Urban Insight
By Sweco

Building the future through circular data

– Tools for mining the 'green gold'

1 Exchange Square in London. Client: PNBJ / LaSalle Investment Management. Image: Secchi Smith

SWECO

Building the future through circular data

– Tools for mining the 'green gold'

Contents

Executive summary

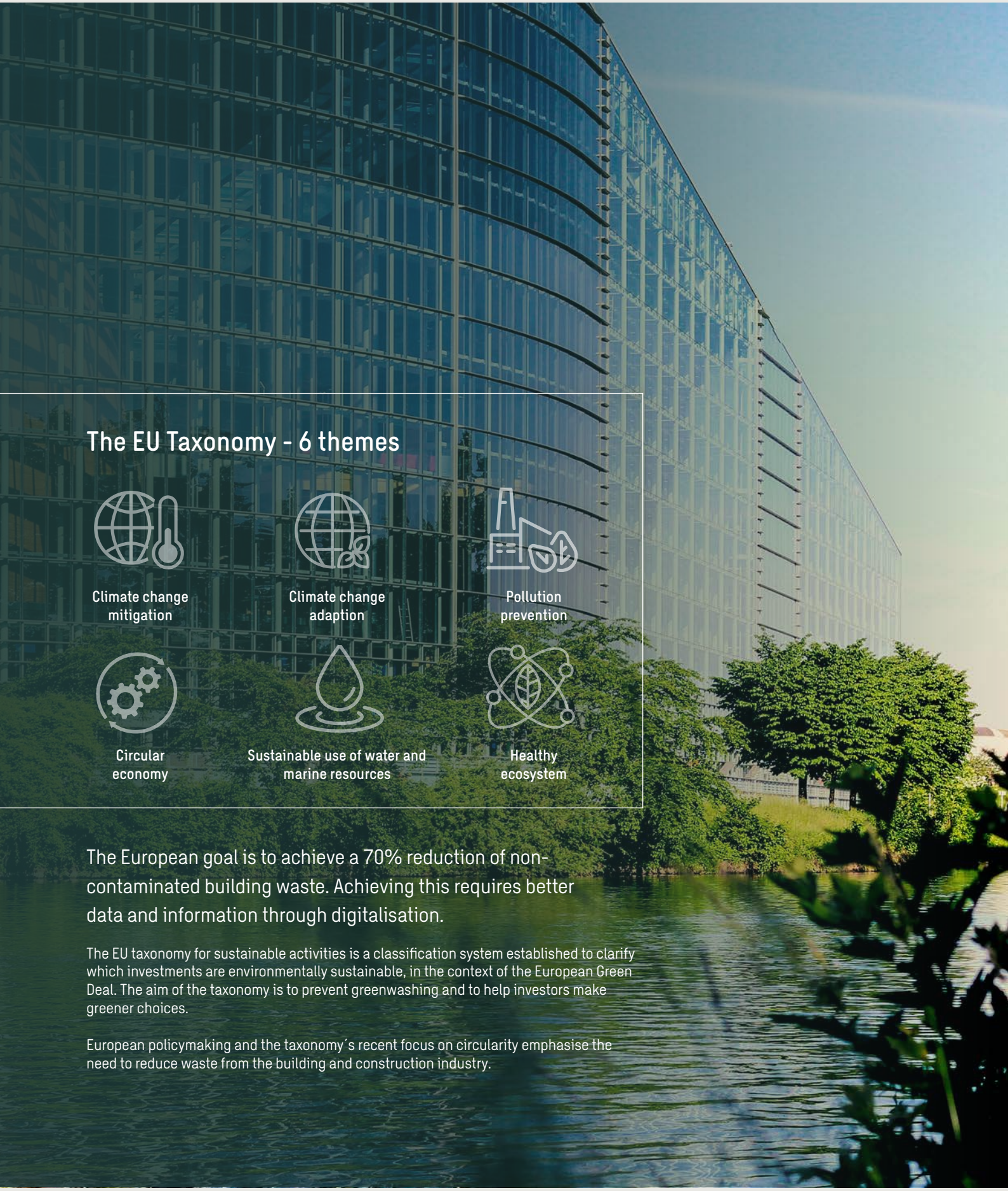
In this Urban Insight by Sweco report "Building the future through circular data", we show how buildings can be built, upcycled, refurbished, rebuilt or managed in a circular way and why it's important for reaching the UN Sustainable Development Goals, reducing costs, aligning with new regulations and attracting green funding.

We present best practice and next practice tools, such as Matchmaking for demolition; Revelop, an e-commerce for building materials; the Carbon Cost Compass for assessing the cost impact of design choices; and Twinfinity, a digital twin tool that helps you manage circular assets in your building. Without these and other digital tools, and the informed decisions they can lead to, the embodied circular values in our buildings will turn into waste – adding to the annual 400 million tonnes of construction waste in Europe we are producing today.

In a new calculation, experts show that every square metre of floor space you demolish in a building could be worth up to EUR 750 in direct and indirect costs.

This report is a call for action. Every second counts.

We urgently need to move from wasteful to resourceful. Sweco shows how this can be done in a collaborative and circular manner, with the help of data.



The EU Taxonomy - 6 themes

- Climate change mitigation
- Climate change adaption
- Pollution prevention
- Circular economy
- Sustainable use of water and marine resources
- Healthy ecosystem

The European goal is to achieve a 70% reduction of non-contaminated building waste. Achieving this requires better data and information through digitalisation.

The EU taxonomy for sustainable activities is a classification system established to clarify which investments are environmentally sustainable, in the context of the European Green Deal. The aim of the taxonomy is to prevent greenwashing and to help investors make greener choices.

European policymaking and the taxonomy´s recent focus on circularity emphasise the need to reduce waste from the building and construction industry.

Introduction

Strong forces of change are affecting our societies in ways that are new to us all. Within a few years, we have been hit by the powerful impact of climate change, pandemics and wars. Meanwhile, a growing population means that fewer resources need to stretch further. Our lifestyle of consumption is a major cause of the increase in greenhouse gases in the atmosphere.

The latest IPCC report[1] presents the scientific evidence to support its call to action. Managing our remaining resources responsibly is more essential to the continued existence of humankind than ever before. A possible light at the end of the tunnel is the implementation of a circular economy, a model where waste is eliminated and where we use what we've got rather than producing new things. The potential is huge as only an estimated 8.6% of the global economy is currently considered circular.[2]

There are few sectors that highlight the scale of the challenge – and the scale of the solutions required – more starkly than the property and construction industries.

The numbers speak for themselves. More than half (55%) of the world's industrial carbon emissions is generated by the production of just five materials: steel, cement, paper, plastic and aluminum. With the exception of paper, the construction industry is the primary consumer of all of these materials.

At the same time, European construction and demolition is estimated to generate more than 400 million tonnes of waste annually.[3] Or, to make it even clearer, this is 36% of all waste produced in Europe every year (excluding major mineral waste).[4] This is because most built-up structures are simply demolished when they come to the end of their lifespan. According to the Ellen MacArthur Foundation, only 20-30% of this construction and demolition waste is recycled or reused. However, waste and pollution are not accidents; they are consequences of decisions made at the design stage.

Another driving force behind the circular transformation is the rising costs of new materials. Increased global demand in the construction sector, combined with the multiple and complex impacts of the pandemic and logistic issues, have resulted in unprecedented shortages, delays and, ultimately, increases in the prices of materials across the economy.

Data is fundamental for circular decision making and financing

In order to act responsibly, we need to understand what we've got, meaning which resources are available to us. To do this, we need data-driven intelligence, regardless of whether you are a developer, an investor, a designer, a planner, a municipality or are involved in any other way in planning buildings.

Sustainability data is increasingly vital to us as financial institutions when assessing risks, making investment decisions and understanding our customers' businesses. Circularity is no doubt an essential pathway towards sustainability, and tools and data that support and validate it will become increasingly important, not least for sustainable finance.

Catharina Belfrage Sahlstrand, Group Head of Sustainability and Climate Action, Handelsbanken

Using data and smart tools allows us to compare, assess and choose among different alternatives and solutions. With better knowledge and experience we can navigate complexities, while avoiding so-called 'infobesity'. We will be able to make better decisions at all levels that will allow us to access resources from the circular economy. This is important, especially at an early stage of a project, where we are able to make the greatest impact and get the 'biggest bang for our buck'.

Talking about money, better data will also help property developers attract green financing through loans and investments in the wake of new regulations such as the EU Taxonomy framework, where the circular economy is one of six key areas, and the European Green Deal. Circularity also makes the data more attractive to the financial sector.

This report addresses multiple UN Sustainable Development Goals, with a particular focus on:

Mining circular value from existing buildings

90% of today's buildings will still exist in 2050, and as material banks they hold a lot of embodied value.[5] Let's take a look at some tools that could enable this value to be understood and utilised, how different resources could benefit different players and how the tools that drive greater knowledge could aid compliance with regulations and climate targets.

