



Open data for smart and climate friendly urban solutions

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Policy guidelines on open data for smart and climate friendly urban solutions

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1 Introduction

The “smart city” is a vision and concept for cities of the future. Guided by this broader image, municipalities in the Baltics and Germany are increasingly developing and piloting, and eventually aim to scale up smart solutions. These solutions seek to modernize, transform and connect existing technical and social infrastructure, and related services as well as improve local governance mechanisms. Objectives vary, but often focus on the quality and well-being of individuals and communities, protecting the climate and environment, and promoting the local economy. To achieve their objectives and to foster climate objectives, municipalities cooperate with companies (both established businesses and start-ups), researchers and in some cases civil society organizations.

An intricate part of these pilots is digital technology. The foundation for many smart city projects is physical infrastructure (e.g. fiber optic connections), public WLAN, mobile telecommunications and sensor technology. In many cases, solutions rely on specifically programmed, sometimes open software, such as apps for car sharing or platforms that enable citizens to share ideas about the sustainable development of their city. To offer such digital services, information needs to be processed (e.g. in the case of car sharing apps, information needs to be processed on customers, payments and the location of cars). Consequently, smart solutions generate, store, distribute and in many cases analyze increasingly large and new forms of structured and unstructured data.

While these solutions often aim to improve a public good for the city, the stored data is in many cases not publicly accessible. Data is dispersed and owned by a multitude of different actors and reflects the multi-stakeholder nature of many smart solutions. Businesses and to some extent municipal subsidiaries see data as the cornerstone of their business models and are reluctant to share data with the wider public. Data is also stored in different formats, which makes it difficult to aggregate, compare and process. As a result, smart solutions in municipalities have become a testbed for realizing the demands of the open data movement.¹

“Open Data” can be best understood as a set of principles governing different aspects of data handling. According to the Open Knowledge Foundation’s definition, “open data and content can be freely used, modified, and shared by anyone for any purpose” (<http://opendefinition.org/>). Core aspects of open data are the public availability of and access to data, the use of data, and the right to modify and distribute data to anyone. These freedoms refer to data that is not protected by privacy laws or directives. To realize these demands, open data usually calls for machine readability and interoperability. This implies that information should be stored in a structured format that can be used across many different platforms and for many different purposes. It further implies that data should not only be published in the form of PDF/text documents, which can only be accessed through additional hurdles and efforts (e.g. web scrapping techniques).

The European Union (EU), EU member states as well as regions and municipalities have been developing specific data platforms, which aim to address the demands of the open data movement. In 2015, the EU established the EU Open Data Portal. Moreover, the Directorate-

¹ This movement should not be confused with the open-source or free software movements, although it partially overlaps. The free software movement demands four freedoms related to software (not data): to “run the program as you wish, for any purpose,” “to study how the program works,” “to redistribute copies” and to “distribute copies of your modified versions”; overlapping with these four freedoms, but not limited to them is “access to the source code” (i.e. open source) (<https://www.gnu.org/philosophy/free-sw.en.html>).

General for Research and Innovation of the European Commission adopted the open access (data) principle for publications as part of the Horizon 2020 (H2020) program. By the end of 2020, scientific research results will be shared with and accessible to the public in order to promote further research activities. Many larger cities in the Baltics and Germany have developed platforms as well, examples include [Kiel](#), [Riga](#) (as part of Latvia's open data portal), [Tartu](#) and [Vilnius](#).

However, in practice these platforms face many challenges. The emphasis on the availability of data neglects the fact that many users lack the digital literacy to access and analyze the data. Platforms are also often overburdened with a wealth of data, which renders it difficult to navigate. Consequently, these platforms are not widely used. Furthermore, these platforms are not always linked to other platforms or they may use different formats. Lastly, the development and maintenance of such platforms is costly, and smaller cities may not feel up to the challenge of developing and maintaining them.

This policy guideline is specifically aimed at municipalities in the Baltics and Germany that have **not yet implemented** the principles of open data or developed open data platforms, **but are interested** in the pros and cons, pitfalls and potentials of doing so, **and / or are planning to develop data platforms**.

This document starts with the hypothesis that open data is **beneficial for municipal climate mitigation**. The guideline outlines these benefits and highlights some of the main barriers of implementation, with the aim of painting a realistic picture of what open data can achieve in and for municipalities (Chapter 2). The document also synthesizes examples from Germany, Estonia, Latvia and Lithuania, and details strategies other municipalities have relied on when developing open data platforms (Chapter 3). Lastly, the document provides a check list and links to further resources (Chapter 4).

