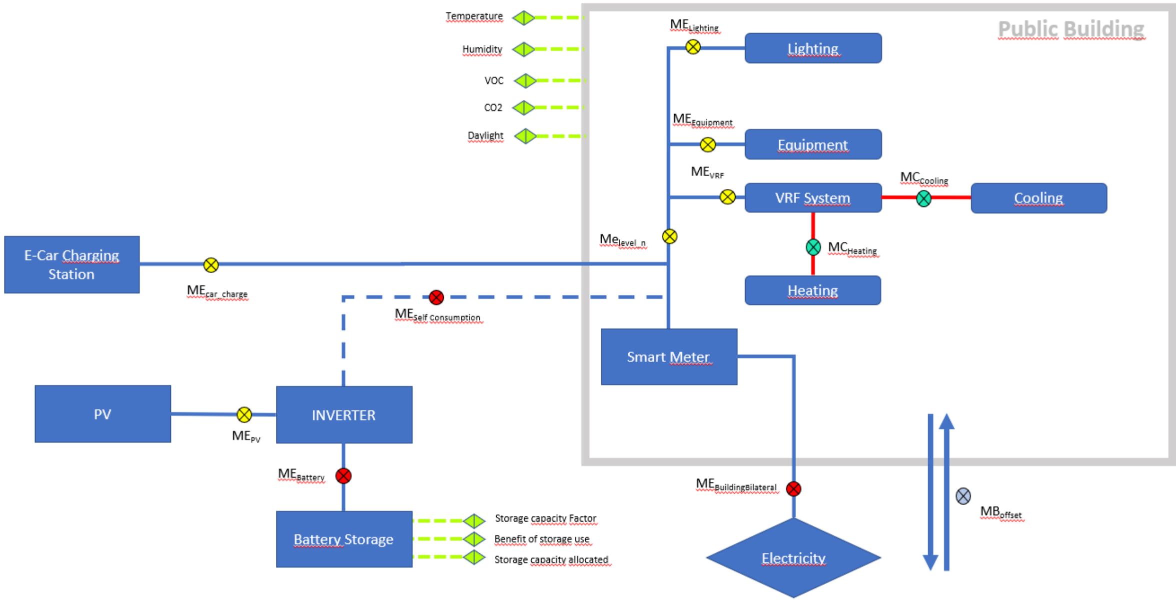

Figure 21 Monitoring and sensor layout for public buildings

Regarding the integration and interoperability of the Smart Controls; SAM is developing number of components to facilitate the integration of controls with the Antalya Urban Platform and support the integration architecture of the Antalya ICT interventions given in following figure.

