Global Alliance
for Buildings and
Construction

THE BUILDING PASSPORT:

A TOOL FOR CAPTURING AND MANAGING WHOLE LIFE DATA AND INFORMATION IN CONSTRUCTION AND REAL ESTATE

PRACTICAL
GUIDELINE

UN
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1972-2022

Disclaimers

Geographical disclaimer

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ABOUT THE GLOBAL ALLIANCE FOR BUILDINGS AND CONSTRUCTION (GLOBALABC)

Founded at COP21, hosted by the United Nations Environment Programme (UNEP) and with over 150 members, including 30 countries, the GlobalABC is the leading global platform for governments, private sector, civil society, research and intergovernmental organizations committed to a common vision: **a zero-emission, efficient and resilient buildings and construction sector.**

The GlobalABC is a voluntary, international, multi-stakeholder partnership. It aims to serve as the global collaborative umbrella organization for other platforms, initiatives and actors to create synergies between them, and increase the scale, pace and impact of climate action towards decarbonization of the buildings and construction sector in line with the Paris Agreement Goals.

The GlobalABC aims at mobilizing ambitious levels of international resources for efficient local operational solutions, aligning existing initiatives, commitments and programmes to achieve greater scale, and catalyzing greater pace and impact of climate action in the buildings and construction sector.

The GlobalABC aims to:

► Be a global advocate for the importance of the sector for global climate action, provide a common language for discussion among decision makers and be a catalyst for action by leading actors in the buildings and construction sector.

► Provide an objective and trusted platform to set targets for decarbonization, track progress, track action, and share knowledge and good practices.

► Suggest key measures for countries to adopt, supporting them in setting priorities in their own strategies, based on their situation, e.g., using the GlobalABC regional and national roadmaps.

Thematic work

The GlobalABC's activities are organized around the following five thematic work areas:

1. Education and Awareness
2. Public Policies
3. Market Transformation
4. Finance
5. Building Measurement, Data and Information

ABOUT THE GLOBALABC WORK AREA ON BUILDING MEASUREMENT DATA AND INFORMATION

Whether constructing, buying, leasing or occupying property assets, global investment decisions and effective policy instruments depend crucially on transparency and comparability, and both rely on consistent data. To gain the confidence of policymakers, builders, developers, architects, investors, and other sector stakeholders, data must be available, storable and credible, i.e., verifiable and transparent.

Measurable, reportable and verifiable (MRV) information is pivotal to accelerating more transparent and efficient processes; to the roll-out of low-carbon technologies; and to fostering sectoral innovation and uptake of energy efficiency in the construction and real estate industry. In order to finance, construct, and renovate low-carbon, sustainable buildings, decision makers in the construction and real estate sector require high-quality data and assessment results.

The failure of embedding MRV mechanisms at the beginning of the life cycle results in large data gaps, discordant certification and performance standards, risky markets, and missed opportunities to harness potential natural and financial resource savings.

This is what the **GlobalABC Work Area on Building Measurement, Data and Information** seeks to address.

The Work Area has the following goals:

► **To promote** overall sectoral data transparency, consistency and information exchange.

► **To provide** guidance to enhance policy and track investments in the real estate and construction sector.

► **To facilitate** accessibility, transparency, understanding and comparability of energy use through the development of practice-oriented building data, measurement and standards in the construction and real estate sector.

ABOUT THESE GUIDELINES

Any transparent business decision-making must be based on a robust evidence base, regardless of the sector or economic activity. In recent years, environmental targets and policies and associated reporting obligations for the construction and real estate sector have become ever more stringent. Against this background, core value chain stakeholders on both the supply and demand sides are increasingly calling for accessible and reliable data and information on buildings.

Policymakers and market participants alike see the development and use of Building Passports as a way of overcoming current data gaps and data barriers, helping to capture, administer and manage building-related data and information across the whole life cycle.

Across markets, a growing number of Building Passport initiatives are in various stages of development. In addition to existing and projected non-profit and governmental schemes, a growing number of commercial applications also exist.

Carrying out an in-depth analysis of all initiatives currently underway is beyond the scope of these guidelines. **Table B.1** in **Annex B** presents a snapshot of global initiatives that are either operational, tested or under development. This overview is accompanied by a selection of operational examples.

However, an analysis of the data that these individual initiatives focus on shows that they vary greatly in their scope and focus. For example, the majority deal only with certain aspects and life cycle activities, such as energy, materials or renovation roadmaps, and only very few cover the full range of data categories and the information needs of all stakeholders.

Over the years, the idea of introducing Building Passports has been much debated, and many questions have arisen around whether and how a Building Passport, Building File or Logbook would and should work in practice.

The overarching goals of these practical guidelines, which represent the collaborative effort of a global Task Force of public and private sector experts, are to illustrate the value of developing holistic, multi-dimensional Building Passports. At the same time, the guidelines reflect key aspects of past discussions about how to make them work in practice, drawing on the experiences of stakeholders and on existing and emerging similar-type initiatives.

As such, the guidelines represent a support tool for existing and future initiatives and projects, with the following objectives:

- ▶ **To explain** the approach of a Building Passport in the context of discussions around the need for a more systematic and coherent approach to building-related data and information.
- ▶ **To help** build capacity for improved data capture and management through practical recommendations and real-life examples of good practice.
- ▶ **To ensure** a minimum of harmonization / standardization.
- ▶ **To foster** more widespread market transformation through progressive digitization of building-related data and information, thus creating greater overall sectoral transparency and opportunities for the development of new business models and tools.

Target audience and geographical scope

The data and information needs of individual stakeholders may differ, but all stakeholders both generate and use data along a building's life cycle. As such, the guidelines are globally relevant for the whole sectoral value chain. Building on first experiences and considerations vis-a-vis Building Passports in some markets, the guidelines are meant to provide practical hints for first application and operationalization in other regions.

A tool for capturing and managing whole life data and information in construction and real estate

Lead authors

Ursula Hartenberger – PathTo2050, Belgium

York Ostermeyer – Chalmers University, Sweden

Thomas Lützkendorf – Karlsruhe Institute of Technology, Germany

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Global Alliance members

Esther An – CDL, Singapore

Sue Arundale – FIEC, Belgium

Carlos Bascou – Confederation of International Contractors Association, France

Anne Claire Gislard – CSTB, France

Norman Gojberg – Construccion Sustenable, Chile

Ian Hamilton – UCL, United Kingdom

Cristiana Ciaraldi Jolivet – WBCSD, Switzerland

Do Y. Kim – Qatar Foundation, Qatar

Judit Kimpian – Architects Council of Europe, Belgium

Christine Lemaitre – DGNB, Germany

Andrea Moro – iiSBE, Italy

Chris Pyke – USGBC, USA

Ommid Saberi – IFC, USA

Saurabh Saraf – CUES Foundation, The Netherlands

Kyryl Tomliak – KT-Energy, Ukraine

Zsolt Toth – BPIE, Belgium

Matthew Ulterino – UNEP FI

Fabrizio Varriale – RICS, United Kingdom

External experts

John Davies – Derwent London, United Kingdom

Kinley Deller – King County, USA

Rowan Griffin – Lendlease, Australia

Mina Hasman – Skidmore, Owing & Merrill, United Kingdom

Caroline Henrotay – Brussels Environment, Belgium

Josefina Lindblom – European Commission

Simon Lumb – The Deeds Depository, United Kingdom

Peter Mayer – BLP Insurance, United Kingdom

Ralf Nörenberg – Ingsko, Germany

Ilektra Papadaki – European Commission

Antonio Paparella – European Commission

Sarah Ratcliffe – Better Building Partnership, United Kingdom

Sarah Sayce – Reading University, United Kingdom

Z Smith – Eskew + Dumez + Ripple, USA

Molly Steinlage – Brussels Environment, Belgium

Raquel Teixeira Dos Santos – European Commission

Pablo van den Bosch – Madaster, The Netherlands

Paula van den Brom – TU Delft, The Netherlands

Roel Vermeiren – Vlaams Energieagentschap, Belgium

Henk Visscher – TU Delft, The Netherlands

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Tom Marshall – GeraldEve, United Kingdom

Michael Scharf – Lafarge Holcim, Switzerland

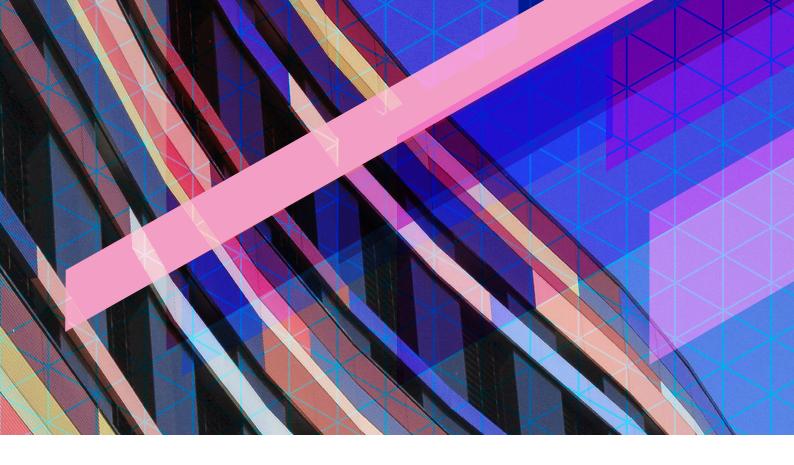**Annabel Short** – Institute for Human Rights and Business, USA

Johann Zirngibl – CSTB, France

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1. WHY IS BUILDING-RELATED INFORMATION IMPORTANT?

Decarbonizing the construction and real estate sector is critical to achieving the Paris Agreement and the United Nations Sustainable Development Goals (SDGs). The sector is responsible for almost 40 per cent of energy- and process-related greenhouse gas emissions. These include direct and indirect emissions from building use, the manufacturing of building materials, and building replacement and renovation. Taking climate action in buildings and construction is among the most cost-effective ways to address rising global emissions.

And yet, investment in energy- and resource-efficient buildings is insufficient, and progress is far too slow. Moreover, significant data gaps have emerged in the sector, as revealed in the **GlobalABC Global Status Reports** and the **GlobalABC Regional Roadmaps[1]**.

Known for its complexity, the construction and real estate sector involves a large group of stakeholders and processes, many of them with their own supply chains. The issue of fragmentation in the sector is not new and is widely seen as one of the greatest barriers to making the sector less carbon- and resource-intensive and to meeting regional, national and international climate targets.

Inextricably linked to these general challenges caused by fragmentation and silo-thinking is the fragmentation of important building-related information flows, with public and private sector efforts often being confounded by a real or perceived lack of data.

Different stakeholders generate relevant information and data at every stage of the buildings and construction life cycle. These data are developed for different purposes, such as urban planning, building design, construction, procurement, cost management, inventory, insurance, operation and maintenance, retrofitting, valuation, financing, investment, etc.

On the data demand side especially, access to and availability of reliable and trustworthy data and information are absolutely crucial. Building-related information is indispensable as a basis for investment and financing decision-making and adequate risk assessment.

In recent years, several developments have triggered a growing demand for robust asset and portfolio-level data, optimized data flows and data exchanges among the investment and financing community (see **Fig. 1**). Relevant developments include the adoption of the Paris Agreement, a series of industry commitments and associated reporting requirements, as well as the emergence of green mortgage lending schemes and the growing issuance of green real estate bonds, coupled with policy initiatives (such as the European Union's Taxonomy for Sustainable Finance[2]).