Table 1: Open data key principles

| <i>Key Principles of Open Data</i> | <i>Description</i> |
|------------------------------------|---|
| Availability and Access | The data must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form. |
| Reuse and Redistribution | The data must be provided under terms that permit reuse and redistribution including the intermixing with other datasets. The data must be machine-readable. |
| Universal Participation | Everyone must be able to use, reuse and redistribute — there should be no discrimination against fields of endeavour or against persons or groups. For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purposes (e.g. only in education), are not allowed. |

Source: Directly quoted from <https://okfn.org/opendata/>

2 Open data for climate friendly smart solutions: background

2.1 Open data: beneficial for municipal climate mitigation

Publishing information under open data principles provides benefits for municipal climate mitigation.

Open data fosters research and innovation on urban climate protection

In general, it is estimated that a large share of generated environmental and climate data is currently not accessible (cf. for scientific research Reichmann et al. 2011). Yet, this data plays a key part in understanding the drivers, levers and intervention points regarding municipal climate mitigation, and that innovation is often triggered by discovering patterns and relationships in data. Publishing structured (i.e. in a standardized, machine-readable form), reliable and recent data is therefore an important driver of innovation. Data sharing has led to new applications and services as well as new processes and structures in cities (Mergel et al. 2018). Examples include the use of geospatial data for mobility services (Hawken et al. 2020a: 7) and open data for an urban heat vulnerability index (Hawken et al. 2020b).

Open data underpins monitoring and evaluation as well as accountability in and between cities

A key demand for cities is accountability on progress in climate protection. However, calculating the climate footprint of a city is a complex endeavor and cities usually do not publish such analysis on a yearly basis. Open data-based city dashboards provide a complimentary approach and information on key measures / indicators, and synthesize available environmental and climate data. Furthermore, several data portals contribute to data sharing and transparency. For example, under the Covenant of Mayors initiative, participating cities evaluate progress made in monitoring reports – an overview of the monitoring reports is available online (<https://www.covenantofmayors.eu/plans-and-actions/progress.html>). (However, this data does not appear to be available in a machine-readable form). Similarly, the UNFCCC NAZCA tracks global climate action (<https://climateaction.unfccc.int/views/stakeholders.html?type=cities>).

Open data supports urban management and planning

City administrations are usually structured with differentiated units, which are assigned specific tasks, competences and resources. This structure in many cases leads to management silos in which cooperation between different units becomes essential for comprehensive, efficient and effective climate action. Open data supports such inter-departmental collaboration by enabling the reuse of collected data by other units (Mergel et al. 2018). The data may also be used to assess the coherence of policy proposals with other measures at the city level.

Open data promotes education and information on climate change at the city level

Climate change awareness has increased over time. However, one of the main challenges still lies in relating global changes (e.g. increase in average temperature over time) to the local experience. Publishing information under the open data principles outlined above supports education and information on climate change impacts on the city level when interlinked with easily accessible data visualization. For example, spatially explicit data on the city level could be used to visualize average temperature increases under different climate scenarios.

2.2 Open data: a realistic picture

While open data provides benefits for urban climate mitigation, it is important to be aware of the barriers for implementation as well as understanding some of the pitfalls. The core message is: Open data is more than publishing data openly.

Open data involves strengthening digital literacy, focusing on users and integrating feedback mechanisms

The open data principles highlight the public availability of and access to data. However, research indicates that it is not enough to simply publish data on a platform to induce the benefits outlined above (Janssen et al. 2012, pp.264-266; Nelson 2017). Instead, it involves improving digital literacy and taking potential users into account, focusing on their needs and preferences (e.g. regarding data formats and visualization). It also requires complementing data portals with appropriate information, tutorials and training programs to reach potential recipients and strengthen competences. This means integrating feedback mechanisms and surveys, and analyzing whether the data published is of use to the intended recipients. Open data platforms that integrate such feedback mechanisms are also more likely to contribute to governmental accountability.

Open data platforms need appropriate political communication

Open data is still surrounded by several myths. One example concerns data privacy: open data, it is sometimes feared, implies an infringement on data protection. However, as outlined above, open data concerns data that is not protected by privacy laws. Another example involves business interests, with open data believed by some to reduce competitiveness and yield no monetary value. However, as argued above, open data provides an enabling environment for innovation. Political communication should address these myths and the concerns that lie behind them.

