D5.14 Replication and Upscaling Plan Leipzig

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Description of the related task and the deliverable. Extract from DoA	T5.5 Project Upscaling & Replication in Light House City (LHC) (BABLE) The aim of this task is twofold: first upscaling of the pilot solutions within the LHCs and secondly identifying opportunities for replication in LHCs. The task will build on the business models mapped in WP7 and individual strategies for scaling-up and replicating the defined interventions in other parts of the city or in a larger scope. As is done with the Fellow Cities (FC) in Task5.4, the LHCs will be supported through identifying suiTable Solutions and detailed planning of a Solution (per LHC) up until securing investment (see subtask5.4.2). Activities in this task will also draw on the knowledge exchange with the SCC1 community (WP6), in order to provide the basis to identify opportunities for replication across the lighthouse projects. Further, it will contain detailed plans for replicating one intervention within the city, including list of functionality suited to local needs, technologies to be implemented, costs of planned implementation measures, suiTable funding and business models, key timescales, lead partners, risks & risk mitigation measures, Local governance & coordination structure. (R/PU, M60)
Participants	BABLE
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1.0	24/09/2024	VTT	Coordinator submits the deliverable to the EC

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PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

About SPARCS

Sustainable energy Positive & zero cARbon CommunitieS demonstrates and validates technically and socioeconomically viable and replicable, innovative solutions for rolling out smart, integrated positive energy systems for the transition to a citizen centred zero carbon & resource efficient economy. SPARCS facilitates the participation of buildings to the energy market enabling new services and a virtual power plant concept, creating VirtualPositiveEnergy communities as energy democratic playground (positive energy districts can exchange energy with energy entities located outside the district). Seven cities will demonstrate 100+ actions turning buildings, blocks, and districts into energy prosumers. Impacts span economic growth, improved quality of life, and environmental benefits towards the EC policy framework for climate and energy, the SET plan and UN Sustainable Development goals. SPARCS co-creation brings together citizens, companies, research organisations, city planning and decision making entities, transforming cities to carbon-free inclusive communities. Lighthouse cities Espoo (FI) and Leipzig (DE) implement large demonstrations. Fellow cities Reykjavik (IS), Maia (PT), Lviv (UA), Kifissia (EL) and Kladno (CZ) prepare replication with hands-on feasibility studies. SPARCS identifies bankable actions to accelerate market uptake, pioneers innovative, exploiTable governance and business models boosting the transformation processes, joint procurement procedures and citizen engaging mechanisms in an overarching city planning instrument towards the bold City Vision 2050. SPARCS engages 30 partners from 8 EU Member States (FI, DE, PT, CY, EL, BE, CZ, IT) and 2 non-EU countries (UA, IS), representing key stakeholders within the value chain of urban challenges and smart, sustainable cities bringing together three distinct but also overlapping knowledge areas: (i) City Energy Systems, (ii) ICT and Interoperability, (iii) Business Innovation and Market Knowledge.

Partners

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EXECUTIVE SUMMARY

This report outlines the development process of the Energy Map Leipzig and highlights its potential implications for other municipalities, which can learn from this process and consider replicating it.

The administration currently lacks data on the expansion of renewable energies and their current status. So far, each office has been left to collect this data on its own, which is inefficient and does not ensure data quality. There is also often a lack of knowledge about how these data can be obtained, leading to time-consuming research.

Until now, external consultants and engineering firms have been commissioned to develop urban concepts and strategies in order to collect or procure this information. However, this approach is tedious and time-consuming. The administration often lacks the expertise to handle these tasks internally.

The aim of the "Leipzig Energy Map" is to quickly identify the potential for renewable energies and their current expansion status in order to develop measures that can be derived from this. Existing analyses by external experts should be incorporated in order to achieve synergies during processing.

Existing data silos are to be broken up in order to free up data and bring it together in a central location. This enables data to be analysed and visualised, and fast data exports can be provided for third parties.

Originally, the target groups were the city administration of Leipzig and the SPARCS partners of the Leipzig consortium. However, the discussions have shown that there is great interest in using the "Leipzig Energy Map" as a source of information for citizens as well. This results in a third target group: the general public.

Chapter 2 describes the problem situation with regard to data availability and data utilisation for administrations.

Chapter 3 describes the development process of the Energy Map (3.1) and the technical infrastructure required for implementation (3.2). The upscaling plan is presented in the following chapter 3.3. This text describes the future development of the Energy Map within the Leipzig city administration. The financing options presented in Chapter 3.4 form the basis for the future development of the Energy Map.

Chapter 3.5 presents the results and recommendations.

The final chapter 4 presents the conclusions and findings drawn from the project.

1. INTRODUCTION

The SPARCS Lighthouse Cities are committed to upscale one chosen solution. To ensure effective replication & upscaling, a structured project development process consisting of 6 phases has been conceptualised. The phases are project selection, preliminary assessment, action plan development, securing funding budget, procurement & implementation, and monitoring & evaluation. Each phase is broken down into steps, with the goal, tasks, outputs, and best practices for each step outlined. This process has guided and supported the Lighthouse Cities to work on a project to be upscaled and design their overall replication strategy.

The objectives of this Replication & Upscaling Report are:

1. Provide a step-by-step overview of the process taken in the replication & upscaling of the chosen solution.
2. Outline the list of functionalities suited to local needs, technologies implemented, costs of planned implementation measures, business models, funding mechanisms, risks, and risk mitigation measures.
3. Demonstrate the contributions of partners both within and outside the SPARCS consortium and provide insight into local governance and coordination structure.
4. Inform and facilitate the replication & upscaling of the chosen solution beyond the SPARCS project.
5. Outline suitable business models for upscaling the implemented interventions (inputs from T5.7 and D7.6, D7.7, and D7.8)

The overarching goal in Leipzig is to achieve climate neutrality by 2040. The city plays a central role in this transformation process and has derived two key tasks from the SPARCS application:

The integration of energy and building data into the City of Leipzig's urban data platform to enable advanced and integrated neighbourhood and building planning (measure L19-1, LPZ, LSW, WSL).

Based on these tasks, the "Leipzig Energy Map" was developed, which is an important addition to sub-measure L20-1, which aims to develop a standard model for smart cities.

1.1 Purpose and target group

The following report presents the development process of the Energy Map Leipzig and demonstrates its implications for other municipalities that can learn from this process and possibly consider replicating it. The report also outlines the further development of the Energy Map Leipzig. In addition to presenting the upscaling plan, the aim of this deliverable is to provide other municipalities with guidance on how to learn from the process in Leipzig and use this information to create an Energy Map if required. As the data situation in Germany is the same, the replication potential for other municipalities is extremely high.

1.2 Relations to other activities

The following Table 1 depicts the main relationship of this deliverable to other activities or deliverables within the SPARCS project.

Table 1 List of other activities, deliverables

Deliverable /Milestone	Contributions
D4.3	Implemented demonstrations of solutions for energy positive blocks in Leipzig
T4.7	Post monitoring
L20	Standard model
D4.7	Replication Strategy

1.3 Replication & Upscaling Process

The Demonstration at Leipzig, both the work of the city and its local consortium, aimed at developing solutions and services for Positive Energy Districts (PEDs) and districts, reaching the development goals of sustainable Leipzig, and achieving the global SDGs by 2025. Replication and exploitation opportunities have been the driver for the actions.

To ensure effective replication & upscaling based on the Smart Energy Solutions agreed upon in the Implementation Plan, each LHC was supported in different activities to replicate and upscale one project by the BABLE Team primarily but also in consultation with other project partners.

To support LHCs in their upscaling process and FCs with their replication process, four steps were previously undertaken by BABLE. First, a preliminary desktop research was carried out to gain a better understanding of the SPARCS project and how it could best support the cities, followed by a virtual workshop with city representatives from the 7 cities to get their perspective on what the project development process of public projects looked like to them. Individual interviews were then conducted with replication managers from other SCC projects to learn from their experience in managing the LHCs and FCs for their respective projects, and then finally, after the analysis of all the inputs and further desktop research, the project development framework was formed. For the SPARCS project, some steps were skipped depending on the city's status and its position in the process.

The process developed for the replication & upscaling phase was also based on the GrowSmarter project, the IVL Swedish Environmental Research Institute; given its work with the City of Stockholm in developing an Excel-based standard process/toolkit for scaling up pilot projects in Swedish cities and its approach that guides cities from identification of scale-up opportunities to full implementation, and many other Horizon 2020 SCC projects as well. Before the commencement of the steps, a responsible person with time, mandate, and the means to get those with decision-making power to kick-start scale-up was appointed to take an active role in leading and driving the upscaling process.

Each LHC was supported with a guided process to upscale pilot solutions. The process consisted of the following stages:

1. Project selection: All the cases implemented during SPARCS were analysed to choose one that will serve as *lighthouse project* to continue with the legacy of SPARCS during and after the end of the project.
2. Preliminary Assessment: In this stage, LHCs were provided with guidance to assess of potential for upscaling of the chosen solution, evaluate of cost and benefits and develop an action plan for implementation.
3. Action Plan Development: In this stage, the scope of the project along with the business model were finalised. Depending on the outcome of earlier stages.
4. Securing Investment: A part of the budget provided to LHCs was leveraged to attract various private and public sector investments. The investment was used to secure first loss and thus empower the city to be part of a larger public-private investment.
5. Procurement/Implementation: In this stage, tools and tasks such as the market consultation, publishing joint tender call, contract award criteria, final decision on technology and supplier and the implementation will be considered.
6. Monitoring and Evaluating: Finally for this stage, after the implementation of the pilot solution, it will be necessary to carry out a monitoring and evaluation with associated KPIs and post management and communication.
   For these last stages 5 and 6, to assure the sustainability of the project, BABLE will provide each LHC with tools to support, although these stages are not included as part of this task and the SPARCS timeline as well.
   The project to upscale for the LHC of Leipzig was the Energy Map.

The diagram below shows the timeline and described phases for the process:

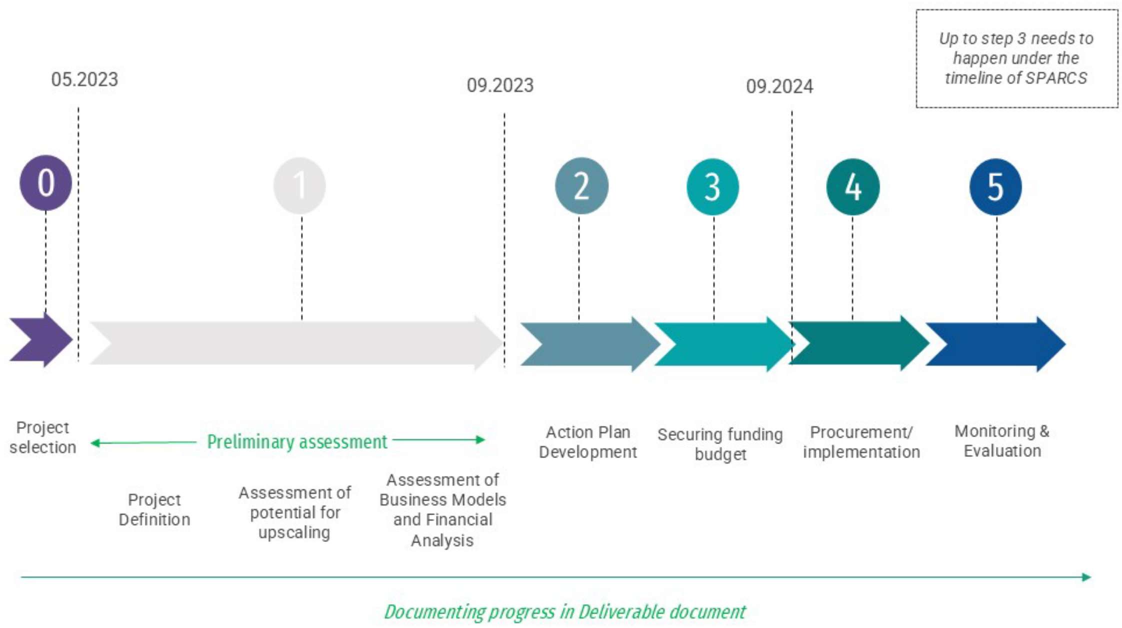

Figure 1 Timeline of the upscaling-process

The manner in which the city has been supported will be presented below.