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[1] *See: https://globalabc.org/resources/publications.*

[2] *A classification system to determine which economic activities are eligible as sustainable investment. See EU Technical Expert Group on Sustainable Finance 2019.*
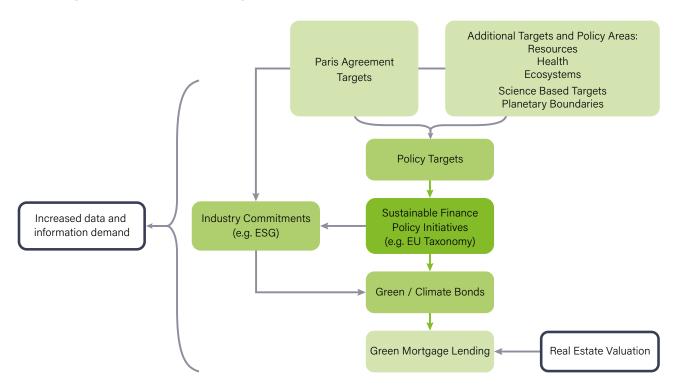
FIG. 1: **Heightened demand for building-related data on the demand side**

WHO NEEDS BUILDING-RELATED INFORMATION?

A need for data exists both on the supply and the demand side, including for industry market participants, their respective advisors, and service providers, as well as policymakers at the local and national levels.

Fig. 2 illustrates the complex network of stakeholders and their building-related data and information needs. **These are needs that the Building Passport can help to meet.**
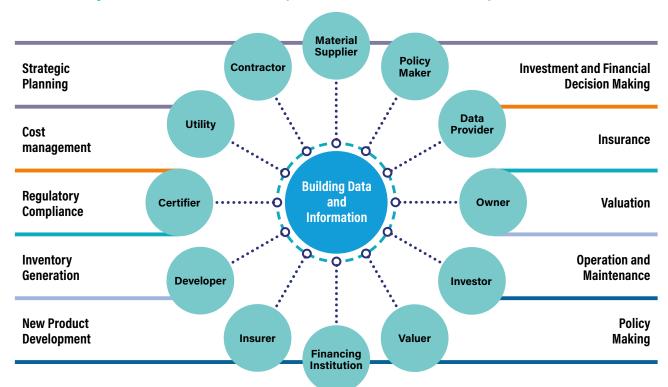
FIG. 2: **Building-related data and information providers and users and their respective data needs**

Data and information needs arise across the whole life cycle, but certain types of information are in particularly high demand:

▶ Energy Performance Certificate / real energy consumption

▶ Greenhouse gas emissions (conversion from energy consumption)

▶ Detailed results of a sustainability assessment / label

▶ Material inventory (type, quantity, quality of installed materials, risks to health and the environment)

▶ Evidence of systematic commissioning

▶ Evidence of systematic maintenance and repair

▶ Resilience to current and future natural hazards at the site

▶ User satisfaction (for rented properties)

Activities around the buildings and construction life cycle that typically represent data demand trigger points include, among others, transactions, buying, selling, insurance, renting and refurbishment (see **Fig. 3**). It is precisely in these areas that the data necessary to either initiate or complete the respective processes are either not available, not accessible or not usable or trustworthy due to inadequate data handling at earlier stages in the life cycle.

FIG. 3: **Data demand trigger points**

WHAT HAPPENS TO INFORMATION ACROSS THE LIFE CYCLE?

At present, little information flows from one life cycle stage to the next. Often none, or only a small part, of the information generated throughout the building life cycle is available to stakeholders on the data and information demand side, such as building owners, tenants, investors, financing institutions, buyers and operators. If information is available at all, it is often no longer useful, as it may be out of date.

At times, data that are collected by one stakeholder are not shared, or the context and / or the methodology of the data collection is not sufficiently clear. Data and information management and their subsequent transfer and assessment are often inadequate, and data that may be relevant are not generated.

WHY DOES THIS HAPPEN?

There are numerous reasons why the data and information base in the construction and real estate sector is often sub-optimal. The main reasons are listed below:

▶ *Multitude of disconnected owners* of data and information.

▶ The *data are lost*, mainly during handovers or transactions, due to the absence of a systematic approach to data capture, storage, analysis and organization.

▶ The *data are collected, but data storage is scattered across the organization*, often unbeknownst to interested parties, either because nobody is assigned to assume data ownership and / or access to the data is limited, e.g., due to it being recorded on paper.

▶ *Data that might be relevant are not generated* because data needs of third parties are either not known or ignored.

▶ *Data that may not be needed immediately*, but that may be useful at a later stage, are *not retained* due to the *absence of a storage facility* [3] (Hartenberger and Lorenz 2017).

▶ *The data are collected and stored by individual stakeholders but not passed on to other involved parties.* Data owners may feel discouraged to share information because of perceived and real legal issues concerning data sharing and managing the associated risks. However, data sharing may also be hindered by vested interests, particularly if the data hold commercial value.

▶ *Data protection and privacy laws* in some jurisdictions are currently preventing a more consistent and coherent approach to data and information capture.

▶ *Difficulties regarding data compatibility and consistency* are caused by a proliferation of metrics, benchmarks and measurement standards, etc.

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3 *In a 2016 global survey carried out by the GlobalABC Work Area on Building Measurement, Data and Information, stakeholders stated that the most prominent barrier was not a lack of data but a lack of data storage facilities. See Hartenberger and Lorenz 2017.*

WHAT ARE THE CONSEQUENCES?

Unsystematic collection and management of building information potentially leads to a whole set of inter-dependent consequences, such as:

▶ **Increased cost:** rebuilding and regenerating lost or inaccessible datasets several times over is expensive and time-consuming for data providers, owners and users.

▶ **Inefficiency:** this occurs at the project level, because processes for data and information sharing are often not aligned, as well as at the market level, where information availability is essential for fast and smooth transactions.

▶ **Lack of transparency:** discrepancies in information availability among stakeholders can benefit certain parties and penalize others, while contributing to the overall lack of transparency in the sector, which in turn may open doors to unethical and corrupt practices (Hartenberger and Lorenz 2018).

▶ **Heightened risk:** financial and environmental risks are not mitigated, as there is not enough information for assessment.

▶ **Missed opportunities:** lack of information hinders effective decision-making about building management, particularly about the types of measures to be included in building renovations as well as end-of-life options and management of building systems, products and materials, including their reuse, repair, remanufacturing, recycling, etc.

In summary, building information underpins all activities at every stage of the construction and real estate life cycle. However, the analysis of the current state of play shows that a more consistent and coherent approach to data capture and management is needed if the sector is to become more resource and climate friendly and to meet its Paris targets and commitments.

This is what the Building Passport will address.

2. WHAT IS A BUILDING PASSPORT?

The role of the Building Passport is essentially that of a repository or container, collector and facilitator of different types of building-related data and information. It records the data and information created by stakeholders and serves as a source of information for others.

Building Passport – a definition

A Building Passport (sometimes referred to as a Digital Building Logbook or (Electronic) Building File) is a whole life cycle repository of building information. It covers a building's administrative documentation as well as data regarding its plot and location, its technical and functional characteristics, and its environmental, social and financial performance.

In its fully digital realization, the Building Passport acts as a single point of input, access and visualization of all the information associated with a building. It is a living document, containing a mix of traceable static "as built" and continuous dynamic record-keeping of performance data and information.

Purpose and benefits

The Building Passport acts as a "one-stop-shop" data and information hub that supports building owners and their service providers in the use and management of the building by facilitating a recording, linking, transfer and sharing of building data and information among stakeholders across life cycle stages. This not only contributes to enhancing understanding of the design, make-up, management, operation and end-of-function of buildings, but also increases transparency and trust, improving policy and financial decision-making and realizing an optimum use of resources.

Beneficiaries

Benefiting stakeholders include, but are not limited to: building owners, built environment professionals, investors and financial institutions, service providers, certifiers, material suppliers and public authorities.

Data security

The Building Passport is a safe instrument that should enable building owners to retain control over data and who has access to it, recognizing that some of the data may need to be held confidentially. Data may be stored within the Building Passport and / or hosted in a different location to which the Building Passport is linked.

As **Fig. 4** shows, **throughout the life cycle** of buildings (i.e., production, construction, use, operation, modernization, continued use, dismantling), **documents, data and other types of information** (planning data, contracts, consumption data, logs, evaluation results) are continuously generated by **one specific group of stakeholders** (e.g., designers, facility managers) who will use some of these documents, data and other types of information.

During certain life cycle activities (e.g., transaction, valuation / appraisal) these documents, data and other types of information will be requested **by other stakeholders** (e.g., tenants, buyers, valuers / appraisers) who then typically adapt existing data to their needs, e.g., through translation and aggregation, but who also generate documents themselves.

The task of a Building Passport is to systematically hold data of all kinds and to support a (sometimes delayed) exchange of information. The Building Passport is thus an **information management tool** that can be used to improve transparency in real estate markets and to support decision-making.

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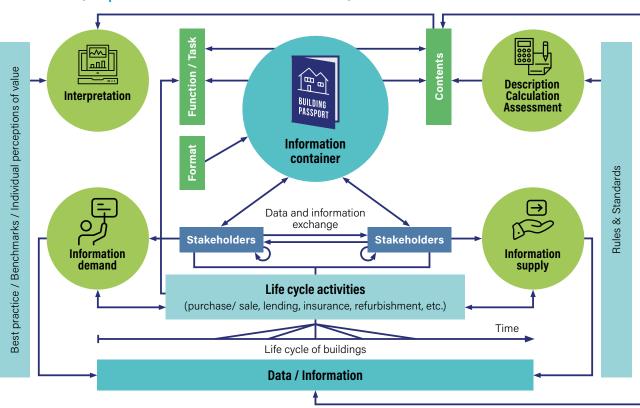
FIG. 4: **The Building Passport as an instrument for case-based information exchange between stakeholders (adapted from Lorenz and Lützkendorf 2008)**

The Building Passport supports all types of construction and real estate activities across the whole life cycle, as illustrated in **Fig. 5**.

It is important to note that, even though it will facilitate better benchmarking of building quality and performance, the Building Passport is **not** a market rating / label or benchmarking tool.

FIG. 5: **Sectoral activities supported by the Building Passport**
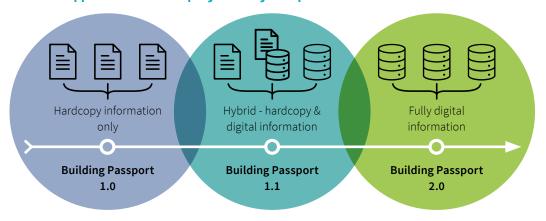
BUILDING PASSPORT FORMAT

Given the speed of technological advancement and potential future large-scale data availability, the roll-out of Building Passports needs to be dynamic and flexible.

Markets develop at different speeds. In addition, the availability of building-related data and the necessary digital infrastructure varies across countries. This is why in some markets, a transitional approach for developing Building Passports may initially be required, as illustrated in **Fig. 6**.