Setting up open data platforms involves formulating strategies to overcome institutional, technical and legislative barriers

There are many barriers to implementing open data platforms (cf. Bibri 2019; Dawes 2016; Janssen 2012). These involve the governmental / institutional level (e.g. lack of policies, standards, financial resources and political will), but also the technical level (e.g. information quality). Table 2 summarizes examples of such barriers. When setting up open data platforms, municipalities should consider possible barriers and formulate strategies to overcome them.

Table 2: Barriers for open data platforms (Bibri 2019; Dawes 2016; Janssen 2012)

| <i>Types of Barriers</i> | <i>Examples of Barriers</i> |
|---------------------------------------|--|
| Governance & Institutional | <ul style="list-style-type: none"> • Lack of appropriate policies and legislation for publicizing data • Lack of feedback mechanisms, which would enable public authorities to evaluate the efficiency and effectiveness of the data • Lack of financial resources and political will to establish and sustain open data programs |
| Task Complexity | <ul style="list-style-type: none"> • Lack of ability to interpret, understand, analyze and differentiate the presented data as well as the ability to combine datasets • Lack of explanation on the datasets and the source from which they have been obtained • Lack of easy usability for complex datasets and formats |

User Participation

- Lack of helpdesk support from the publishers
- Lack of awareness of the potential uses of open data

Legislation

- Lack of incentives for users to input data
- Lack of incentives for public organizations to publish the data
- Requirement to register before being able to download data may lead to privacy violations, as users are forced to provide personal information in exchange for datasets
- Lack of data analysis skills and statistical knowledge to understand the data
- Lack of time available to users to explore the datasets
- Violation of user privacy and security
- Lack of license and permit to reuse and redistribute open data
- Requirement for permission to reuse and redistribute the open data

Information Quality

- Lack of complete information on the published datasets
- Lack of accurate information, validated by different sources

Technical & Logistical

- Lack of expertise to handle spillover risks from weak open data management
- Lack of monitoring and evaluation technologies, and IoT devices that can collect data
- Lack of technologies to ensure inclusion and universal participation

3 Baltic and German experiences: Open data platforms and municipal climate mitigation

3.1 Lithuania: Open data platform in Vilnius

An interesting Lithuanian case of open data policy is the Vilnius city municipality open data platform “Atviras Vilnius” (<https://atviras.vilnius.lt/>). The platform is under the regulation of an open data policy document approved by Vilnius City Council. Under the policy document, data is made available if it is not sensitive and does not contradict the general data protection regulation.

The main open data platform – Vilnius API (<https://api.vilnius.lt/>) – contains various types of data, applications and tools, and works as a navigator to other data sources.

Vilnius API stores data in two ways: proactively (government data) and reactively (data from the private sector, NGOs and citizens). Publically available is information buildings, transport, procurement and budget. Environmental and transport data occupy a large part of the platform.

According to the Vilnius policy, anyone may access and submit data to Vilnius API. The city “has opened a three-way conversation between governance, business and citizens” (Shan 2018) and also integrates input from citizens entering the platform.

The data is operated by the Vilnius city municipality. In addition, it is linked to other Lithuanian national data platforms, such as GIS (the national geoportal) and the Official Statistics Portal. It includes several public and private applications, such as Tvarkau miestą, Traffi, sviesoforai.lt, Vilnius Transport GTFS (Open Mobility Data), which use this database and the data.

Vilnius API forms the umbrella for two open data platforms, GitHub and Vilnius City Open Data portal. GitHub provides data, which is collected and prepared for use not only by the government but also by the private sector and citizens. Examples of actors that use the data include the Vilnius Waste System Administrator, the Vilnius traffic detector, a Vilnius recycling data project and the Vilnius City Municipality General Plan. The Vilnius City Open Data portal contains various types of environmental (e.g. historical data from temperature sensors as well as data on the emergency removal of trees, noise pollution, public areas, condition of trees and waste containers) and transport data (e.g. Vilnius city transport districts, road load, number of cars and average monthly traffic flow). Both portals offer information in a number of machine and human readable formats (e.g. MD, CSV, XLSX, PJM, SHP, SHX, KML and Shapefile). Therefore, the data can be easily accessed and used.

One successful open data strategy is to define a clear vision and motivating goals for the city government to implement an open data policy. Vilnius has set the standard for other cities in this regard with five other Lithuanian cities currently following Vilnius’ activities.