1.3.1 Upscaling methodology: from idea to implementable project

All the interventions implemented during SPARCS were analysed to choose one that serves as a lighthouse project to continue with the legacy of SPARCS during and after the end of the project. This phase included the following activities presented in 2.1.1 – 2.1.3

a) Evaluating project ideas

This activity was aimed at analysing and identifying all the project ideas that could be implemented, this included: (1) all interventions were listed and reviewed, (2) further project ideas, already created by the city, were analysed, (3) an initial analysis of the replication potential was done - measured by the alignment with city strategies and the impact the project idea could have if replicated in the city, and (4) Leipzig's role was defined. The activity was facilitated by BABLE and completed by Leipzig and its local consortium. The following Figure 2 and Figure 3 shows the use cases

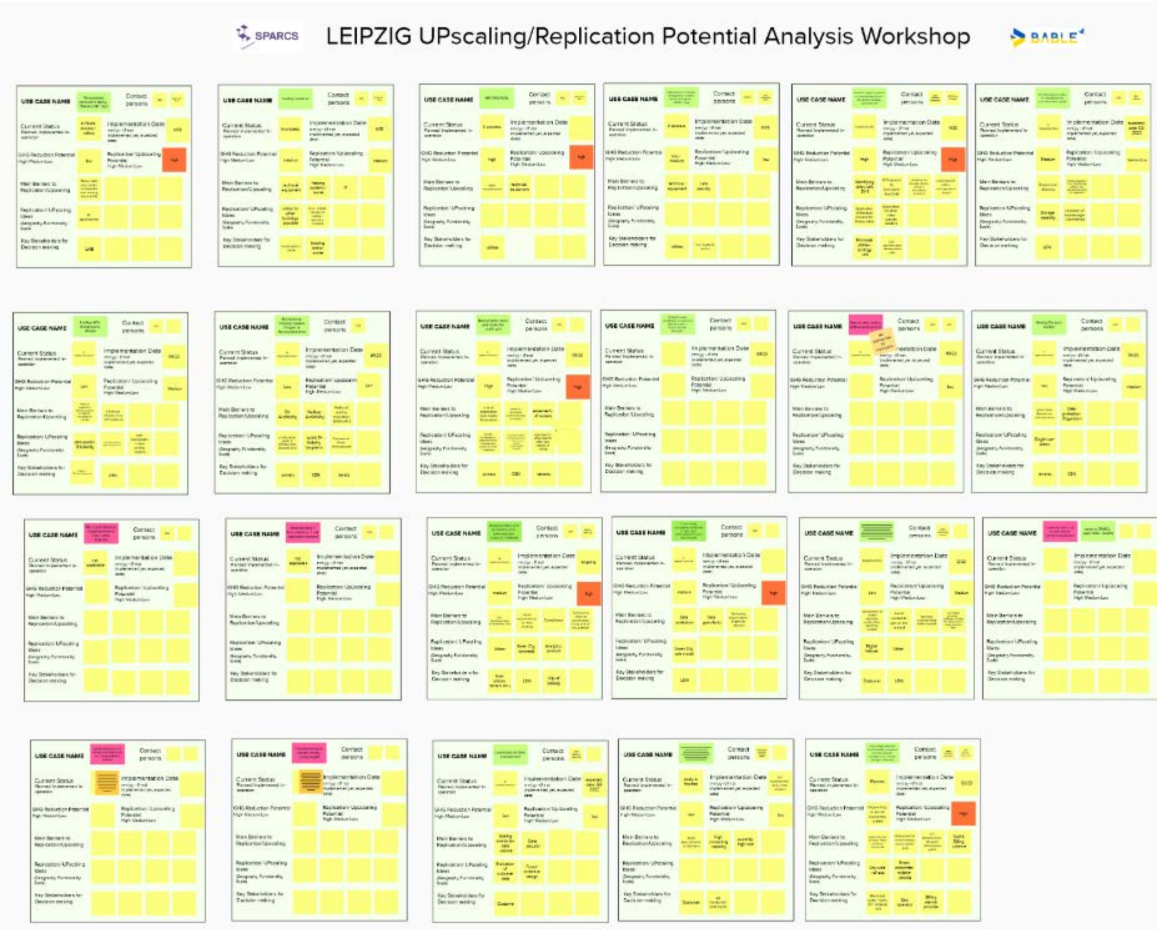

Figure 2 - Use Case Evaluation Sheets- completed by each responsible partner

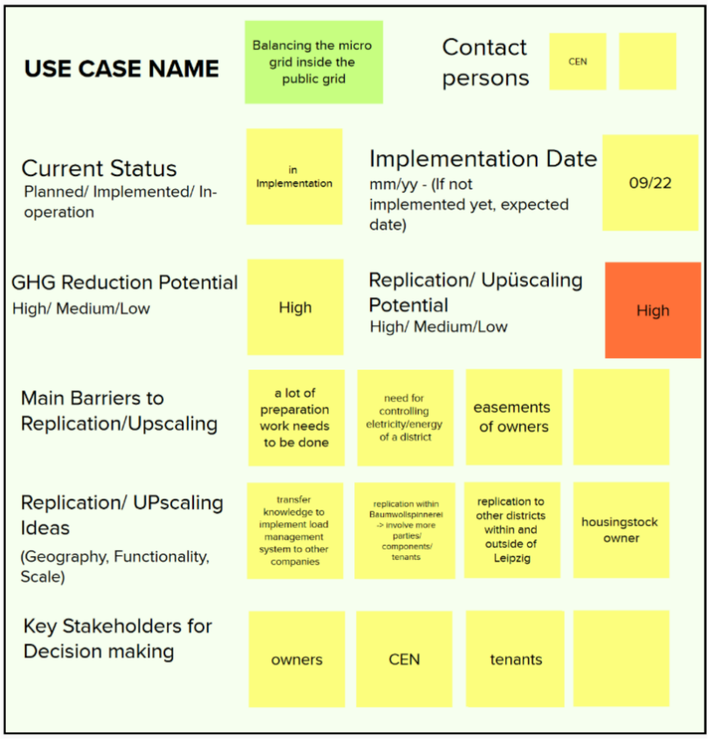

Figure 3 - Use Case Evaluation Sheet example

b) Regular coordination and alignment

Without being a linear process, the different workshops supported the from the City of Leipzig, to better understand the role of the city in the upscaling process and where most potential and impact holds. These concrete activities were complemented by monthly meetings between the core team from the City of Leipzig and BABLE, where different topics were addressed: strategic elements in the agenda of the city, discussions with strategic partners, coordination with other departments, etc.

The meetings serve to provide the City of Leipzig's team with guidance, methodologies, and advice on how to address critical aspects related to projects and help them navigate the complexities that scaling up one pilot project to scale implies. A series of guiding questions were utilised to guide the discussions and the project maturation process in all its phases, from its conception to securing its budget.

2. Leipzig Energy Map

In order to successfully expand renewable energies (such as solar energy, wind power and geothermal energy), it is necessary to constantly monitor and visualise the current situation: How far has the expansion progressed and where are potential areas located? This is necessary to assure that strategic measures are taken in time.

The consistent expansion of renewable energies is very important for achieving climate protection targets. In order to create a planning basis for this, the Digital City Unit is developing the Leipzig Energy Map as a pilot project for the city of Leipzig together with the Office for Geoinformation and Land Use Planning in the SPARCS and CUT (Connected Urban Twins) projects in close cooperation with other offices of the city of Leipzig. Data from various sources is collected, checked for plausibility and visualised in maps. The various data layers are listed below.

Table 9 in the appendix contains a detailed table with all the information.

- Current status of the building:
  - Location and plant-specific data of electricity-producing plants such as photovoltaic, wind, biomass, block-type power plants, hydroelectric power plants
  - Location and system-specific data of electricity storage systems
  - Location and system-specific data on electric charging points for electromobility
  - Summarised representations by postcode area of the electricity-producing plants
- Potential analysis:
  - PV potential of the roofs
  - Solar thermal potential of the roofs
  - Geothermal potential
- Building structures
  - Buildings by type of ownership
  - Listed buildings
  - Energy grids

The following two images show screen shots of the Leipzig Energy Map. The selected layers can be used to answer the respective question in the image.

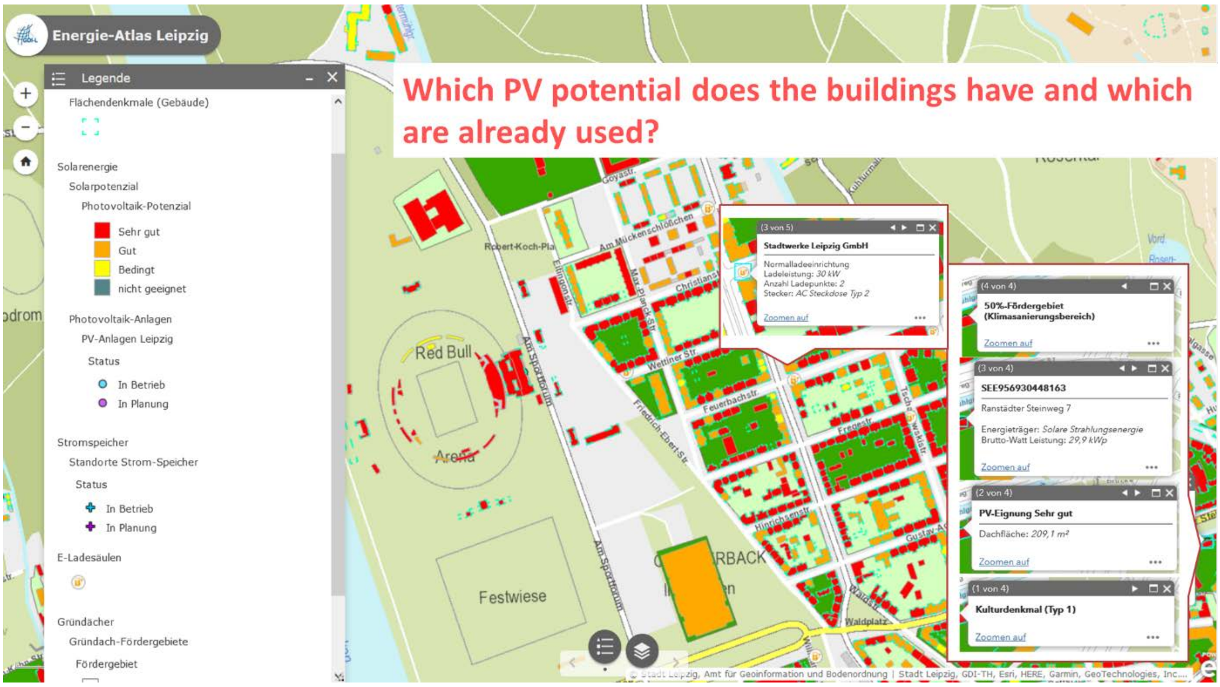

Figure 4: Leipzig Energy Map: visualisation of the solar potential per building, listed building, existing PV system, location of the e- charging station(source: LPZ)

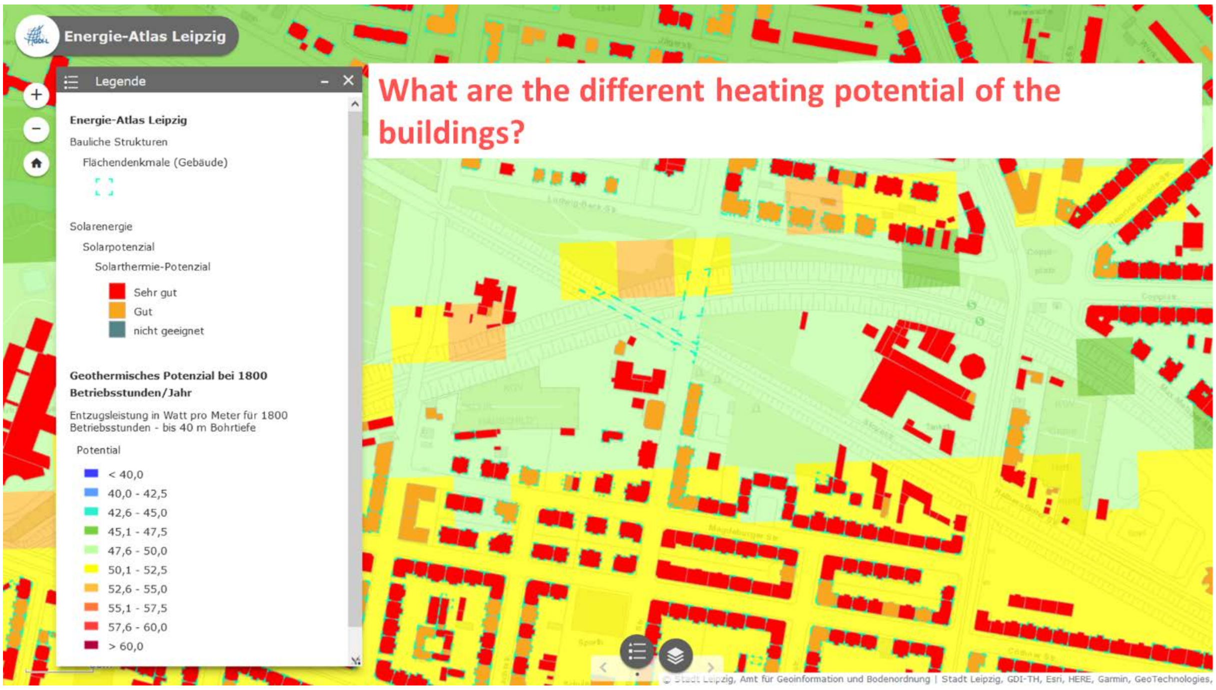

Figure 5: Leipzig Energy Map: visualisation of the geothermal potential and solarthermal potential per building, monument protected buildings (source: LPZ)

Various offices such as the Office for Urban Renewal or the Urban Planning Office must recognise the potential and challenges of a neighbourhood, for example in the course of neighbourhood development. The Leipzig Energy Map helps to quickly recognise these.

To ensure a sustainable energy supply in buildings and neighbourhoods, many decisions that need to be made depend on the local conditions: Some of these solutions can be cleverly combined with each other, others cannot.

To facilitate the choice between these different solutions, the Leipzig Energy Map is being developed as a tool that visualises these options and helps to evaluate them (see Figure 6). This will enable various specialist departments of the City of Leipzig to make more sustainable decisions for climate protection and the achievement of climate neutrality.