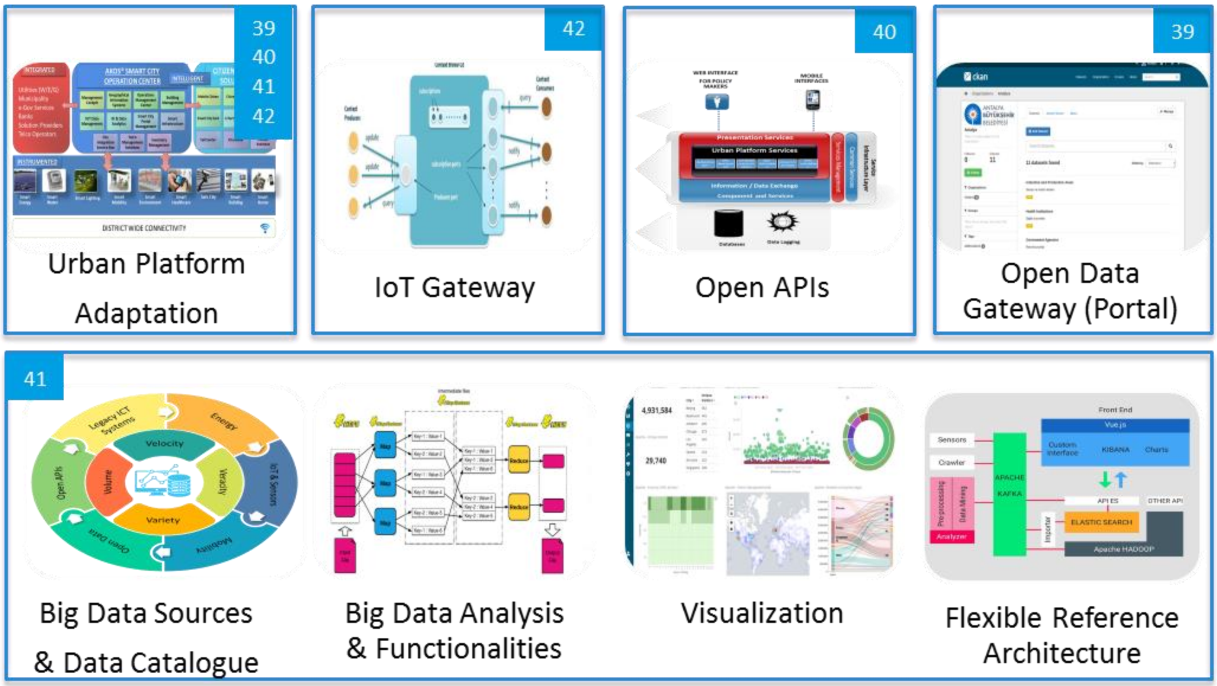

Figure 22 AUP Components and Actions

With the help of the integration architecture, the smart control components are able to communicate by using specified data formats and/or communication and the generated data will be shared through the urban platform. The further details of the integration and interoperability specifications are given in deliverable D4.24.

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4.6.3 Planning of the tasks

Action 6 will be implemented through a tendering process. The tender process cover design, procurement, management of permit processes, installation, testing and commissioning of several systems including Smart Controls, monitoring and sensor.

All documentation including the specifications has been finalized and the tender process is expected to start by December 2020.

The construction is expected to start by Q1 of 2021 and commissioning by April 2021.

4.6.4 Health, safety and waste management requirements

Occupational Health and Safety Law No: 6331 (OHS), which is based on the EU Directive No 89/391 was enacted in 2012. The installation of the equipment and operation will be conducted in accordance with the provisions of this Law and related regulations.

During periodic maintenance or repair, any waste such as cables, fuses, etc. will be sorted depending on their toxicity and hazardous class and any waste considered as hazardous waste will be managed in accordance with the requirements of Hazardous Waste Management Regulation No29314.

4.6.5 Risks and proposed risk-mitigation measures

Next steps include finalization of the tender process followed by construction and commissioning of the systems. As an administrative process, delays might occur in finalization of the tender and assigning a contract to a company as well as delays in project execution. The minimize the risk, the tender documents include requirements for companies that could enter into the tender process.

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4.7 A7 Smart meters

4.7.1 Management structure

Smart meters deployed for electricity monitoring and management of High-Performance Buildings [Action 1 and Action2]. The DSO will be the owner of these meters if the meters are installed to the distribution network, which is defined as between building main switchboard and the step-down transformer station. Purchase, installation and maintenance will be under the responsibility of the building / flat owner. The initial costs as well as maintenance and repair costs are transferred to the owners of the facility.

4.7.2 Technical specifications of the city infrastructure

Heightened demand for power availability, distributed generation, and greater efficiency are creating a need for more consumption and power quality measurements at the edge. Smart electricity meters allow you to accommodate auxiliary meters through a standards compliant interface and are fully capable of securely connecting to ZigBee radio frequency or LonWorks® PL, M-bus, Multipurpose Expansion Port (MEP) or Open Smart Grid Protocol (OSGP) devices for Home Area Network integration, energy management or other services. A Smart Meter and Powerful Grid Sensor are combined on smart meter.

A sophisticated and advanced Building Energy Management (BEM) system will be deployed like BEMOSS that will be integrated with the Urban ICT Platform to monitor these smart meters. Kepez Santral BEM will be able to integrate Smart Appliances, Smart Grid, Smart Meters, Smart Street Lighting, Building Automation System and IoT devices. This BEM is expected to provide scalability, robustness, plug and play, open protocol, interoperability, cost-effectiveness, as well as local and remote monitoring, allowing it to work with load control devices from different manufacturers that operate on different communication technologies and protocols. It supports different communication technologies and data exchange protocols like Ethernet (IEEE 802.3), Serial (RS-485), ZigBee (IEEE 802.15.4) and Wi-Fi (IEEE 802.11); and BACnet, Modbus, Web, ZigBee API, OpenADR and Smart Energy Profile (SEP) protocols. With its multi-layer architecture, it can be easily expandable to the entire building.