European policymaking and the taxonomy´s recent focus on circularity emphasise the need to reduce waste from the building and construction industry. The European goal is to achieve a 70% reduction of non-contaminated building waste. Certain countries, such as Sweden, aim to become zero-waste societies by 2050, and the Netherlands aims to achieve 50% circularity of construction by 2030 and 100 % by 2050. To achieve these goals, better data and information through digitalisation is key. If you are in control of your sustainability data and can understand, analyse and visualise it, you will be better equipped to attract green funding and harvest the 'green gold'.

There are tools for bridging the gap between the inherent yet unquantified value within buildings and decisions that key players need to make in order to extract maximum value and to comply with requirements such as the EU Taxonomy Regulations and the net-zero targets.

To meet net-zero challenges, one of the central missions for the construction industry is to reduce energy operating costs, as well as to reduce carbon emissions from materials.

Energy prices, the EU taxonomy and policies such as the European Commission's Fit for 55 missions emphasise the need for energy refurbishment across Europe. However, in many cases, energy refurbishment means replacing building materials, which will produce more waste and increase carbon emissions. The importance of embodied emissions will only increase as more and more buildings are constructed or renovated to higher energy efficiency standards, which will greatly reduce the share of operational emissions.

90% of today's building stock will exist in 2050. This means we have to become better at design, maintenance and reuse of the existing stock. This has to start with the education of our future stakeholders.

Erik Stenberg, associate professor, School of Architecture,
KTH – Royal Institute of Technology

Under the goals of the Renovation Wave Strategy from the EU, 35 million building units will renovated by 2030. This marks a renovation wave for Europe - greening our buildings, creating jobs, improving lives.[5]

Examples of reuse ambitions in the Kaj 16 project are:

- 6400 m^3 concrete from the old building are reused on site
- 75% of all round ventilation ducts in the residential areas are reused
- 75% of all sprinkler pipes are reused
- 100% of all cable ladders are reused
- 100% of all steel doors are reused
- 100% of all acoustic ceilings in the offices are reused
- 100% of all partition walls in glass are reused
- 1100 m^2 facade metal sheets from the old building are reused in Kaj 16
- 100% of all rebar is from recycled steel

Image: Vasakronan/TMRW/Dorte Mandrup

Recycling in focus at Kaj 16

Vasakronan's ambition with Kaj 16 is to minimise carbon footprint with very high ambitions for using reused materials. Sweco acts as reuse coordinators and will help Vasakronan to minimise carbon emissions during construction. Together with Vasakronan and the designers, Sweco has established comprehensive reuse ambitions for the project.

Project: mixed-use building including offices and residential
Size: 37,500 sqm
Type: 17 storey wooden building
Client: Vasakronan
Location: Gothenburg, Sweden
Designer: Dorte Mandrup
Role of Sweco: reuse and carbon coordinators

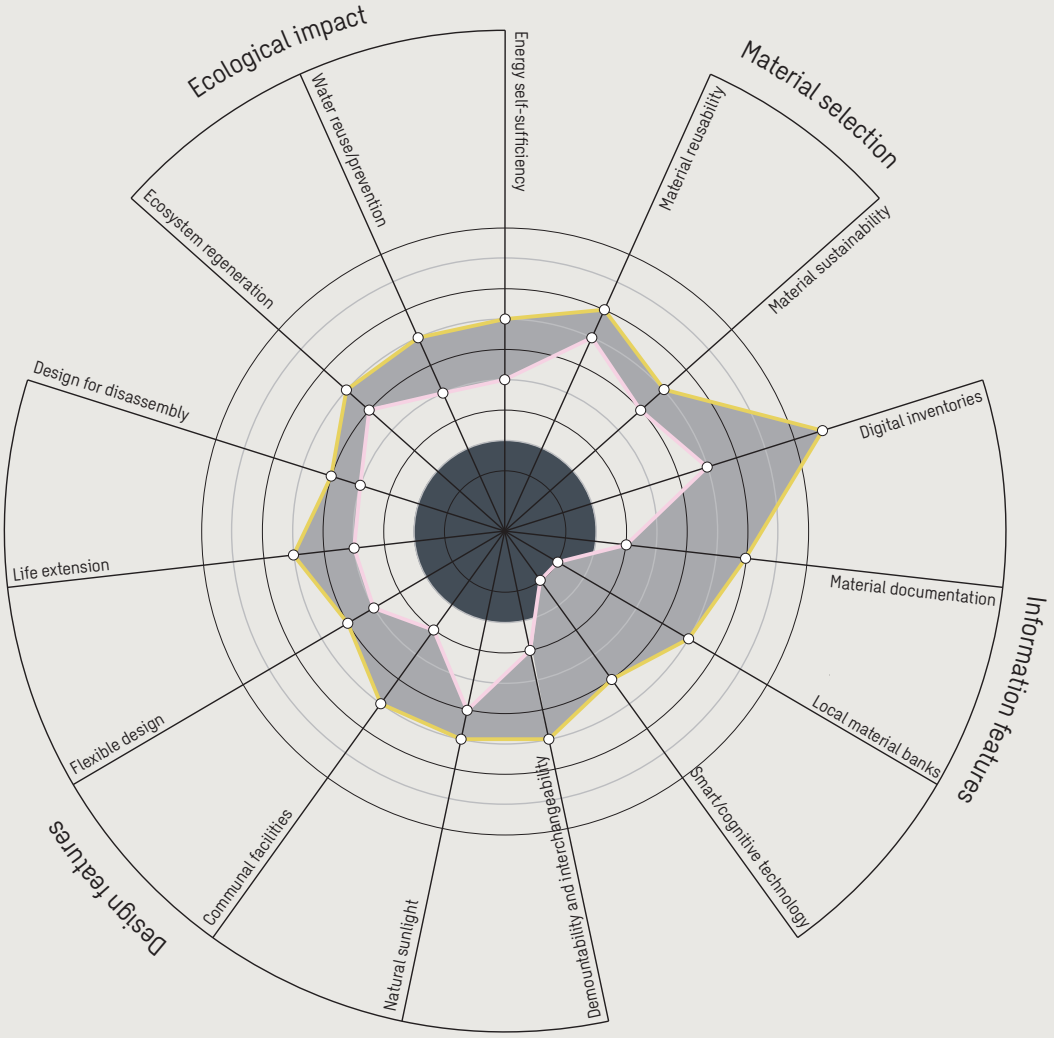
New currencies to describe circular resources

Carbon emissions from the production of a steel beam as short as 40 cm or of 30 square metres of recycled brick – the size of a normal bathroom – are equivalent to the annual emissions created by the average Swede[6]. New standards for calculating carbon emissions from used materials are being developed.

The benefits of the circular economy for new builds and existing property are based on a deeper understanding of the value that can be extracted by the circular economy and the different currencies that describe that value, such as monetary, environmental, socio-economic and circular indexes. One way to understand the circular index is through the proportion of a building´s components that can be disassembled and reused. Another is a value gap diagram, which illustrates interconnected indicators against which circular values can be identified.

New regulations and laws put increasing demands for reducing climate impact in construction projects. At the same time, property owners should take into account the project's economic aspects. Projects with circularity at their heart connect financial and environmental sustainability.

Karin Hurtig, Architect at Sweco.



Value gap diagram - identify where you need to focus your efforts to create the most circular value

The indicators are prerequisites for circular material flows and sharing resources in a smarter way. The diagram presents the circular building as a whole system, with interdependent indicators. A circular system is reliant on good performance across all applicable indicators. Poor performance in a single indicator can undermine the circular value creation of the whole.

- Pink line: The "What is", or the circular status of a building. What are the weaknesses?
- Orange line: The "What could be", or the assessment of the building´s circular potential. These are the opportunities!
- Dark grey area: The difference between the pink and the orange line is the value added – the circular value gap.

Location: Lisbjerg
Client: Lejerbo
Client advisor: Pluskontoret | GXN/3XN
Engineer: Sweco
Architect: ROOM
Delivery: 2023
Turnkey contractor: Torntoft & Mortensen A/S
Scope: 60 public housing units (two point houses in five storeys, a storey house in three storeys and four terraced houses in two and three storeys) as well as outdoor areas.
Visualisations: RUM

Circle House in Lisbjerg, Denmark. The world's first circular social housing project where 90% of the materials used must be able to be dismantled, circulated and recycled without losing significant value.

Collaboration: The project involves over 60 companies across the Danish construction industry.

CO_2e as the new currency in budgeting

Carbon can be used as a way to describe the value of taking a circular approach. One tool for doing so, developed by Sweco, is called C3, the Carbon Cost Compass. C3 supports strategic decisions at very early stages of construction development, assessing both the carbon emissions as well as the cost impact of design choices in the first stages of life-cycle analysis. With the tool, a property owner can estimate at a very early stage the amount of embodied carbon for a certain building, which could then guide decisions regarding demolition or retrofit strategies. Such early-stage estimations could help property developers decide whether to save entire buildings from demolition or parts of them depending on their embodied carbon levels.