Figure 6: Decision-making aid Leipzig Energy Map (source: LPZ)

Climate protection and the associated expansion of renewable energy require interdisciplinary cooperation with a wide range of authorities and external stakeholders. This requires a centralised tool that can be accessed by all parties involved and that can answer questions about the expansion of renewable energies in a city quickly and easily.

As an innovative data space, the Leipzig Energy Map offers a central platform that enables all stakeholders to develop and realise ideas together. By using a single tool, all stakeholders can effectively exchange ideas and work together. The Map presents expansion opportunities for renewable energies and monument protection together by linking both aspects and thus promoting sustainable development.

2.1 State of the Problem

Climate change is undoubtedly one of the most pressing global challenges of our time. One of the key measures to combat this problem is the expansion of renewable energies (RE). These include resources such as solar energy, wind power and hydropower, which are environmentally friendly and help to reduce greenhouse gas emissions.

Cities play a key role in the expansion of renewable energies. With their high population density and energy consumption, cities are both polluters and solution providers. They can take the lead as pioneers by investing in renewable energy, promoting energy efficiency and sustainable transport systems.

The availability and utilisation of data is also crucial. Often, data is trapped in "data silos", meaning that it is isolated in different departments or systems and is not easily accessible or interoperable. There is an urgent need to liberate this data in order to realise its full potential and develop innovative solutions.

Every municipality needs to share data with local actors in the energy transition in order to drive it forward and manage it together. Sharing data requires the cooperation of all stakeholders as this transformation can only succeed if everyone works together.

In order to deal effectively with these complex challenges, the creation of co-operations is essential. Cooperation between city administrations, companies, NGOs and civil society can create synergies and pool resources for the expansion of renewable energies and the use of data (*Figure 7*).

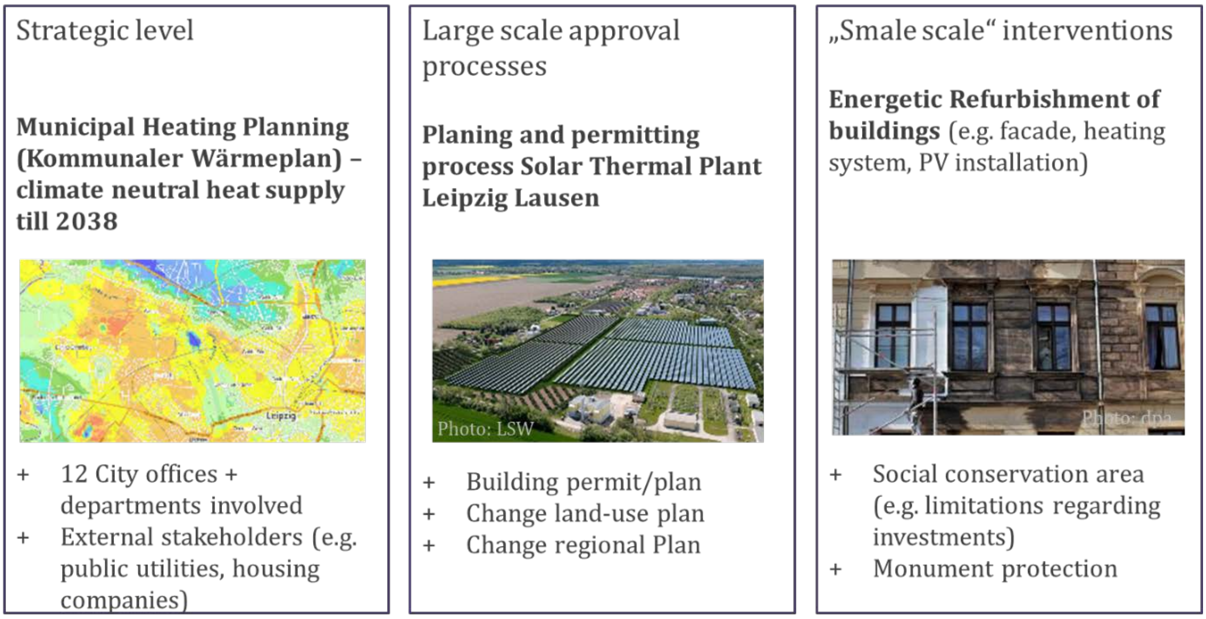

Figure 7: Energy transition projects demand for cross-silo cooperation and data structures (examples from Leipzig) (source: LPZ)

The business world has changed as well. Long, rigid development processes are no longer practicable in today's world. Instead, fast and agile development approaches are favoured to respond flexibly to change, test new ideas and drive innovation. This agility is crucial, as there is no longer time for lengthy processes when it comes to counteracting climate change. In this way, planning and approval processes can be accelerated and monitoring of the energy transition improved while the potential of data is used.

2.1.1 Role of the City in the development of renewable energies

In order to achieve the urban target of greenhouse gas neutrality by 2040 (SECAP Leipzig) and the ambitious 2030 target as part of the EU mission for climate-neutral and smart cities, the city can take on various roles in different areas of influence. The following areas of influence arise:

1. Consumption and role model
    - This area highlights the importance of reducing the company's own energy consumption and using renewable energies to act as a role model for politicians and the administration.
2. Supply and offer
    - It is important to generate and offer a greenhouse gas-neutral energy supply, especially for municipal companies.
3. Regulation
    - Funding programmes are intended to create incentives to involve other stakeholders in activities to achieve the climate targets.
4. Counselling and motivation
    - The aim is to provide advisory tools and motivate the population through public relations work to use renewable energies and live in a more resource-efficient way. The target group is civil society.

A common database for renewable energies is required in order to cover all of these areas of influence. This facilitates the analysis of the current situation regarding the expansion of renewable energies and the identification of the corresponding potential. In this way, the actual progress in the expansion of renewable energy in the city can be recognised and appropriate measures can be taken in time to accelerate the expansion of renewable energy systems.

The municipal heating plan is a central instrument for designing a climate-neutral heating supply within sustainable integrated urban development and a key component of the City of Leipzig's Energy and Climate Protection Programme 2030 (EKSP). The city administration develops the heating plan in cooperation with Leipziger Stadtwerke and Leipziger Wohnungs- und Baugesellschaft. The aim is to pave the way to a climate-neutral heat supply for every building in the city by 2038. In the course of drawing up the heating plan, the conditions under which a climate-neutral heat supply for the city of Leipzig can be achieved by 2035 will be examined.

The framework concept is one of several measures in the EKSP 2030. The framework concept for the planning control of land requirements for the generation of renewable energies - RaKoFEE for short - is an instrument for guiding the expansion in the urban area and reconciling it with municipal needs. The content of the framework concept is the development of a balanced set of criteria which, by means of consideration, enables statements to be made on the possible suitability or non-suitability of areas for the compatible construction of wind and solar energy plants in outdoor areas. The site concept is being developed in close consultation with the Leipzig-Western Saxony Regional Planning Association.

2.1.2 Avaibility of Data

There is currently a large amount of climate and energy-related data available at both municipal (Leipzig) and national level, for example on renewable energy potential and the analysis of existing facilities. However, this data is often stored in separate data silos at municipal, state and federal level and generally only covers part of the issues. Furthermore, they often do not take into account location-specific features such as monument protected buildings or social characteristics. As a result, potential usually only provide rough indications and often shows potential that does not exist in reality, fuelling unrealistic expectations.

Another problem is that although the data is presented on various websites, it is not available on a specific municipal data platform. This means that data cannot simply be passed on to other stakeholders, such as engineering firms, so that they can investigate specific issues. Instead, complex actual and potential analyses often have to be carried out from scratch. If the data were easily accessible within the city of Leipzig, processes could be accelerated and designed more dynamic.

The aim is therefore to create a common data room that enables everyone within the city administration to visualise data, analyse this data and ensure data exports.

In Germany, there are various institutions that compile data in order to determine the potential for renewable energies or to record their expansion status:

- Market master data register *[Marktstammdatenregister]* (MaStR) (nationwide)
- E-charging station register of the Federal Network Agency (nationwide)
- Solar roof register of the Saxon Energy Agency (Federal State of Saxony)
- Geothermal Map of the Free State of Saxony (Federal State of Saxony)

By combining the various data in one data room, it is possible to display, analyse and export this data together (see Figure 8).

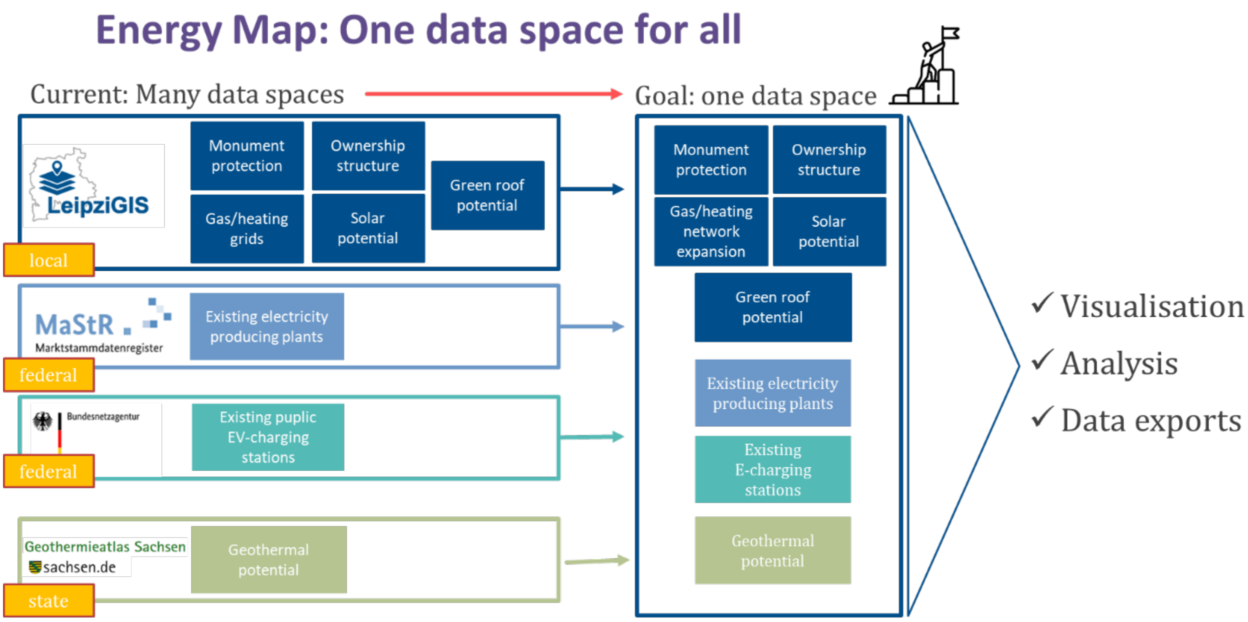

Figure 8 Schematic representation of the different data spaces and their merging (source: LPZ)

The aforementioned data sources and data are freely available and standardised REST APIs are used to provide the data. These are automatically queried by the UDP system and the data received is processed according to the internal specifications.

For the "Leipzig Energy Map", a first step was taken to combine these data sets from various data sources in one data space, the Urban Data Platform (see Chapter 2.4.1) and store them in the LeipziGIS (see chapter a)). This enables visualisation, analysis and data export to third parties.

As all the necessary data is being collated, the data sets can now be merged in accordance with the Leipzig specifications and the potential for renewable energies can be estimated and presented more realistically.

In order to use the Leipzig Energy Map, data must be synchronised repeatedly to ensure that the data are up to date. As the data basis is being successively extended, for example the MaStR, into which the expansion of renewable energies is continuously integrated, a one-off query is not sufficient; data must be constantly synchronised. In short, the Leipzig Energy Map will change organically and evolve in line with growing requirements.

a) Data of the City of Leipzig

The Office for Geoinformation and Land Management of Leipzig City Council is the central service provider for the city council and for external customers. They continuously support and develop all geoinformation systems and realise GIS projects.

Georeferenced data is displayed in the web-based geoinformation system (LeipziGIS), which is accessible to the city administration (see Figure 9).

Figure 9 Existing geoinformation system (GIS) of the Leipzig city administration for employees: LeipziGIS (source: LPZ)

Currently, only a few topics relating to renewable energies, e.g. installed capacity of electricity-producing plants in Leipzig or potential for renewable heat supply, are shown in the LeipziGIS for the city administration. The Leipzig Energy Map closes this gap. The following Table 2 below shows the municipal data that is included in the Leipzig Energy Map and the data to be added in the future.

Table 2: Existing data and future data in LeipziGIS for the Leipzig Energy Map

Current Data in LeipziGIS	Solar potential
	Monument protection
	Ownership structure
	Gas/heating grids
	Green roof potential
Further data for the expansion of renewable energies	Results of the concept of the Municipal heat planning
	Results of the Framework concept: Potential areas for renewable energies (RaKoFEE)

As part of the municipal heating plan and framework concept, potential areas for renewable energies in Leipzig are currently being drawn up. Both plans aim to promote and massively expand the use of renewable energies.

Municipal heat planning

Municipal heat planning aims to plan and implement climate-neutral heat generation and distribution by 2038. This process comprises various work packages:

1. **Inventory analysis:** Recording and evaluation of the current situation in the area of heat supply.
2. **Potential analysis:** Identification of opportunities and resources for sustainable heat generation and distribution.
3. **Scenarios:** Development of various scenarios that represent the future development of the heat supply.
4. **Action planning:** Derivation of concrete measures to achieve the defined goals.