FIG. 6: **Transitional approach for developing Building Passports**

Hardcopy information only — **Building Passport 1.0**

Hybrid - hardcopy & digital information — **Building Passport 1.1**

Fully digital information — **Building Passport 2.0**

BUILDING PASSPORT TYPES

▶ **Building Passport 1.0 (non-digital / hardcopy)**

In markets where little or no information about buildings is available, and where it is not yet feasible to use a digital storage system, a hardcopy version of the Building Passport should be produced by conducting a survey and recording the essential data points with the help of a hardcopy template form. This systematic collection of building-related documents, such as building permits, maintenance and retrofit records, energy performance certificates, sustainability assessment results, etc., will provide the building owner with a low-cost paper record of the main information about the building in question and simplify the subsequent future step-by-step digitalization of the collected data.

▶ **Building Passport 1.1 (hybrid hardcopy / digital)**

On the way to full digitalization, static data (i.e., planning and design stage-related information) could initially remain in hardcopy format, sitting alongside more dynamic digital operational stage data.

▶ **Building Passport 2.0 (digital)**

In order to realize their full potential, Building Passports should be fully digitalized. The functionality and scope of the digital Building Passport version are flexible. It has the potential to eventually reflect the whole life cycle with a capacity for unlimited data access, input and output, and data export. The digital version is built on a more advanced set of types of information, facilitating easy report generation and potentially acting as an "alarm clock" for forthcoming maintenance work or being able to calculate certain values, e.g., carbon dioxide (CO_2) emissions by itself.

The digital version follows a modular concept, i.e., it is recommended to start off with a core set of data points and then to widen the list of data points, as and when more data in a specific data category become available. It is also capable of embracing future technological developments, such as widespread use of Building Information Modelling (BIM), the Internet of Things (IoT), digital twins and blockchain (Ganter and Lützkendorf 2019). A digital passport would also lend itself to data mining purposes and to tracking any changes over time, maintaining a historic record of interventions by the various stakeholders and previous owners.

Ultimately, with increasing digitisation of the construction and real estate sector, and in view of ongoing initiatives such as the European Commission's work on the Digital Building Logbook (European Commission 2020a), in order to reap the full benefits of the Building Passport (see section 3), the digital version offers a wider scope for the future.

LINK TO OTHER INITIATIVES FOCUSED ON BUILDING DATA AND INFORMATION

Most of the current passport-type projects and initiatives tend to have a one-dimensional (sustainability) focus, for example on energy efficiency, renovation or building materials.

By contrast, the Building Passport does not focus on one particular aspect of data or information but contains *all* building-related information, including data and information (either in an aggregated or disaggregated format) that is generated by other more narrowly focused specific data capture and management initiatives.

For example, data from Energy Performance Certificates, sustainability certification schemes, material and / or renovation and climate passports as well as bills of materials, could be either directly added to the Building Passport as a readable document or digitally tagged to the Building Passport, for example via a unique building identifier (see section 5).

Building Passports, BIM and digital twins

Building Passports, Building Information Modelling (BIM) and digital twin models are complementary and "share the burden" of the generation, capture, storage and management of building-related data. The level of detail provided by BIM may not be adequate for all stakeholders, e.g., for banks at the point of loan origination or risk underwriting. In contrast, a Building Passport with a user-friendly front-end platform could present the information in a way that is both relevant and useful (and manageable) for banks.

With a building digital twin essentially being an IoT-based Building Management System (BMS) used for real-time data collection and facility management, the Building Passport will be able to "feed" on data coming from existing BIM and digital twin models. A Building Passport can thus initially be created and updated independently of BIM and digital twins. In the medium term, data exchange should be supported via appropriate interfaces.

At present, BMS and digital twins are mainly associated with larger non-residential buildings, whereas Building Passports cover all building typologies.

3. BUILDING PASSPORT BENEFITS AND DRIVERS

OVERARCHING BENEFITS

The introduction of Building Passports can deliver a wide range of benefits in relation to fast-tracking progress in key policy areas and regarding the sectoral implementation of the United Nations Sustainable Development Goals (see selected examples in Annex A). Supported policy areas include: addressing the challenges of climate change, adopting circular economy principles, and fostering sustainable finance and investment.

The overarching benefits that a widespread introduction of the various versions of the Building Passport would deliver to all life cycle stakeholders are illustrated in Fig. 7.

FIG. 7: **Overarching benefits of Building Passports**

COST SAVINGS: information and data no longer lost and collected and recorded only once; no more duplication

IMPROVED EFFICIENCY: all information is accessible in one place; simplification of processes and reduction of administrative burden; digital version has unlimited information storage capability

GREATER TRANSPARENCY: accurate information is accessed more easily, providing third parties with information, needed for specific purpose; all stakeholder can access the same information; reduces the scope for corrupt practices

RISK MITIGATION: accurate information enables better risk assessment and mitigation

IMPROVED BASIS FOR DECISION-MAKING: accurate information allows decisions regarding the building to be made on the basis of verified evidence

OVERCOMING SECTORAL FRAGMENTATION: better alignment, creation of synergies of sectoral value chain through information sharing

FOSTERING OF INNOVATION: higher productivity levels and the development of new business models

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BENEFITS FOR INDIVIDUAL STAKEHOLDERS

Besides these overarching advantages, the Building Passport also offers a variety of stakeholder-specific benefits (Hartenberger *et al.* 2019), which vary according to stakeholders' life cycle activities.

The complex web of direct and indirect beneficiaries of these specific individual benefits is summarized in **Fig. 8**, which shows that there are typically multiple direct and indirect advantages for each stakeholder group, strengthening the business case for the introduction of Building Passports. A detailed overview of how the Building Passport supports specific life cycle activities can be found in **Table A.4** in **Annex A.**

FIG. 8: **Specific benefits linked to individual beneficiaries**

Individual and institutional stakeholders and public authorities in their role as: investor, client, buyer, owner, portfolio manager, vendor, owner-occupier, private landlord, housing company, real estate company, property fund, REIT, public authorities with building stock, companies with building stock

Service providers during design: design and construction, i.e. designer, engineer, consultant

Service provider during operation: facility managers, cleaning & maintenance service providers

Financial services providers: valuers/appraisers, risk assessors, financial institutions, insurance companies

Conveyancing service providers: lawyers and solicitors

Construction products industry

Waste and recycling industry

Public authorities in their role as building authority, building inspector, funding programme provider

Supplier of utility services: energy supplier, water supplier, waste water management, waste management

Construction services providers: constructors, de-constructors, construction companies, craftsmen

Developers

Real estate services providers: estate agents/ brokers

Tenants

Assessment providers: sustainability assessors, LCA specialists, sustainability certifiers

Public authorities in their role as lawmakers and monitoring bodies: local governments, national governments, statistical offices

Standardised, evidence-based and third-party validated transaction documents

Improved data-driven building statistics

Data-driven property evaluation/ risk assessment

Standardised, evidence-based and third-party validated sustainability ratings and reports

Standardised, evidence- and data- based refurbishment plans

Data-based facilitation of improved material flows, recycling and reuse

Data-based service and maintenance plans

ADDITIONAL BENEFITS THROUGH POTENTIAL FUTURE FUNCTIONALITIES

Depending on the respective Building Passport format, a variety of future Building Passport functionalities will result in additional benefits.

Assisting the facilitation of:

▶ Easier and more accurate life cycle costing.

▶ Estimation of the environmental impacts of the building over its lifetime (including deconstruction and material re-use).

▶ Targeted campaigns such as best practices in energy efficiency through social networking.

Creating potential for:

▶ Generation of alerts and updates on the performance / condition of the building, renovation roadmaps, PDF reports and dataset exports in common formats (e.g., Excel files).

▶ Monitoring of resource consumption (energy, water, gas, etc.) when the Building Passport is linked to meters.

▶ Authorizations to third-party stakeholders (e.g., solicitors, agents, public authorities, mortgage lending institutions, insurers, etc.) to use and / or update the logbook.

▶ Tracking of information changes through provision of a chronology function – for any information visible in the Passport, it should always be possible to track changes and authors of those changes, i.e., who changed X to Y, and when (potentially with the help of blockchain technology).

▶ Support of portfolio analysis and management.

And, providing the basis for:

▶ Valuation, financial due-diligence and risk management.

▶ Benchmarking of assets with similar buildings.

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STAKEHOLDER VOICES IN SUPPORT OF BUILDING PASSPORTS

"Utilizing Building Passports would help King County to systematically and cost effectively manage our government-owned and -maintained properties while more accurately tracking the embodied carbon and operations-related greenhouse gas impacts."

Local authority

"Having an accurate picture of the building stock is the starting point for the design and proper implementation of any building-related policy. **The Building Passport could become an extremely useful tool to support data-driven and actionable analysis, innovative policy** *and market solutions. It can also support the efforts to translate building data into proposals for better legislation and decarbonization pathways for the built environment."*

Think tank

"A Building Passport helps to take stock and share real performance over time to build up statistical data on materials and environmental performance."

Policymaker

"A Building Passport will help with ensuring compliance with building regulation and standards as data will be available for holding stakeholders accountable. In addition, information accessible to key institutional markets will help drive the demand for energy-efficient buildings."

Policymaker

"The Building Passport would help my organization to better advise occupiers and investors by providing standardized information to aid comparison and benchmarking."

Real estate advisory services provider

"A Building Passport is a crucial tool for embedding long-term efficiency and resilience throughout a building's life. As key stakeholders along the value chain carefully evaluate a multitude of factors to inform decisions during early design stages of a building, by hosting complex data in a central, digital platform, a Building Passport has the ability to extend this consistent evaluation and review beyond a built environment's construction/renovation completion date. Retaining key building information in a systematic manner would not only enable efficient management and effective maintenance of that building throughout its life, but also provide an opportunity to enhance its quality over time."

Interdisciplinary design practitioner

"Building Passports will help sustainability certifiers and certification bodies such as the DGNB to obtain building-level data crucial for certification much more easily. At the same time, Building Passports also provide a much-needed central repository for relevant data and information generated by sustainability certifications."

Sustainable buildings certifier

"The Building Passport would help Madaster because it facilitates transparency and efficiency in data management in the real estate and construction sector, which is necessary to foster circularity and reuse of materials in the built environment. Madaster is a global online register for materials and products applied in the built environment. Our data platform automatically generates building passports and provides financial and environmental valuations of construction objects registered. Madaster is focused on static data related to materials and products. The linked data set-up of Madaster facilitates enrichment data with, e.g., LCA, financial, CO_2 and certification information. With the adoption of the Building Passport concept, circularity and reuse of materials in the built environment can be realized, leading to a strong reduction of waste and carbon emissions. The trigger for this change is transparency in the data of products and materials used in buildings. The data can be used to calculate the financial and environmental impact of buildings at the material and product level, and this information can be leveraged in, e.g., marketplaces for reused products or carbon emission rights. Although Madaster is not a marketplace it provides its users the possibility to send their data to such platforms."

Online real estate data platform

"At the country level, the Building Passport will facilitate compliance with international climate change commitments and advance the improvement of building standards. At the local government level, Building Passports will provide information necessary for implementing cost-effective climate change mitigation and adaptation policies, enable local authorities to learn more about the overall building stock and help manage their own portfolios of public buildings. Having more and better information will lead to better control of standards and building quality, help improve the efficiency of institutions but also support research and sectoral innovation. From a private sector perspective, the Building Passport will support certification and appraisal and optimize project development. In addition, it would push material suppliers towards continuously improving the quality of their products and product innovation. Finally, construction companies can and will use this instrument to send out signals of evidenced building quality to the market."