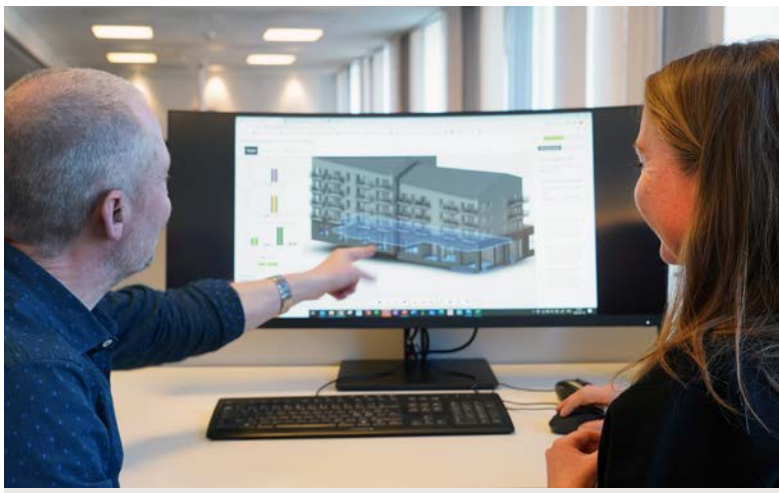
Moreover, the tool guides material design choices, both for retrofitting and for new construction. It immediately illustrates the different carbon and cost impacts between, for example, wood, concrete or steel for structural frames, foundations, façades or roofing.

Circularity is a vital instrument for helping cities reach their net-zero carbon targets.

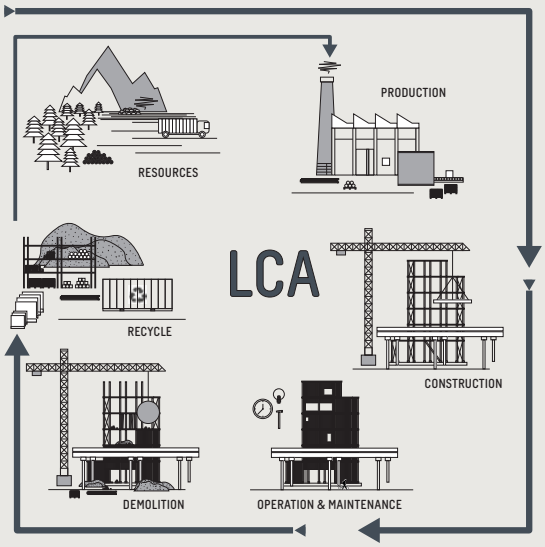
Lukas Ljungqvist, Sustainability Strategist and R&D Coordinator, City of Stockholm.

New digital services give building and property developers the opportunity to make the most optimal design choices for environmentally and economically sustainable buildings.

Elise Grosse, Head of Sustainability, Sweco Architects



The tool C3 - Carbon Cost Compass, supports professional creative dialogue between client and consultant.



Life Cycle Assessment
Complexity lies behind the decision whether to renovate or rebuild. Data is not enough. It needs to be coupled with an understanding of the project context.

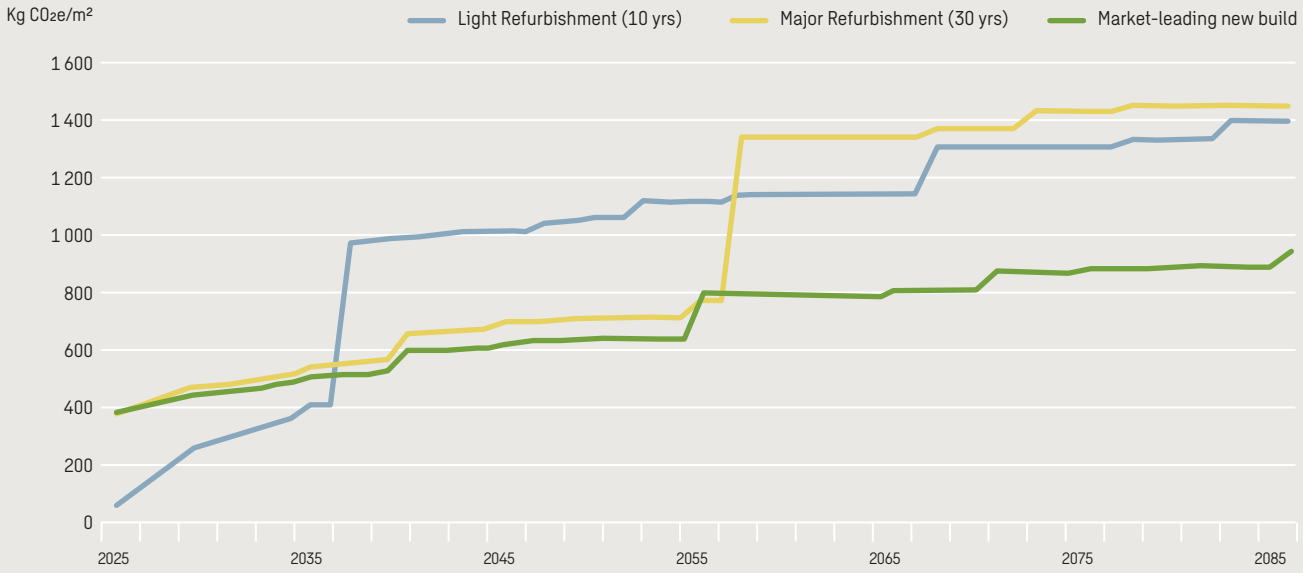
New build or refurbishment?

Complexity lies behind the decision of whether to refurbish or rebuild. Analysis tools are needed, coupled with an understanding of each project to guide decision-making. Although the individual circumstances, lifetime and optimal outcome of each project are of course unique, trends can be identified.

The following diagram summarises whole life carbon – the interplay between operational and embodied carbon emissions – of 35 Sweco projects in the UK. Project categories range from light renovation to market-leading new builds. The assessment is in accordance with the UK Royal Institute of Chartered Surveyors (RICS) Whole Life Carbon Assessment methodology.

Those actors in control of their sustainability data and who can make sense of it, analyse and visualise it, are better equipped to attract green funding, and harvest the 'green gold' of circularity.

Alastair Carruth, Senior consultant within waste and resource management at Sweco



Data gathering is key. It is important to prioritise surveys at the earliest stage, such as structural surveys, architectural surveys, current energy performance surveys – what are typically called 'condition surveys'. This information indicates what can be kept and what needs replacing. The quantification of existing materials, for example through Sweco's C3 tool, is vital as it quantifies the materials and carbon that can be saved. It also facilitates the recycling and reuse of materials.

- **Blue line.** Light refurbishment with a lifetime of approximately 10 years. Although initial embodied carbon is low, operational energy emissions increase rapidly from Year 1 to Year 10. At Year 10 a complete overhaul is needed if the building lifetime is to be extended, and the embodied emissions subsequently increase.
- **Yellow line.** Major refurbishment with a lifetime of approximately 30 years. Although this analysis projects demolition at Year 30, if there was a comprehensive refurbishment, such as that carried out on the Blique hotel, the building should not need demolishing and the spike after Year 30 might decrease significantly. It is therefore possible for whole life carbon to perform better than a best-practice new build.
- **Green line.** Market-leading new build. New builds in the future are possible yet must achieve exceptional carbon performance. In this scenario, there is complete access to the most energy-efficient solutions. There may often be a higher initial embodied carbon, but with exceptional performance the whole life performance could work out to be a robust solution.

A key conclusion from this analysis is that the future of construction lies in high-quality refurbishment and market-leading new builds. Refurbishment could become the default assumption for any project looking to achieve strong whole life carbon performance, and only when you have exhausted the reasonable achievability of a refurbishment that meets both embodied and operational requirements should a new-build development be progressed. The opportunity may not always exist for market-leading new builds, so the role of refurbishment, such as the Blique hotel, is critical. To understand the optimal outcome for any given project, however, it is necessary to undertake analyses using tools like the Whole Life Cycle Assessment or the Sweco C3 tool. By collating, analysing and contextualizing such data, better decisions and outcomes can be achieved.

Herein also lies an additional challenge for property owners, designers and data analysts: if you can not only build with ultra-low-carbon materials, but also design buildings that employs the circular principles of future flexibility, adaptability and deconstructability, and use tools that demonstrate this, why should a new building not last nearly 200 years and be continually adaptable over time?