Framework concept: Potential areas for renewable energies (RaKoFEE)

With the framework concept, the city is creating a binding framework for a consistent energy transition by identifying a balanced area for the generation of solar and wind energy in relation to other important concerns. In this way, Leipzig as a municipality can think ahead in terms of spatial planning management of the expansion of renewable energies and take it into account in dialogue with the population, companies and city politicians. In particular, project inquiries from companies in the energy industry and the objectives of Leipzig's municipal utilities are thus given a spatial orientation framework.

A key content of the framework concept will be to develop a balanced set of criteria which, by weighing up the options, will enable statements to be made on the possible suitability or non-suitability of areas for the compatible construction of wind and solar energy plants in outdoor areas.

The set of criteria is based on the legal foundations, technical and economic requirements, as well as other factors from the specialised planning, such as possible conflicts of use (residential, commercial, and recreational), the value of the soil and the significance of the cultural landscape. The concept is to be finalised by the end of 2024.

Results and data from both concepts are of crucial importance for the further work of all specialised departments involved in the energy transition process. Access to these data sets should therefore be guaranteed for all specialised departments in the administration. The Leipzig Energy Map should be one way of realising this.

b) Data at the federal state level of Germany

Germany consists of 16 federal states, each of which is responsible for climate protection measures on its own territory. This includes support services such as the provision of data to promote the expansion of renewable energy systems. Leipzig is located in the federal state of Saxony. Two data sets are provided by the federal state of Saxony in order to identify the potential for renewable energy plants. These are the Saxon solar roof cadastre[1] and the geothermal Map[2] of Saxony.

<u>Solar cadastre Saxony</u>

The Saxony Solar Roof Cadastre (see Figure 10) is based on a geodata-based determination of the solar potential (PV) for every building in Saxony. The solar energy potential is calculated using geographic information systems (GIS). High-precision year-round irradiation analyses are carried out in order to precisely calculate the solar irradiation as well as the shading caused by roof structures or vegetation and include it in the potential analysis. Potential parameters such as the potential electricity yield, the possible CO2 savings and the possible kWp output to be installed are determined for each suitable partial roof area. The Saxony Solar Cadastre is operated by Sächsische Energieagentur GmbH.

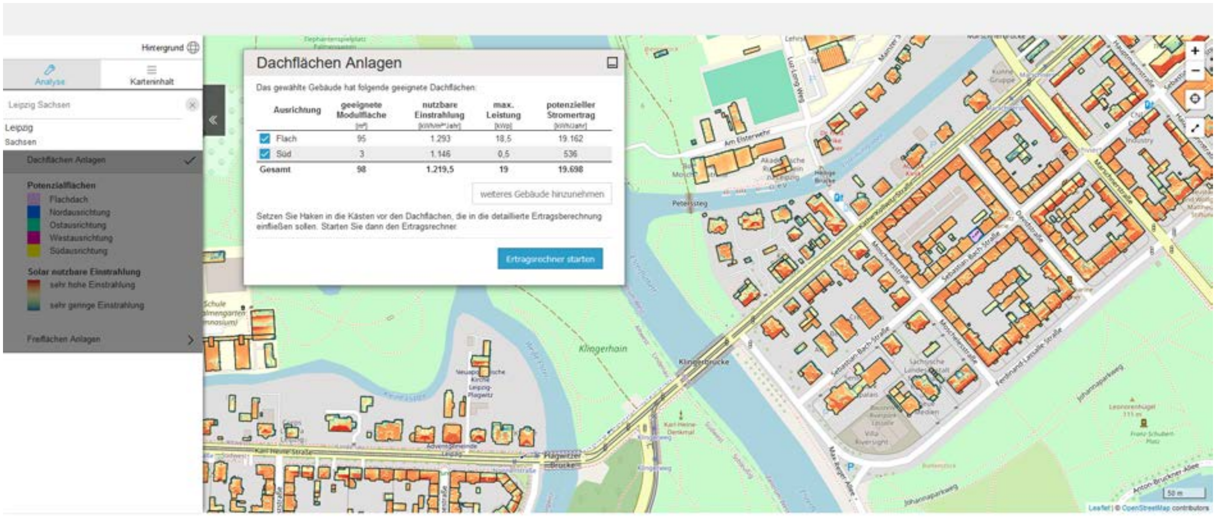

Figure 10: Solar roof cadastre Saxony (source Saxony Solar Cadastre)

[1] https://solarkataster-sachsen.de/

[2] https://www.geologie.sachsen.de/geothermieatlas-13914.html

An economic efficiency calculator is also integrated into the Saxony Solar Cadastre. However, this function was not transferred to the Leipzig Energy Map (see Figure 11 and Figure 12).

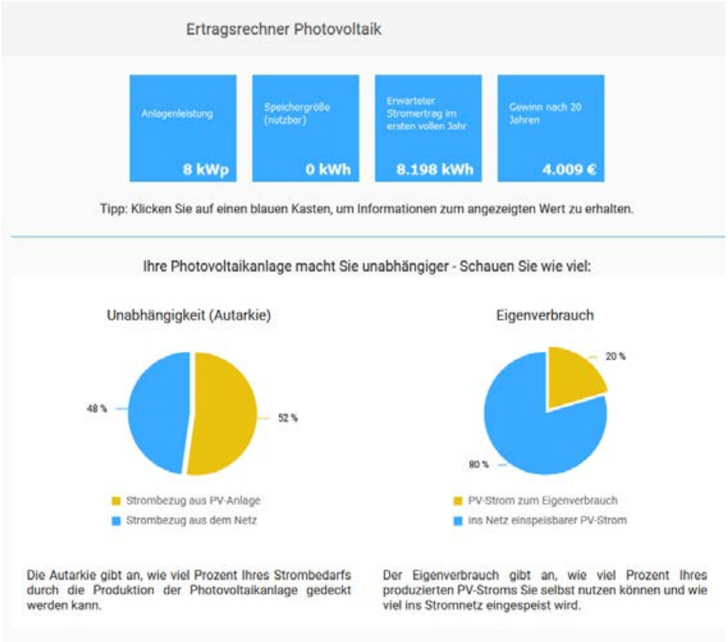

Figure 11: Illustrations for calculating the yield of a planned PV system in the Saxony solar register (source Saxony Solar Cadastre)

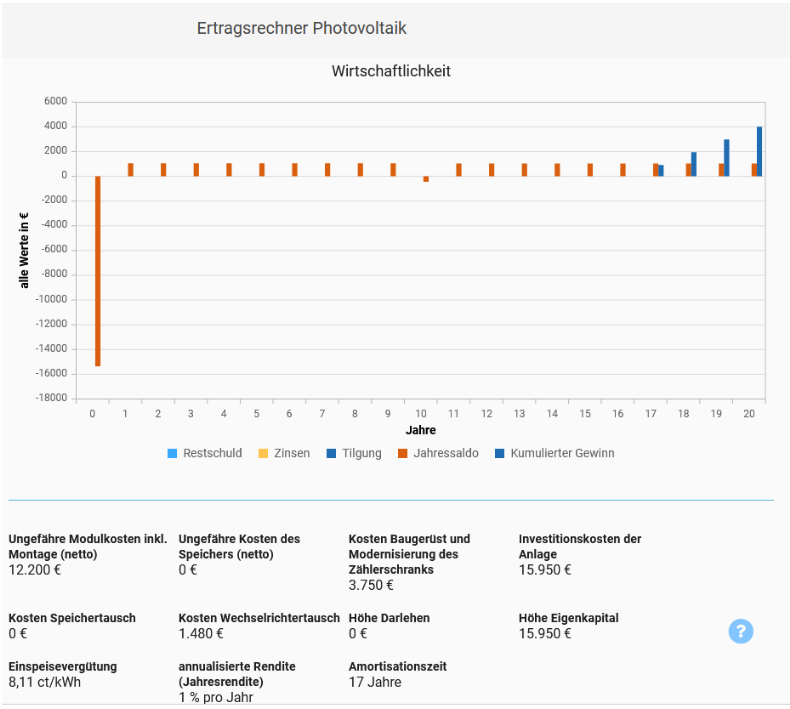

Figure 12: Presentation of the profitability calculation of a planned PV system in the Saxony solar register (source: Saxony Solar Cadastre)

Geothermal Map Saxony

The Geothermal Map provides maps showing the geothermal extraction rates near the surface in W/m (see Figure 13). These maps serve as an overview for the utilisation of geothermal energy using geothermal probes. The maps show how suitable a site is for near-surface geothermal energy utilisation based on its geological properties. They provide an initial orientation aid for the practical planning of geothermal systems and thus support the project. The work contains maps for annual heating periods of 1800 and 2400 hours and for drilling depths of 40, 70, 100 and 130 metres.

The Geothermal Map is operated and provided by the Free State of Saxony.

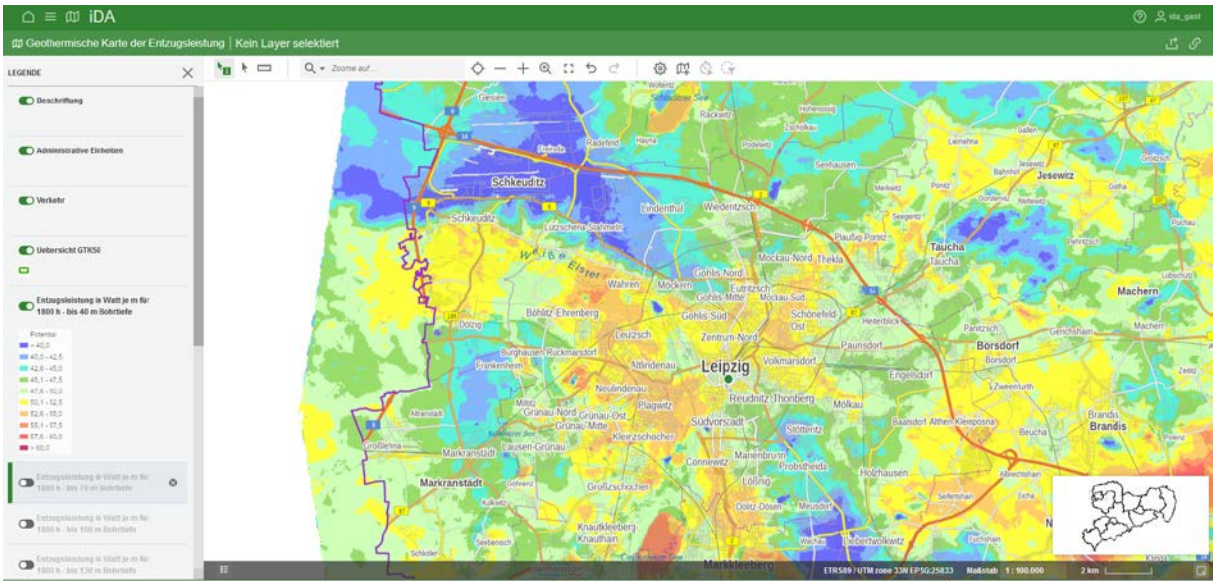

Figure 13: Geothermal Map of the state of Saxony (source: Saxony Geothermal Map)

c) Germanwide Data

In Germany, there are two registers that provide information on the current stock of electricity-producing systems and electric charging points. These are MaStR and the e-charging station register, both managed by the Federal Network Agency. Data from these two registers were transferred to the Leipzig Energy Map.

Market Master Data Register[3]

The MaStR is maintained by the German Federal Network Agency and contains information on all German energy systems (see

[3] https://www.marktstammdatenregister.de/MaStR

Table 3). The stakeholders in the German energy market (grid companies, transmission system operators, etc.) are legally obliged to report important master data on the installations in their grid area to the MaStR. The data is then consolidated, checked and made available centrally to interested parties so that authorities, among others, can use this information to fulfil their tasks.

Table 3: Contents of the MaStR

Electricity-producing plants	Detailed information on the plants
- CHP plants - Biomass - CHP plants - Other energy sources - Photovoltaics - Battery storage - CHP plants - Hydro - Wind	Power of an energy system
	Commissioning date
	Location (energy systems with a power of less than 30 kW do not publish an exact location, only the postcode area)
	Current expansion status (in operation, decommissioned, in planning)
	Estimated feed-in power
	Operator
	Electrical voltage level

Depending on the electricity-producing systems, system-specific properties such as the number of PV modules are indicated as well.

When analysing the data, it became apparent that there are some implausibilities in the MaStR, e.g. wind turbines whose geocoordinates are not located in Germany. A comprehensive research has been conducted on this issue e.g. by the Helmholtz Centre for Environmental Research[4]. In order to visualise the supply situation in the urban area and to determine initial key figures, e.g. on PV additions, these inaccuracies are initially acceptable. In the future, it is planned to prequalify the data together with third parties such as the Helmholtz Centre (Application Laboratory for Artificial Intelligence and Big Data of the Federal Environment Agency), to reuse it as adjusted data and to make it available to others .

The data from the MaStR is updated monthly in the Leipzig Energy Map.

Register of EV-charging stations[5]

The charging station register is provided by the Federal Network Agency. The register lists all publicly accessible electric charging points in Germany. For the Leipzig Energy Map, the publicly available data from the charging station register is imported and displayed on a monthly basis.

