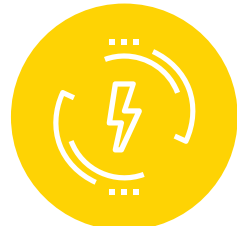


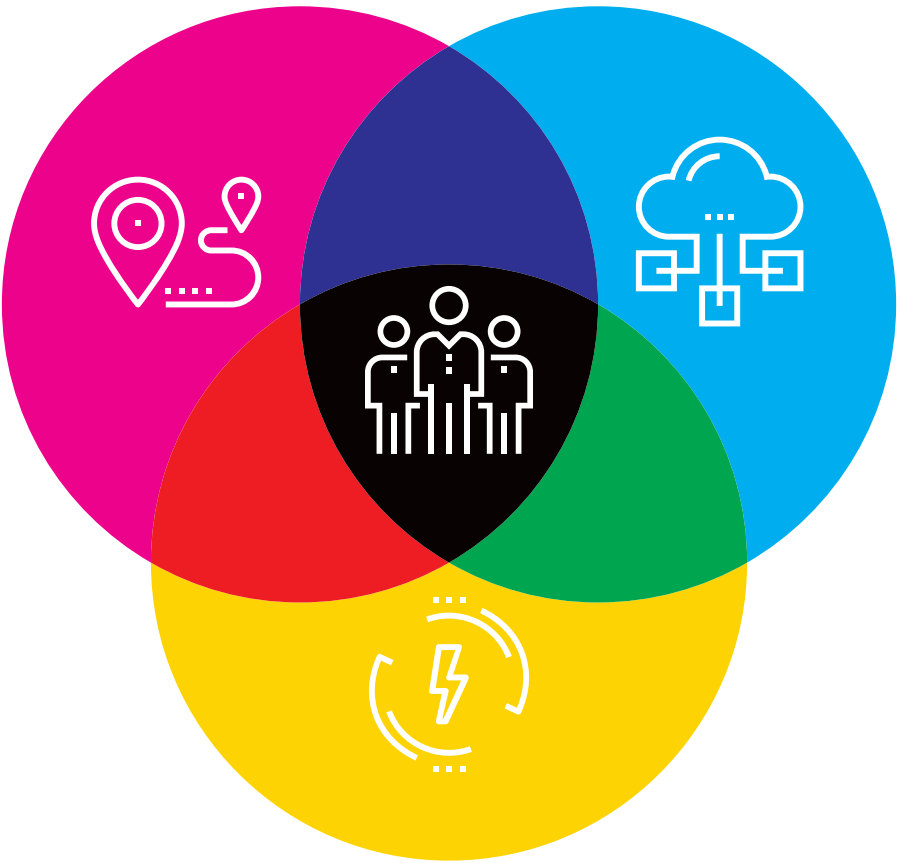


AN INNOVATIVE PALETTE
OF SOLUTIONS FOR YOUR CITY

INNOVATION HANDBOOK

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ACRONYMS

BEMS	Buildings Energy Management Systems
DFH	District Future House
HDPs	High-performance districts
SHEMS	Smart Home Energy Management Systems
IoT	Internet of Things
RES	Renewable energy sources
SHEMS	Smart Home Energy Management Systems
UDP	Urban Data Platform

MATchUP is a EU-funded Smart City project aiming to design and implement solutions that can turn urban problems into smart opportunities to improve the citizens’ quality of life and boost the local economies.

The final aim is to create a prosperous and more liveable urban environment for communities through dedicated actions to improve the **energy efficiency**, increase the **sustainable mobility** and invest on **technology** that can serve as a model of urban transformation for other cities in Europe and beyond.

MATchUP has been demonstrated in three lighthouse cities and four follower cities that joined forces to reshape their social, economic and environmental models and to promote social inclusion, liveability and prosperity for their citizens.



INTRODUCTION

MAThUP first aim is to maximise the upscaling and replication of the actions implemented, with special focus on transferability of business models.

This innovation handbook is the results of 5 years of collaboration between 28 partners from 8 countries, using their expertise to develop pioneering solutions and contribute to the improvement

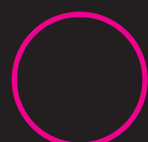
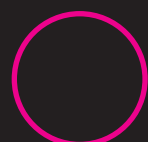
of European research and technological advancement.

This book provides an overview of the most successful, innovative, and replicable solutions developed by the project and includes insights on each technology. The areas explored are energy, mobility, and ICT. The book wants to guide policy and decision makers, investors, market analysts and cities' technical

staff through tools to bring innovation in their urban centres, and structure cutting-edge policies that facilitate the digital, technological, and sustainable transformation of cities.

We hand out our results to you and hope to be inspirational for your works and outlooks.

