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White paper on GIS- and data-driven tools for identifying and planning energy efficient building renovations in Switzerland

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Content

1 Introduction

Heating of buildings takes up 50 % of Switzerland's energy demand on average (Kemmler and Trachsel 2023), which is a major challenge to achieve the Swiss decarbonisation goals. It is a significant portion, and it is unevenly distributed over the year with high demands in the winter half year due to heating. Innovative solutions are required to upgrade the Swiss building stock in terms of heat and electricity production and energy efficiency. Not only new buildings need to be built, but also the hundreds of thousands of old buildings need to be renovated and switched to renewable energy supplies to meet the net-zero target set by the country and international agreements. According to figures from 2021, 58 % of the 1.77 million buildings in Switzerland were still using fossil fuel for heating (Bundesamt für Statistik 2024).

The current rate of energy refurbishment in Switzerland is not sufficient to reach the net-zero goals, and it should increase to at least 2 - 3 % for the building sector to contribute to the agreed upon goals. Current refurbishment rates for Switzerland as a whole are not available. A study for Geneva shows a renovation rate of only 0.2 % for refurbishments increasing the efficiency by two classes (Grandjean et al., 2022). It can be assumed that one important way to increase the rate of energy refurbishment is to make building owners aware of the need for energy refurbishment of their buildings and to inform them about possible and favourable steps towards an energy efficient building with high rate of renewable energy supply. This increase can be efficiently supported when accurate and up-to date building information is available to the decision-makers and stakeholders. Innovative digital tools are being developed all over the world to maximise the use of such building information. Some of these tools can be used for renovation planning of individual buildings as well as for development of thermal networks in municipalities and cities, finding out where the energy density is high enough for a thermal network, or calculating CO_2 emissions of cities. It can be especially useful to store and display building related data in a Geographic Information System (GIS) framework. Various analysis can be carried out when the relevant information is collected and made available through such tools.

However, in Switzerland, the lack of uniform and readily available data makes it a challenge to develop such tools, and to the user to be able to rely on such tools for the decision making in the renovation sector. Collection and dissemination of accurate building data is a challenging task due to differences in data recording across the Swiss cantons and municipalities, privacy concerns and accessibility of existing data. It has been found by SFOE through their hackathon events that it amounts to great effort and expense to repeatedly search for, prepare and interpret data on the energy system (Suter and Rohrbach 2022). There are also data restrictions imposed by companies, that hinder the efficient use of available data.

As opposed to other European countries where certain data on the energy system are readily available, it is rarely the case in Switzerland that the relevant data is available, downloadable and that is uniform across the country. Some examples of unavailable data are details of district heating systems or electricity consumption of buildings, municipalities, or cantons. Data certainly exists for this information, but their distribution and availability vary between the different data providers (Suter and Rohrbach 2022).

In this paper we summarize the current building renovation situation in Switzerland and discuss the available and needed building related data relevant to refurbishments. We show some examples of currently existing tools that can aid the renovation process and present a case study of the municipality of Stäfa where, problematically, different tools provide significantly different results even when it comes to basic information that is needed to make decisions about renovations. We discuss how important accurate and up-to-date data is when it comes to decision making in renovations, and what are the current issues in Switzerland, including heterogeneity across cantons and data-openness. GIS Mapping could give the framework of an open and homogeneous database, so the

existing tools can rely on the most up-to-date and accurate data and aid the process of renovating the Swiss building stock. Some municipalities and cantons already start to use GIS as the basis of their databases.

2 Current status of building related GIS-data and -tools in Switzerland

2.1 Building Renovations in Switzerland: status and stakeholder motivation

Renovation activities in connection to energy efficiency in Switzerland have been going on for decades, with an increasing rate, especially since 2006 (Jakob 2007). However, there are still 1.1 million old buildings in need of energy renovation, that means around 40'000 buildings to be renovated each year if they are all to be renovated by 2050. This means that the renovation rate needs to further increase to at least 2.2 % per year. Comprehensive data on the actual renovation rate is hard to come by in Switzerland, as it is not included in the federal statistics database (Bundesamt für Statistik 2024).Some attempts from the legislative side, for example the planned Climate Innovation Act of 2025, can hope to drive the renovation rate, but only if cantonal policies and subsidies are also available, as well as the tools to help planning the renovations (Nägeli et al. 2020).