The following information is published for each charging station:

- Operator
- Location
- Number of charging points
- Type of charging point (AC or DC)
- Nominal power charging point

[4] https://web.app.ufz.de/ee-monitor/

[5]https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/E-Mobilitaet/Ladesaeulenkarte/start.html

2.2 Cooperation

Many organisations are developing solutions to show the potential of renewable energies and their expansion status. These data should be used to create synergies and conserve resources. This enables a stronger focus on the planning and implementation of measures. Strengthening cooperation with other data providers is of great importance.

In Leipzig, the city administration and SPARCS partners, such as Leipziger Stadtwerke and WSL, are working on visualising the potential of renewable energies and their expansion status. The efforts of these partners could be made more efficient through a centralised presentation and provision of data. The development of a joint product is particularly important in view of the need for the rapid expansion of renewable energies and the current shortage of skilled labour.

2.3 Development process

Due to the complexity of the objective, an iterative approach was chosen. First, a vision of the product was created and then a pilot (MVP - Minimum Viable Product) was defined using the "user story" mapping method. The pilot was a web-based GIS application with the previously described data from chapter 0. The implementation of the pilot product took three months and was concluded with a joint workshop with all participating specialist departments. .

The following Table 4 lists the involved offices:

Table 4: Overview of the stakeholders involved within the Leipzig city administration

Offices involved	Role	Possible work assignment of the "Leipzig Energy Map"
Sustainable Development Unit (RNK)	User/user	Obtaining a complete overview of actual and potential analyses for the urban area and neighbourhoods
Urban Planning Office (SPA)	User/user	Creation of development plans to promote renewable energies
Office for Housing and Urban Renewal (AWS)	User/user	Obtaining an overview of actual and potential analyses for neighbourhoods
Office for Facility Management (AGM)	User/user	Recognising potential for municipal buildings
Office for Environmental Protection (AfU)	User/user	Operates the public solar cadastre of the city of Leipzig
Office for Urban Greenery and Water	User/user	Blue-green infrastructure
Office for Building Regulations and Monument Protection (ABD)	User/user	Harmonising the expansion of renewable energy systems with monument protection requirements
Transport and Civil Engineering Office (VTA)	User/user	Expansion of electric charging stations, electricity grid capacity

Economic development (WiFö)	User/user	Expansion of electric charging points to support the local industries in advising them on the utilisation of renewable energy potential
Office for Geoinformation and Land Organisation (AGB)	Converter	

In this workshop, the use of the Leipzig Energy Map (pilot) was demonstrated and improvement requests for further development were collected. Immediately after the workshop, colleagues from the specialist departments were able to use the Leipzig Energy Map (pilot) in their daily work (Figure 14 and Figure 15).

Figure 14: Impressions of the Leipzig Energy Map workshop

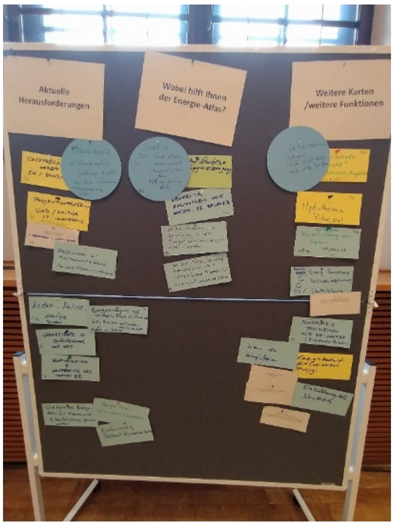

Figure 15 Impressions of the Leipzig Energy Map workshop

Further feedback was collected over the following eight weeks. It became clear that each department had different requirements, which is why further product ideas were developed in addition to the map visualisations. After the feedback rounds, the feedback was incorporated into the Leipzig Energy Map and then transferred to the existing LeipziGIS. From then on, the Leipzig Energy Map will be a standard product of the city administration to which every employee in the Leipzig city administration will have access. Henceforth, the Leipzig Energy Map will be technically supported and automatically updated by the Office for Geoinformation and Land Use Planning.

The development steps of the Leipzig Energy Map can be summarised as follows:

1. Development of a prototype in a WebGIS application
2. Feedback rounds through an office workshop and bilateral discussions with specialised offices
3. Integration into the inventory system (LeipziGIS) (see chapter 2.1.2a))
4. Further developments (see chapter 2.5)

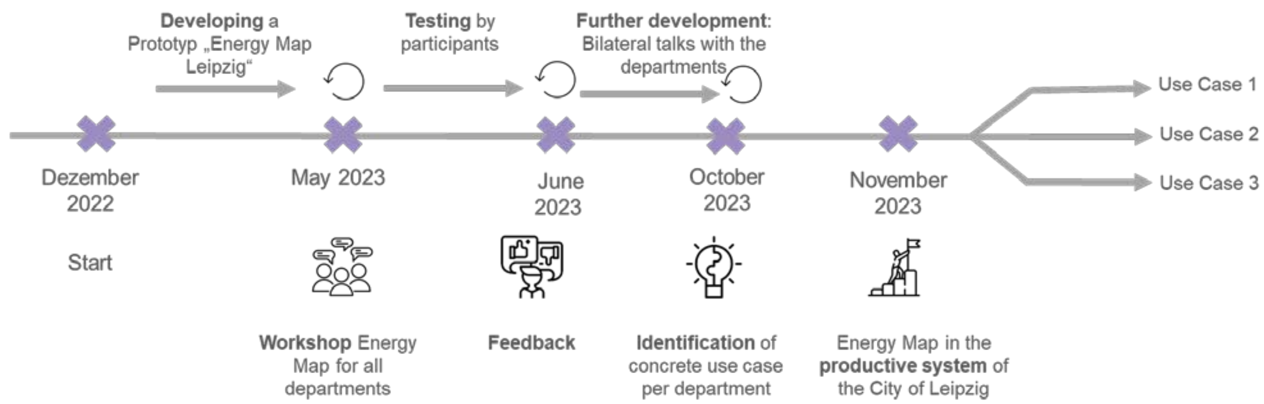

Figure 16 Development process of the "Leipzig Energy Map" Outcome (source: LPZ)

After the feedback from the department workshop and the bilateral discussions with the various departments of the city administration had been collected and implemented in the pilot, the pilot was integrated into the inventory system of the geoinformation system of the Leipzig city administration, LeipziGIS (Chapter 2.1.2a)).

The Leipzig Energy Map can be accessed and used by every employee of Leipzig City Council.

The following table summarises all the data and layers presented in the Energy Map. This compilation of data now enables the Leipzig city administration to create the actual and potential data itself. These can be used for the updating of the climate protection concept of the city of Leipzig and for the creation of energy neighbourhood concepts. For these concepts, the fields of mobility and climate impact adaptation still need to be developed. This data can be supplemented in a future development of the energy twin.

By maintaining, visualising and updating the data for these concepts itself, the city administration can now have concepts created more flexibly and prepare lengthy surveys of the current situation and potential in a shorter time and, if necessary, hand them over to external service providers such as engineering firms. This considerably shortens the amount of time spent on the creation of such concepts (Table 5).

Table 5 List of layers in the Energy Map incl. data source

Layer name	First layer level	Data source
Building structure	Area monument	Internal data in LeipziGIS
	Buildings by type of ownership	Internal data in LeipziGIS
	Energy grids	Internal data in LeipziGIS
Solar potential	Photovoltaic potential	Internal data in LeipziGIS
	Solar thermal potential	Internal data in LeipziGIS
Geothermal potential	Geothermal potential at 1800 operating hours/year (W/m)	Geothermal Map Saxony
	Geothermal potential at 2400 operating hours/year (W/m)	Geothermal Map Saxony
Locations of combined heat and power plants	In operation	Market master data register
	In planning	Market master data register
	Decommissioned for good	Market master data register
Locations of wind turbines	In operation	Market master data register
	In planning	Market master data register
Locations of biomass plants	In operation	Market master data register
	In planning	Market master data register
Hydropower plant locations	In operation	Market master data register
	In planning	Market master data register
Electricity storage locations	In operation	Market master data register
	In planning	Market master data register
Locations of e-charging stations		Federal Network Agency
Green roofs	Green roof areas	Internal data in LeipziGIS
Summary and evaluation of electricity-producing plants (in operation)	System output in comparison (gross output)	Own calculation (data from market master data register)
	System output per postcode area (gross output)	Own calculation (data from market master data register)
Expansion levels by energy source per postcode area	Photovoltaic systems	Market master data register
	Combined heat and power plants	Market master data register
	Wind turbines	Market master data register
	Biomass plants	Market master data register
	Hydropower	Market master data register
	Electricity storage	Market master data register
	Miscellaneous	Market master data register

2.4 Technical infrastructure for realisation

In addition to LeipziGIS, other technical components such as the Urban Data Platform and the Open Data Portal are required for technical implementation. These are described in more detail in this chapter.

2.4.1 Urban data platform

The Leipzig Urban Data Platform consists of a technical and organisational core that meets the requirements of the various stakeholders and the urban data space in general. This means that the Urban Data Platform is not just a service-orientated infrastructure for networking data, but also a conceptual approach that networks the city's stakeholders with one another.

The Leipzig Urban Data Space comprises all types of data that may be relevant for the municipal community, economic and political area of Leipzig. It contains all data relevant to the city of Leipzig and its stakeholders from all subject areas (energy, mobility, environment, health, culture, etc.) that arise in the context of analogue and digital city life. The boundary of Leipzig's urban data space does not necessarily end at the city limits, but can also be characterised by economic, environmental and social spaces. The Urban Data Platform is a coordinated core component of the Smart City consisting of technical and organisational components.

The aims of the Urban Data Platform are to provide easy access to urban data from different sources and to utilise the analytical capabilities of existing IT systems and IT services multiple times. The platform is designed to enable the target group-specific availability of data and services in order to inform, support or make decisions. The urban data platform follows the principle of a "system of systems".

As a system of systems, the platform provides its own services and applications based on intelligently networked data, but is also dependent on and complements the specialised services and capabilities of the data-bearing systems (e.g. specialist information systems, IoT platform). The Urban Data Platform (Figure 17) thus contributes to the utilisation of added value and process efficiency, but also to resilience. The ability to support or prepare decisions is heavily dependent on the data basis and the available technologies and is subject to data protection, data security and economic and ethical guiding principles.

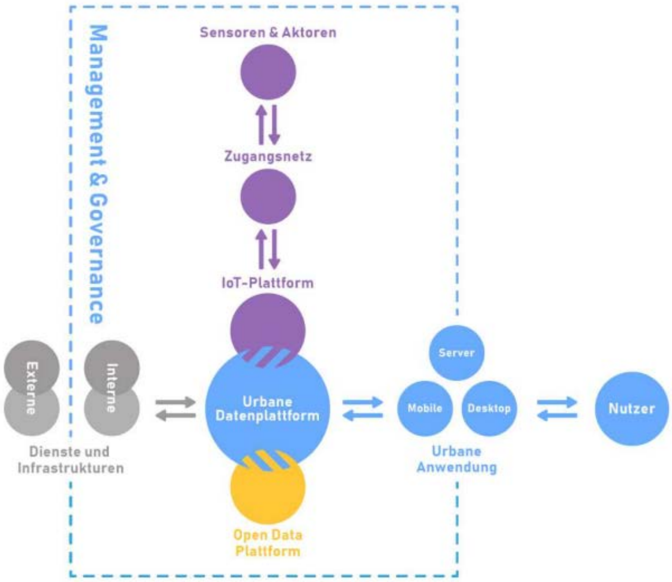

Figure 17: Overview of the Urban Data Platform and its connections (source: LPZ)

2.4.2 Sharing data via Open Data Portal (City of Leipzig)

The City of Leipzig has been operating the **Leipzig Open Data Portal** (ODP-L) since 2016 and is pursuing the following goals:

- strengthen the **transparency** of administrative action
- support **citizen participation** and cooperation in democratic, planning and decision-making processes
- promote **innovation and value creation** (e.g. data-based app developments, data analyses)
- serve as a **database for** administrative **monitoring applications** (e.g. indicators of the city of Leipzig's urban development strategy, environmental indicators)
- promote **data competence within the city administration** and
- contribute to the **consolidation of the data infrastructure** within the city administration.

Accordingly, the portal is aimed at interested **citizens, politicians, administrative staff,** stakeholders from **science, companies** in the IT and creative industries and freelance **app developers**.

The ODP-L is a web application based on the open source software CKAN that serves the public provision of administrative data in open, standardised and machine-readable formats. The portal functions as a data catalogue in the sense of recording and maintaining descriptive metadata and also as a storage location for the data itself if required. The following figure shows the start page of the ODP-L, on which all available public datasets are listed.