An entire building transformed by circularity – The Blique Hotel case

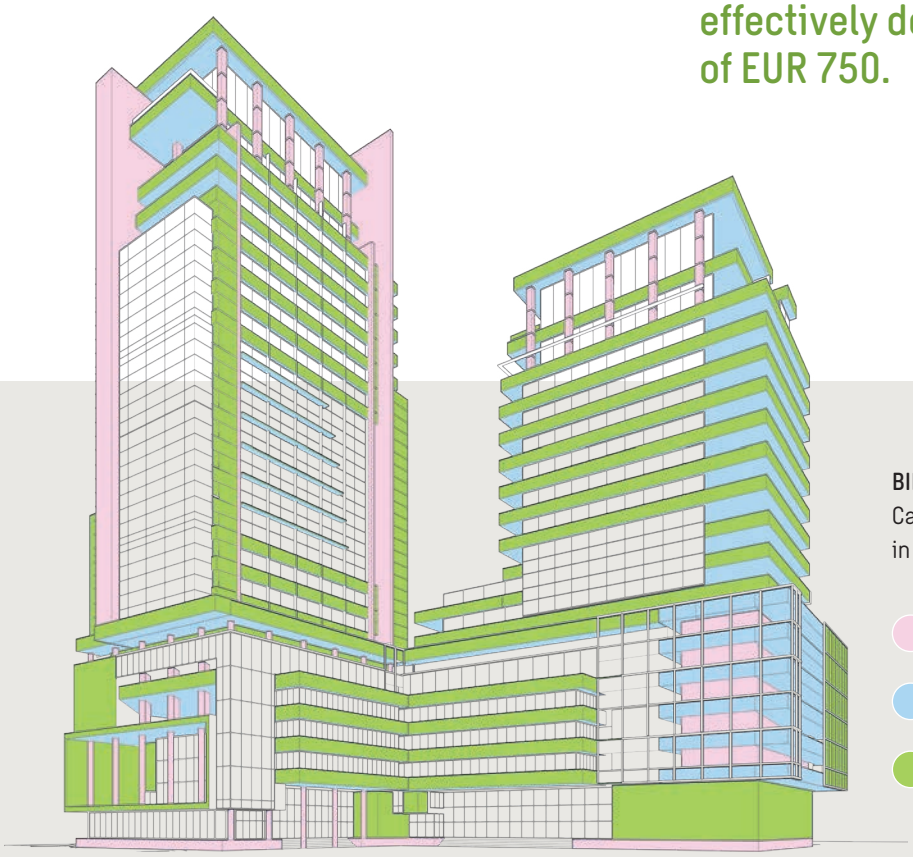
The Blique Hotel is an example of how to extract and upcycle the resources contained in an existing building. Originally, it was an old warehouse and office building from the 19th century in central Stockholm, Sweden. Due to the low ceiling heights, demolition was likely.

However, because of its cultural and historical value, a competition was held to transform the building. Through the vision of a multi-disciplinary team from Sweco consisting of an architect, a cultural heritage specialist, a structural engineer and a material broker, the warehouse was transformed into a fashionable hotel providing new social benefits and a stronger identity for the neighborhood.
Due to a lack of building documentation, a laser scan inventory was carried out to model it in 3D. The team then assessed the values of existing materials.

Using the digital model of the building and the tools, it was easy for us to calculate the total savings of embodied carbon in materials reused in the Blique Hotel case. In total, 3,600 tonnes of carbon emissions were saved.

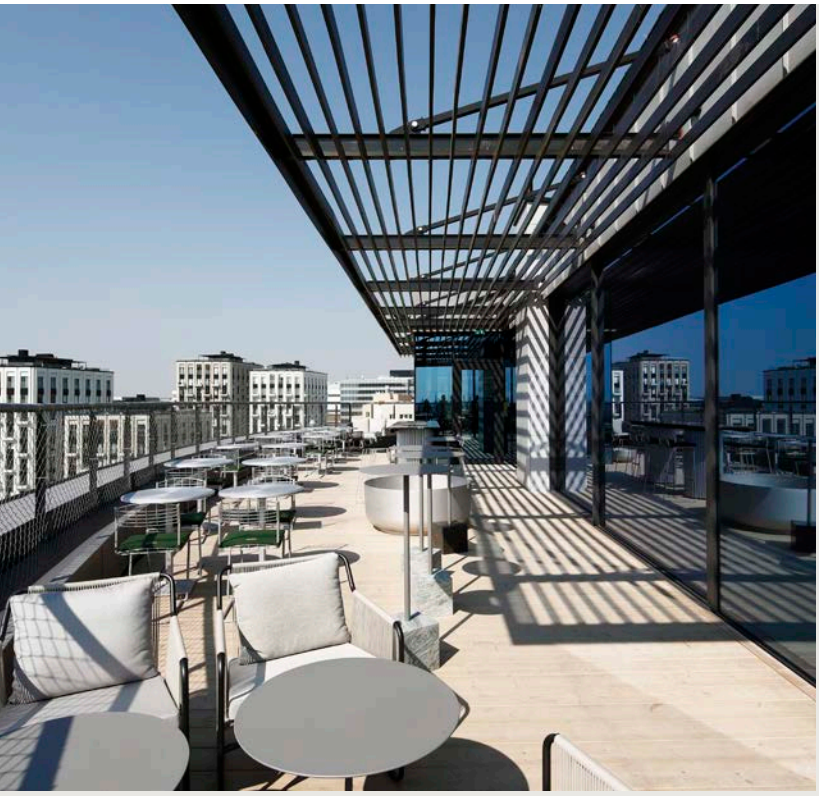
In order to translate that into monetary values, we used the so-called 'shadow cost', which in Sweden means that every kilo of CO_2e costs society at large 0.7 euros. Multiplying 3,600 tonnes by 0.7 EUR/kg, we concluded that the Blique Hotel had saved EUR 2.5 million. Moreover, the savings gained from reusing materials were worth EUR 8.6 million in new materials that did not have to be purchased. The savings for reducing waste totalled EUR 63/sqm.

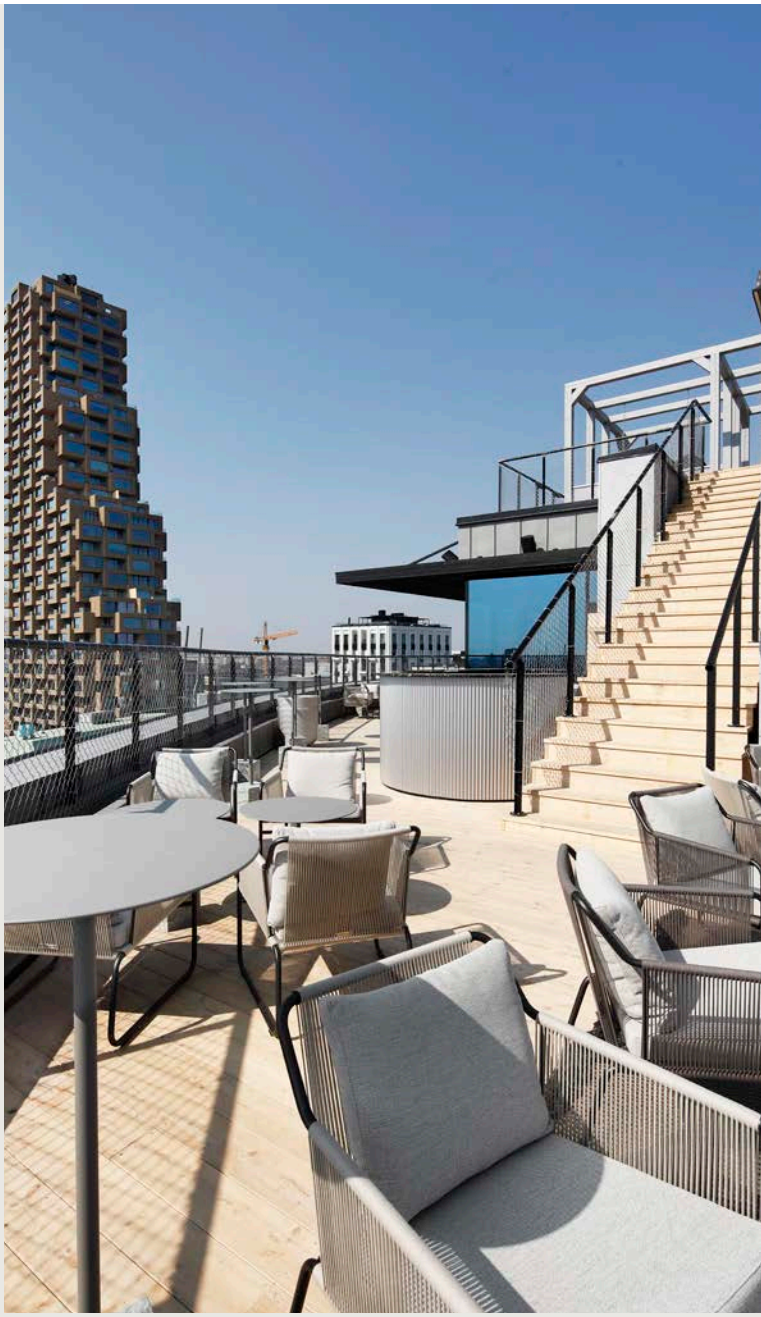
For every square metre of floor space we demolish, we can be effectively destroying a value of EUR 750.