3.2 Open data in Latvia

Latvia and the other Baltic countries are often praised for their overall level of ICT development, implementation of centralized open data platforms and adoption of innovative tools for public goods. The three Baltic countries have benefited from the experiences of other

EU member states when building their ICT and data systems from scratch following their independence, and subsequent rapid economic and technologic development.

On the national level, Latvia has well implemented general open data legislation, and a high level of data centralization and data availability. However, on the municipal level, data integration leaves much to be desired. Although Latvia ranks well above the EU average in the Open Data Maturity index (EU Open Data Report), some fundamental barriers to the implementation of open data in national and municipal institutions persist. For example, public sector bodies often commercialize the data they provide, with the revenue from these activities providing a significant source of funding; data anonymization and structuration require extra funds and well-trained staff, which are not always available to the institutions; and public and semi-public institutions remain reluctant to share information unless it is specifically required by law.

Nevertheless, an increasing number of civic, private and municipal initiatives have surfaced over recent years, which succeed despite the obstacles. The most ambitious example has been the Riga mobility point, a collaboration between the Riga municipal agency Riga Energy Agency and the community NGO VEFRESH. The idea of the project was to foster IoT and mobility innovations in Riga that provide easy access, publicly accessible infrastructure (public IoT testbed). The open data repository is run by the NGO. Two sensors are tested and data is collected on different fields, such as pollution, noise and temperature. The initiative serves as a lighthouse for what can be achieved and encourages municipalities to reach higher. As a result, several municipalities including Riga have begun to open their datasets to the public and implement up-to-date digital public participation tools. Some municipalities have even gone the extra mile and appointed a data analyst to their permanent staff.

3.3 Germany: Berlin Opendata

Berlin Opendata was established in 2011 and was one of the first municipal data platforms in Germany. At the time of writing, the platform provides access to more than 2,000 municipal authority datasets. Storage and maintenance of the data remains the responsibility of the local authorities; the platform serves as a gateway for accessing this data. The local authorities are also responsible for registering their data on the platform.

The platform is based on the principle of federation. This means that the data stocks of subordinate instances (e.g. districts or the portals of other senate administrations) can be transferred to the portal via an automated process (“harvesting”). Similarly, the platform serves superordinate data platforms, such as the German federal government’s govdata.de or the EU’s european-dataportal.eu. The data provided is split into 20 different categories,² such as “geography and municipal planning,” “health,” and “social benefits.” Out of all the datasets currently available on the platform, eight have been assigned to the category of “environment and climate.” Most of the data is available in XLS, HTML or PDF format. Additionally, there are map material (KML) and web-based databases. The platform is run by the Senatsverwaltung für Wirtschaft, Energie und Betriebe Berlin (i.e. the municipality). There are currently 63 different applications based on data from the platform. These applications range from services

² The available categories are "labour market and education," "demography," "geography and urban planning," "health," "youth," "art and culture," "public administration, budget and taxes," "minutes and resolutions," "other," "social services," "sport and recreation," "tourism," "environment and climate," "supply and disposal," "consumer protection," "transport," "elections," "economy," and "housing and real estate."

that incorporate into a map of Berlin information on the wheelchair accessibility of public spaces to an overview of the distribution of kindergartens across Berlin.

The creation of the platform was preceded by a study by the Fraunhofer Institut für offene Kommunikationssysteme (FOKUS) as well as an online poll to analyze the preferences and interests of the residents of Berlin.

One factor that proved to be important to the success of the strategy was the engagement of other municipal data platform providers, FOKUS, multiple open data initiatives around the world and the residents of Berlin. The effort that went into planning and designing the platform prior to its launch turned out to be a crucial factor in its success (see Both and Schieferdecker 2012).

4 Conclusion

“Open Data” can be best understood as a set of principles governing different aspects of data handling. Core aspects of open data are the public availability of and access to data, the use of data, and the right to modify and distribute data to anyone.

Realizing these principles is beneficial for municipal climate mitigation: it fosters research and innovation on urban climate protection; it underpins monitoring and evaluation, as well as accountability in and between cities; and it supports urban management and planning. It also promotes education and information on climate change at the city level.

However, realizing open data principles faces many obstacles, including reaching the target audience. Therefore, key recommendations include strengthening digital literacy, focusing on users and integrating feedback mechanisms; and complementing the launch of open data platforms with appropriate political communication as well as strategies to overcome institutional, technical and legislative barriers.

The examples from the Baltics and Germany demonstrate that formulating a clear vision for open data in municipal decision-making and engaging a broad range of actors are crucial to achieving success.

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