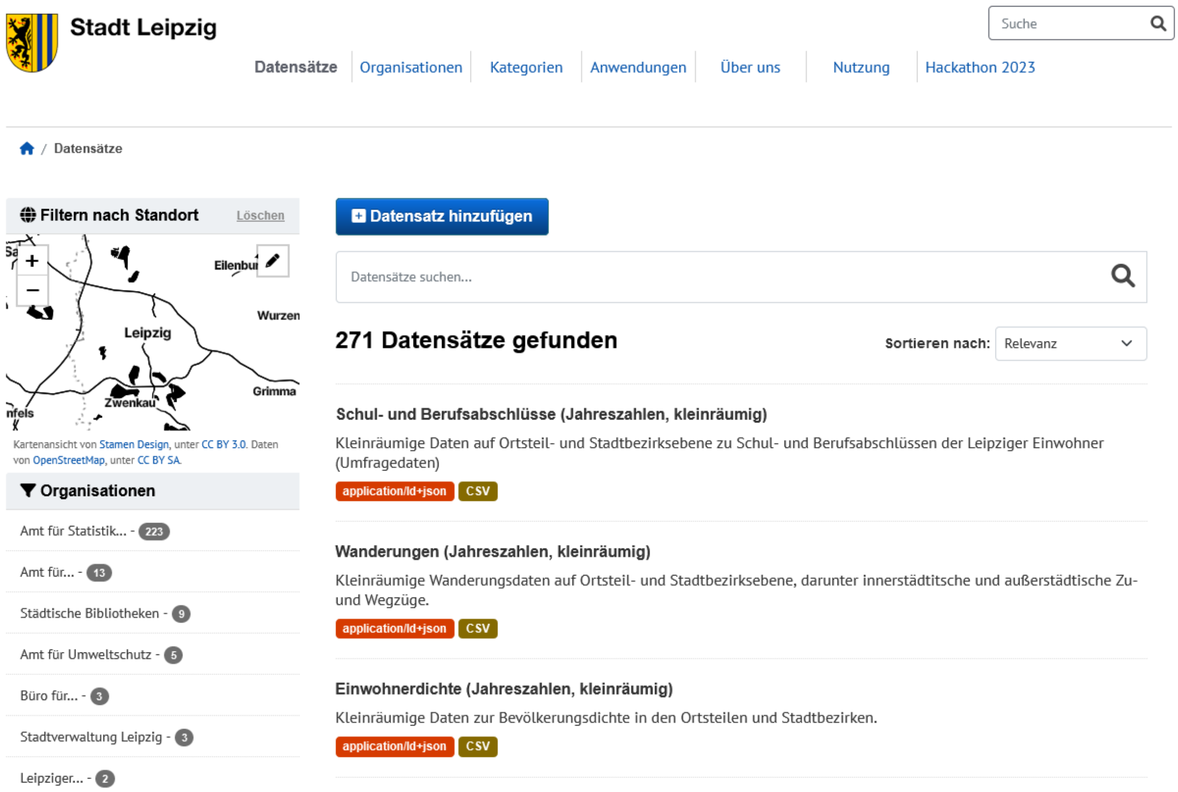

Figure 18: View of the data catalogue (source: LPZ)

A full text field and corresponding filter categories (also known as "facets") support users in their search for suitable data. The ODP-L is connected to several other specialised procedures via interfaces. For example, there is a connection to the Leipzig Information System, which provides current statistical data on important areas of Leipzig's urban development in the form of tables, diagrams and thematic maps. In addition, data from the ODP-L is exported to the Open Data Portal of the Free State of Saxony via a standardised metadata portal. From there, you can access the federal GovData portal and the EU portal.

2.5 Upscaling-Plan

During the development process for the Leipzig Energy Map, further needs and use cases emerged. These are shown in the following diagram. Stakeholders within the city administration as well as external stakeholders wanted further developments and new products centred around the Energy Map. It was recognised that a joint planning and presentation tool is needed in order to jointly drive forward the expansion of renewable energies.

Various products and developments have been named, which are explained below:

- Data preparation (e.g. dashboards and visualisation for citizens)
- Expansion of the database (municipal companies)
- Expansion of functions (scenarios and analyses)

The future areas of application of the Energy Map are shown in the following Figure 19 below.

Figure 19: Future features: information, analyses and scenarios on energy transition and climate neutrality (source: LPZ)

As described above, further product ideas have been developed. These are shown in the following Figure 20 below.

Energy Map Leipzig

Products	Target group	Project status	Description
Energy Map in LeipziGIS	Employees of the city administration	Realised	Data visualisation
Dashboard developments	Employees of the city administration	In realisation	Analysis tool for the expansion rate of renewable energy systems and e-charging stations
Energy atlas as a citizen information tool	Citizens	Planning	**Citizen information about:** • Potentials • Existing plants • Urban strategies for municipal heat planning and RaKo-FEE • E-Mob • Municipal buildings • Blue-green infrastructure
Energy Map in the Open Data Portal	Citizens	Planning	Data sharing with citizens
Scenario development for heat supply	Employees of the city administration	Application idea for funding	Scenario creation

Figure 20: Energy Map and its products (source: LPZ)

SPARCS

2.5.1 Dashboards

Dashboards are to be created in order to be able to better compile and visualise historical installation rates and forecasts. The freely accessible data sources of the MaStR and e-charging station register of the Federal Network Agency are to be used. This offers the advantage that the dashboards developed can easily be replicated for other municipalities. Therefore, the development of the dashboards is also subject to the condition that they are developed as open source tools. This means that the source code is published and other local authorities can transfer the tool to their local authority without the need for development capacity. This is important for other local authorities to save their resources and use products that have already been developed since not every municipality has development potential. The two dashboards are briefly described below.

<u>Energy transition dashboard</u>

As annual trends cannot be shown on the maps, other forms of data visualisation are required. The following information is provided for this purpose.

- Location of the plants
  - o System < 30 kW(p) = summarised representation per postcode area
  - o System > 30 kW(p) = address-specific representation
- Distribution of electrical power
- Annual expansion of the systems
- Presentation, degree of progress incl. evaluation of target achievement (by means of tachometer display)
- Addition of balcony PV systems
- Various scenarios

The aim is to recognise progress in the expansion of renewable energies for the urban area more quickly. This means that countermeasures can be taken more quickly as well. The data can be automatically updated in the dashboard on a daily basis. The following graphics show an initial pilot of the dashboard. This will be used to obtain feedback from the relevant stakeholders in order to further develop and finalise it.

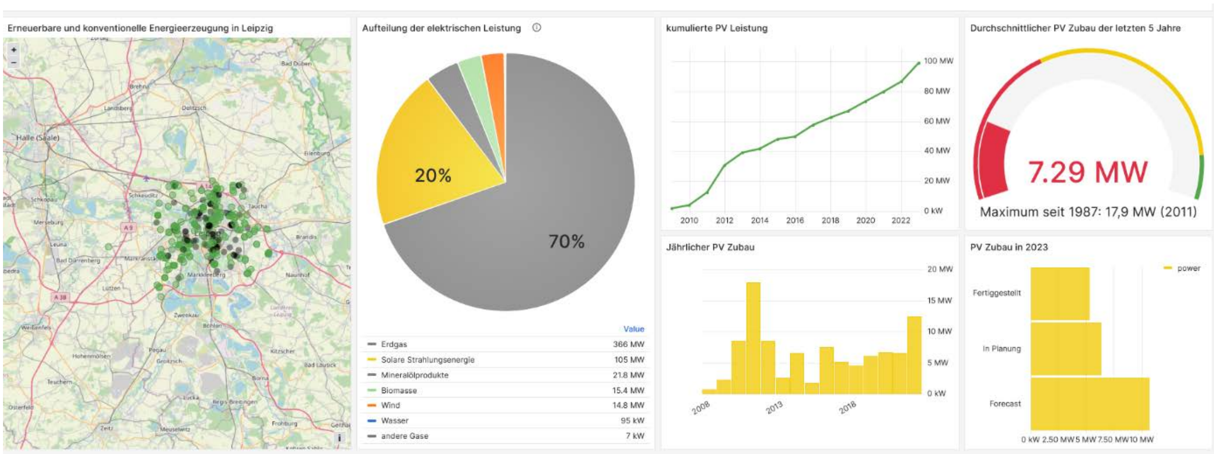

Figure 21: Energy transition dashboard (pilot) (source: LPZ)

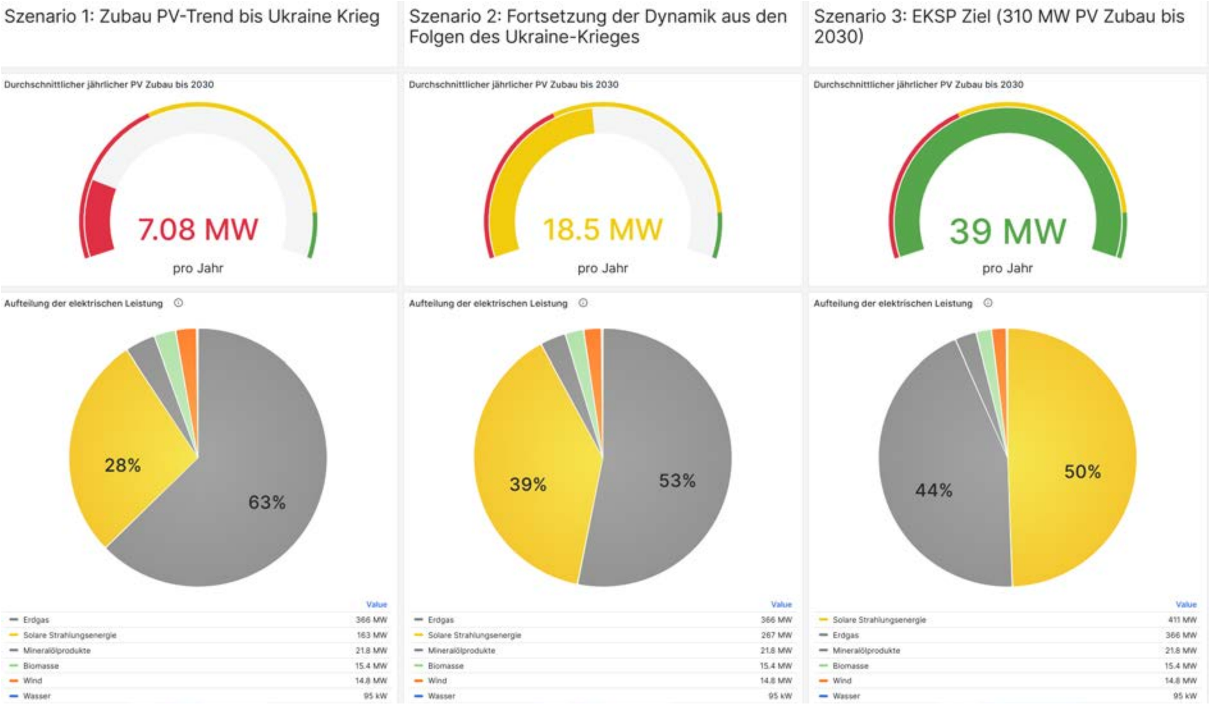

Figure 22: Energy transition dashboard (pilot): Visualisation of 3 different scenarios.
Scenario 1: PV expansion trend before the Ukraine war
Scenario 2: Continuation of PV expansion with the start of the Ukraine war
Scenario 3: SECAP target (310 MV PV expansion by 2030)) (source: LPZ)

E-Mobility Dashboard

The E-Mobility dashboard displays the data from the charging station register of the Federal Network Agency and is intended to provide information on the current expansion status and potential areas for future e-charging stations. A Smart City Challenge was organised for the development, in which start-ups submit ideas for implementation in a competition and the winner of the competition implements a finished product. The title of the challenge was “Charging station dashboard for monitoring and planning the urban charging infrastructure”. On the one hand, the charging station dashboard should allow conclusions to be drawn about the expansion of the charging infrastructure to date and, on the other hand, form the basis for planning new charging stations. For this purpose, a modern web application is to be developed that analyses the locations of the charging infrastructure on a daily basis, examines historical data for drivers/determinants of the expansion and compares definable expansion scenarios. Furthermore, it should be possible to extend the analyses to additional data sources of the city of Leipzig, for example to intersect topics in terms of content and thus gain better insights.

- Specialised questions
    - Where are (all) charging points currently located in the city?
    - What types of charging infrastructure are particularly common?
    - In which city districts have a particularly large number of charging points been built in the past?
    - How does this fit in with demand?
    - Are there explanatory models/patterns for this historical addition?
    - How many charging points are there per urban area if we extrapolate the current installation rate into the future, e.g. increase or decrease by 10 %?
    - What demand for cable networks can derive from this?
    - What influence does specific neighbourhood-related information have on the development of registration figures?

- Technological requirements:
    - Open Source, with publication on Open Code
    - a containerised application
    - Modern tech stack
    - Clear data pipeline
    - Stable application that can be monitored
    - Meaningful data visualisation
    - Maintenance and expansion of the software should be possible by the City of Leipzig

2.5.2 Energy Map as a communication-tool for citizens

In the joint workshop on the Leipzig Energy Map, it became very quickly clear that there is a great need for the tool for internal administrative use, but also for communication with citizens about the energy transition.

In the energy transition, the municipality is increasingly becoming the focus of centralised communication with citizens. There is therefore a need for a low-threshold, easy-to-understand tool to present the current status and municipal goals of the energy transition in order to support communication on climate change mitigation measures. The following graphic shows the needs of the various offices.