BIM visualisation and BIMitigation
Carbon-intense materials are highlighted in different colours.

- High embodied carbon
- Medium embodied carbon
- Low embodied carbon



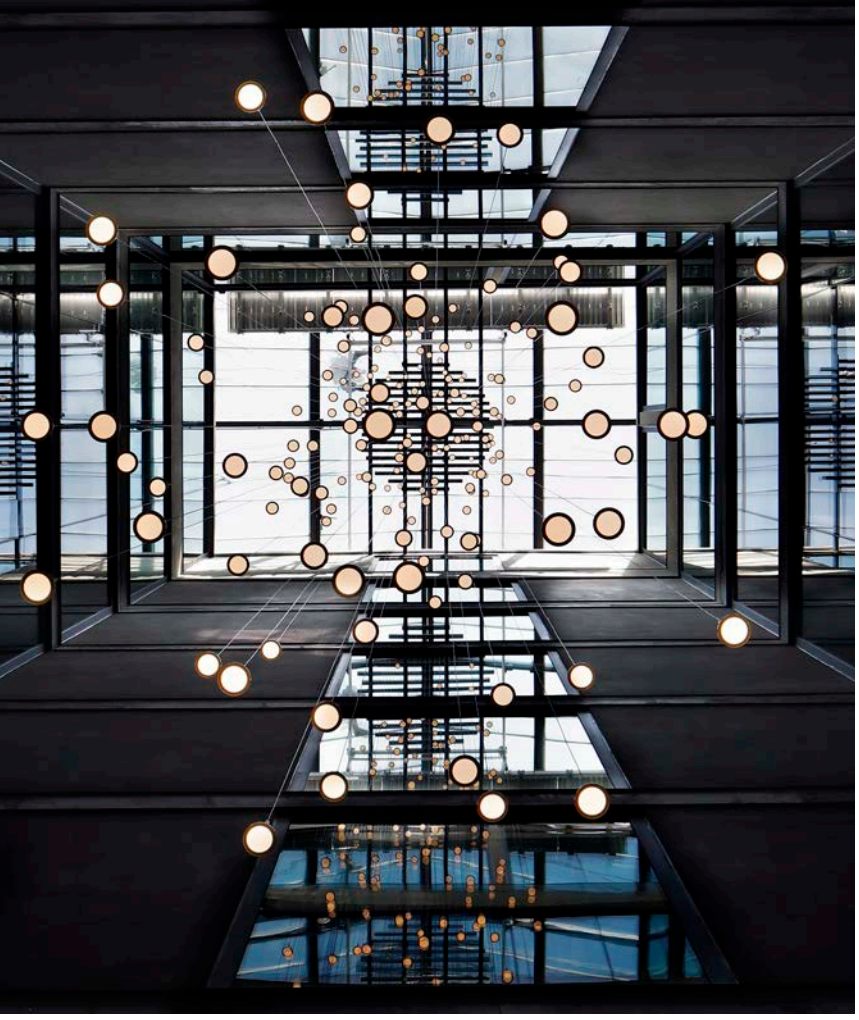


Blique Hotel – Project achievements

Blique by Nobis hotel. Architects: Ewa Buhr-Berg and Karin Hurtig at Sweco,
Photographer: Jeanette Hägglund
Location: Stockholm, Sweden
Client/developer: Kungsleden Fastigheter AB
Services provided: Architecture, design, cultural environment and measurement technique
Collaborators: Interior by Wingårdh

Reused material
3 600
tonnes CO_{2e}

Saved value
EUR 750/sqm



Hotel Blique by Nobis.
Architects: Ewa Buhr-Berg and
Karin Hurtig at Sweco.
Photographer: Jeanette Hägglund.

Total avoided costs

11.5 million €

cost of carbon to society
+ procured material cost
+waste cost

Cost of carbon to society per tonnes CO_2e emissions

EUR 700/tonnes*

*7kr/kg CO2e according to Swedish Transport Agency

Material cost
(for new materials)

8.6 million €

19

What if we upcycled entire buildings throughout Europe?

What if we had an overview of buildings and available material assets across all of Europe? In that way, we could match demolition projects with construction and save a huge amount of carbon emissions by the increased reuse of building materials.

If we extrapolate the results of the Blique Hotel project, assuming they were applied to just 100 European buildings with an average size of 15,000 m² we could avoid total costs of more than EUR 1.1 billion. That result, which is based on Swedish carbon factors, includes embodied carbon savings, new material cost savings and the avoided costs of carbon emissions to society.

If neighbourhoods, districts, regions and cities would work together to reuse buildings throughout Europe, carbon and cost savings would be significant. For example, huge savings could be achieved in building districts that have retrofitted needs and residential areas such as the Million public housing programme in Sweden, Plattenbau in Germany or large housing estates in Europe.

Applying the method of reuse to 1,000 similar buildings with a heavy core foundation and structure, such as Germany´s plattenbau, Sweden´s miljonprogram, or 1990´s commercial buildings, we could avoid costs of more than EUR 11.5 billion.

Imagine, what could you do with 11.5 billion euros?
It would cover the investment needed to construct the world's largest offshore wind farm, Dogger Bank, in the North Sea, which will cost approximately EUR 11 billion.

Carbon emission and financial savings (in euros) in a district by the increased reuse of building materials

	PROPERTIES		
Number of properties	10	100	1,000
Embodied carbon tCO_2e	36,000	360,000	3.6 million
New material costs avoided	81.7 million	817 million	8.17 billion
Societal cost of carbon	23.9 million	239 million	2.39 million
Cost of waste avoided	9.5 million	95 million	950 million
Total avoided cost	115 million	1.15 billion	11.5 billion

The table shows embodied carbon savings, new material cost savings and the avoided costs of carbon emissions to society. Assumed average building floorspace: 15000 sqm.

From demolition to design for reuse

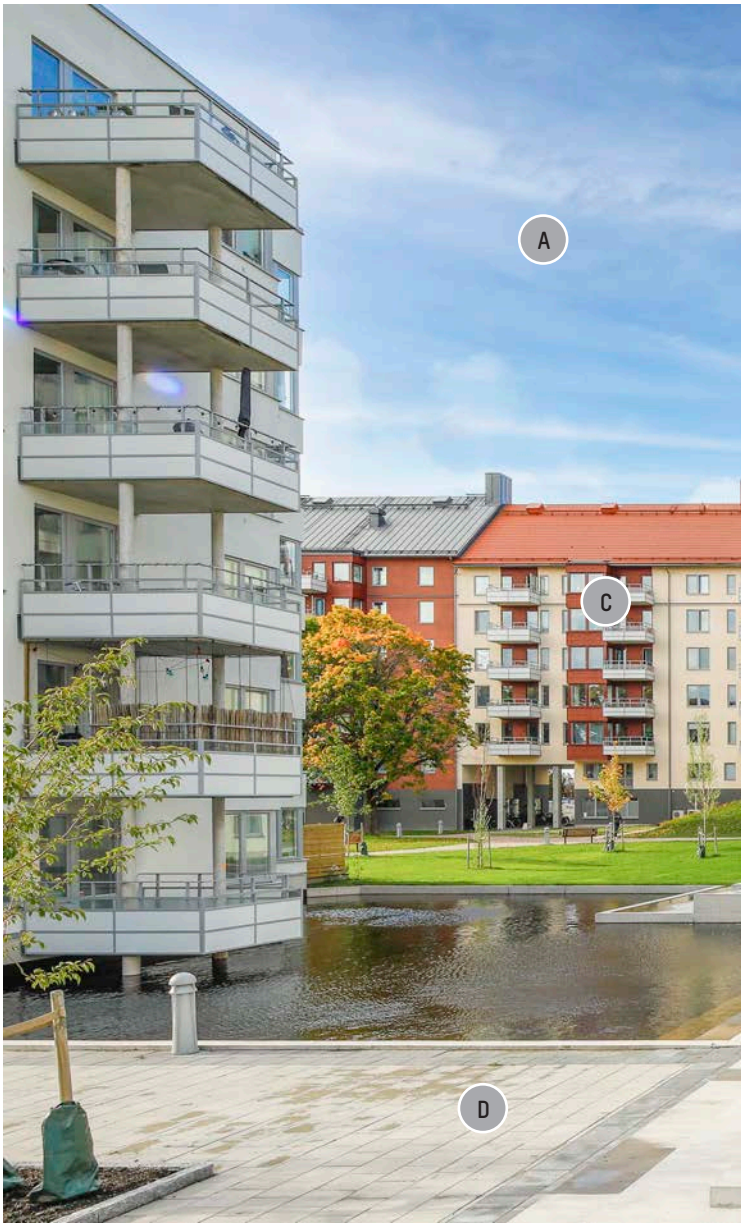
In order for digital tools to have the maximum impact and to actually realise the benefits they identify, it is crucial that key processes in projects and developments play their part in paving the way for greater circularity.