Sustainable construction expert

4. HOW DO BUILDING PASSPORTS WORK IN PRACTICE?

The Building Passport is not intended to be a self-contained database, but rather is a flexible container where information can be recorded and accessed in different ways by different stakeholders.

Users should be able to manually input information and upload documents as well as import data from external sources (e.g., a spreadsheet, or an Energy Performance Certificate, etc.) and establish links with external databases. Such links would enable automatic updates of the respective data within the Building Passport and allow specific data from the Building Passport to be fed into an external database.

For information to be imported to and exported from the Passport, appropriate data exchange formats are required.

DATA AND INFORMATION CATEGORIES

Rather than being limited to specific types of information, such as energy- or materials-related issues, the Building Passport has the potential to cover a wide range of different types of building-related information. From a practical perspective, it can also help with managing carbon performance by drawing up maintenance plans and compiling bills of materials.

The data format can be numerical or descriptive and can also consist of linked documents.

Some building data and information will be of a static nature and some will be dynamic, i.e., regularly updated and amended[4] (Hovorka, Lippo and Virta 2012).

- ► **Examples of static data:** administrative documents, spatial planning and design documents, bills of material, etc.
- ► **Examples of dynamic data:** data from operation and use, such as maintenance records, energy use, etc.

Some data will be collected in real time, and other data and information will need to be tagged from external sources.

Even though not all data may be available right from the start, and not all of it may be of the same relevance to every individual stakeholder, information requirements should be standardized as much as possible for all Building Passports. Depending on the stakeholder, the level of granularity of information needed may also differ.

Documents, data and information should be assigned to the categories in the Building Passport in such a way that they can be easily found if there is a need for the information. In principle, organizing them according to thematic groups is just as feasible as organizing them according to life cycle phases and life cycle activities.

In addition to this organization according to thematic groups or life cycle activities, there exist other aspects related to the data model structure. These include, for example "primary data" (input data for calculation) and "secondary data" (results of calculations)[5]. Not all of these data might actually need to be stored in the Building Passport.

The approach taken in **Fig. 9** and in **Table 1** is based on organizing the Building Passport information in thematic groups. It should be noted that individual data points in these data categories may be more relevant for certain geographic locations and markets than others.

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4 Hovorka, Lippo and Virta (2012) distinguish between the so-called building "birth certificate" (static data) and the building "health certificate" (dynamic data).

5 For more information, see ALDREN Renovation Passport: https://adlren.eu.

FIG. 9: **Options for Building Passport data categories**

Given the intended flexible, modular nature of the Building Passport, data and information categories can be added and updated over time, and would be customizable by the user in a given thematic information location. With an advanced Building Passport 2.0 cloud-based format, the same data and information may appear in different thematic information locations.

The amount of information needed and covered by individual Building Passports depends on the building typology. More complex buildings require more complex Building Passports and subsequently more data points than a single-family home

A tool for capturing and managing whole life data and information in construction and real estate

TABLE 1: **Building Passport content and structure – based on selected examples**

Data and information / document categories	Use / Operation / Management	Maintenance works / Replacement of building components	Transactions	Lending, financing, insurance	Refurbishments, conversion – and dismantling planning
A1 Identification of plot and plot-related characteristics (including tenure)			X	X	
B1 Identification of building			X	X	
B2 Design documents		X			X
B3 Contracts (including any responsible procurement provisions, documentation related to workers' conditions and equity)			X		
B4 Certificates (e.g., building report / certificate / documentation related to processes of community engagement prior to construction)			X	X	
B5 Energy Performance Certificate / sustainability label			X	X	
C1 Material inventory (including, where obtainable, documentation of source, e.g., environmental product declaration and / or assessment of risk of labour abuses)		X	X	X	
D1 Surfaces, cubatures					
D2 Building description			X	X	X
D3 Technical features and characteristics		X	X	X	X
D4 Dismantling and recycling strategy (including workers' safety)			X		X
E1 Use and operation data / consumption	X			X	
E2 Maintenance manuals	X	X			
E3 Proof of maintenance (including contracts / documentation in regarding working conditions – also for sub-contractors)			X	X	
F1 Environmental performance and carbon footprint			X	X	
F2 Impact on occupant health (e.g., indoor air quality, access to natural daylight) and local environment			X	X	
F3 Results of user satisfaction surveys	X				
F4 Operational cost	X	X			

D3 Technical features and characteristics (selection):

- Structural stability
- Fire safety
- Noise protection and acoustics
- Thermal and damp protection
- Resilience with regard to climate change impact
- Adaptability / flexibility of use
- Accessibility
- Cleaning and ease of maintenance

DATA SOURCES

Data and information input into the Building Passport is taking place at every phase of the building life cycle, throughout design and construction (or retrofit), use and operation, as well as during transaction processes (see **Fig. 10**).

FIG. 10: **Building Passport data and information input sources**

Tools and schemes that could serve as potential sources of existing data, populating the Building Passport, include:

- Design results
- Energy Performance Certificates
- Sustainability certifications
- Building Information Modelling
- Bill of materials
- Life cycle assessment (LCA) results
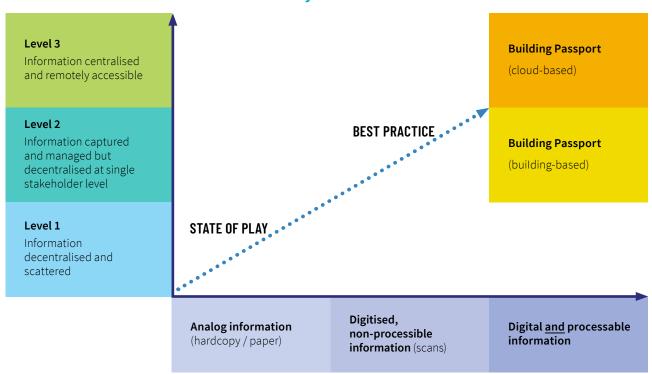
In cases where there are data gaps, synthetic or statistical data can also be used for modelling the building stock.

DATA AND INFORMATION STORAGE OPTIONS

Just as there initially will be different Building Passport types, the level of sophistication of storage options may also vary, as **Fig. 11** illustrates.

FIG. 11: **Different levels of centralisation of building data and information**

STORAGE OPTION – LEVEL 1	STORAGE OPTION – LEVEL 2	STORAGE OPTION – LEVEL 3
This is likely the current state of play for the majority of stakeholders trying to source and manage internally decentralised scattered analog (hardcopy) information.	One tier up, information is adequately captured and managed internally but still decentralised, i.e., merely at a single-building level without remote accessibility. In this case, a corresponding Building Passport is building based. The information is analog, digitised (i.e., scanned, CD-ROM), digital or a hybrid mix of all of these formats.	One tier up, information is adequately captured and managed internally but still decentralised, i.e., merely at a single-building level without remote accessibility. In this case, a corresponding Building Passport is building based. The information is analog, digitised (i.e., scanned, CD-ROM), digital or a hybrid mix of all of these formats.

DATA INPUT

The Building Passport captures all data and information that is being generated at the various stages of the life cycle. It works on the principle that there are several potential sources to fill one data field. Taking the example of energy performance, the information source could be an Energy Performance Certificate, data on energy consumption or even information about insulation levels of external walls.

Regarding who will input the data into the Building Passport, this will depend on the building typology. For example, with a single-family home, one part of the Building Passport data and information will usually be provided by public authorities (e.g., planning documents, information about the location).
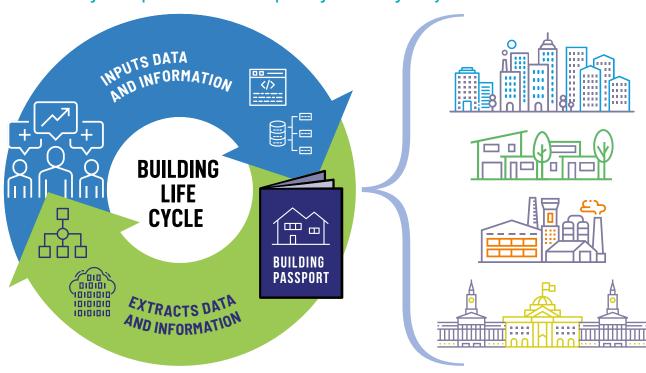
The scope of inputting will be dependent on whether it is a new construction or an existing building. With a newly constructed building some of the information will be inputted by the architect or developer. Afterwards, it will be mainly the building owner who will "feed" the passport with data and information over time. In the case of existing buildings, it may mainly be the building owner who populates the passport.

The circle of stakeholders inputting data and information widens according to building size, use and complexity. With larger commercial buildings, it is typically the facility manager who acts as the port of call for most of the data and information input.

Data input and data extraction by stakeholders are not two separate activities. Across the life cycle, stakeholders may extract Building Passport data and information. On the basis of this data and information, they may then generate new data and information that they in turn input into the Passport (see **Fig. 12**). For example, a valuer working for a bank extracts data on the technical characteristics of the building and returns a valuation report containing information on the financial performance of the building.

FIG. 12: **Building data input and extraction loops along the building life cycle**

A tool for capturing and managing whole life data and information in construction and real estate

DATA RECORDING
AND DATA EXCHANGE

With a fully developed Building Passport 2.0 format, it would be possible to capture building data and information on-site with the help of an electronic device, e.g., smart phone, tablet, etc.

Given its emphasis on objective and robust data, a Building Passport 2.0 will be able to support the shift away from the traditional on-site interpretation of visible / objective information towards on-site data recording with the interpretation being handled centrally, supported by machine learning and similar methods. This will reduce personal bias and the need for on-site expertise. For the collection of objective data no expert is needed, while for interpretation of such information a certain level of expertise is necessary.

The need for more robust data, as well as the shift away from on-site data interpretation, in combination with the diffusion of digital technologies will result in an increase in swarm data collection solutions. These solutions range from undirected data that can be mined and organized (creating city models from pictures taken) to more direct data collection via specialized devices and applications that allow non-experts to generate an objective data point. These data sets can then be cross-linked with data from sources such as 3-D city models, LIDAR data, meter data, etc. where applicable.

As data sources and information input into Building Passports will be diverse, the need for aligned formats and data standards will naturally increase.

While the Building Passport itself is not an effort of international norms and standardization, different platforms will need to exchange data at some point in time, and respective data protocols will emerge naturally. This will range from the very obvious (an aligned definition of net floor area) to the more complex (energy demand). With high likelihood the agreed definitions will be those that can be generated most robustly.

However, in order to be implemented effectively, the digital Building Passport 2.0 needs to be supported by a precise way to associate each building with its own Building Passport and the data and information therein. This is why every building needs to be given an identifier by national or local cadastres / registries. In this way data and information can then be linked to the Building Passport through this national building ID. Such a system is commonly referred to as a *unique building identifier* or *unique property reference number* (Pacific Northwest National Laboratory n.d.).

For this, a clear methodology for defining the perimeter of what constitutes a "building" is needed. In the case of detached buildings used for a single purpose (such as a single-family house), the building constitutes a discrete unit that can be associated with a single Building Passport. Conversely, when buildings contain more than one unit (e.g., a block of flats), each unit is associated with a distinct Building Passport, whereby certain shared characteristics such as information regarding external walls, building age or type of construction may form part of all individual passports. Thus, a system is needed to precisely identify building units. Since addresses are not always precise and their format varies greatly across the world, a building unit ID based on an alphanumerical code represents a better system.