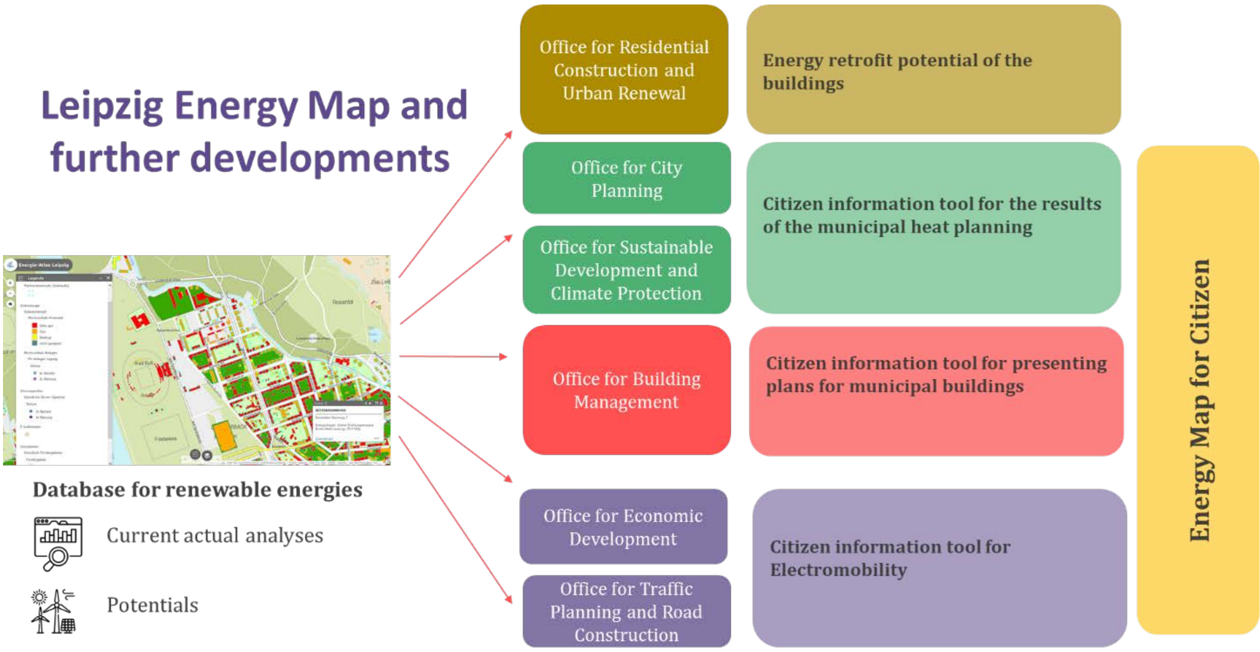

Figure 23: Overview of the offices' requirements for a Leipzig Energy Map for citizens (source: LPZ)

Expanding citizen access to the Leipzig Energy Map involves several strategic approaches that could increase engagement, improve transparency, and foster a more informed community (Table 6).

Table 6 Overview of the Energy Map measures for citizens

Measure	Objective	Methods
Public Awareness Campaigns	Raise awareness about the availability and benefits of the Energy Map.	Utilize local media, social media platforms, and community events to promote the tool. Develop informational brochures, videos, and tutorials that explain how citizens can access and use the map.
Integration with Public Portals	Make the Energy Map easily accessible through popular local and national online portals.	Integrate the Energy Map into the city's official website and the Open Data Portal where citizens already go for information. This ensures that the map is just one click away from the resources they regularly use.
Educational Workshops and Webinars	Educate citizens on how to interpret and utilize the data provided by the Energy Map.	Organise regular workshops and webinars that guide citizens through the functionalities of the Energy Map. These sessions can be held at local community centers, libraries, or online.
Feedback and Improvement Channels	Engage citizens in the ongoing development and enhancement of the Energy Map.	Establish a feedback mechanism through which citizens can suggest improvements, report issues, or request new data layers. This could be facilitated through online

		surveys, interactive forums, or regular community feedback sessions.
Collaborations with Educational Institutions	Leverage partnerships with schools and universities to integrate the Energy Map into educational curriculums.	Work with local educational institutions to develop projects or assignments that utilize the Energy Map, helping to familiarize students with this tool from an early age.
Mobile Optimization and App Development	Increase accessibility by making the Energy Map available on mobile devices.	Ensure that the online platform of the Energy Map is mobile-friendly. Additionally, consider developing a dedicated mobile app that provides optimized access to the map features and data.
Multilingual Support	Make the Energy Map accessible to non-German speaking residents.	Provide translations of the Energy Map's interface and resources into other languages commonly spoken in the community, such as English, Arabic, or Turkish.
Accessible Design	Ensure that the Energy Map is usable for all citizens, including those with disabilities.	Design the Energy Map's interface according to accessibility standards, ensuring it is usable for people with visual, hearing, motor, or cognitive impairments. This includes screen reader compatibility, high-contrast visuals, and easy navigation.

In the future, a centralised tool is to be developed to bundle the requirements. This will provide citizens with a central location where their enquiries can be answered. This location can be supplemented with further links and explanations. A tool is to be developed in continuing projects such as the funding project EnAct4CleanCities as a pilot project as part of the EU's 100 Climate Neutral and Smart Cities Mission.

2.5.3 Data exchange with Leipzig companies (Netz, LWB and LSW)

All stakeholders are becoming increasingly aware of the shared use and modelling of data, including city-owned companies, such as Leipziger Stadtwerke, Netz Leipzig and Leipziger Wohnungs- und Baugesellschaft (LWB). The LWB in particular has a strong desire to utilise the Leipzig Energy Map jointly and to enrich it with internal LWB data (see post-monitoring strategy).

In Leipzig, the municipal heat planning (see chapter 2.1.2a)) is currently being drawn up. During the creation process, it became increasingly clear that a common database (data model) was needed that would enable joint planning to be developed and data updates to be added to the data model automatically. To make this possible, a data/model specialist group was set up to develop solutions for the following topics:

- Data updating and monitoring of municipal heat planning
- Publication of the data
- Data protection and data security

In future, the data from the energy Map will also be shared via the interfaces developed with the city's own companies.

As part of the preparation of the post-monitoring report, the Leipzig Energy Map was also presented to the SPARCS partners and they were asked about the added value for them. The Leipziger Wohnungsbaugesellschaft (LWB) and its subsidiary WSL in particular are very interested in using the Energy Map.

The vision of joint data utilisation envisages the Energy Map being automatically filled with data from Leipziger Wohnungsbaugesellschaft (LWB). This would allow the tool to be continuously improved and its data sets refined (e.g. refurbishment status, e-charging points). Particularly noteworthy is the agreement on a clear categorisation of the buildings, which is used throughout the city both within the administration and by Leipzig's businesses. This standardised assignment forms the basis for automated data exchange, without which the data could not be used effectively.

2.5.4 Scenario calculation with the Leipzig Energy Map

As part of the municipal heat planning, it became apparent that the Leipzig city administration needed its own data model, which, in addition to data management, also includes continuous data updating. In addition, the data model should also be able to calculate scenarios. This chapter describes this task. The Energy Map serves as the data basis for this. The data should also be shared and jointly processed with municipal companies such as Leipziger Stadtwerke, Netz Leipzig, LWB and WSL (see 2.1.2a)).

Leipzig is committed to transforming its district heating systems from fossil fuels to renewables that is inclusive to population groups with lower incomes. Therefore, actions have already been initiated towards the extension of district heating system and decentralised approaches, mostly related to data gathering and planning. Leipziger Stadtwerke and Leipzig University have already started to develop tools for data understanding and decision support. Furthermore, IoT devices have been developed collecting data at district heating transfer stations in the buildings. The data from these devices and the knowledge about their operation is important for the pilot. Likewise, the results from the project SPARCS about municipal heat planning and the city administration's own Energy Map also build on this.

The Leipzig scenario calculation pilot tackles the challenge of enabling the energy transition (introducing renewable energy sources) while maintaining stable rents in different city districts. It requires a joint planning tool, which calculates scenarios for a renewable and socially acceptable energy supply. These scenarios build the baseline for discussions with all relevant stakeholders (energy suppliers, grid operators, housing companies, municipalities, and users). First, different energy transition scenarios are evaluated with respect to economic, ecological, and social impact. Then, each scenario is aligned with a transformation pathway for urban energy transition including specific objectives and actions to increase the renewable energies share and reasonable technologies but also improve data-based decision making. Sufficient technologies are ready, but it is difficult to decide when, where and how to use them, especially with respect to socio-economic factors. The challenge is to find a smart mix of technologies and make good decisions in a complex world to align actions.

Due to the complexity of the socially acceptable energy transition, the variation of data, and the large number of involved stakeholders, AI-supported data management is needed to help combine the right data and simulate different scenarios quickly. In this solution, AI will support to analyse and process the different perspectives of the stakeholders involved for creating different transition scenarios.

AI will be applied for:

1. analysis of complex and high-resolution data
2. development of efficient algorithms for the optimisation task of a socially acceptable energy transition
3. sensitivity analysis of the different pathways with regard to the energy transition components (production, consumption, storage) and of socio-economic factors
4. evaluation of different paths to find the best suitable solution
5. feature selection to define key drivers of the transition scenarios
6. data aggregation and pre-processing for effective and scalable calculation of solutions.

2.6 Business Model Canvas

As part of a consortium meeting, BABLE held a large workshop to develop business model canvases. The guideline of the workshop was to ensure that the upscaling of the Leipzig Energy Map focuses on enhancing the collaboration and data integration across municipal departments and key stakeholders, which is essential for effective decision-making and urban planning. The Business Model Canvas shows that critical funding for this expansion comes from a mix of EU projects, national government support, and municipal budgets, ensuring a sustainable financial model. The project leverages public ownership of the Urban Data Platform, making crucial data accessible and promoting transparency. A significant value is placed on developing open-source products, which not only fosters local adaptation but also encourages replication by other municipalities. Overall, these efforts aim to increase the efficiency of municipal services and contribute to Leipzig's climate neutrality goals by providing detailed, actionable insights into the energy landscape. The result was the following business model canvas for the Energy Map.

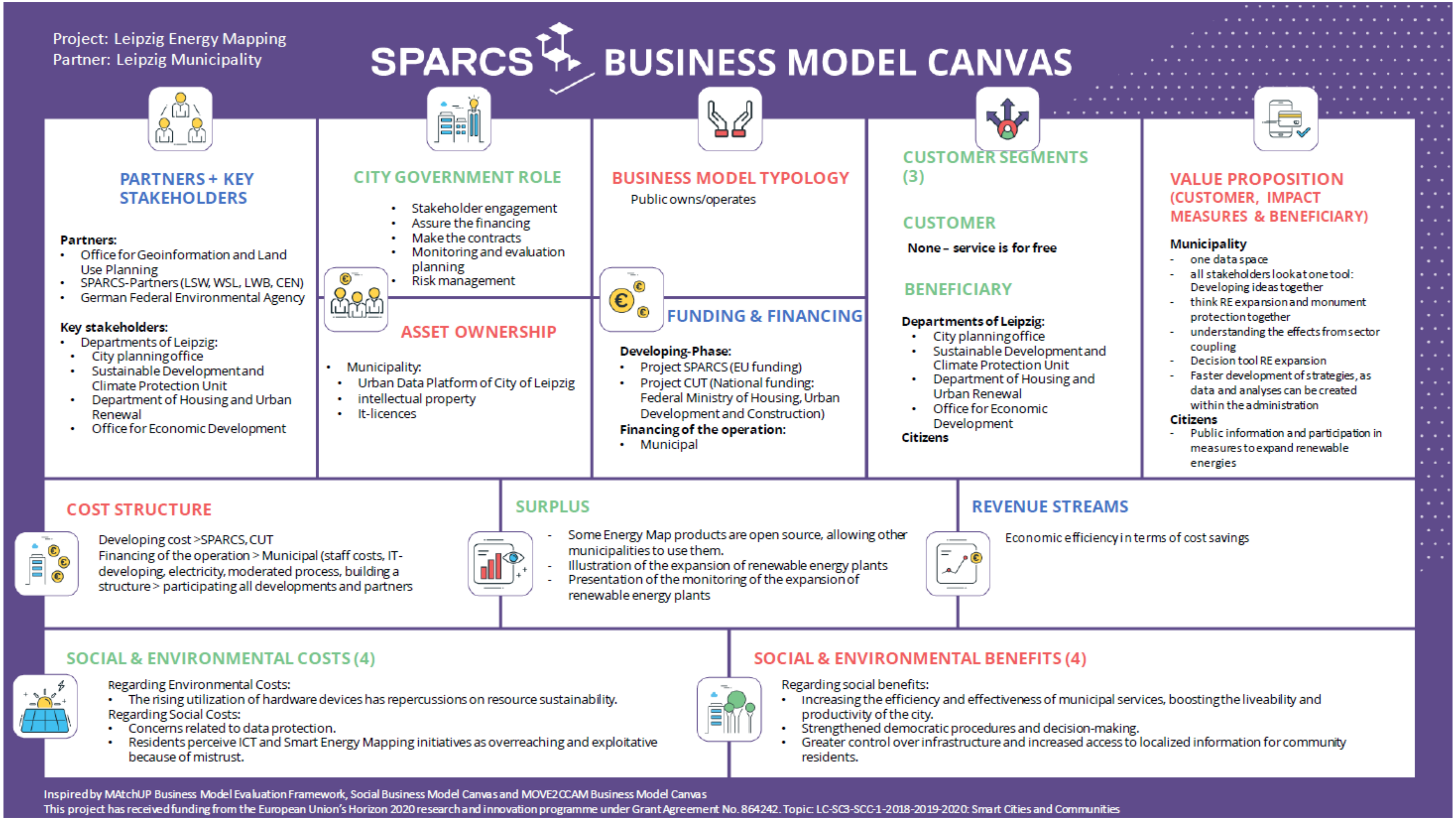

Figure 24 Business Model Canvas Energy Map Leipzig (source: BABLE)

Based on the products of the Energy Map Leipzig, detailed in each of these potential business models aligns with the intended target groups and project statuses of the various components of the Leipzig Energy Map (Table 7).