Ernesto Faubel-Cubells, MAThUP Coordinator



DISTRICT FUTURE HOUSE



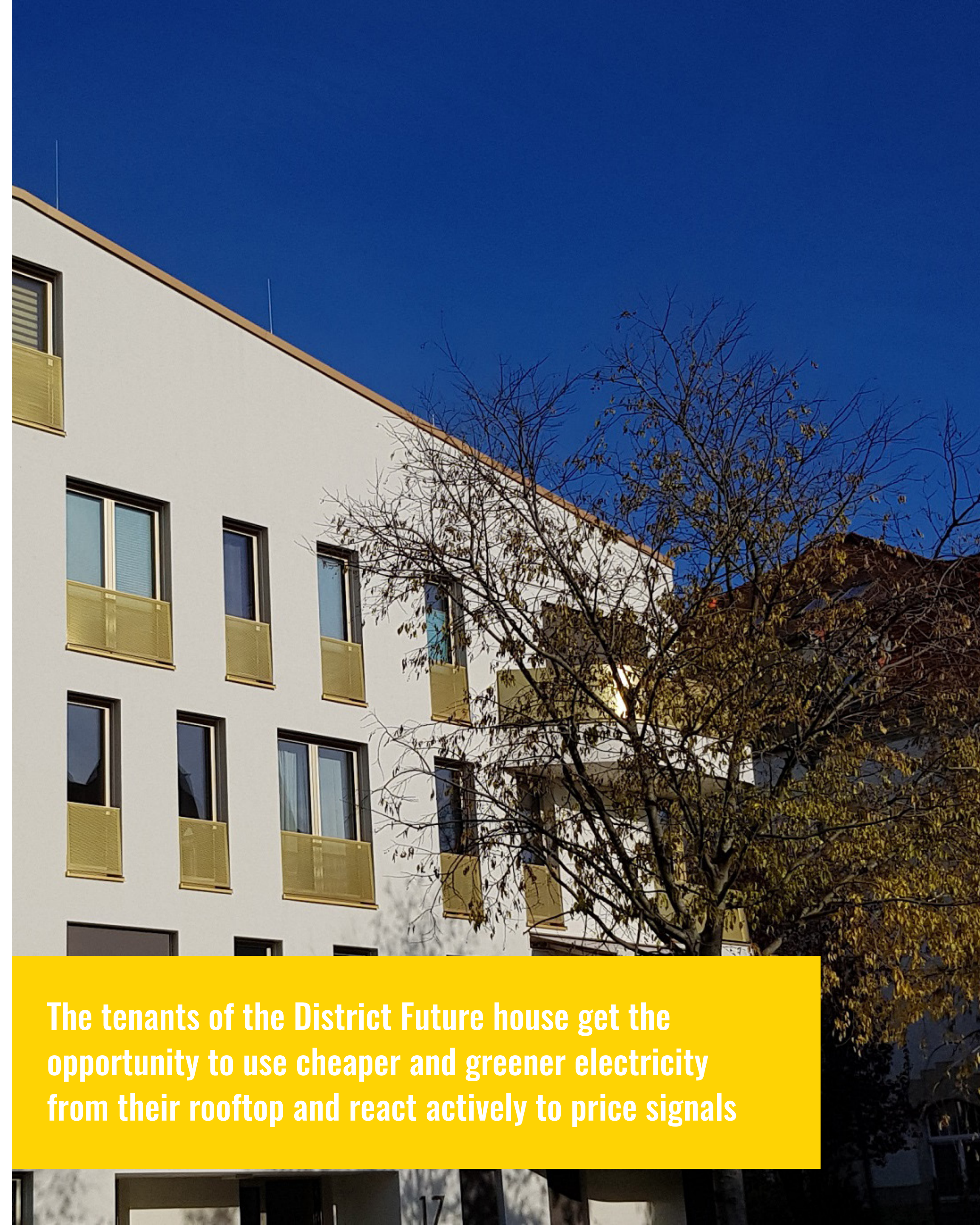
JOHANNSTADT DISTRICT, DRESDEN (GERMANY)

The District Future House (DFH) is a **smart concept** in which the building is equipped with **innovative technologies**, like building management systems, photovoltaic systems and electrical storage to reduce the electricity demand from the grid and increase the self-sufficiency rate. The building is also connected to the Dresden district **heating network**.

The DFH has sensors to allow monitoring the energy production, hierarchic energy management, and control. Residents are offered a tenant electricity model (also called shared consumption model), which provides a lower price for the tenants' electricity compared to the standard tariff. The tenant electricity model turns energy consumers into "**smart tenants**", enabling real-time information on energy consumption and prices for active synchronization of energy supply and demand.

INNOVATION

- Wide range of smart technologies in just one building
- Local consumption of local generated energy, reducing grid loads
- Occupants are first controllers of their consumptions
- Automatised and digitalised billing processes considering discounts



The tenants of the District Future house get the opportunity to use cheaper and greener electricity from their rooftop and react actively to price signals



BUSINESS OPPORTUNITY

In this energy transition process, business opportunities will arise for companies operating in all stages of the value chain, from construction and retrofitting companies to tech developers and service providers. The factors mentioned below indicate a positive outlook for the expansion of the DFH concept and similar, as well as the single technologies tested in the MAtchUP project:

- Countries are pushed to reach the **energy and climate targets** set by the EU policies (EU Green Deal, Clean Energy for all, etc.).
- Government **support for the construction** of new environmentally friendly buildings, and **the retrofitting** of existing infrastructures.
- Growing number of **residents' requests** for more sustainable buildings.
- Growing **investors' needs** and expectations for more sustainable investment opportunities and access to funds to more environmentally sustainable portfolios ⁽¹⁾.

SWOT ANALYSIS

STRENGTHS

- Access to new services.
- Less energy consumption and GHG emissions.
- Increase of environmental awareness and company's image.
- Costs saving solution.
- Activation of tenants as part of energy transition.

WEAKNESSES

- High initial costs of advanced equipment.
- Complexity of the system esp. pricing and billing process.
- The model is building-specific and must be customised to new use cases.

OPPORTUNITIES

- The increased role of the building sector in achieving energy transition.
- EU policies are promoting and supporting renewable energies.
- Strict legislation addressing energy efficiency.

THREATS

- Stakeholders' and residents' unwillingness to change.