On district level, smart meters are the property of the distribution company (DSO), which in this case is Akdeniz Elektrik Dağıtım A.Ş.[9].

4.7.3 Planning of the tasks

Public tender is expected to start within December 2020. The installation will start in January 2021 and will be commissioned in March 2021.

[9] Ref: www.akdenizedas.com.tr

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4.7.4 Health, safety and waste management requirements

Occupational Health and Safety Law No: 6331 (OHS), which is based on the EU Directive No 89/391 was enacted in 2012. The installation of the equipment and operation will be conducted in accordance with the provisions of this law and related regulations.

During periodic maintenance or repair, any waste such as cables, fuses, etc. will be sorted depending on their toxicity and hazardous class and any waste considered as hazardous waste will be managed in accordance with the requirements of Hazardous Waste Management Regulation No29314.

4.7.5 Risks and proposed risk-mitigation measures

There are no identified risks

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5 Implementation

5.1 New Construction / Retrofitting

MAtchUP involves actions regarding new construction and retrofitting.

[A1] Residential Blocks:

Involves construction of high-performance residential buildings in Kepez District

[A2] Retrofitting of Public Tertiary Building:

Involves construction of high-performance public building in Kepez District

5.1.1 Status of the intervention

[A1] Residential Blocks:

The construction works of Kepez Santral has started in 2017. The construction works of Kepez Santral Urban Regeneration Project is divided into 6 zones. 9 residential building blocks under [A1] belong to A zone as shown in the figure below. The first zone to be completed is the A zone. All 9 building blocks of the A zone has been completed and registered to their flat owners within August 2020.

[A2] New Construction of Public Tertiary Building:

Construction of building has been finalized in 2017, with an energy rating of B. Interventions on HVAC systems as well as Building Energy Management will be completed by Q1 of 2021.

5.1.2 Risks found and corrective actions performed

The actions are well advanced and no major risks are identified.

5.1.3 Business model and financial scheme applied

Both constructions are planned within the Kepez District Urban Regeneration Area and part of a larger strategical transformative intervention on a city much larger scale. The business model could be explained as “Urban Regeneration Model”. Contractor (SURYAPI) is the party responsible for financing and execution of the Urban Transformation, which the plans and designs were developed by the Municipality (in collaboration with Antepe) through 1/5000 and 1/1000 scale development plans, which is also acting as the regulatory authority of the process on behalf of Ministry of Urbanization and Environment. The land value is increased through changing the allowed height of building blocks. This allows the investor/contractor to bare the risks and provide the necessary upfront investment (through bank loans and other financial tools) in return of owning property from the newly built buildings. The infrastructure and public areas / buildings /zones which fall under the responsibility of the Municipality is financed through “Ilbank” a specialized creditor bank in Urban Transformation area.

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Once the construction and transformation is finalized the new property re-registered back to the pre-owners with respect to their contracts with the Investor. This model allows access to necessary financial tools and motivation for the private companies' involvement in such a large scale (thus high-risk) projects.

5.1.4 Citizen engagement strategy implemented

Citizen engagement strategy of Antalya for Kepez Smart District has started before demolition of the project area completely. People living in the district have been informed by the experts from Municipal Urban Transformation Directorate, Ministry Of Environment And Urbanisation as well as Sampaş which is Consultant Company. In the context of citizen engagement several meetings have been organised in order to inform right owners

Furthermore, in regard to MAtchUP, citizen engagement activities have started immediately after the kick-off meeting in Valencia. Press release issued by three mayors has been posted by local regional and national media in order to raise awareness what smart city implementations have been planned in the project.

5.1.5 Next steps

Constructions for A1 and A2 are completed. Each action has reached the initially planned target of B energy rating. The verification requires deployment of monitoring equipment to gather actual data on energy consumptions at both residential blocks and municipality building. This is linked with the achievement of A6 and A7, which covers installation of monitoring equipment such as calorimeters, sensors and energy analysers. This is planned for Q1 of 2021.