Gain more time to incorporate recovered materials into design

Municipalities and property owners play an important role as owners and developers of both land and buildings. By developing procurement routines for construction and demolition, as well as through their blueprints, installations and groundwork, they can have a profound impact on the transition towards circularity. Sweco is currently working with the municipality of Malmö Stad on circular procurement and design instructions, linked to the EU Circular Builders project[7].

However, the gap in time between the planning and the actual demolition could disrupt the best laid plans. It often takes years to plan, design and construct a building, going through building permits and procuring contractors.

At the other end of the life cycle, demolition could be decided upon with very short notice, sometimes as little as two months before the actual demolition takes place. Even if the demolition itself was planned several years ago, property owners typically postpone publishing this information for as long as possible in order to avoid negative reactions to the change from local actors. The timely matchmaking of supply and demand of reused materials is an interesting challenge.



Circularity in your neighbourhood

A The area has been assessed to identify potential material flows from renovation and demolition within the area in the near future.

B This building is designed with a digital twin to maximise circular use.

C The property owner has developed procurement routines for construction and demolition to transform the properties into material banks.

D This is reclaimed material from a renovated metro station, made possible through the use of a digital market place.

Reclaim – how to predict what will be demolished

Reclaim (recovery and long-term asset inventory management) is a prototype tool developed by Sweco that aims to predict which buildings will be demolished in the future. The purpose is not simply to identify exactly which particular building will be demolished and when, but it instead enables us to visualise a future material bank within a wider area with a degree of confidence that some of those materials will soon become available following demolition.

The predictions from Reclaim are based on machine learning from historical government data, such as the year of construction, asset value, address or the history of permits for demolition, refurbishment, owner relations and function. The algorithm recognises patterns in the data for demolished buildings, returning suggestions for buildings that are likely to follow that pattern as a result.

Different cities have different patterns of demolition. For example, some cities were reconstructed after the war, whereas some cities remained intact. The tool provides a forecast setting out which demolitions and materials to expect in the next 10 years in a given geographical area.

By using digital tools, we can overview buildings and material assets and organise them as a local material bank. They provide more time to incorporate the reuse of materials in a design. They drive a reverse design process, where the design is adapted to the availability of materials.

Digital tools enable you to better match demolition with construction and thus increase the reuse of building materials and save on carbon emissions.

Matchmaking for demolition

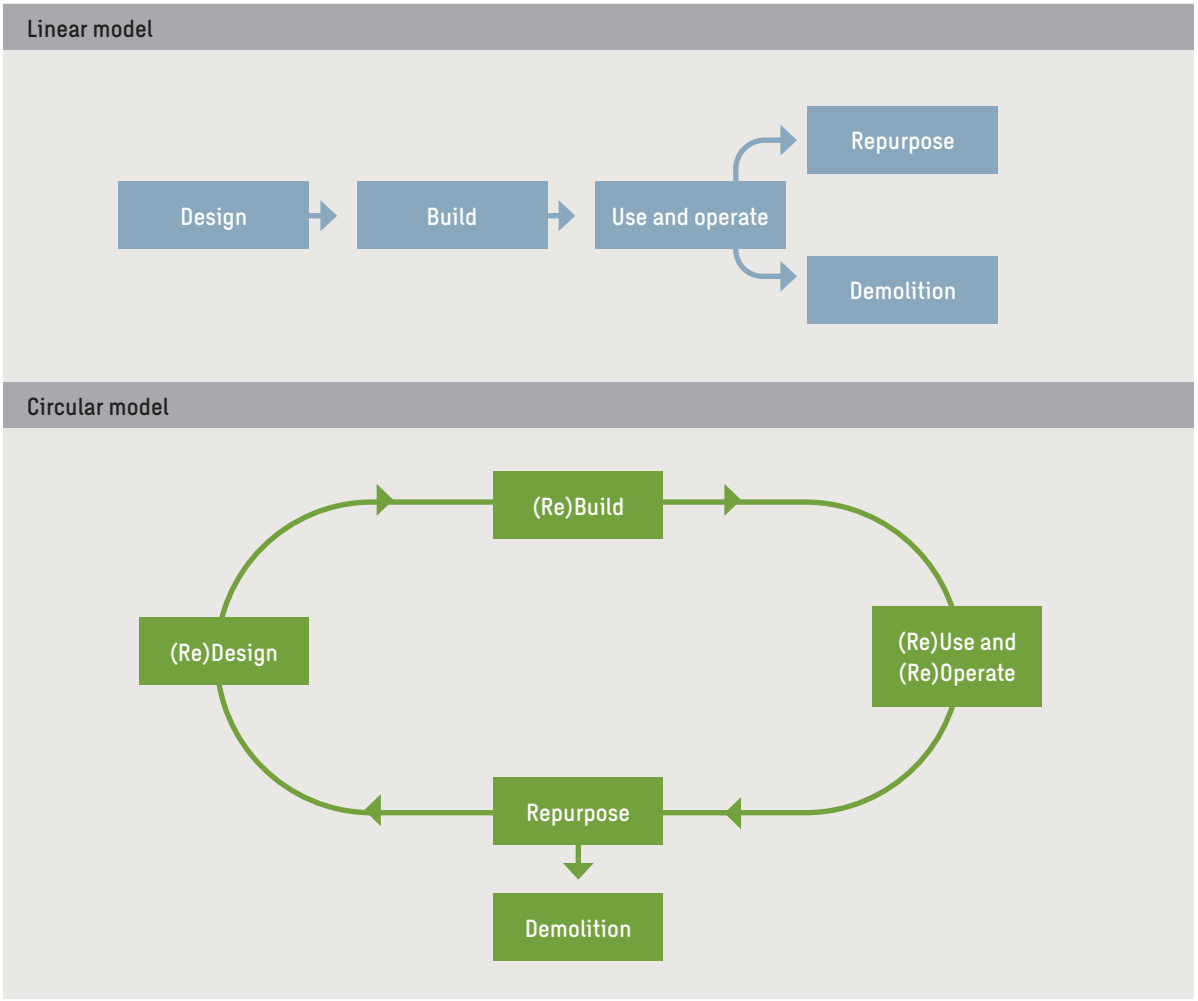
Matchmaking for demolition is another prototype tool from Sweco aimed at bridging the time gap between planning and demolition and better matching supply and demand for the reuse of materials in design and construction. This software tool scans the internet in Sweden for official municipality documents, targeting words like demolition, land allocation and exploitation/development. The software generates a link to any municipality document mentioning these words and informs architects in advance of plans for demolition and construction in any specific location, enabling them to match this with their own design plans for construction within the same area.

Minimising risks with material passports

The purpose of material passports is to link and store circular data of buildings or infrastructure projects for the purpose of asset management, maintenance or reuse decisions. The passport contains data about objects, making it easier to estimate their circular value and to take strategic decisions.

Information includes, for instance, which material or substance an object is made of, its qualities and estimated life cycle, geodata to make it easy to locate it and estimate its transportation costs, economic parameters, such as what it would cost to upcycle it, ecological parameters, such as embodied carbon already invested in the material, and cultural and esthetic values.

Material passports address a significant barrier in the circular reuse of recovered materials, as documentation and information about origins are often crucial prerequisites for reuse. They reduce the perceived or actual risk associated with the unknowns of recovered materials and play a major role in reducing scepticism. It should be noted that human behaviour is also a major factor in circularity. Risk-averse attitudes are normal, so tools that address such concerns are critical.



Shift from a linear to a circular economy (Peters M. et al 2016)[8]

Digital platforms as circular marketplaces for reuse

Even after identifying the value of existing buildings and finding direct and indirect ways of unlocking that value, much of this value cannot be converted without a marketplace for materials.

How to increase the reuse of building components?
The development of digital platforms for the reuse of building components, which is occurring simultaneously in several European countries, is one way to reduce building waste. The purpose here is to create a market for reuse and to better match need and supply. Digital platforms allow interested parties to share information, meeting the need for new circular services and creating a resource-efficient management of material resources. By digitising the material inventories and entering them into a digital marketplace, resources that can be reused, upcycled and rebuilt are made visible.

The CC Build platform is an open digital platform where all parties can publish and view available building materials[9]. Sweco consultants are so-called 'super users', active on the platform several times a day, harvesting circular resources for their clients. There are also commercial platforms, for example Loopfront and Madaster[10,11].

With these applications, a property owner or municipality could easily create a database with the necessary information about the products and materials and classify them efficiently in order to know which products could be reused in a cost-efficient way, freeing up more time for creativity.