As **Fig. 13** shows, by using a unique building identifier, relevant data and information can be linked to the respective building by third-party stakeholders. By the same token, the building owner can choose to grant access to either the Building Passport in its entirety or certain parts if deemed necessary for specific purposes.

FIG. 13: **Building data capture and granting of third-party access**

DATA QUALITY AND DATA VALIDATION

An important consideration is an assessment of the likely quality and rigor of the data, i.e., its accuracy, whether it is based on estimates, whether it is up to date or outdated and whether there is any record or proof of validation. This verification of data is paramount for the Building Passport to be relied on by all parties: whoever includes data needs to verify it and be held accountable for its accuracy.

DATA OWNERSHIP, DATA SHARING AND DATA PROTECTION

The Building Passport is a safe instrument that should enable building owners to retain control over data and who has access to it, recognizing that some of these data may need to be held confidentially. Data may be stored within the Building Passport and / or hosted in a different location to which the Building Passport is linked.

The Building Passport and all the data and information it contains about the building belongs to the respective building owner, who can decide to grant potential data access to third parties, such as public authorities, financing institutions, estate agents, solicitors, valuers, contractors, etc. In this way, the building owner has control over the level of access to potentially sensitive information, such as personal data or commercial data. But this also means that it is the building owner's responsibility to maintain and update the Passport

In the case of a property trust or institutional owner, the Building Passport data would be maintained by the fund or asset owner and kept up to date by the asset or facility manager.

In a non-residential landlord-tenant situation, Building Passport data sharing modalities regarding non-confidential user / tenant performance data could be integrated into so-called green leases.

The ownership of the overall digital portal or infrastructure can lie with public authorities or third-party service providers, e.g., data warehouses. Real estate portfolios can be directly linked to these portals.

5. THE MAKING OF BUILDING PASSPORTS

TESTING THE BUILDING PASSPORT

During the preparatory stages of the development of these guidelines, the Task Force tested a draft list of data categories on two public buildings (a kindergarten and a multi-family apartment block) in the city of Zhytomyr in Ukraine, to check the feasibility and ease of data sourcing in a real-life context.

Most of the requested information regarding physical characteristics of the tested buildings was available. However, it proved harder to source data regarding technical parameters in relation to building systems and environmental and financial information.

OVERCOMING POTENTIAL (REAL AND PERCEIVED) BARRIERS
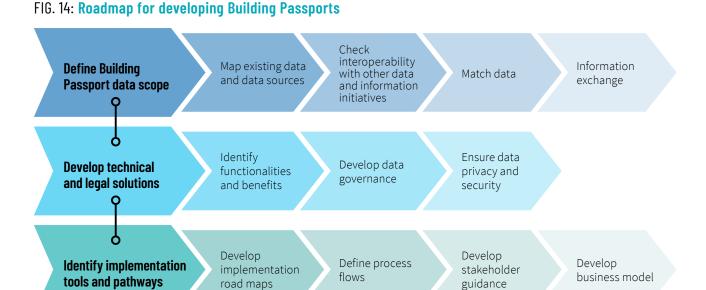
Although the benefits of the Building Passport are unarguably manifold, a number of considerations should be kept in mind to make the introduction of Building Passports a success.

The recommendations in this section are designed to overcome potential (real and perceived) barriers, which include:

► **Potential costs** caused by additional administrative and software requirements and the need for third-party services.

► **Potential for faulty data** (and associated legal liability) due to data in the Building Passport not being accurate / validated / updated.

► **Potential risks around privacy and data protection** regarding personal and commercial sensitivity of data as well as issues related to cybersecurity.

► **Potential stakeholder perception of additional work** without a benefit for themselves if there is no incentive to keep and manage the data.

► **Potential unwillingness** of data providers (e.g., the seller) to guarantee for data accuracy (Saull and Baum 2019).

RECOMMENDATIONS FOR IMPLEMENTATION

For successful implementation, **Fig. 14** provides a roadmap for developing Building Passports.

FIG. 14: **Roadmap for developing Building Passports**

Important aspects to consider are:

▶ *MODULARITY:*

Take an agile, step-by-step approach, making it a dynamic tool with regular launches of additional features. Start with taking stock and capturing essential existing and easily accessible data, even if this is initially in paper or digitized format only. Add additional information as and when it becomes available, and switch to fully digital records whenever feasible. Ultimately, aim for a fully realized, digital Building Passport, covering the entire life cycle and a wide range of benefits / stakeholder groups.

▶ *PRIORITIZATION:*

Data categories: Prioritize data categories needed for different building typologies. Small residential units do not require the same level of sophistication and detail as large commercial units.

This applies equally to informal settlements, where the starting point of information collection would be to document the plot, the type of tenure, materials used and material sources, which can vary greatly locally (Celentano, Salcedo Villanueva and Habert 2020), as well as the availability of basic amenities, such as access to clean water. Here, as far as the logistics of collecting the information are concerned, documentation could be done via the already existing – and often very innovative – digital solutions in emerging markets.

Information and communications technology (ICT) solutions like the Building Passport could also provide the opportunity for citizen involvement in the design, monitoring and evaluation of slum upgrading projects.

Building types: In the first instance, focus on buildings that have exemplary character For example, public authorities may wish to start with public buildings or buildings that are frequented by a significant number of people.

Focusing on new construction could be another option, because it can be expected that Building Passports of new buildings will be created during construction and populated with data coming from architects, engineers, constructors and surveyors who have worked on the projects. Thus there is potential for several reliable datasets to be included from the beginning of the building's life cycle.

Conversely, most passports of existing buildings can be realistically expected to be created during a property transaction or a renovation (i.e., somewhere in the middle of the building life cycle), and can initially be populated with a limited set of data, likely related to the transaction or the renovation.

Therefore, the approach to each of these scenarios depends on the activity in question (see **Table 2**).

TABLE 2: "Building" the Building Passport – different approaches and starting points

Activity	Format	Approach
New construction	Digital	All data and information to be logged from project conception through to design and construction and handover; to be extended and maintained over the life time of the building
Renovation	Hybrid	Start with logging existing available building data; to be extended by detailed diagnosis during the work and further supplemented after the renovation
Operation	Hybrid	Start with logging existing available (visible and accessible) data and information and capture operational data

▶ *LEGAL PROVISIONS:*

Create clear legal frameworks for data protection, privacy and intellectual property rights rules.

▶ *DEFINITION OF SCOPE:*

Clearly determine the nature of the information that the Building Passport should cover. However, it is important to bear in mind that different stakeholders need different data at different times. It is therefore advisable to take a "long list" approach, offering a wide range of data and information, thus avoiding a proliferation of passports for individual data and information categories and needs.

▶ *STANDARDIZED APPROACH:*

Develop a supporting standard for data collection and data management based on local and national standards (e.g., in relation to calculation of net floor area). Wherever possible and relevant, as for example regarding the assessment of sustainability aspects, references to existing standards, shared definitions or frontrunner examples should be provided at least as default options.

▶ *COST:*

When developing and rolling out Building Passports, account for the cost of future operation of the associated infrastructure and foresee a long-term plan for maintenance and updates of the platform and data validation.

▶ *DATA VALIDATION:*

Include processes and protocols for validating data quality and accuracy; start with data from data sources where trustworthiness is ensured by data validation and certification processes, e.g., public databases.

▶ *INTERACTIVE INFRASTRUCTURE:*

Ensure easy and free access to Building Passport portals, for example with e-ID or a smartphone with which users can show and validate their identity and confirm transactions. Include attractive interactive features such as applications for energy grants and the possibility to easily upload their own documents, etc.

▶ *COLLABORATION:*

Create win-win partnerships with the various owners of data (e.g., government departments / agencies on energy, housing, environment) and split costs.

▶ *COMMUNICATION:*

Consumer acceptance is crucial to any successful roll-out. Therefore, engage and educate end users throughout the Building Passport development phase. Once the tool is live, focus on individual user needs and technical abilities and communicate immediate benefits for users to ensure buy-in. Identify those stakeholders that can contribute or benefit from participating in that process, not only considering the data that they can provide and / or retrieve, but also how they can assist the promotion of the Building Passport concept.

▶ *ADMINISTRATIVE:*

Ensure minimal administrative burden and user-friendliness by providing adequate guidance for multiple parties on what needs to be provided. As Building Passports require "maintenance" by the owner in order to keep the record up to date, fully explain owners' involvement in the maintenance of the data throughout ownership.

▶ *ALIGNMENT AND CONSISTENCY:*

Ensure alignment and compatibility with other initiatives, tools (such as Energy Performance Certificates), roadmaps and industry standards – the latter should be integrated rather than being replaced.

6. SUMMARY AND NEXT STEPS

A building is a valuable asset, and as such it is common sense to keep all building-related information and documentation in one secure place. Against the background of increasing demand for this information across the construction and real estate value chain, it is becoming more important than ever to have ready access to reliable building information.

With the introduction of widescale reporting requirements, demand for more robust building documentation is set to further rise. In addition, there is now a growing trend towards greater digitization in construction and real estate and in the use of IT-based solutions for managing single and multiple assets.

Therefore, tools are needed to improve the current, often inconsistent, approach taken by sector participants with regard to the capture and management of building-related data. This will assist the sector in meeting not only market demand but also climate targets and other policy objectives, all of which are heavily dependent on the availability of data.

Addressing global challenges such as climate change and resource scarcity, which over the past years have led to a shift in value perceptions and calls for greater sectoral transparency, need to be supported by available tools. Stakeholders increasingly want to assume more responsibility for the environment and society and to align their production and consumption patterns with sustainable development principles.
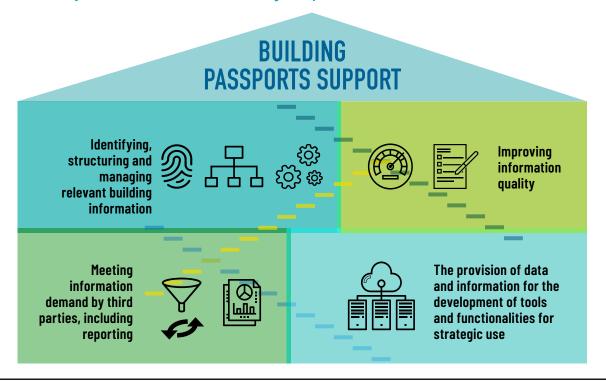
Therefore, for developed and developing markets alike, the existence of measurable, reportable and verifiable data regarding both traditional (technical and functional quality) and new (environmental performance) aspects is crucial for investment and finance decision-making processes *and* for setting baselines and targets for climate strategies.

The Building Passport is the appropriate instrument for this.

Building Passports, Building Files or Building Logbooks not only can help address the overarching building data and information-related aspects summarized in **Fig. 15**; they also offer a wide range of additional benefits and functionalities for individual stakeholders and linkages with other sectoral tools and global initiatives. They can help with optimizing real estate management and facilitating smoother transactions, and they underpin all decision-making processes.

While Building Passports are by definition always linked to individual buildings, they are also instrumental for portfolio management, allowing building quality and performance comparisons across portfolios.

FIG. 15: **Summary of core functions of the Building Passport**

NEXT STEPS

These guidelines from the Global Alliance of Buildings and Construction represent the first step of the Global ABC's work on Building Passports. They are meant to raise awareness about the rationale for Building Passports and to stimulate debate around the importance of data within the built environment community. The guidelines are designed to support stakeholders in developing Building Passports and managing building-related data and information more generally.