Based on various surveys, the landscape of building owners and their willingness and capabilities to invest in renovations is heterogeneous in Switzerland. A common theme in many of these surveys is the feedback from homeowners that the policies and subsidies regarding renovations are too complicated and the bureaucracy is too involved, resulting in discouraged owners when it comes to renovations (Maciosek et al. 2022; Wekhof and Houde 2023; Lehmann et al. 2023). Changes in policies from canton to canton also makes it more difficult for stakeholders to inform themselves.

Maciosek's survey (Maciosek et al. 2022) shows that while 44 % of single-family house owners are ready to invest in improvements in their homes, only 15 % mean a renovation that is related to energy (7 % heating system upgrade and 8 % solar investments). Another survey from Wekhof and Houde (2023) shows that single-family house owners in the Zürich area find complicated policies and financing a barrier to renovation, while their determinants are more related to urgent need to replace something broken rather than economical or environmental considerations. On the other hand, a recent survey (Drometer et al. 2023) carried out within the Renowave project show a high level of willingness among homeowners to implement energy efficient renovations: 72 % are planning such renovations, 18 % have already carried out all energy efficient renovations, while only 10 % states that they do not intend to implement any such renovations.

Private multi-family house owners have even further considerations, there is the question of whether the investment cost should be paid by the owner or the tenants, as well as possible disruptions in the tenant's occupancy. Maciosek's survey found no mood for collective investment from the tenants, and according to Lehmann et al. (2023) multi-family house owners also prefer not to pass the costs on to the tenant. In most of the settings, multi-family house owners also live in the house and prefer to keep the long-staying tenants instead of increasing rental prices and risking them to leave and having to search for new tenants. In general, the renovation rate of multi-family houses is lower than that of single-family houses (Lehmann et al. 2023).

2.2 Software tools that aid the renovation process

At the planning stage, a lot of online tools are available to aid the estimation of essential parameters that are needed for effective renovation[1]. Some of these tools include heat demand and hot water

[1] To name a few tools: myenergyguide.ch, swissenergyplanning.ch, evalo.ch.

usage of a building, they offer model-based energy monitoring, refurbishment pressure, building mass index, potential for adding energy storage, possible monitoring of efficiency increase. Others support the development of energy concept for buildings, neighbourhoods, districts and communities. Companies that develop these tools target building owners, municipalities, or energy suppliers, planning companies or even banks with their planning aids.

A lot of data that the companies use to make their tools as accurate as possible are openly available, such as data from the GWR database, renewable energy potential data (such as solar, wind, ground water, or geothermal), building geometries, energy production plants, population and company statistics, weather data, or energy costs (for example grid electricity or gas costs). Based on the available information and their models that often rely on statistics and machine learning, these tools can calculate among others heat demand, hot water demand, industrial heat demand, and building volume. Optimised energy concepts can be developed, as well as hourly energy demand and renewable resource profiles.

However, other data that could be useful in making these tools more accurate are not freely or openly available. Information on the status of renovation on a building (ranging from permit applications to actual renovations carried out on facades, roofs, cellar insulations, window replacements, etc.) is often not available. The actual heat and electricity consumption of a building is not always measured and if so, the data is usually private and not publicly available. Lack of data on cost and technical performance of energy conversion technologies is also hindering the efficiency of such planner tools. Results of a survey conducted by the authors of this paper among tool developers show that if some or all these data were available, the monitoring efficiency would increase, and they could provide more precise heat demand models.

The above-mentioned data types typically concern just one building, but when it comes to planning an optimal configuration of a supply system for several buildings up to district heating networks, it is important to consider the spatial dimension. GIS-based data is necessary for specific planning of such systems on a large scale. Automation planning, information and sales processes can be aided when all the available data is stored in a GIS-layer that represents the real-world connections and dependencies of the separate elements of a system. Building-specific data enables the development of tools for efficient and property-specific advice/ information for building owners.

GIS-based tools could provide among others the energy and financial savings potential of buildings, monitoring of refurbishment measures carried out and effective savings and registration of materials used for the circular use of building materials. Building energy demand profiles under different envelope retrofitting scenarios and renewable energy potentials (solar, groundwater, geothermal) also ideally require knowledge of the surroundings that can be very well modelled with GIS-based data.

For the data to be the basis for discussion in politics and society, it also needs to be visually interpretable. Planning of refurbishment programmes and individual building renovations therefore would benefit from easily understandable GIS-based building data. It could also be used to aid the evaluation of the benefits and trade-offs of centralised heat supply vs. individual building level heat supply.