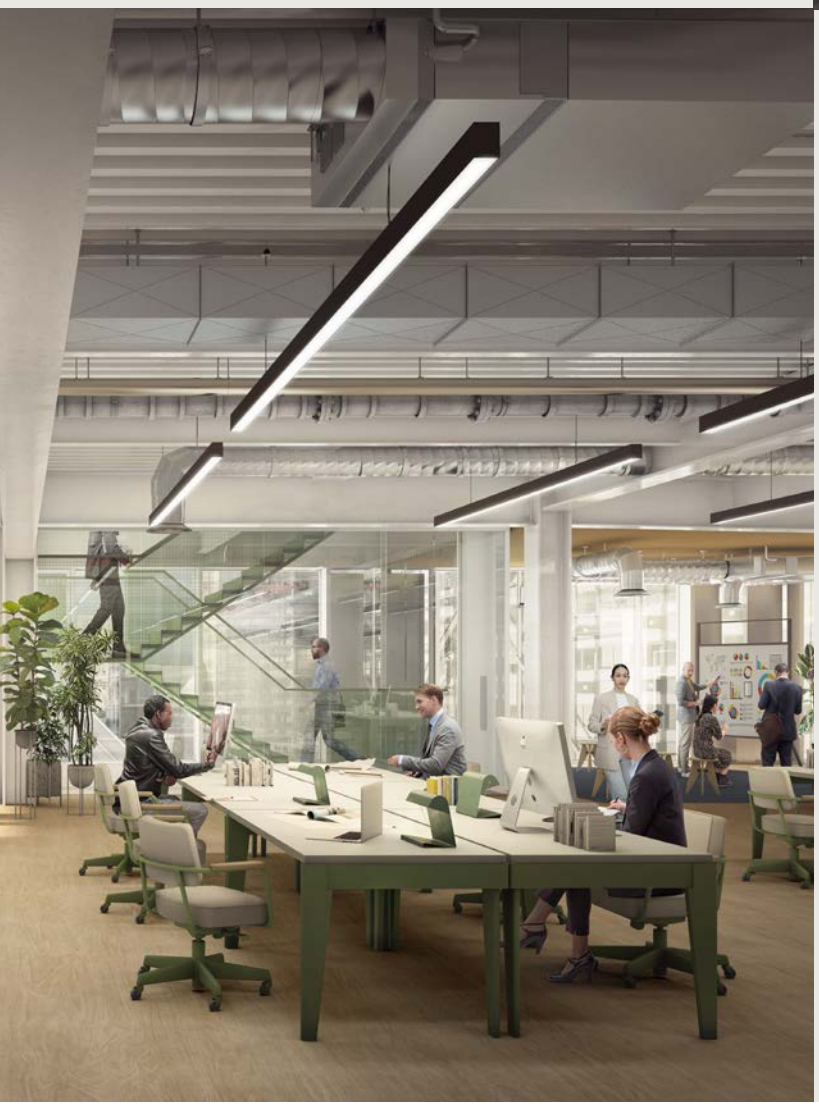
Recent developments include the combination of recycling services and digital platforms. Through the digital platform, objects for reuse as well as multi-disciplinary expertise in recycling at Sweco can easily be accessed.

Working with reused material in design requires more effort to find a circular option, as the fragmentation of information makes it inconvenient. In the Netherlands, a lot of groups have their own marketplace for reused materials, selling their own things. With the Sweco tool Revelop, the intention is to create a more efficient digital platform where all parties can see available materials and create a link to designer tools as well, for example, BIM (building information modeling).

Using the link between the digital marketplace and BIM design tools, the designer can connect data on what is available and add an artificial intelligence program to match demand with supply - a reverse design process. In the event of there being no available matching materials for parts of the construction, the designer can adapt the design to match the available supply - a reversed design process with a starting point in available materials.

1 Exchange Square in London.
By reusing foundations and 90% of the structure, the project saved 6,798m³ of concrete, saving 1,132 truck trips to site. 90% of the existing structural frame was retained. The steel retained in the frame is equivalent to one-half of the Eiffel Tower.

Client: PNBJ I / LaSalle Investment Management
Development Manager: M3 Consulting
Architect: Fletcher Priest Architects
Structural Engineer: Heyne Tillett Steel
Building Service & Sustainability: Sweco
1 Exchange Square
City of London, WC2, London
RIBA Stage 4 Design
Cut and carve redevelopment and extension
Images: Secchi Smith.



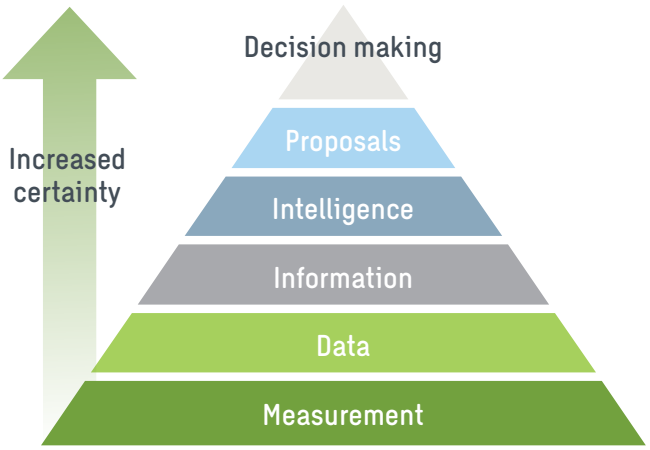
Project description:
- 90% of the existing structure has been retained in order to limit the project's embodied carbon impact.
- 48% of the existing granite cladding and associated supporting steelwork is proposed to be retained.
- Upgrades to facade insulation are proposed, with the incorporation of triple glazed units with high thermal performance (low u-value).
- Optimised window-wall ratio with passive solar control.
- Incorporation of green roofs (13,000 sq. ft.) and blue roof (15,000 sq. ft.) systems.
- Landscaped terraces provided on every level, 33,000 sq. ft. in total
- 801 cycle parking spaces with electric charging points.

Data ecosystems – avoiding silos

In order to better guide decision-making and extract circular value, different sources of data can be combined into an ecosystem of data, avoiding silos and enabling cross-functional and cross-border collaborations.

One example could be different resources linked to a certain value chain, while another example is the material flow within a city. It is crucial that both corporate and governmental structures enable this on a systemic level in order for a whole value chain to operate in a circular manner. We need to look at the interconnection of resources in order for the whole ecosystem to function. It should be possible to excel at data and information management even with different organisational systems and structures.

Unfortunately, that is not always the case today, as we still have silos regarding how data is organised and how accessible it is. Sometimes, it is also hard to convince organisations to share their data, for example, between a municipality and a private company. Another challenge is multiple data formats. The discussion about standardised formats has been going on for several years, but the complexity, diversity and pace of change all make it difficult.



The diagram shows the journey that information takes from raw data through to decision-making. Data tools could be used at every stage of this journey. Illustration by Sweco.

We are suffering from a lack of information. We have lots of data from different systems – but the data points don't become valuable until they are linked together and form a whole. As one of Sweden's largest property owners, we could increase reuse and create more circular processes if we can reuse a property via digital documents in the early stages before redevelopment or tenant adaptation begins.

Akademiska Hus, one of Sweden´s largest property owners

Digital twins – an ecosystem of data for a building

For property portfolios, one way to organise and create smart access to all necessary data for strategic decision making and reporting on buildings is to create a digital twin. For new buildings, 3D modeling is becoming more of an everyday practice for managing the complexity of information. It creates a good foundation for transitioning to a digital twin for the facility management phase and building operation. Existing buildings often lack adequate or up-to-date documentation.

A digital twin allows for the more resourceful use of a building's assets from construction throughout its life, such as documenting its materials and properties, smarter operation, or creating the foundation for new business models that share resources between stakeholders.

The data is all there. The challenge is to make different data sets and standards fit into a consolidated platform, kind of like square pegs and round holes.

Steven Brown, Head of Digital Twin, Sweco.

Twinfinity is a digital twin tool, developed by Sweco, which is used mainly by commercial clients. Twinfinity combines building data with other data such as live sensor data (humidity, temperature, user behaviour), operational data (energy, occupancy), financial data (tenant leases) or any kind of data available. This creates circular value on several levels, for example, circular asset management when making strategic decisions regarding renovation or smarter use of space.

The term "digital twin" was originally coined by Dr. Michael Grieves back in 2002, and NASA was one of the first to use this technology in its space research projects.

The digital twin can be a virtual copy of a piece of equipment but also of a larger object such as a building, a factory and even an entire city. Sustainable operation and sustainable maintenance provide both financial gain and a climate gain. Here, the concept of digital twins can function as an enabler to achieve the set goals.

Ask yourself, how could you use a digital twin to lower carbon impact?

Digitalisation of Vasakronan's buildings
Using Sweco's Twinfinity® platform, Vasakronan created digital twins of all of its 170 buildings. By gaining full control and an overview of all data, operation and management can be optimised, climate impact can be reduced, and work methods and service offerings can be smarter and more flexible.