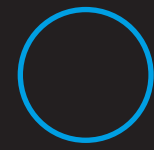
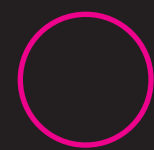
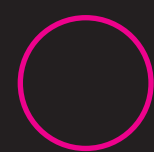
VALUE PROPOSITION

The DHF concept brings together a **wide range of technologies**, from PV panels, to storage systems, management, and smart systems for energy and control. Together, they address several aspects related to the **building's sustainability and energy efficiency**. At the city level, this set of smart solutions can **reduce CO₂ emissions** and thereby contribute to improve the urban air quality. The DFH can promote the production and consumption of **local renewable energy** that can be stored and used at the consumer's choice. For residents, this solution will enable **more control** over their energy consumption and can generate economic savings. Participants in the tenant electricity model no longer act as consumers but as prosumers, which can create an ecological awareness.

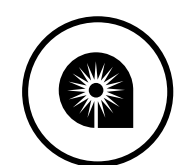
REPLICATION POTENTIAL

PRO: Decarbonization is a need and citizens can help to get it and to face climate change. ⁽²⁾





HIGH-PERFORMANCE DISTRICT



KEPEZ-SANTRAL DISTRICT, ANTALYA (TURKEY)

High-performance districts (HPDs) are **pioneering strategy** for achieving governments' commitments to energy security, resilience, environmental sustainability, and reduced emissions. The result is a model to enhance the **energy performances of the district**, made of different types of energy-efficient buildings, smart urban concepts and a variety of district-scale approaches to optimize energy use.⁽¹⁾

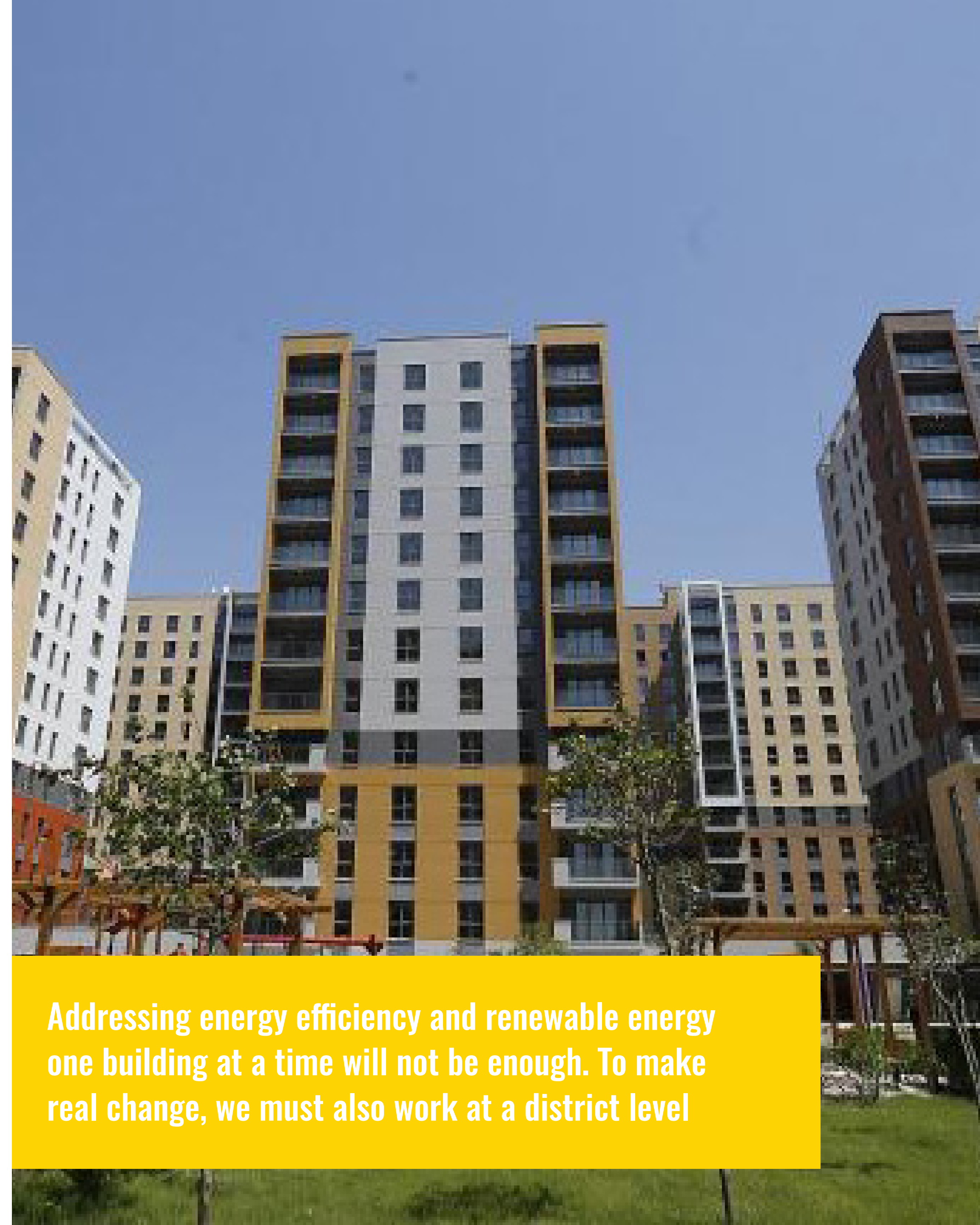
The MAtchUP model is made of several energy and mobility solutions, implemented in the Kepez-Santral district, in Antalya, to test the usage of **sustainable technologies and construction methods**.

The High-Performance District concept is developed in **new private and residential buildings**, as well as retrofitted **public tertiary buildings**, and comprise:

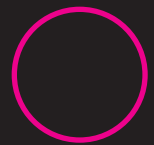
- Smart controls and Buildings Energy Management Systems (BEMS).
- Smart energy integration.
- RES, storage, and management.