Switzerland has an excellent framework for GIS-based data collection and distribution organised by swisstopo (Bundesamt für Landestopografie). An ever increasing GIS-based database can be found in map.geo.admin.ch with maps ranging from basic geographic information to maps concerning nature, environment, population and economy. In this already existing framework, it would be possible to include maps relating to the renovation process, especially individual building data.

3 Building-data needed for the renovation process

3.1 Needed Data for Effective Renovations

According to the Open Energy Data Switzerland's survey (Suter and Rohrbach 2022) and expert interviews that we conducted there is a unison opinion that there is need for easily accessible data, ideally in a central location. It would make quick and simple overview of the existing data possible. With advances in digitizing the available data, it could be possible to make sure that all data is as up to date as possible with a high level of harmonisation achieved among the structure and metadata. When the data is of good quality, real and modelled data are well defined and explained, with clear terms of usage, the available vast amount of data on Switzerland's energy system can be the essential core of building renovation decision making.

Open data platforms exist in Switzerland in other sectors, for example for mobility (https://opentransportdata.swiss/), where the economic benefits of innovations in data sharing is estimated to largely exceed the investment costs in establishing the platform. Many countries in Europe already have guidelines and digital solutions for open energy data sharing, among them an outstanding example the United Kingdom where the "open-by-default" principle is applied, accompanied by carefully regulated energy data guidelines. This kind of approach that exist in other countries and in other sectors in Switzerland is perceived to be a long way off by the Open Energy Data Switzerland's 2022 report (Suter and Rohrbach 2022).

The GWR dataset contains information about all buildings in Switzerland, however it is often only basic information, referring to the time when the building was originally built. Renovation dates and details are often missing and therefore the GWR database does not give an up-to-date picture of the Swiss building stock situation. As shown in Section 3.3, during an energy planning project in Stäfa (canton Zurich) updates have been made to each building in the area, but it is slow and painstaking work to individually update the heating system information for space heating and domestic hot water for each individual building. It is not feasible to manually update each building in Switzerland and maintain an up-to-date status of such efforts.

The data that is needed for such a high-quality building database exists, but it is kept at different places (cantons, municipalities, energy providers), and therefore it is almost impossible to have an overview of the Swiss situation. This hinders decision making and causes missed opportunities when it comes to renovating the Swiss building stock.

Table 1 shows essential data types that are necessary for decisions in building renovation and usually found in a detailed energy certificate (GEAK: www.geak.ch). For these types of data, we show their availability and quality from sources other than a GEAK certificate that is normally not publicly available. These data concerns only the building itself, another issue is that it is often extremely difficult to get in touch with the owner of a building as the name and address of a homeowner is not publicly available data.

Recommendations from the Open Energy Data Switzerland call for better data access and more transparency in the energy sector (Suter and Rohrbach 2022). This is essential for a timely and smooth increase of the renovation rate in the building sector without which Switzerland cannot hope to reach the 2050 net-zero target. Specific recommendations are to 1) study and apply best practices from countries where there are already using more transparent and digitally innovative solutions for data sharing; 2) simplify legal processes with open energy data guidelines and 3) organize country-wide access to energy data.

Table 1: Data types related to refurbishment and their availability.

	Data	Open source	Quality	Included in GEAK	Comment
Basic building information	Energy reference area (ERA)	No	-	Yes	
	Floor area	GWR	medium	Yes	
	No. of floors	GWR	medium	Yes	
	Building year	GWR	good	Yes	
	Primary energy source for space heating preparation & Primary energy source for domestic hot water (DHW) preparation	GWR	medium	Yes	
		Municipal data (where available)	excellent		Oil, gas, wood heating systems
		Building application data (where available)	excellent		Air source heat pumps
		Geothermal probe database (where available)	excellent		Ground source heat pumps
	Building type	GWR	good	Yes	Mixed use is often not well documented
	Renovation status	No	-	Yes	
Consumption (measured or estimated)	Heat	No	-	Yes	
	Hot water		-	Yes	
	Electricity		-	Yes	
Characteristic of the building	Building envelope efficiency	No	-	Yes	
	Total energy efficiency		-	Yes	
	Direct CO_2 emissions		-	Yes	
	Greenhouse gas emissions		-	Yes	
GIS-based data	District heating (potential)	No	-	-	
	Visual elements	Swiss building 3D (swisstopo)	-	-	
	Individual/shared buildings	No	-	-	
	Geothermal (potential)	No	-	-	

3.2 Availability and Shortcomings

For the previously described tools to be able to support decision-making when it comes to an efficient and timely renovation process, it is essential that they are based on up-to-date and accurate building information. GIS-based data and in turn tools that rely on this data could be used to pre-select strategies, find the buildings that when renovated can forward the decarbonisation goals the best.