5.2 Smart control and BEMS

5.2.1 Status of the intervention

Actions 6 and 7 will be implemented through a tendering process. The tender process cover design, procurement, management of permit processes, installation, testing and commissioning of several systems including Smart Controls, monitoring and sensor.

All documentation including the specifications has been finalized and the tender process is expected to start by December 2020.

The construction is expected to start by Q1 of 2021 and commissioning by April 2021.

5.2.2 Risks found and corrective actions performed

Next steps include finalization of the tender process followed by deployment and commissioning of the systems. As an administrative process, delays might occur in finalization of the tender and assigning a contract to a company as well as delays in project execution. The minimize the risk, the tender documents include requirements for companies that could enter into the tender process.

5.2.3 Business model and financial scheme applied

For residential buildings, the smart meters and domotics are installed by the Contractor (SURYAPI), which also covers the initial investment costs of total construction (including the domotics and smart meters). Financials on this action are not detailed yet.

5.2.4 Citizen engagement strategy implemented

Internal communication tools such as flyer, dedicated events, meetings with the building users will increase transparency, public acceptance of the interventions, and awareness for energy saving potentials.

5.2.5 Next steps

An open tender is planned for December 2020 which will cover several topics and actions grouped under one contract. Actions bundled for the tender are Smart Controls and Domotics [A6], Smart Meters [A7], LED Public Lighting [A8] and Smart Control of Public Lighting [A9]. The tender process will be finalized in January 2021. All actions are expected to be commissioned by March 2021.

5.3 Clean energy generation / building renewables

There are two separate renewable energy systems integrated to the buildings:

[A3] PV installation for public buildings, and

[A4] Solar thermal collectors' installation for residential buildings

5.3.1 Status of the intervention

There are two separate building integrated renewable energy systems applied under the MAtchUP.

[A3] PV installation for public buildings:

Public tender for this activity has started in October 2020 and finalized in November 2020. Installation will start In December 2020 and commissioning is expected by March 2021.The system is designed as an integrated system with PV and storage units.

[A4] Solar thermal collectors' installation for residential buildings

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Residential buildings are completed and the infrastructure of solar collectors are finalized, as well piping, storage tanks, pumps and heat exchangers. The solar collectors and supportive structures will be implemented when the flats are re-registered o their owners. The installation of solar collectors together with the supportive structures is expected to be finalized by 2nd Quarter of 2021.

5.3.2 Risks found and corrective actions performed

No corrective actions have been applied

5.3.3 Business model and financial scheme applied

The system will benefit from smart tariff. The grid has two tariff types to choose. Single tariff and smart tariff. If single time is selected the electricity price is fixed to 7 $cent/kWh for all day. If smart tariff is selected then the applied tariff changes throughout the day. The peak hours are 11.6 $cent/kWh however low-demand hours are 3.4 $cent/kWh.

The battery group will serve as a flexibility unit for shifting PV generation to the desired time frame. The demand for loads will be covered from battery groups during peak time when the electricity tariff is the highest.

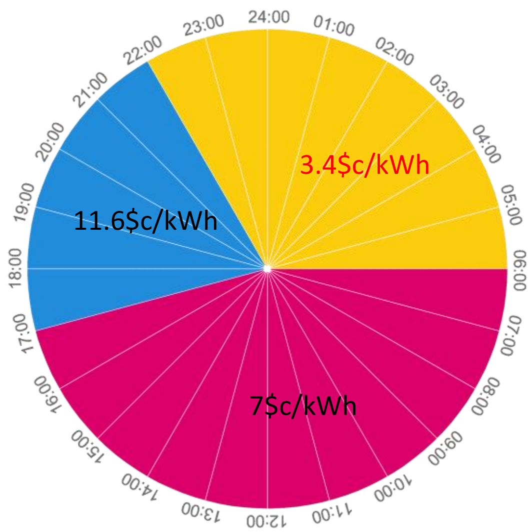

Figure 23 Smart tariff

PV system will provide energy during regular time frame which is also the time period when PV generation is high. The grid electricity will be used during off-peak times when it is cheapest. This will allow to lower the use of grid electricity during peak times lowering the energy cost for the system.

The initial investment cost is estimated to reach approximately 5.9 million TL.