INNOVATION

- Multi-building approach
- Large-scale benefits distributed to the whole district
- Involvement and collaboration of many stakeholders and utilities



Addressing energy efficiency and renewable energy one building at a time will not be enough. To make real change, we must also work at a district level



BUSINESS OPPORTUNITY

The building sector is crucial for achieving EU's energy and environmental goals. Although HPDs are gaining attraction in the market, they currently represent a **small fraction of commercial and residential building developments**. It is estimated that today, roughly 75% of the EU building stock is energy inefficient ⁽²⁾.

To boost energy performance of buildings, the EU has implemented a legislative framework that includes the **Energy Performance of Buildings Directive** 2010/31/EU and the **Energy Efficiency Directive** 2012/27/EU ⁽³⁾. These directives will promote the decarbonisation of building stock by 2050, and create a stable environment for investment decisions, for both consumers and businesses. The new rules also ease access to financing for improving the building stock ⁽⁴⁾.

VALUE PROPOSITION

The high-performance district model aggregates various sets of smart solutions that can be implemented at the district level. The model enables the development of **economies of scale**, which reduce the implementation costs, and contribute to higher district-wide efficiency thanks to a **building and energy load diversity**. Also, it introduces new business models, where, for instance, building owners and district stakeholders may become producers of energy. Finally, the HPD facilitates the achievement of the **net-zero energy** and the possibility to evolve into positive energy district.

REPLICATION POTENTIAL

PROS: Solution already tested in many locations.

High impact to promote energy efficiency ⁽⁵⁾.



SWOT ANALYSIS

STRENGTHS

- Opportunity of new district models.
- Customized implementation proved in a real urban process.
- New business models, good examples for nearby cities.

WEAKNESSES

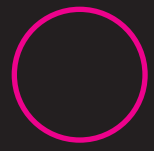
- Difficult for residents to adopt a very different, high performance, technology-based smart district.
- Challenging process for informing & involving residents of the district.

OPPORTUNITIES

- Emerging approach.
- High replication potential.
- High opportunities of new business solutions, products and services.

THREATS

- Changes in the legislation.
- Changes in the market dynamics.
- Requires the collaboration with many stakeholders and utilities.



INTERMODAL MOBILITY HUBS



DRESDEN (GERMANY)

The intermodal mobility hubs **connect different means of transports**, like carsharing, bike sharing and public charging infrastructure with the public city transport, in order to ensure maximum effectiveness. The objective is the simple and above all flexible use of different, environmentally friendly means of transport to make people's journey easy, adaptable and low carbon. This will reduce the use of private cars and therefore lead to the fulfilment of the EU energy, mobility and climate targets.

In Dresden, 80 intermodal mobility hubs will be implemented by the end of 2023, with 50 of them already operating (three of them in the Johannstadt district). The hubs are also equipped with charging infrastructures for electric vehicles.

INNOVATION

- Interconnection, several means of transport in just one place.
- High replication and knowledge transfer potential.
- Space-saving design of the transport infrastructure.
- Calculation of the realistic cost of mobility hubs.
- Partnering with mobility service providers, such as nextbike (Bikesharing) and teilAuto (Carsharing)
- Partnering with car brand Volkswagen to transform Dresden to a model city for electromobility



Dedicated locations where a range of sustainable transport modes are co-located in close proximity, bring far more benefit to society than just a place to.



BUSINESS OPPORTUNITY

Local and national governments are giving increased attention to mobility hubs as they seek to solve several problems with a single solution. In Europe, the need for attractive mobility hubs is increasing for a number of reasons which encourage further public transport demand growth ⁽¹⁾:

- People increased their **journeys** across countries and need to move within the cities.
- There's a need for **shorter distance "last-mile" travel options**, to reduce the time spent on the road, move efficiently and enjoy the city.
- The rapid development of **shared micro-mobility** services (shared bicycles, e-scooters, mopeds and cars), in addition to the growth in demand for personal cycling parking.
- The possibility to **partnering** with car brands (e.g. in Dresden the city partnered with Volkswagen) and mobility service providers to improve the number of e-vehicles with shared benefits.

Mobility as a Service provides applications that enable users to access different transport modes in the city and to access relevant time and space information for planning and payments.

SWOT ANALYSIS

STRENGTHS

- Acceptance of sharing economy.
- Less space necessary for private parking, thus better design of the urban space.
- Increased accessibility to areas which are poorly reached by the public transportation.
- Beneficial effects on environment by reducing external factors.

WEAKNESSES

- Need of close coordination of all involved partners (public transport operator, city administration departments, mobility service providers) to reach decisions.

OPPORTUNITIES

- Marketing for sustainable and socially viable mobility due to a visible infrastructure element in public transport areas.
- Public sector bodies have a clear pressure to decarbonise their fleets and meet sustainability targets.

THREATS

- Potential legal issues concerning carsharing in public space.
- Evaluation of the design concept from the different point of views (marketing, urban design, cooperate design).

VALUE PROPOSITION

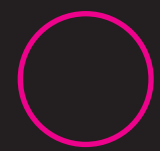
Growing urbanization, climate change, and demographic and societal changes are some of the trends that have put **pressure on transport networks** and are pressuring governments to provide better integrated solutions for citizens. In this context new transport solutions are needed, and future urban transport systems will have to introduce new mobility services and **promote innovation in public transport**, especially providing a great opportunity for the deployment of multimodal passenger transport ⁽²⁾. The expansion of multimodal hubs will lead to higher acceptance of the sharing economy, beneficial effects on the environment and the liveability of cities and the chance to meet the EU targets in terms of energy, mobility and climate.

REPLICATION POTENTIAL

PRO: Traffic reduction is a need of all cities, low economic costs.

CON: Impact of the solution is not assured ⁽³⁾.