The data available on the building stock in Switzerland is not sufficient at the moment for efficiently moving along the net-zero goals of the country in the building sector.

Some of the major shortcomings in general are according to (Suter and Rohrbach 2022):

- Differences in data-recording between cantons or even between municipalities.
- Low prioritization on the part of data providers to digitalise the data due to fears of too much manual effort.
- Ambiguous or unattributed responsibilities, fear of disclosing trade secrets.
- Few and inconsistent data on already existing renovations.

Business and public interests for potential data release should be weighed against each other while considering data protection. In addition, there is no sufficient uniformity across municipalities and cantons when it comes to standard data models, definition of terms, explanatory metadata, or standard reference data. According to the demands of the Swiss Association of Consulting Energies (suisse.ing) it would be necessary for the Federal Administration to manage and harmonize data collection and presentation at both cantonal and federal level (Marti 2019).

Since then the Open Government Data Strategy (2019-2023) and the Open Government Data Masterplan (2024-2027) have been making strides in the publication of open government data through their opendata.swiss website. This initiative aims to address the issues about transparency, participation and innovation in all sectors of society („Masterplan Open Government Data 2024-2027“). However, data that is not collected uniformly across the cantons, data that is not recorded digitally, or data that is privately owned cannot be made easily accessible. For example, the national building register (GWR) database has information on all buildings in Switzerland, and it can be useful for statistics when it comes to the location or size of a building, but it severely lacks up-to-date information if any or what kind of renovation has been done on a building compared to its initial state. It also doesn’t have sufficient information about the energy need of a building, or the split between space heating/cooling and domestic hot water needs. This information typically needs to be collected on a building-to-building level, involving for example an energy consultant, energy companies which want to realise thermal networks or municipalities that wish to influence or make specific subsidies for renovation. They can produce a certificate (GEAK) on which one can reliably base renovation decisions, but in order to drive the renovations on a regional and national level, the decision makers would need GEAK or similar certificates of all buildings in their region, not only for a few.

3.3 Example: Building renovations in the municipality of Stäfa, ZH

A comprehensive study was carried out by SPF Institute for Solar Technology of university OST in the municipality of Stäfa in canton Zürich to analyse the current situation and possible development scenarios to decarbonise the building sector (Ruesch et al. 2023). From this study estimates of the energy reference area and heat demand (space heating and domestic hot water) of each building were done. These were calculated using a simple approach with the gross floor area and number of floors of each building provided by the GWR database. The energy reference area was estimated using the gross floor area, building usage and the height of the building, information that is available from the GWR database. Individual building heat demand then was estimated based on the previously assumed energy reference area and detailed building usage information that was available from the cantonal energy authority.

We requested two companies to provide us with available information about each building in Stäfa. We received results for the energy reference area and for the individual heat and domestic hot water demand of the buildings. By comparing these values, we found vast differences in results concerning individual buildings.

Figure 1 shows a comparison between the energy reference area calculated by the SPF Stäfa project and one of the companies' results received. We show the buildings with an energy reference area below 2000 m^2. While the SPF project was using a simple approach to calculate the energy reference area from information gathered from the GWR, the companies which provided the energy reference area and heat demand data used more sophisticated methods involving geometry of each building from the 3D Swisstopo database. As a general trend the values match well, still the differences in individual values are striking when one considers how important and unambiguous this value should be for a single building.