Table 7 Overview of the target groups and business models of the Energy Atlas for Citizens

Development	Target Group	Potential Business Model
Energy Map in LeipziGIS	Employees of the city administration	Cost-saving model through internal efficiency. This tool is an internal asset that reduces reliance on external data sources and consultants by centralizing data access and analysis, thereby reducing operational costs and enhancing decision-making efficiency.
Dashboard Developments	Employees of the city administration	Leipzig could offer customized dashboard services to other municipalities or local businesses, providing them with tailored data visualizations and analytics tools. This could be set up as a subscription or a one-time fee service, generating ongoing revenue.
Energy Map in the Open Data Portal	Citizens	While generally not a direct revenue generator, this model enhances transparency and could support funding or grants from organizations interested in promoting open data initiatives and community engagement.
Scenario Development for Heat Supply	External stakeholders	This advanced analytical tool could be offered to external stakeholders, such as real estate developers or large institutions, who need detailed scenario analysis for their planning and development efforts.

2.7 Fundings

The Energy Map was developed and implemented as part of SPARCS. The Energy Map has now been transferred to the production system and is therefore a standard product within the Leipzig city administration. Further funding is required for the further development of the planned new products.

Local Government Funding: As part of the city's long-term sustainability and digital transformation strategy, argue for a dedicated budget line for the maintenance and development of the Energy Map. This would ensure continuous improvement and alignment with the city's climate goals.

For the future, it is important to secure permanent funding via the budget of Leipzig City Council. This requires continuous sensitisation and persuasion of the mayors of the city administration. The great added value of the Energy Map and its products must be recognised and considered necessary. Until then, further developments must be financed via new funding pots.

EU Funding Opportunities: Continue to explore relevant calls under EU programs like Horizon Europe, which supports energy, digital, and urban development projects. Specific calls related to Smart Cities and Communities or climate-neutral goals could be aligned with the objectives of the Energy Map.

To this end, new funding is being acquired by the Digital City Unit. The following is a list of further funding for which applications are being submitted.

- Driving Urban Transitions 2023 call: MonuPED
- Pilot Call: EnAct4CleanCities
- HORIZON-CL4-2024-DIGITAL-EMERGING-01: AI Data and Robotics Partnership

Further option to secure funding for upscaling the Energy Map are listed below. These strategies need to align with the overall goals of the Energy Map, ensuring that any funding or revenue generation efforts contribute to its sustainability and scalability.

- **Public-Private Partnerships (PPPs):** Engage with private sector partners who might benefit from the data and analytics provided by the Energy Map. Partnerships could involve data sharing agreements, joint development projects, or co-financing of specific enhancements to the Map.
- **Grants from Environmental and Energy Foundations**: Many foundations focus on supporting sustainable development and technology projects. Applying for grants that support innovative municipal tools for energy management could provide another funding stream.
- **Revenue Generating Services**: Develop service offerings around the Energy Map, such as advanced data analytics. (see chapter 3.4 Business Model Canvas)
- **Sponsorships**: Seek sponsorships from companies within the renewable energy sector or related industries. This could include data partnerships where companies provide funding in exchange for access to tailored data insights.

2.8 Results and Recommendations

To identify the added value for each stakeholder based on specific criteria i.e. time savings, monitoring, renewable energy expansion a workshop was held on March 25th, 2025. Participants in the workshop were the Digital City Unit, the offices using the Energy Map, such as the Department for Sustainable Development and Climate Protection (RNK) and the Urban Planning Office (SPA). SPARCS partner Bable moderated the workshop. The workshop aimed to identify and enhancing the added value of the Energy Map for various stakeholders. It employed a structured, multi-phase methodology designed to maximize stakeholder engagement, gather comprehensive insights, and derive actionable recommendations. The recommendations aimed at sustaining and evolving the Energy Map as a critical tool for urban energy management and planning. The workshop brought profound insights and specific requirements for the further development of the Energy Map, which are described as follows:

1. Unified Usage Tool: The Energy Map is recognised as a common tool for all users within city administration and beyond. This platform enables the use of consistent and current data for planning and implementing measures in the

field of renewable energies. The uniformity of the tool promotes efficiency and supports decision-making at all administrative levels.

2. Bidirectional Data Exchange: The value of bidirectional data exchange was particularly emphasised. This exchange is essential for integrating data from various sources, including Leipzig's municipal utilities, network operators, and other relevant stakeholders. This approach not only offers added value through the merging of data but also supports more comprehensive and accurate analysis and planning.
3. Dynamic Data Processing: The Energy Map is characterised by its ability to continuously adapt to new data requirements or data quality improvements. This flexibility is crucial for responding to changing requirements and developing new applications. It was recognised that the Map is not a static tool but a platform that is constantly evolving to meet the growing need for data competency and to support the expansion of renewable energy installations.
4. Creation of New Roles: The complexity and dynamic nature of the Energy Map require dedicated care and further development. It was suggested to create a new role or position composed of representatives from two different offices (RDS and GDI). This position is intended to bridge the technical and administrative aspects of the Map and help develop new applications in close collaboration with various city departments. This underscores the need for interdisciplinary cooperation and the exchange of expertise.

3. Conclusions

3.1 Summary of achievements

Sustaining the Leipzig Energy Map over the long term requires a multi-faceted approach, focusing on process improvements, stakeholder engagement, and technological adaptability. By implementing these strategies, the Leipzig Energy Map can become a sustainable, evolving tool that supports cities in their transition towards climate neutrality and smart urban development.

1. Continuous Process Improvement: The core of the Energy Map's sustainability lies in its ability to streamline the cycle of monitoring, planning, implementation, and re-monitoring of the implementation. This seamless process facilitates the efficient use of data in energy management and urban planning, making the tool an indispensable tool for city administrations.

2. Dynamic Data Management Framework: The Energy Map must evolve with changing data landscapes and technological advancements. Implementing a dynamic framework that can adapt to new energy scenarios, incorporate emerging data sources, and refine data analysis techniques is crucial. This adaptability ensures the Energy Map remains a relevant and powerful tool for energy planning and decision-making.

3. Establishment of Dedicated Roles: Given the complexity and the evolving nature of the Energy Map, creating specialised positions or roles is essential. These roles should focus on managing the Energy Map's development, facilitating cross-departmental collaboration, and ensuring its integration into city planning processes. Such positions could serve as a bridge between technical teams, administrative bodies, and external stakeholders, driving the continuous enhancement of the Energy Map.

4. Engagement and Communication Strategy: Developing a comprehensive stakeholder engagement and communication plan is vital. This strategy should highlight the unique benefits of the Energy Map, addressing the specific needs and interests of different stakeholder groups. By emphasising its USPs, the plan would promote wider acceptance and utilisation of the Map across various sectors.

5. Infrastructure for Bidirectional Data Exchange: To support comprehensive energy planning and analysis, the Energy Map infrastructure must facilitate bidirectional data exchange. This capability will enable the integration of diverse data sets from municipal departments, utility providers, and other stakeholders, enriching the Energy Map's data pool and enhancing its utility in urban energy management.

3.2 Impacts

The Energy Map has a considerable positive impact on the work of the city administration and significantly accelerates the energy transition. Offices can recognise potential more quickly and develop targeted measures based on this, eliminating the need for lengthy commissions to external service providers. External experts are only called in for specific issues in neighbourhood development, which increases efficiency and reduces costs.

The Leipzig Energy Map enables city council enquiries to be answered quickly and administrative processes to be accelerated, leaving more time for essential tasks. This promotes smoother and faster decision-making. In addition, the Energy Map enables up-to-date monitoring with daily updated data, which means that the city administration is always up to date and can react flexibly to changes.

Overall, the Energy Map helps to drive forward the energy transition more efficiently by enabling better coordination, faster decision-making processes and effective utilisation of existing potential.

3.3 Other conclusions and lessons learnt

The creation of the Leipzig Energy Map has produced important lessons learnt and findings that have significantly influenced the effectiveness and efficiency of the project:

The use of rapid prototyping made it possible to create prototypes of the energy Map at an early stage and improve them iteratively. This accelerated the development process and helped to respond quickly to requirements and feedback.

The formation of cross-functional teams, which included experts from various fields such as technology, urban planning and data analysis, fostered a diverse perspective and a comprehensive view of the challenges associated with the Energy Map.

The implementation of fast feedback loops made it possible to continuously collect feedback from users and stakeholders to adapt and improve the tool according to their needs and requirements.

Co-operation proved to be the key to success. By working closely with various municipal departments, external partners and interest groups, it was possible to gain a comprehensive understanding of the needs and requirements of all stakeholders, which in turn led to a more effective implementation of the Energy Map.

Fostering a culture of error that allowed team members to talk openly about mistakes, learn from them and drive improvement contributed significantly to the success of the project by creating an atmosphere that encouraged innovation and continuous improvement.

4. Acronyms and Terms

4.1 List of Abbreviations

ICT: Information and Communication Technologies

IoT: Internet of Things

MaStR: Market master data register (Marktstammdatenregister)

ODP-L: Leipzig Open Data Portal

PV: Photovoltaic

SECAP: Energy and Climate Action Programme 2030

GIS: Geoinformation system

4.2 List of partner acronyms used in SPARCS

Table 8 List of partner acronyms used in SPARCS

PARTNERS	
City of Leipzig	LPZ
Fraunhofer Gesellschaft Zur Forderung der Angewandten Forschung e. V.	FHG
BABLE UG	BABLE
WSL Wohnen & Service Leipzig GmbH	WSL
Leipziger Wohnungs- und Baugesellschaft mbH	LWF
Stadtwerke Leipzig GmbH	LSW
Cenero Energy GmbH	CEN
Seecon Engineers GmbH	SEE
University of Leipzig	ULEI
Suite5 Data Intelligence Solutions Limited	SUITE5
Gopa Com	GOPA

SPARCS

5. Appendices

Table 9 Detailed list of layers in the Energy Map incl. data source

Layer name	First layer level	Second layer level	Data source
Building structure	Area monument		Internal data in LeipziGIS
	Buildings by type of ownership	Municipal	Internal data in LeipziGIS
		Foundations	Internal data in LeipziGIS
		Co-operatives	Internal data in LeipziGIS
		Other	Internal data in LeipziGIS
		Private property	Internal data in LeipziGIS
		No information	Internal data in LeipziGIS
	Energy grids	Gas pipe	Internal data in LeipziGIS
		Above-ground district heating	Internal data in LeipziGIS
		Underground district heating	Internal data in LeipziGIS
Solar potential	Photovotaic potential	Very good	Internal data in LeipziGIS
		good	Internal data in LeipziGIS
		Not suitable	Internal data in LeipziGIS
	Solar thermal potential	Very good	Internal data in LeipziGIS
		good	Internal data in LeipziGIS
		Not suitable	Internal data in LeipziGIS
Geothermal potential	Geothermal potential at 1800 operating hours/year (W/m)	Up to 40 m drilling depth	Geothermal Map Saxony
		Up to 70 m drilling depth	Geothermal Map Saxony
		Up to 100 m drilling depth	Geothermal Map Saxony
		Up to 130 m drilling depth	Geothermal Map Saxony
	Geothermal potential at 2400 operating hours/year (W/m)	Up to 40 m drilling depth	Geothermal Map Saxony
		Up to 70 m boron depth	Geothermal Map Saxony
		Up to 100 m boron depth	Geothermal Map Saxony
		Up to 130 m drilling depth	Geothermal Map Saxony
Locations of combined heat and power plants	In operation		Market master data register

	In planning		Market master data register
	Decommissioned for good		Market master data register
Locations of wind turbines	In operation		Market master data register
	In planning		Market master data register
Locations of biomass plants	In operation		Market master data register
	In planning		Market master data register
Hydropower plant locations	In operation		Market master data register
	In planning		Market master data register
Electricity storage locations	In operation		Market master data register
	In planning		Market master data register
Locations of e-charging stations			Federal Network Agency
Green roofs	Green roof areas		Internal data in LeipziGIS
Summary and evaluation of electricity-producing plants (in operation)	System output in comparison (gross output)	< 0.5 kW	Own calculation (data from MaSR)
		0.5 -2.5 kW	Own calculation (data from MaSR)
		2.5-10 kW	Own calculation (data from MaSR)
		10 - 25 kW	Own calculation (data from MaSR)
	System output per postcode area (gross output)	< 3 kW	Own calculation (data from MaSR)
		3-10 kW	Own calculation (data from MaSR)
		10-15 kW	Own calculation (data from MaSR)
		15-40 kW	Own calculation (data from MaSR)
		>40 kW	Own calculation (data from MaSR)
Expansion levels by energy source per postcode area	Photovoltaic systems		Market master data register
	Combined heat and power plants		Market master data register
	Wind turbines		Market master data register
	Biomass plants		Market master data register
	Hydropower		Market master data register
	Electricity storage		Market master data register
	Miscellaneous		Market master data register