LAST-MILE LOGISTICS



VALENCIA (SPAIN)

Even if often underestimated, urban logistics is also one of the focus topics in the EU Commission's Urban Mobility Package. The EU Commission states that "captive fleets such as mail delivery vehicles and garbage trucks are well-suited for the early introduction of new types of vehicles and alternative fuels". Without **urban logistics**, the current urban lifestyle would not be possible. Citizens are used to some benefits provided by the existence of last-mile logistics system; at the same time, they want clean and more liveable city centres.

The last-mile logistic pilot in the Maritime District in Valencia is using eBikes to provide the service. The data generated feeds the VLCi platform, which provides strategic information that contributes to changing the urban delivery transport (from fossil fuel delivery vehicles towards e-bike vehicles). The main aim is not only to reduce noise, and pollution in urban areas, but also reduce congestion, save energy, and create new market opportunities for the local economy.

INNOVATION

- E-bikes are a promising solution when it comes to last-mile delivery, especially in urban environments, where they can speed up deliveries and produce less carbon dioxide compared to other means. In addition, they respond to the current EU policies and targets for the 2035 ⁽¹⁾.



The world is looking for practical, fast and sustainable solutions. Last-miles logistic is the combination of such needs.



BUSINESS OPPORTUNITY

- Urban logistics is a **strategic economic sector** and last mile delivery is one sector that is growing rapidly, mainly due to **the expansion of online retail and e-commerce**. It is estimated that by 2025, at least 500 million deliveries will be made per day within cities.
- By 2025, **cities are likely to be larger** (60% of the world's population is expected to live in cities), ICT will be pervasive (more than 80 billion connected devices), and the online retail sector will have risen to nearly 20% of total retailing.
- There is an **urgent need to develop an adequate transport system** for light commercial vehicles which, operating in efficient and fast conditions, prove able to contemporarily guarantee consumers' needs and environmental sustainability.
- In this context, the last mile logistics based on e-bikes for urban freight is a growing market in Europe.

VALUE PROPOSITION

The last-mile logistic consists in the use of eco-friendly transportations for last-mile delivery services that contributes to environmental sustainability and generate business opportunities for local companies. The benefits connected to this solution are many, **from environmental, to social and economic** ones. Indeed, the aim is not only to reduce noise, and pollution in urban areas, but also reduce congestion, save energy, improve the quality of life, improve the social relations and create new market opportunities for the local economy.

REPLICATION POTENTIAL

CON: Low impact of the solution ⁽²⁾.



SWOT ANALYSIS

STRENGTHS

- Increasing demand for effective daily last-mile delivery of goods.
- Increasing demand from the civil society for environmentally sustainable and highly liveable city centres.
- Use of efficient and clean vehicles.

WEAKNESSES

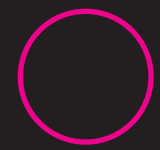
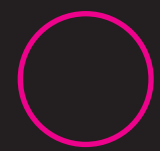
- Necessary alliances of various stakeholders.
- Vehicles with limited capacity (bikes).
- Diminishing returns in biking performance.

OPPORTUNITIES

- Trend towards sustainability.
- Increasing request of urban delivery.
- Growing urbanization and demographic growth.
- Increasing attention to environmental issues and sustainable mobility.
- Mobility restrictions in urban areas affect the performance of traditional vehicles.

THREATS

- Habits of the population.
- Growing competition.
- High prices.



URBAN DATA PLATFORM + IOT INTEGRATION



VALENCIA (SPAIN)

Urban data platforms are at the heart of the **digital transformation** of cities and communities, as they connect, analyse and visualise all data coming from the whole urban structure. From here, data can be accessible to participants in cities ecosystem, including citizens, businesses and public policy makers.

Valencia's Urban Data platform collects all types of information from both the Valencia City Council systems and other systems and devices deployed in the city. It provides a **holistic view of the information** with the aim of improvement and development of innovative smart city services, facilitate data-driven decision making and provide better digital services to the citizens at lesser costs.

MATCHUP datasets are related to smart meters in residential and public buildings, renewable energy generation, transportation e-vehicles and charging stations. All data collected is anonymized and will be open and available for citizens and companies.

INNOVATION

- Integration of data from Internet of Things (IoT) devices and existing systems
- Open data available to citizens and companies
- Facilitates data-driven decision making



Urban data platforms are helping smart cities to evolve by combining data and returning them as practical solutions to city-wide problems.