As a next step, the GlobalABC will be working with interested parties – both governments and private sector stakeholders – in designing, adopting and operating Building Passports. The GlobalABC is encouraging its members to use these guidelines and to engage in piloting the development and application of Building Passports.

STAKEHOLDER ENDORSEMENTS

"The GlobalABC Building Passport serves as a comprehensive data and information repository which is crucial across the whole life cycle of construction and real estate. Notable for disjointed and isolated information storage, the built environment requires such solutions to improve decision-making and promote trust."

Moses Itanola, Executive Director, BIM Africa, Nigeria

"Working with the Global ABC Building Passport Team has been an interesting and very useful exercise. The local and regional considerations across the globe have helped to crystallize coherent thought into building practice and all its implications to form a comprehensive volume of passport guidelines. The development of the Building Passport standards and the collaboration with the GlobalABC has been insightful in enhancing the current version of the Property Logbook at The National Deeds Depository. The success and blueprint of the GlobalABC members working together on the Building Passport has also been invaluable in helping establish the Residential Logbook Association (RLBA) in the UK, which has been set up as a group of Property Logbook providers, to agree on minimum required data fields and format standards across all member firms with the aim of strengthening the accuracy and availability of property information and helping to improve the home buying and selling process."

Simon Lumb, *Director*, **The National Deeds Depository, United Kingdom**

"With rising national and global commitment on carbon neutrality, carbon emissions reduction in the building and construction industry calls for technology transformation using building data. The Building Passport guidelines captured key frameworks on how the database building information can benefit various stakeholders involved in the industry. We are developing a discussion with the researchers and local government about how the local building and construction industry data can be structured for carbon emissions, reduction and sustainable development based on the guidelines. I expect that the GlobalABC's Building Passport guidelines will be an important stepping stone for our future building data management system establishment."

Doyoon Kim, Senior Sustainability Expert, Qatar Foundation, Qatar

"The Building Passport has been long overdue for the construction sector. While there have been scattered efforts to connect databases to buildings, developing a comprehensive set of information that can stay with a building has been a challenge. The Building Passport is an effective instrument to enable wide-ranging data collection and the recording, managing and sharing with relevant parties. Comparing buildings to cars, building data is far less managed or shared than data from the automotive industry, despite buildings having much higher value. My hope is that the Building Passport is the first step in the development of a global initiative that will continue to evolve to benefit future growth in the building sector and support more efficient resource management."

Ommid Saberi, Green Building Specialist – IFC, Washington, D.C., USA

"Fragmented, incomplete and inconsistent data are a global challenge to the green building industry. The Building Passport represents an important effort to address these foundational issues and provide a practical framework to facilitate the exchange of information across the life cycle of the built environment and among our numerous stakeholders. We appreciated the opportunity to engage with the authors during the development of the guidelines and we support its emphasis on transparency and interoperability. We are looking forward to leveraging the Building Passport."

Chris Pyke, Ph.D., SVP, Arc Skoru, part of the GBCI family of organizations, Washington, D.C., USA

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8. GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

BIM — **B**uilding **I**nformation **M**odelling is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of a building. Building information models are computer files that can be extracted, exchanged or networked to support decision-making regarding buildings.

Blockchain — A **blockchain** is a growing list of records, called blocks, that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp and transaction data. A blockchain is resistant to modification of its data, because once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks. Transactions between two parties can be recorded in an efficient and in a verifiable, secure and permanent fashion. In terms of the built environment, blockchain could be transformational through building a new foundation for machines and humans to interact and transact with each other.

BMS — A **B**uilding **M**anagement **S**ystem is a computer-based system installed in buildings that controls and monitors the building's mechanical and electrical equipment during operation, including ventilation, lighting, power systems, fire systems and security systems.

Digital twin — In the context of buildings, a **digital twin** is a digital replica of an existing building, the so-called physical twin. Digital twins integrate the Internet of Things, artificial intelligence, machine learning and software analytics with spatial network graphs to create a living digital simulation model of a built asset. This simulation model updates and changes every time its physical counterpart changes.

ESG — **E**nvironmental, **S**ocial and **G**overnance refers to three criteria in measuring the sustainability and societal impact of an investment.

Green lease — A **green lease** is a commercial lease that includes specific clauses that govern respective tenant and landlord responsibilities in relation to the sustainable operation and use of an asset, such as energy efficiency measures and waste and water management.

LCA — **L**ife **C**ycle **A**ssessment, sometimes referred to as **L**ife **C**ycle **A**nalysis, is a methodology for assessing the environmental impacts associated with all the stages of a product's or service's life cycle.
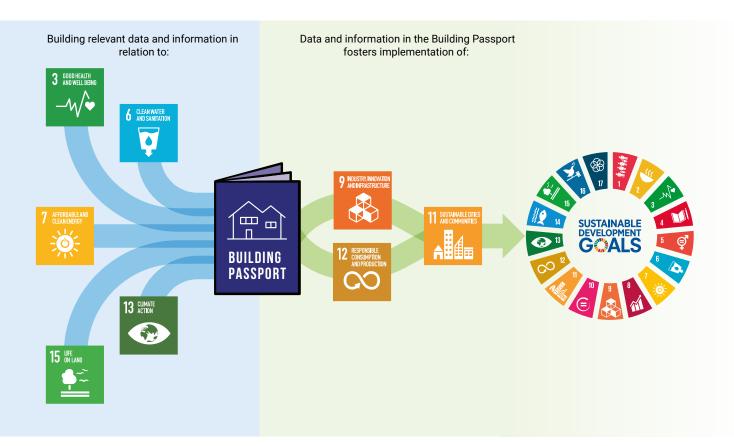
9. ANNEXES

ANNEX A — SUPPORT OF SDG IMPLEMENTATION, GLOBALABC ROADMAPS AND SPECIFIC STAKEHOLDER INTERESTS

FOSTERING SDG IMPLEMENTATION

Building-related data and information are indispensable for successfully implementing and reporting against the United Nations Sustainable Development Goals (SDGs) (United Nations n.d.). A better understanding of building performance through optimized availability of and access to relevant building information will make it easier to articulate the business case for engaging with the SDGs and with wider sustainability aspects that they may not typically have considered during the design, construction and use of buildings, as explained in the graphic below.

The following five examples show how Building Passports can help deliver on key Sustainable Development Goals.

EXAMPLE 1:

Link to SDG 13 – Addressing climate change mitigation and adaptation

Thomas Lützkendorf, Karlsruhe Institute of Technology

Building Passports will contain information that supports an assessment of life cycle greenhouse gas emissions and their sources, the type and scope of possible mitigation measures as well as the degree of resilience to the adverse consequences of climate change and the possibilities for climate adaptation.

CLIMATE CHANGE MITIGATION

To evaluate the impacts on the global climate, the predicted operational energy demand and the measured operational energy consumption must be converted into greenhouse gas emissions using emission factors (see **Table A.1**).

Embodied greenhouse gas emissions can be indicated in the result of a life cycle assessment. A concept for reducing emissions can also be attached, e.g., a refurbishment plan.

TABLE A.1: **Building Passport climate mitigation data and information (examples only)**

Building and energy supply specific characteristic(s) covered	Related aspects
Description of the building and its life cycle, bill of materials, results of life cycle assessment	Embodied greenhouse gas emissions
Energy demand / consumption, energy carriers used, emission factors	Operational greenhouse gas emissions per year
Type and extent of use of refrigerants in heating, ventilation and cooling (HVAC) systems	Documentation of the refrigerants used

CLIMATE CHANGE ADAPTATION

Adaptation to emerging adverse consequences of climate change is increasingly becoming an important aspect (GlobalABC 2021). With its technical characteristics, any building must respond to specific requirements and to the local context.

Therefore, within the Building Passport, technical characteristics have to be linked to the characteristics of the local environment, e.g., propensity to flooding, exposure to high winds, etc. (see **Table A.2**). A concept for potential future climate adaptation measures can also be attached.

TABLE A.2: **Building Passport climate adaptation data and information (examples only)**

Location, plot and building specific characteristic(s) covered	Related aspects
Local consequences of climate change (current status and trend)	Danger of sub-soil changes, floods, storms, hail, heat waves, among other things
Resilience of the building to local consequences of climate change	Load-bearing capacity, load-bearing reserves and other technical characteristics
Thermal comfort	Shading possibilities, presence of air conditioning systems

EXAMPLE 2:

Link to SDG12 – Embedding greater circularity and whole life cycle thinking

(1) Ilektra Papadaki, Josefina Lindblom and Raquel Teixeira Dos Santos, European Commission;

(2) Pablo van den Bosch, Madaster

(1) At the EU level, the potential role of Digital Building Logbooks as single repositories and gateways to all building-related data, and therefore enablers of circularity for the construction sector and the built environment, is highlighted in the new Circular Economy Action Plan (European Commission 2020b) and the Renovation Wave Strategy (European Commission 2020c).

Collecting, maintaining, organizing and making information available through Building Passports / Building Logbooks can improve the overall transparency, trust and collaboration among different stakeholders and support sustainable decision-making when it comes to interventions (e.g., renovation, refurbishment or deconstruction) in buildings. Additionally, information on construction techniques, materials, systems and equipment used (type, quantity / amount, origin, carbon footprint, recycled content), their lifespan, and dismantling, reusing and recycling possibilities can be collected, organized and updated in a systematic way. As a result, durability, adaptability and circularity principles can be promoted throughout the building's life cycle.

Additionally, Building Passports / Logbooks can be fed with data and aggregate the results coming from assessment tools and frameworks[6] (European Commission 2020a). An important example is Level(s), the recently developed EU framework for sustainable buildings, which has a set of core indicators related to life cycle performance, circularity, health and comfort, resilience to climate change and life cycle cost and value (European Commission n.d.).

(2) With the adoption of Building Passports, circularity and reuse of materials in the built environment can be achieved, leading to a strong reduction of waste and carbon emissions. The trigger for this change is transparency in the data of products and materials used in buildings. The data can be used to calculate the financial and environmental impact of buildings at the material and product level, and this information can be leveraged in, e.g., marketplaces for reused products or carbon emission rights / allowances.

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6   *The extended EU definition of digital building logbooks provides further information on their potential role in circular economy; see European Commission 2020a.*

EXAMPLE 3:

Link to SDG 9 – Stimulating sustainable finance and investment

Matthew Ulterino, UNEP FI and James Kavanagh, RICS

Lenders, investors and other financial intermediaries, including real estate developers and operators, benefit from standardized and comparable data to allow them to make assessments on risks and returns. Accessible and reliable data can inform decision-making and speed transactions. This applies to all projects from the smallest to the largest and / or all financial institutions, from the most basic to the most sophisticated. Building Passports can help reduce transaction friction and, because certain benefits and features can be easily identified and quantified, reward those that integrate efficiency and circularity in building design and operation.

Real estate is an enormous global generator and store of wealth. In developing economies and emerging markets where property markets are generally shallow, and where land and property record keeping is often lacking formal and well-structured processes, Building Passports can be a vehicle through which sectoral innovation emerges. Currently, the lack of registered and published land and property records and data has several negative effects, such as weak tenure security and the inability to attribute value and borrow and capitalize on assets (UN Habitat Global Land Tool Network forthcoming). The development of Building Passports can ameliorate many of these existing barriers and yield several benefits. These include taxation and regulation, environmental improvement, wealth creation, and better functioning land, property and financing markets.