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5.3.4 Citizen engagement strategy implemented

Antalya has a very active solar community, citizens, producers and research community in the solar area. The implementation of the PV system linked with electricity storage at the public building will not only have an impact on a technical level such as increase in self-reliance, increase in quality of the electricity infrastructure and distribution grid, it will also serve as an awareness and knowledge increasing activity. The technology, experience and results will be promoted (at different scales) for the citizens and institutions in Antalya. Best practices will be identified and a toolkit will be developed for the development of local renewable energy production and self-consumption projects adapted to each specific context. The tool will analyse the best business cases in renewable energy production, storage and will provide a decision support process to promote these actions. The Municipality will act as the information exchange medium in this topic.

5.3.5 Next steps

As of September 2020, all necessary permits from the distribution company for connection has been required. Public tender for this activity has started in October 2020 and finalized in November 2020. Installation will start In December 2020 and commissioning is expected by March 2021.

5.4 Smart energy integration / RES, Storage and management at building level

The building level electricity storage is designed as an integrated part of a system which is linked with PV system.

5.4.1 Status of the intervention

Public tender for this activity has started in October 2020 and finalized in November 2020[10]. Installation will start In December 2020 and commissioning is expected by March 2021.The system is designed as an integrated system with PV and storage units.

5.4.2 Risks found and corrective actions performed

No corrective actions have been applied

[10] Local news on the RES action https://antalya.bel.tr/Haberler/HaberDetay/?Id=8611&CategoryName=Genel&NewsOnPage=2&PageID=

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5.4.3 Business model and financial scheme applied

The building level electricity storage is designed as an integrated part of a system which is linked with PV system hence the business model and financial scheme are considered as a whole. Please refer to section 5.3.3 for further detail.

5.4.4 Citizen engagement strategy implemented

Antalya has a very active solar community, citizens, producers and research community in the solar area. The implementation of the PV system linked with electricity storage at the public building will not only have an impact on a technical level such as increase in self-reliance, increase in quality of the electricity infrastructure and distribution grid, it will also serve as an awareness and knowledge increasing activity. The technology, experience and results will be promoted (at different scales) for the citizens and institutions in Antalya. Best practices will be identified and a toolkit will be developed for the development of local renewable energy production and self-consumption projects adapted to each specific context. The tool will analyse the best business cases in renewable energy production, storage and will provide a decision support process to promote these actions. The Municipality will act as the information exchange medium in this topic.

5.4.5 Next steps

Public tender for this activity has started in October 2020 and finalized in November 2020. Installation will start In December 2020 and commissioning is expected by March 2021.The system is designed as an integrated system with PV and storage units.

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6 Conclusions

The deliverable provides information on how Antalya contributes to MAtchUP goals and objectives through the development of a new high-performance District, based on a combination of new constructions, integration of RES with storage solutions for flexibility and smart controls for building energy management. Kepez Santral District plays an important role in Antalya actions. Due to the high risk of earthquake, Antalya Municipality has undertaken a very ambitious project to transform the district from a high-risk area to a high-performance smart district. This transformation is the Urban Regeneration and MAtchUP is a small but exemplary part of this transformation. It involves new construction of both residential and public buildings with high performance that aims to have at least an energy efficiency rate of B, which is way beyond the business as usual performance for Turkey. The buildings are integrated with renewable energy systems for a cleaner and sustainable energy solutions also supporting decentralization of energy generation, which is a crucial element in smart city concept. The RES systems are connected with storage solutions to enable flexibility on energy supply and demand management.

Antalya has showed consistent progress throughout these actions. Actions towards securing a B Energy rating performance of the buildings (residential and tertiary) are completed and building level RES implementation with storage and smart meter and controls are well advanced. Public tender for PV and storage systems are finalized and deployment of systems will start very soon (December 2020) which will be commissioned very quickly by March 2021. Actions related with smart controls and BEMS are also well advanced. The tender preparations are almost finalized and an open tender is planned for December 2020 which will cover several topics and actions grouped under one contract. Actions bundled for the tender are Smart Controls and Domotics [A6], Smart Meters [A7]. The tender process will be finalized in January 2021.

With commissioning of smart controls and smart meters, energy savings and other technical impacts will be monitored throughout the remaining project lifetime.

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