BUSINESS OPPORTUNITY

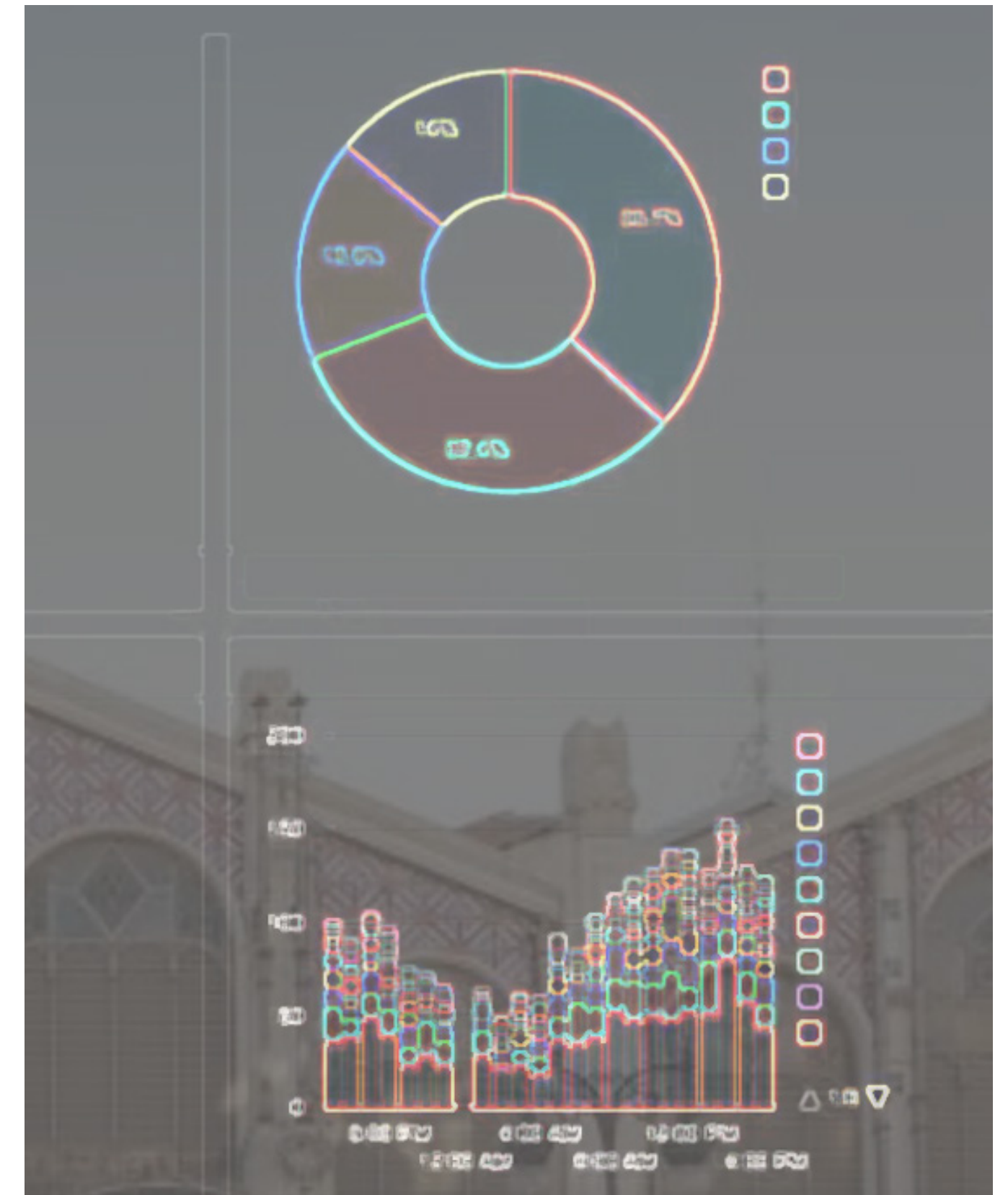
- The development of Urban Data Platforms in Europe is **still in its early stages**. Only 31% of EU cities have an UDP in operation ⁽¹⁾.
- Overall, the usage of the currently available platforms is very low for both society and business players, but **cities have clear ambitions** to establish an open interoperable city-wide enabling platform that supports multiple services.
- 70% of the platforms currently facilitate making **data available to users in an open way**, but companies are not taking full advantage of engagement.
- Urban data platforms can **foster innovation and unlock opportunities** for citizens and SMEs.

VALUE PROPOSITION

The implementation of the Urban Data Platform is a key element for a city to become smart, contributing to the improvement of **interoperability** for city administration and citizens. The UDP serves as the basis for many smart city applications, mapping, combining, and storing data from a wide range of sources. Based on the UDP, the city government can benefit from improved management and policy decisions based on the data collected. In addition, it can better provide access to city **data through visualization** tools and generate business opportunities for companies and citizens. Lastly, the UDP can increase the **attractiveness of the city** towards students, potential new residents, commercial companies, start-ups, and tech-skilled workers.

REPLICATION POTENTIAL

PRO: Trend in all cities to use in the decision-making process ⁽²⁾.



SWOT ANALYSIS

STRENGTHS

- Support in strategic city planning and evaluation of evolution.
- Enhanced knowledge of citizens' needs and the possibility to tailor services.
- More transparent data.

WEAKNESSES

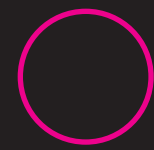
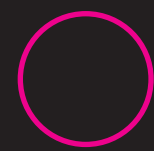
- High development costs.
- Dependence on the availability of existing IoT devices.
- IoT security risks.
- Complexity in the integration of data from different devices.

OPPORTUNITIES

- Increasing interest from citizens in smart solutions and ecology.
- Increased possibility of employment.
- Growing demand for data usage in specific applications (mobility, energy).
- Foster local entrepreneurship.

THREATS

- Skills to leverage the data for new business development.
- Possible concerns over data security and privacy.
- The reluctance of citizens towards monitoring and control.