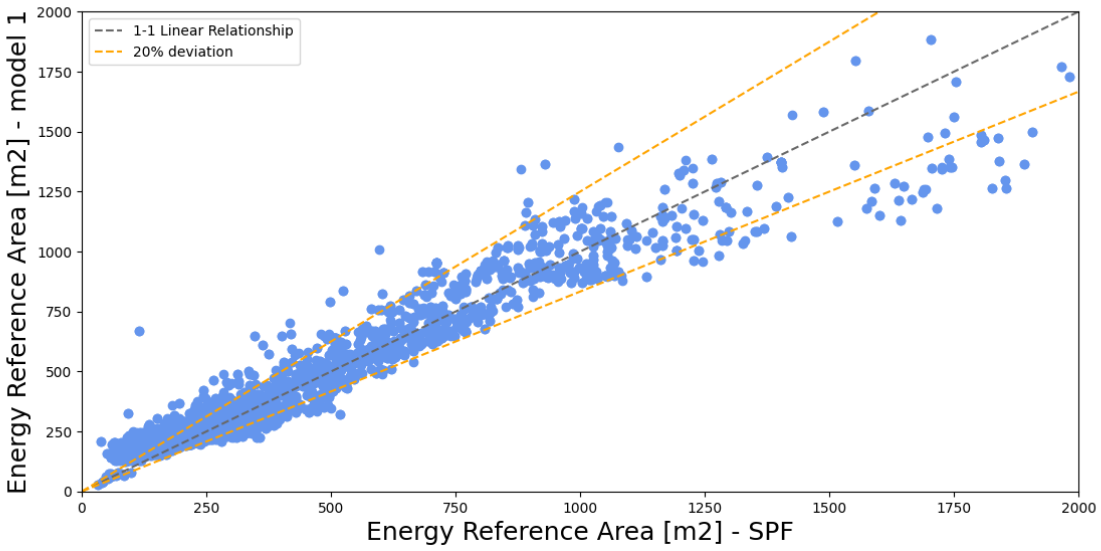

Figure 1: Comparison of Energy Reference Area between an anonym source (y axis) and the SPF study on Stäfa potential (x axis) for buildings up to 2000 m^2 energy reference area.

When comparing the heat demand for space heating or domestic hot water needs, the differences get even larger between the 3 datasets that we compare (SPF study and two anonym companies' results). The methodology of calculating the heat demand for space heating and domestic hot water varies slightly between the data providers. One based on statistics and SIA standard for heating, while the other relies more on some measured data available and machine learning. Figure 2 and Figure 3 show comparison between the three datasets of heat demand for space heating and domestic hot water, respectively. These figures show the smaller buildings below an energy reference area of 750 m^2.

The energy reference area and heat demand are basic information that needs to be known to plan an effective energy related renovation. The assumptions that these tools use to calculate the heat demand for space heating and domestic hot water are based on reasonable assumptions (e.g. number of people living in an apartment, average hot water consumption based on statistics), still the results can be very different for individual buildings as the graphics show. This points to a lack of uniform underlying data, and the importance of basic information such as the energy reference area. The GWR database does not provide this information, therefore the developers of these tools already have to make assumptions at an early stage in the process. The SPF project that evaluated the renovation potential in Stäfa improved on this basic information using additional data such as gas consumption, electricity consumption, building application and on-site visits.

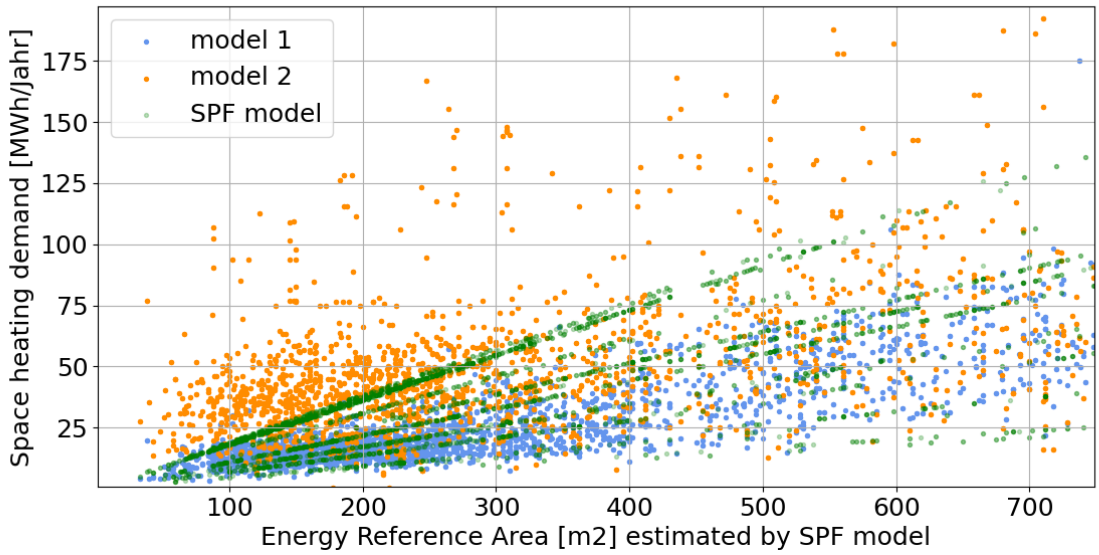

Figure 2: Comparison of heat demand for space heating between the SPF and two anonym company results (buildings up to 750 m2 energy reference area are shown).