Through increased digitization and more accurate and accessible records, stakeholders in the real estate market can more readily build value from their assets and transact to realize financial gain. Creating more depth and liquidity in markets can also help reduce financing costs, which can be a major barrier in less mature markets such that property ownership is all but impossible to those on low incomes or of limited means.

Building Passports can also provide an information base against which investments are made in energy efficiency or other "building systems as a service" features that reduce material flows and environmental impact. Data that support green financial innovation can help bring forward more capital that otherwise would not be put to its best use in achieving the Paris Agreement climate goals and the global SDGs. The ability to track the use of proceeds and benefits achieved for instruments, such as green or social bonds or sustainability-linked loans, is highly dependent on accessible and accurate data and supports confidence in the market.

EXAMPLE 4:

Link to SDG 3 – Supporting indoor health and occupant well-being

Kurt Emil Eriksen, Velux A/S and
Ursula Hartenberger, PathTo2050

The primary function of buildings is to provide shelter for people and a place to play, work and relax. According to the Organisation for Economic Co-operation and Development (OECD), most people spend about 90 per cent of their time indoors: in their home, their office, at school, in shops and restaurants, and in other facilities (Harju 2014).

Healthy indoor environments contribute greatly to human health and well-being. The introduction of Building Passports and the availability of better-quality data will make it possible to draw conclusions about a building's indoor climate and occupant well-being and comfort, such as exposure to potentially harmful substances in materials, air quality, adequate ventilation and access to natural light.

Data from the design and procurement stages, which are typically regulated by building regulations, and from ongoing monitoring during the building's use phase, will enable building owners, facility managers and consultants to optimize the use of the building, not just in terms of reducing energy consumption but also by helping to create healthier indoor environments.

In buildings where Building Management Systems (BMS) are installed, the indoor climate can be monitored, and information on indoor temperature, CO_2 levels and humidity are automatically available, and information on the use of technical solutions, such as ventilation, cooling and intelligent solar shading, can be registered. Parallel to this, the use of artificial light should be monitored in combination with the use profile of the building.

Table A.3 shows examples of core indoor air quality and comfort data categories through which the Building Passport could support better building occupant health. The left column lists indoor health and comfort-related features that would typically be logged in the Building Passport at the design stage, and the right column shows the corresponding performance measurement data logged during building use, depending on the building typology. While in general measurements of the kind described in the table may not be the rule in conventional owner-occupied residential dwellings (unless they are equipped with specialized continuous measurement devices), in commercial buildings this would or should be standard practice. For rented assets, a user satisfaction survey can provide valuable insights regarding indoor air and comfort performance levels.

TABLE A.3: Examples of data categories for health and well-being

Focus area	Design stage features	Monitoring / measurement of performance in use
Use of building	• Expected user phase during day and year	• User satisfaction survey
Air quality	• Design values for CO_2 level • Ventilation strategies • Volatilization from materials • Use of ventilation, natural / mechanical	• Moisture levels • CO_2 levels
Comfort	• Design values on indoor temperature during summer and winter • Shading strategy (including external shading) • Ventilation strategy (natural / mechanical) • Use of cooling	• Indoor and outdoor temperature levels
Daylight	• Design values on daylight conditions • Strategy for use of artificial light	• Light intensity levels

EXAMPLE 5:

Link to SDG 11 – Advancing the transition to sustainable cities and communities

*Martina Otto, Head of Cities Unit,
UN Environment Programme*

The transition towards low-carbon, resource-efficient, nature-positive and socially equitable cities is crucial to advancing towards the Sustainable Development Goals and the New Urban Agenda.

Growing urbanization, with an expected 66 per cent of global populations living in cities by 2050, could translate into resource requirements of urban areas growing to nearly 90 billion tons per year by 2050, with high demand for land, food supplies and raw materials, exceeding what the planet can sustainably provide. Seventy-five per cent of greenhouse gas emissions are attributed to cities. At the same time, biodiversity and green areas in and around cities provide ecosystem benefits and services, increasing the resilience of cities, contributing to climate mitigation and improving human health (flood management, reduced heat-island effect, clean air, recreation, etc.).

SDG 11, in its first target, calls for ensuring access for all to adequate, safe and affordable housing by 2030. Estimations show that floor space is set to double by 2060. Adequate housing at times of climate change and resource scarcities must include solutions that range from passive design and nature-based solutions that reduce the greenhouse gas emissions linked to energy consumption in buildings while providing the thermal comfort needed, to building design that uses materials efficiently and considers material alternatives – from reuse and recycling, to the use of waste products from other processes, to re-growing raw materials.

Having access to more anonymized quality building-level data will allow mayors and city planners to aggregate these data to develop more accurate building stock models and statistics, to evaluate the performance of their respective building stock and to devise more targeted strategic sustainability-focused programmes and policies to drive the much-needed transition within the built environment.

SUPPORTING THE ROLL-OUT OF GLOBALABC REGIONAL ROADMAPS

The GlobalABC Regional Roadmaps are intended to identify common goals, targets and timelines for key actions across eight suggested "activities", acting as guidance to governments seeking to establish their own action plans. Each of the eight activities represents a segment of the buildings and construction sector: urban planning, new buildings, existing buildings, appliances and systems, building operations, materials, resilience and clean energy. Building-related data are generated and needed during all activities.

The Building Passport data categories listed in Part III of these guidelines relate directly to Regional Roadmap activities 4, 5, 6 and 7. Building Passports, when built into these activities, can act as Roadmap enablers and constitute a key support factor for the achievement of the targets and timelines associated with the activities.

Activity 1: Urban planning

This activity covers land use, zoning and other planning associated with how the buildings, transport and energy systems interact.

Activity 2: New buildings

This activity covers all aspects of new buildings, including the design process, design strategies, codes and labels.

Activity 3: Existing buildings

This activity covers all aspects of the improvement of existing buildings.

Activity 4: Building operations

This activity covers all aspects of the operations and management of buildings.

Activity 5: Appliances and systems

This activity covers lighting, appliance and equipment systems that are used in both new and existing buildings.

Activity 6: Materials

This activity covers envelope, structural and product materials used in buildings.

Activity 7: Resilience

This activity covers all aspects of building resilience that enables increased capacity to adapt to and mitigate the effects of changing climates and other natural disasters.

Activity 8: Clean energy

This activity covers the clean energy transition away from carbon-intensive fuels to renewable energy resources.

SPECIFIC BUILDING PASSPORT BENEFITS

Building on the benefits section in section 3, Table A.4 provides a more in-depth overview of Building Passport benefit categories and corresponding specific benefits.

TABLE A.4: **Specific benefits of Building Passports**

Benefit category	Specific benefits
Standardized, evidence-based and third-party validated transaction documents	• Increased and more reliable data transparency during transactions, supporting due diligence, capital expenditure planning and tenant recruitment • Shortening of conveyance periods through (semi-) automatized document generation • Fewer transactions falling through due to better expectation management • Availability of information regarding performance issues (e.g., building energy, water efficiency and resilience) prior to purchase • Additional services provision for the buyer
Data-driven property evaluation / risk assessment	• Lower risk of value loss in comparison to undocumented buildings • Higher levels of trust and confidence about overall building quality • More equitable and fairer rent negotiations on the basis of higher transparency levels and reliable data • Availability of information regarding performance issues (e.g., building energy, water efficiency and resilience) prior to entering into rental contract • Better benchmarking of developed building • Centralization of information, data accessibility and (semi-) automation facilitates use of information for sustainability schemes / certification • Reduced credit risk in relation to financial instruments (e.g., loans, mortgages) due to lower risk of value loss compared to undocumented building • Support of mortgage lending with reliable data and exposure of low-performing buildings • Significant reduction of effort and cost when generating reports due to (semi-) automatized document generation • Higher levels of accuracy of valuations due to higher transparency and reliability of data • Potential preferential insurance premiums for well-documented buildings due to reduced risk perception compared to undocumented buildings • Reduced insurance liability

A tool for capturing and managing whole life data and information in construction and real estate

Benefit category	Specific benefits
Standardized, evidence and data-based refurbishment plans	• Optimized portfolio management through improved maintenance and retrofit works planning, preserving the quality of use of the building through availability of reliable data • Better management of and access to information about design, existing building structure and materials used when retrofitting and/or extending building, supporting decision-making over the whole life cycle • Better follow-up / control of mandatory refurbishment actions to meet sustainability and climate change objectives • Facilitation of smart energy use, operational energy use reduction and energy cost reduction strategies
Data-based facilitation of improved material flows, recycling and reuse	• Higher transparency and reliable data supports materials flows from one building to another during adaptations and transformations • Potential increase of building value through supporting multiple uses/functions and life cycle prolongation on the basis of information regarding the adaptability and transformation capacity • Improved traceability of chemical substances, repair and refurbishment of materials • Creation of linkages of data from material passports, containing information on products' recovery characteristics with data resulting from maintenance, repair, etc., improving the value definition of the products and increasing their potential to be reused, refurbished, etc.
Data-based service and maintenance plans	• More grounded service charges as a result of improved transparency • Reduced unplanned reactive maintenance incidents as lingering issues are not overlooked and owners / occupiers / facility managers can inform themselves on previous related damages and cost-effective management actions
Standardized, evidence-based and third-party validated sustainability ratings and reports	• Support of internal and external voluntary and regulatory corporate reporting against sustainability goals, (e.g., energy / greenhouse gas; climate risk; SDGs, etc.) • Seamless integration with other data-driven initiatives, systems and tools: e.g., Environmental Product Declarations, offering framework / structure for building-related information for BIM capability, etc. • Reduced effort (and cost) when generating building certificates due to (semi-) automation of documentation generation
Improved data-driven building statistics	• More effective and better informed policy and incentives development and monitoring of long-term trajectories, e.g., climate goals, resource efficiency, etc. • Significant increase of the accurateness of building stock models • Provision of energy use context data

ANNEX B — OVERVIEW OF GLOBAL BUILDING PASSPORT INITIATIVES AND SELECTED EXAMPLES

As mentioned in the introduction to these guidelines, a growing number of Building Passport initiatives are at various stages of development. The map below depicts the geographical location of current global initiatives that are either operational, under development, tested or discontinued. According to a recent study undertaken for the European Commission, there are at present 21 initiatives in Europe alone (European Commission 2020d).

Table B.1 represents a snapshot overview of global initiatives (operational, tested and under development). Both the map and the overview show a distinct clustering of initiatives in the Europe region. The reason for this is closely tied to stringent and ambitious legislative frameworks in relation to the environmental performance of buildings and associated reporting requirements within the EU, triggering heightened stakeholder demand for better-documented buildings and optimized performance information.

However, the individual initiatives vary greatly in scope and focus. The majority deal only with certain aspects and life cycle activities, such as energy, materials or renovation roadmaps, and only very few cover the full range of data categories as recommended in these guidelines.