SOFTWARE FOR HOME ENERGY & ENVIRONMENTAL DATA MONITORING



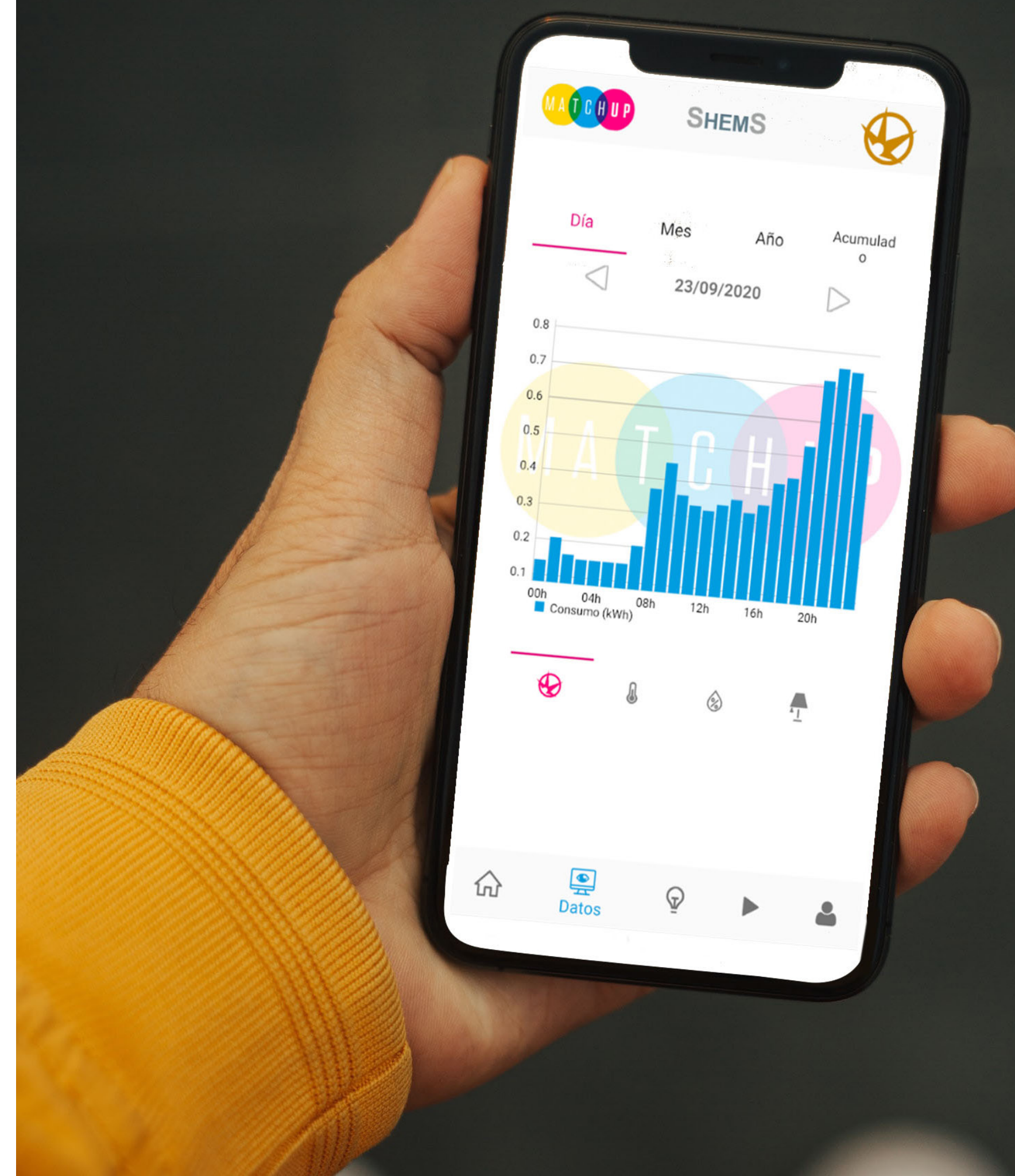
VALENCIA (SPAIN)

The software for energy and environmental data visualization and savings calculation supports the development of Smart Home Energy Management Systems (SHEMS), an effective tool that enables users to **monitor and reduce energy consumption in households**. It is based on a smartphone app, working through the VLCi platform. The software provides the following functionalities:

- Energy monitoring, by displaying the energy consumption information to consumers. In addition, it can also provide information related to energy generation and storage for prosumers. Users can see in an energy dashboard their electricity and gas consumption and CO2 emissions.
- Modification of the users' behaviour in order to reduce their consumption by means of gamification techniques.

INNOVATION

- Used by both city council and citizens
- Near real-time statistics and graphs about energy and environmental data



Data visualizations add credibility to environmental communication and aid audiences in their interpretation.

BUSINESS OPPORTUNITY

- The EU legislative framework establishes to **boost the energy performance of buildings** ^{(1), (2)}. Together, they promote policies that are driving the growth in the energy management market.
- The software for energy and environmental data visualization is a key component of the Smart Home Energy Management Systems, and as such, benefits from the growing adoption of this solution that aims to optimize the energy management in residential buildings.

The scenario above indicates an important **market opportunity** for companies providing specialized data visualization tools for the energy market. Indeed, there is a growing number of start-ups employing big data and analytics to derive insights from energy generation and consumption in various sites. The key future in this segment is the use of data visualization tools to make the delivery of information more intuitive for the users.

SWOT ANALYSIS

STRENGTHS

- Easy energy and environmental data visualisation based on a mobile app.
- Supports energy monitoring and consumption for domestic users.

WEAKNESSES

- Interoperability issues (integration of software with devices coming from different vendors).

OPPORTUNITIES

- Rising energy costs inducing people to save energy and to monitor their energy consumption.
- The current market is focused on IoT developments, and these types of products are easy to launch and operate.