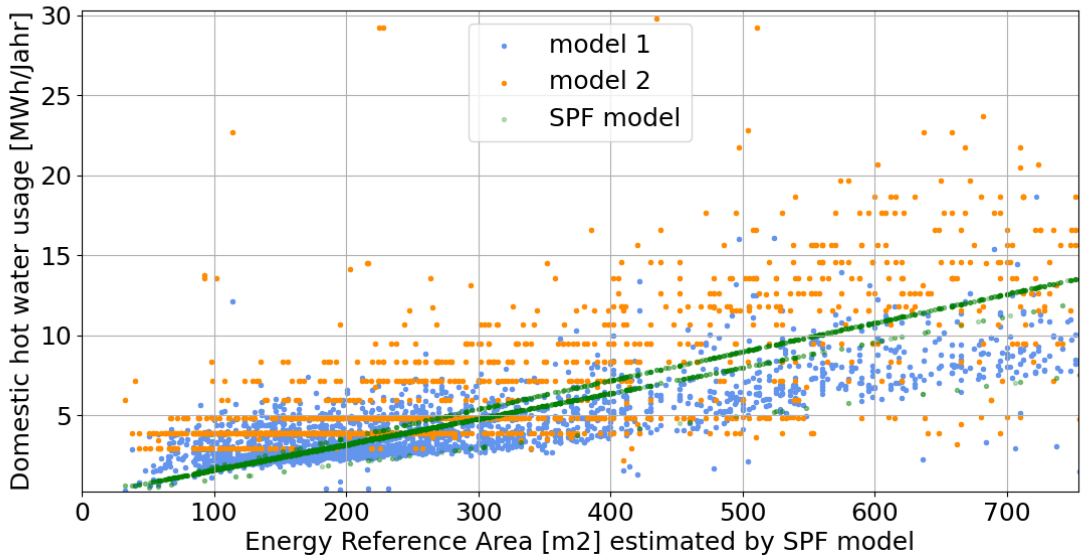

Figure 3: Comparison of heat demand for domestic hot water between the SPF and two anonym company results (buildings up to 750 m2 energy reference area are shown)

The SPF project in Stäfa is also a great example of making use of a GIS framework when collecting and interpreting the data. All the improved building data were not only collected in traditional databases, but also entered in a GIS database. This allowed for a detailed analysis of the energy and renovation situation in the municipality and offer essential overviews for decision makers. Figure 4 shows the initial assessment of the buildings in Stäfa, based on which many further analysis was carried out, including district heating potential, waste heat and lake water potential, wood and biogas energy usage, solar potential, geothermal energy potential, and various scenarios derived from the combination of building renovations and the usage of different renewable energy solutions (Ruesch et al. 2023).