TABLE B.1: **Overview of Building Passport initiatives**

Initiative*	Country	Status	Scope	Link
Electronic Building Passport (EBP) (pitt&sherry and Queensland University of Technology 2015; Miller and Lützkendorf 2016)	Australia	Tested	• Voluntary at time of testing • Public • Focus: energy and sustainability	https://energymining.sa.gov.au/__data/assets/pdf_file/0005/315419/NEEBP-phase-2-project-2-electronic-building-passport-final-report.pdf
Post Interventie Dossier / Dossier d' intervention ultérieure	Belgium	Operational	• Mandatory • Public • Focus: maintenance record	https://www.vlaanderen.be/postinterventiedossier-pid *(only available in Dutch)*
Woningpas	Belgium	Operational	• Voluntary • Public • Focus: wide	https://woningpas.vlaanderen.be *(only available in Dutch)*
Bedrebolig	Denmark	Operational	• Voluntary • Public • Focus: energy and renovation	https://sparenergi.dk/forbruger/vaerktoejer/bedrebolig *(only available in Danish)*
Ilmastoviisaat Taloyhiöt	Finland	Under development	• Voluntary • Private • Focus: energy efficiency	https://figbc.fi/en/projects *(only available in Finnish)*
Property Logbook	United Kingdom	Operational	• Voluntary • Private • Focus: residential, wide	https://propertylogbook.co.uk
Energy Logbook	United Kingdom	Operational	• Voluntary • Private • Focus: residential, energy efficiency	https://propertylogbook.co.uk
Homebook	France	Tested	• Voluntary • Private • Focus: energy efficiency	https://homebooksystem.fr *(only available in French)*
Le carnet numérique du logement	France	Tested	• Mandatory • Public • Focus: energy efficiency, systems, • hazardous materials	https://www.cohesion-territoires.gouv.fr/quels-sont-les-diagnostics-immobiliers-fournir-en-cas-de-vente *(only available in French)*
Passeport Efficacité Énergétique	France	Tested	• Voluntary • Public • Focus: energy efficiency	https://www.experience-p2e.org *(only available in French)*
Eigenheim Manager	Germany	Operational	• Voluntary • Private • Focus: consumption and cost reduction, maintenance support	https://eigenheim-manager.de/faq *(only available in German)*
QDF Hausakte	Germany	Operational	• Voluntary • Private • Focus: wide	https://www.fertighauswelt.de/hausbau/ratgeber/hausakte.html *(only available in German)*
Property Register	Iceland	Operational	• Mandatory • Public • Focus: wide	https://skra.is/english/individuals/real-properties/about-the-property-register
Building Renovation Passport	Ireland	Tested	• Voluntary • Private • Focus: renovation	https://www.igbc.ie/policy-and-regulation/renovation-strategies/building-renovation-passports

| Initiative*	Country	Status	Scope	Link
PAS-E	Spain	Under development	• Voluntary • Private • Focus: sustainability, urban • regeneration, quality of life	http://pas-e.es/#/en
BASTA	Sweden	Operational	• Voluntary • Private • Focus: materials	https://www.bastaonline.se/?lang=en
Min Villa	Sweden	Operational	• Voluntary • Private • Focus: maintenance	https://minvilla.villaagarna.se (only available in Swedish)
ProduktKollen	Sweden	Operational	• Voluntary • Private • Focus: environmental • certificates, product and • products safety documentation, manuals	https://www.produktkollen.se (only available in Swedish)
Klimadeklaration	Sweden	Under development	• Mandatory • Public • Focus: climate impact of new construction projects	https://www.regeringen.se/4a4044/contentassets/3e13a513131b447f8b1e41eddcbbf6b5/klimatdeklaration-for-byggnader-ds-20204.pdf (only available in Swedish)
Federal Building and Housing Register (FEA)	Switzerland	Operational	• Mandatory • Public • Focus: • wide	https://www.bfs.admin.ch/bfs/en/home/registers/federal-register-buildings-dwellings.html
Madaster	The Netherlands	Operational	• Voluntary • Public • Focus: materials	https://www.madaster.com/en
Platform CB'23	The Netherlands	Under development	• Focus: circularity	https://platformcb23.nl/english
CIBSE TM31	United Kingdom	Operational	• Mandatory • Public • Focus: wide	https://www.cibse.org/Knowledge/knowledge-items/detail?id=a0q20000008I7eiAAC
Home Report	United Kingdom (Scotland)	Operational	• Mandatory • Public • Focus: wide	https://www.gov.scot/policies/homeowners/home-reports
Arc Platform	USA (global)	Operational	• Voluntary • Private • Focus: sustainability	https://arcskoru.com
Building Renovation Logbook	Ukraine	Operational	• Public • Focus: energy efficiency, renovation roadmaps	https://eeplatform.org.ua (only available in Ukrainian or Russian)
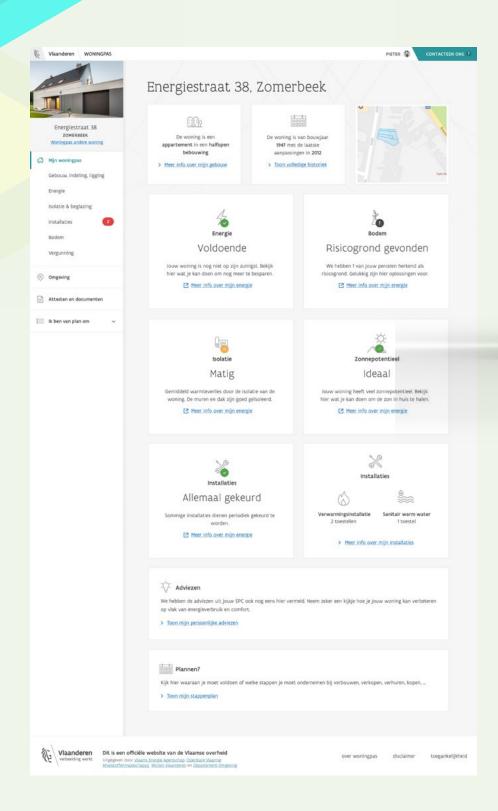
*available online – status February 2021

Providing a detailed analysis of all the individual initiatives featured above goes beyond these guidelines.

The following selected examples represent government and industry-led examples of both operational Building Passports as well as initiatives that are in the process of implementation.

EXAMPLE 1:
Woningpas, Flanders, Belgium (government-led)

A tool for capturing and managing whole life data and information in construction and real estate

Woningpas, Flanders, Belgium (digital/ operational)

The Flemish **Woningpas** is a free, voluntary, digital Building Passport for residential buildings, jointly developed by four Flemish government departments and agencies (Energy, Waste, Environment and Housing). It has been operational since late 2018. It is owned by the building owner and can be accessed by the Belgian "My Citizen" portal or the homepage

https://woningpas.vlaanderen.be (5 different ways to login including e-1D)

The home owner can consult the property data him -or herself but can also give other stakeholders, for example, architects or future buyers permission to view the **Woningpas** without obligation.

The passport takes a wide building data and information approach and features data available in public databases on energy performance, renovation advice, housing quality (such as stability, humidity, safety), data on the environment and in future other building aspects such as durability, water, installations and building permits.

From an energy efficiency perspective, the **Woningpas** stores information about inspections, certificates and permits, data from the energy performance certificate (EPC) or the EPB declaration, thus making it easier for homeowners to assess the energy performance of their home.

Ultimately, the **Woningpas** will make it possible to track the evolution of each individual building.

The **Woningpas** is introduced in stages. Whenever an additional feature is ready, it is launched. As of 2021, for example, the **Woningpas** will offer a timeline of the renovation works for which an energy grant was issued. In addition, the owner can also supplement this timeline with his own renovation works.

TABLE B.2: **Woningpas data and information categories**

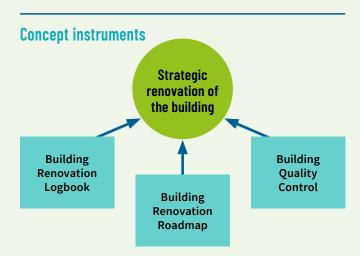| Woningpas Data and information category	Data and information	
Administrative	► Address	► Planning permits (history)
Location & Plot	► Spatial planning ► Flood sensitivity	► Heritage value of building and surroundings ► Mobility score
Materials & Systems	► Insulation score per component (e.g., glazing, walls, roof, etc.)	► Details of installations (e.g., heating, domestic water, cooling, ventilation, solar panels, etc.)
Technical / Functional Characteristics	► Year of construction, ► Year of renovation ► Surfaces and volumes ► Stability	► Soil and soil certificate
Use & Operation	► Indoor climate ► Humidity	► Safety
Financial, Social & Environmental Performance	► Record of renovation works for which incentives have been granted	► Energy Performance Certificate ► EPB declaration

EXAMPLE 2:
Building Renovation Logbook initiative, Ukraine
(government-led)

The **Building Renovation Logbook** is an integral part of the **Strategic Building Renovation Concept Toolkit** aimed at large-scale modernization of buildings in Ukraine. The concept looks at the building as a whole and provides an **individual long-term, step-by-step renovation plan** that takes into account the needs of building owners and users as well as the specific technical situation of the facility.
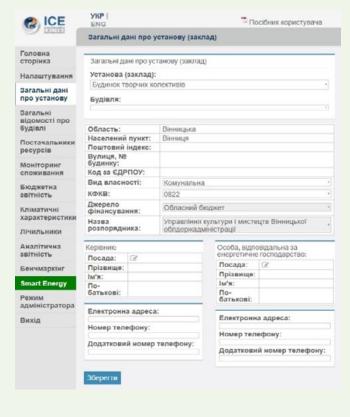
The so-called Concept Toolkit provides analysis to support the benefits of renovation, both at the individual building level and with a view to implementing long-term national strategies in the field. The concept was developed for the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH project "Energy Efficiency Reforms in Ukraine / Professional Qualifications Component" by FIATU LLC.

The main purpose of the concept is to develop individual **Building Renovation Roadmaps** that, in combination with the other tools of the concept, i.e., the **Building Renovation Logbook** and the **Building Quality Control**, are designed to raise awareness and form the basis for the renovation work, as well as guarantee energy efficiency every time a renovation takes place.

The Building Renovation Logbook is the main repository of all relevant building-related information and includes five main thematic blocks (general and administrative information, technical information, building operation information, energy efficiency data and intellectual property information).

Its core rationale is to provide an understanding of the current state of the building with regard to the energy performance of the building envelope, its in-use performance as well as that of its equipment.

Concept instruments

A tool for capturing and managing whole life data and information in construction and real estate
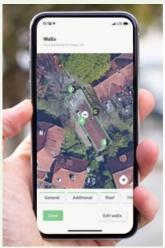
EXAMPLE 3:

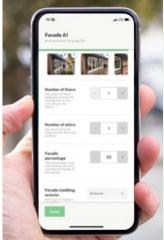# Building data collection initiative at the European Foundation for Living

(industry-led)

The **Building data collection initiative** is a bottom-up initiative of building owners from the UK (Catalyst, Places for People, Clarion), France (Paris Habitat, Polylogis, Vilogia), Italy (Redo) and Ireland (Cluid), organized by the European Federation for Living (EFL).

The initiative aims at generating a building inventory of the stock of the building owners to be able to proceed into using artificial intelligence approaches to generate optimal decarbonization roadmaps and have a data basis to access green finance at scale.

The approach chosen is focused on using simple smartphones as data collection devices and applying machine learning. Logic links and cross-checks with energy meter data help to build robust inventories time-efficiently.

The building inventories are provided to the building owners in the form of a building data repository or Building Passport that covers physical building data, meter data, upload functions for documents, maintenance data and predictions for the lifetime of components.

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