THREATS

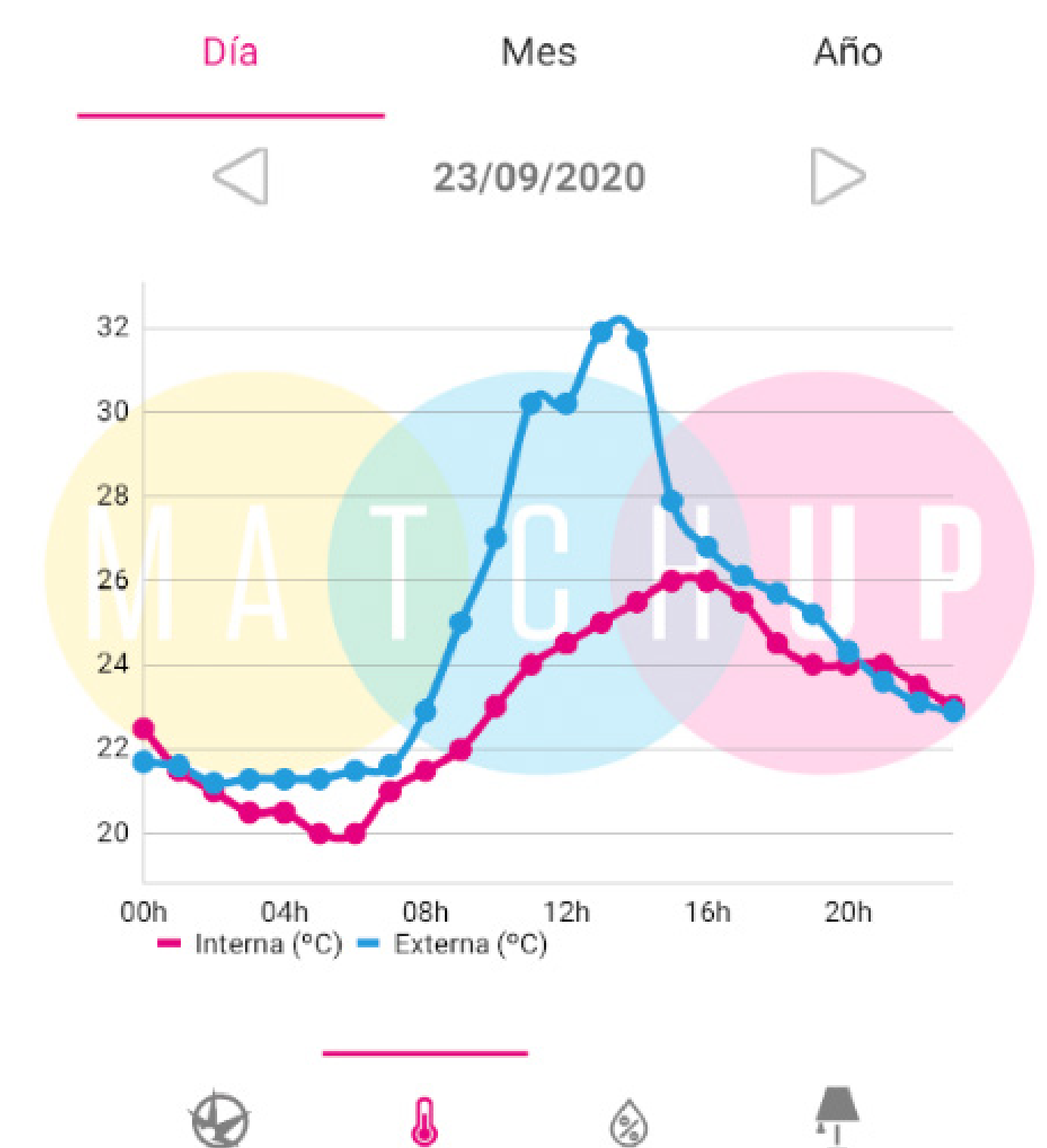
- Highly competitive market.
- New European privacy framework to be taken into account.
- Low value from residents.

VALUE PROPOSITION

The software for energy and environmental data visualization can be **further replicated** in other cities and sectors. It is an effective tool that enables users to monitor and reduce energy consumption in households. Also, the App SHEMS gives pieces of advice to **help users improve energy efficiency**.

REPLICATION POTENTIAL

CON: Low social acceptance, the impact of the solution is not assured. ⁽³⁾





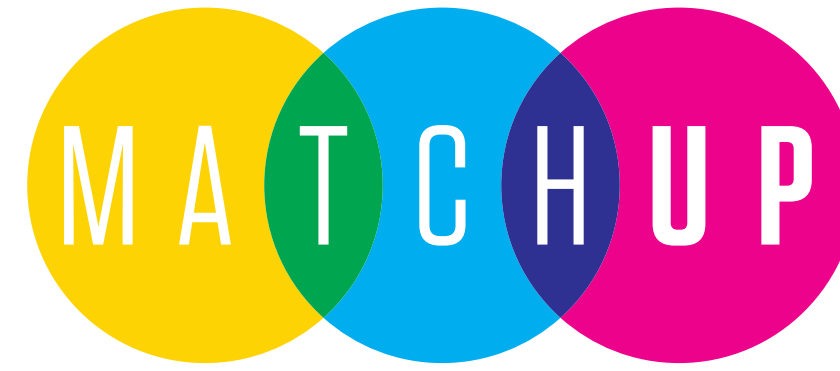
CONCLUSIONS

Cities are changing fast. The swift transformation and growth have led growing problems for many of them: traffic congestion, pollution, energy costs and break downs to name just a few. But cities are also the world's best laboratories for solutions. MAtchUP has tested several innovations in different

European countries, under different conditions and legislations and with different stakeholders. The conclusion we came is that making a city truly smart means improving the interoperability of all the sectors and solutions and put data and digital technology to work to make better decisions and deliver a better quality of life.

The digital and technological transformation of cities is the key to their advancement also in terms of sustainability and liveability. Replicating the successful stories and the lessons learnt of others, can fasten the path and improve the resilience of cities to external shocks.

Ernesto Faubel-Cubells, MAtchUP Coordinator



PROJECT COORDINATOR

Ayuntamiento de València

coordinator@matchup-project.eu

COMMUNICATION SECRETARIAT

Fondazione iCons

info@matchup-project.eu

STAY IN TOUCH:

 www.matchup-project.eu

 [@matchupEU](https://twitter.com/matchupEU)



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