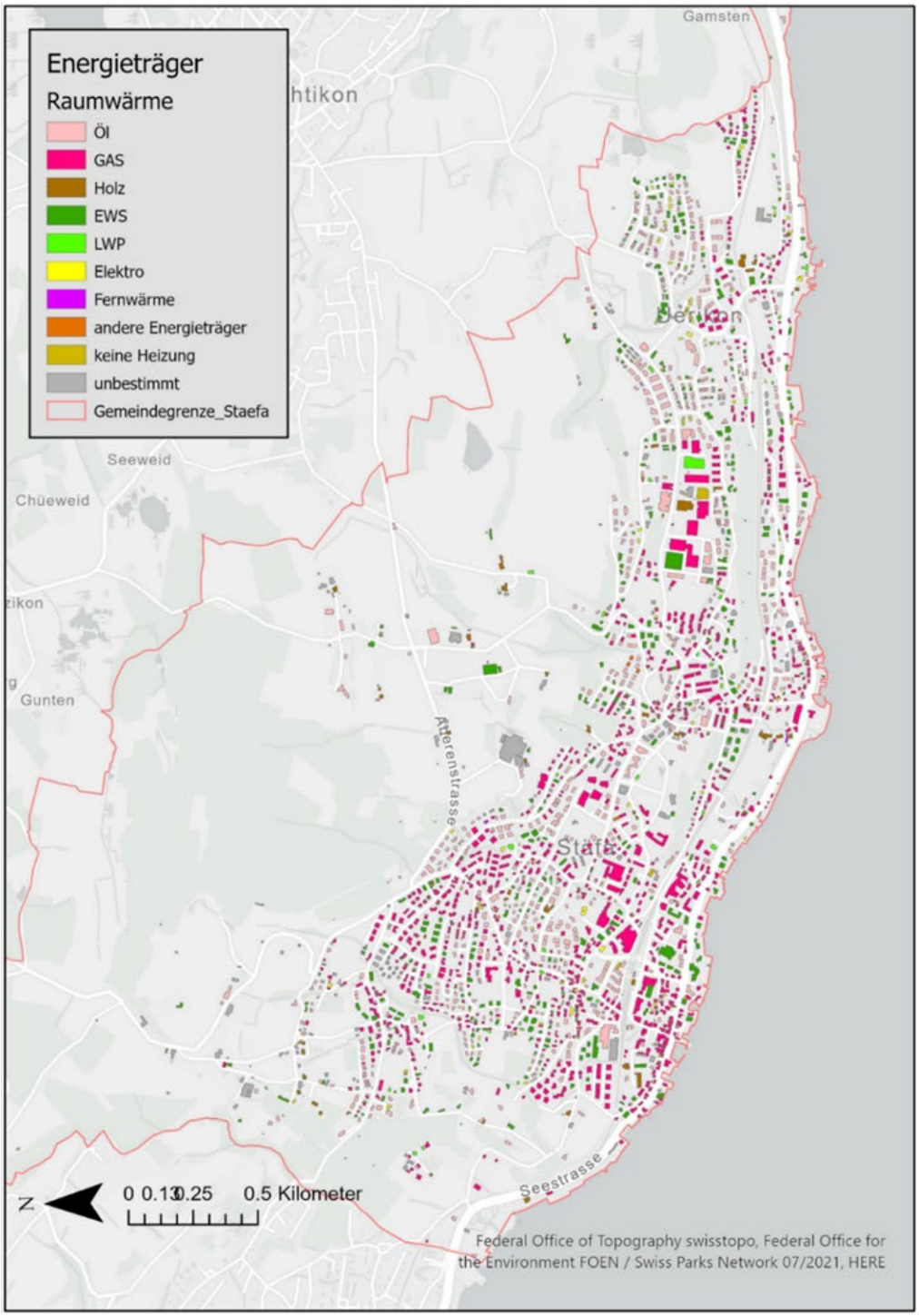

Figure 4: Primary energy carrier of each building in the municipality of Stäfa.

4 Key Recommendations and Conclusions

To start a wave of renovations that helps the country reach the 2050-climate goals, this kind of data collection, model improvement and result analysis, as showed in the Stäfa example, should be done not just on an ad-hoc basis but in a uniform and centralised way using all available open data in Switzerland. It should be possible to easily validate the modelled heat demand data of the Stäfa example using measurements or energy certificates. To make this data truly effective, digitizing it and integrating it into open-source databases is a crucial step. While there is a wealth of information available, much of it is still managed in paper form in most of the cantons. Transitioning to digital platforms would streamline data access and analysis, facilitating more accurate and timely decision-making. Making these valuable databases digital and open source would significantly enhance the ability to track progress, identify optimal renovation strategies, and ultimately accelerate the renovation rate necessary to meet the 2050 goals.

For the energy refurbishment, GIS tools that aid the renovation of the Swiss building stock, it is essential that most or all the data types listed in Table 1 are freely available to use, however a lot of information is either not recorded or measured, or the data is not openly available for such purposes. In the federal building statistics (GWR database) only a fraction of this data is available and with varying validity, especially when it comes to updates to the database due to renovations. Some municipalities and cantons have comprehensive datasets regarding their building stock and energy related information; however, these are not uniform across the country and not always publicly available. Energy certificates (i.e. GEAK) provide detailed information on individual buildings, but they are not publicly available and offer insight on specific buildings without much consideration of its surroundings and the greater picture of the 2050 energy transition goals in mind.

The GWR database could play a great role when properly updated. According to Swiss federal law this would be the responsibility of the municipalities (Bundesamt für Statistik, 2015), however it is most often not carried out and in practice not monitored if it is up to date in a certain municipality. Through an example of the municipality of Stäfa we show that the currently available online tools and methods, even though they are based on well thought out assumptions and models that use machine learning, can come to very different results even when it comes to some of the most basic parameters of a building. These parameters and many more that are based on them play a great role in renovation decisions and when wrongly assessed it can lead to negative surprises. It can ultimately result in wrong decisions in a first planning phase. Some of these mismatches and deviations could be avoided if the original data that they base their calculations on are more accurate and up to date than the traditional GWR database, for example if there was more accurate information on the state of renovations already taken place in a building.

Switzerland could learn from other countries with successful national building data platforms. For example, Denmark's Building Energy Label Database provides a centralized, open-access registry of building energy performance, allowing for more informed decision-making at all levels[2]. The Netherlands has also implemented a similar system, the Dutch Environmental Database, ensuring uniform data collection and better policy coordination[3]. A Swiss GIS-based solution could take inspiration from these models.

A GIS-based platform could provide the framework for data collection and usage. It would be a great step towards homogenising the building related data available often in various formats and level of openness in the different cantons of Switzerland. Combining building data with geo-information in

[2] www.euki.de/en/euki-publications/factsheet-energy-performance-certificate-database-denmark
[3] https://milieudatabase.nl/en

an easily accessible and interpretable database would be very beneficial when it comes to planning on a municipal or even cantonal level. Such platform could not only contain individual building profiles but also important information on their surroundings such as climate information, and district heating and geothermal potentials. A concrete implementation plan for such a database should include:

- **Technical Requirements:** Standardized energy performance data fields, API (Application Programming Interface) compatibility for public/private stakeholders, and periodic updates from verified sources.
- **Responsibilities:** The Swiss Federal Office of Energy (SFOE) or the Federal Statistical Office (BfS) could oversee the framework, while cantons manage local data contributions.
- **Timetable:** A phased rollout starting with pilot municipalities (e.g., Zurich, Geneva) before expanding nationwide.

Based on such a database, better models and estimations could be made using the already available tools that are out on the market to aid the building renovation process.

Planners and decision makers would have a visual tool that makes locating areas prime for refurbishment easier and simpler than working with traditional databases such as the GWR. A key challenge in the Swiss renovation process is the variability in regulations and subsidies across cantons. Efforts to harmonize building efficiency standards and incentives have already shown promise: The **GEAK (Gebäudeenergieausweis der Kantone)** provides a standardized energy certification system across Switzerland, helping homeowners assess their buildings' energy performance. Additionally, recent efforts to align major building labels – including **Minergie, SNBS, and GEAK** – aim to simplify subsidy structures and improve guidance for property owners. Expanding and making such coordinated programs public would enhance transparency, making renovation incentives more predictable and accessible across different cantons.

In urban areas, it is crucial to approach the renovation process as part of a broader strategy, integrating neighbourhood and district-wide energy solutions alongside individual building renovations.

In this white paper based on the findings presented earlier we recommend the following tasks and steps to improve the GIS-based data solutions for energy refurbishment of buildings:

The most important role should be played by the **Public Authorities (Municipalities, Cantons and Federal Agencies)** to lead a coordinated national strategy in digitizing and harmonizing building related data. They can propose incentives to ensure high-quality data submissions from local authorities and standardize data formats and terminologies across cantons and municipalities.

The GIS-data based tools can only work well if the submitted data is complete, accurate and timely. **Data Providers (Statistical Offices, Energy Suppliers, Property Registries)** have a great role to facilitate secure and anonymized data collection. They can develop APIs (Application Programming Interface) for real-time data exchange with GIS tools, as well as improve metadata documentation for building datasets. It could also be in their scope to collaborate with public entities to validate or fill gaps in data records.

GIS and Energy Tool Developers are able to provide great assistance to the renovation efforts in Switzerland. They should develop modular and interoperable systems adaptable to evolving data standards and external platforms (e.g. GEAK, swisstopo, GWR); and enhance usability and visualization for non-technical stakeholders. To ensure the quality of displayed and calculated data, these tools should be able to highlight data quality issues, flag outdated records, or perform comparisons among different methods. Guided workflows for building assessment and renovation strategy planning could be provided by these tools.

Building Owners and Housing Associations are in a position to make valuable contributions to such GIS-based databases through crowdsourced or certified updates of building characteristics. They can submit voluntary GEAK certificates or renovation logs into public platforms. User-friendly computer tools or mobile apps should be made available to them for such submissions, as well as for reviewing and correcting their building's GIS profile.

Academic and Research Institutions should play a supporting role in the renovation efforts through data improvement with models and algorithm development to cross-check, estimate, or verify building or energy data. They can help develop evidence-based usability standards in GIS-based tools and test the usability of the GIS interfaces with target groups (planners, owners, policy makers).

Energy Planners and Consultants have access to high-quality verifiable data and therefore can contribute to the GIS-based tools and the renovation strategy planning. Specifically, they should report data anomalies and inconsistencies that they might find to the relevant data custodians and help municipalities benchmark and validate GIS layers against real-world conditions.

Future solutions could focus not only on individual buildings (as seen with tools like the GEAK certificate) but also on entire districts, enabling more cost-effective and sustainable achievement of 2050 energy goals.

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