As an example, the platform enables circular management by mapping all material that can be recycled and specifying its location. It is also possible to visualise carbon footprint, indoor climate and supporting data for sustainability certification.

Client: Vasakronan
Country: Sweden
Image by Sweco

Digi M.A.P. – an ecosystem of data on an urban scale

Digi M.A.P. is a method developed by Sweco that puts the geographic information system (GIS) into the hands of the users. Today, a lot of data, especially GIS, is handled by GIS engineers who do not fully grasp which data is useful in the process, how to use it, and when.

The complexity of a city model is difficult to understand. However, with Digi M.A.P. we combine different datasets into a digital map. A multidisciplinary team can hold a strategic discussion and gain new insights about complex urban situations by filtering out the different datasets and layers of information.

Digi M.A.P. can also serve as a platform to increase gig economy services. Envision a sort of digital map for circular services with real-time data such as material flows with geographic location, prognoses for which buildings will be scheduled for renovation and demolition (Reclaim) and new building plans projecting scenarios onto a Digi M.A.P. With another tool developed by Sweco, Revelop, designers can shop for reusable objects for their planned construction projects, for example, by using a QR code. The system matches what they need with the products available on the marketplace.

Other gig economy-oriented services could add offerings to the marketplace, such as a digital service for storage. It identifies suitable storage options, such as underused warehousing, with the option to store materials in transit from an old building to a new project. Matchmaking for demolition is another such example.

To illustrate the potential of sharing resources for circular transportation, LogTrade is software[12] that cities can use to move goods using gig services. For example, if windows from a demolition site need to be transported to a building site, they will be labelled with a QR code and the gig service will match the goods with a suitable hauler. Anyone passing by could offer to move materials and goods, thereby contributing to the circular transportation system within the city.

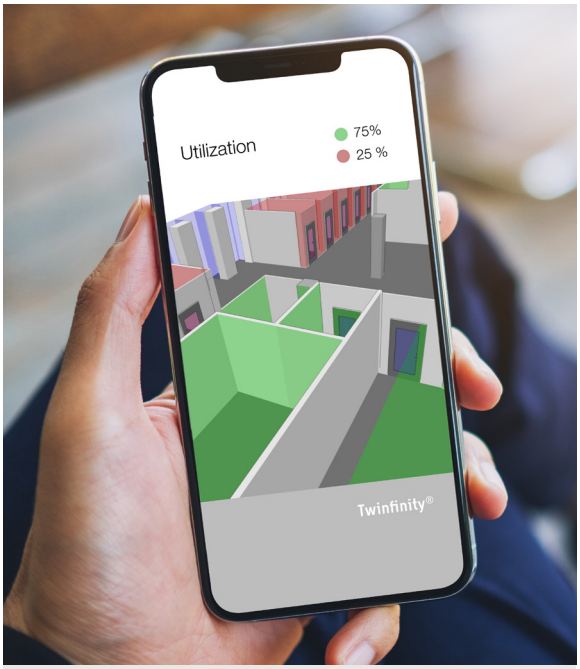


Image by Sweco

Full control over data provides optimised, resource-smart and sustainable management. Twinfinity is a cloud-based platform for digital twins. By connecting property data to a 3D model, data can be visualised, analysed and show how the property is constructed and operates.

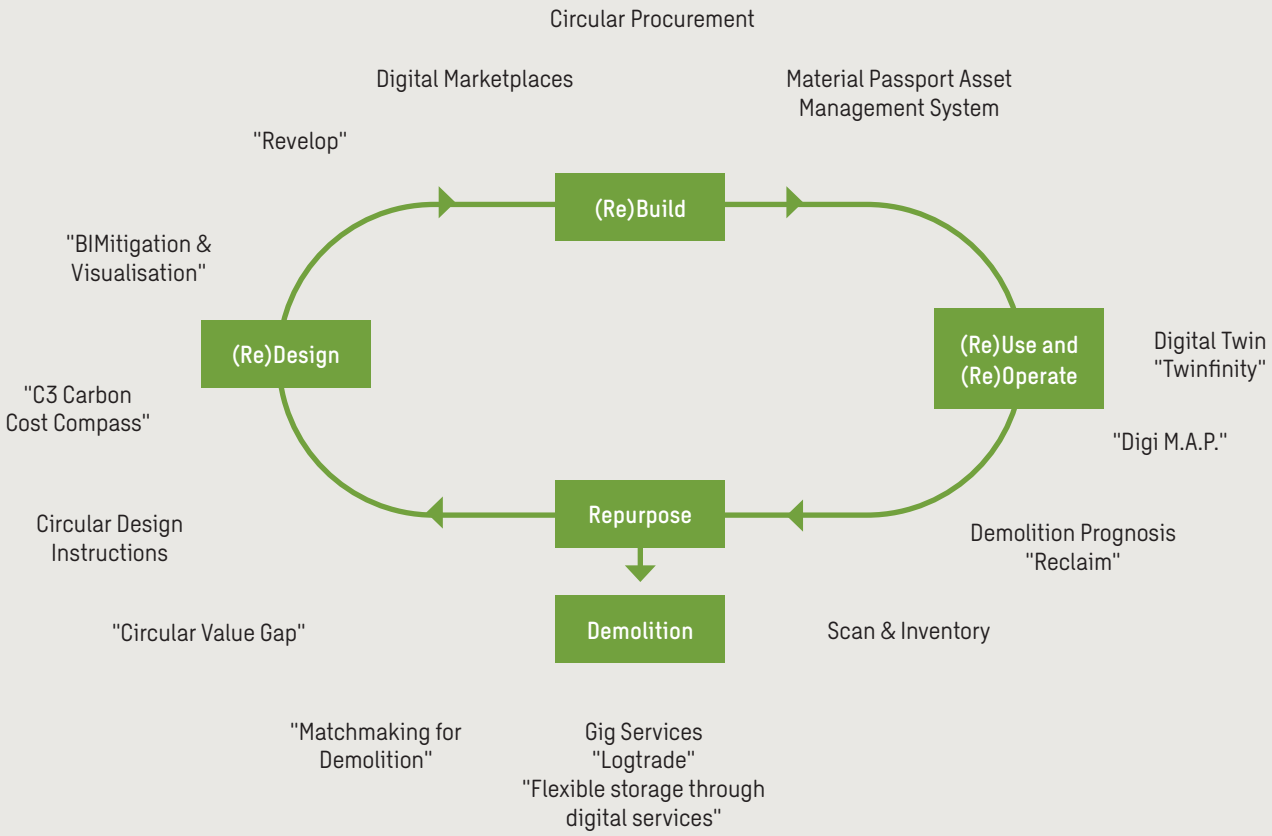
The only thing that increases in value when you share it is knowledge.

Professor Colin Pillinger, British planetary scientist.

It is critical that organisations are able to adapt to the fast changing data landscape and should take interest in the rapid development of tools. New methods can disrupt whole value-chain logistics and business models, leading to increased circular value creation.

Alastair Carruth, senior consultant within waste and resource management at Sweco.

How to: best and next practice



Recommendations

While the benefits of a circular-based society are becoming increasingly familiar, the journey to get there is less understood. By leveraging rapid advances in technology, Sweco has created best practice and next practice tools for generating value in the property and construction sectors. We hope that the snapshots in this report have inspired you to reflect on your own circular value creation and that we have helped you understand how to use data, knowledge and information to make better decisions and drive the circular transformation of the construction industry.

Stop demolishing value
For every square metre of floor space we demolish, we can effectively be destroying a value of EUR 750. Stop demolishing circular values and start exploring renovation and retrofitting as an alternative to rebuilding.

Create value from existing buildings
Use what you have and avoid emissions, costs and waste in line with EU requirements. Data tools are crucial in providing the overview of resources and the intelligence needed to illustrate 'embodied values' and make smarter circular decisions.

Create the biggest bang for your buck
Circular decisions at an early stage of a project, in the design phase, will make the greatest environmental impact and lead to the 'biggest bang for your buck'. Use data-driven design tools in combination with multi-disciplinary experts to design products and buildings that function within closed-loop resource systems.

Describe values with new currencies
Circular value creation requires us to handle different types of values, not only financial ones. They are described in different units: € for monetary values, kWh for energy, CO2 for climate impact, Circularity Index for adaptivity, assembly and disassembly, and so forth.

Avoid risk with circularity
Circularity is an instrument for achieving a portfolio of net-zero carbon buildings, or even carbon positive ones. A carbon fee or tax is likely to become reality also for the real estate and construction sector. Closed-loop, resourceful and effective systems are also less exposed to outside risks such as price shocks and material scarcity.

Extract the 'green gold'
Those actors in control of their sustainability data and who can make sense of it, analyse and visualise it, are better equipped to attract green funding, hence harvest the 'green gold'.

Manage your buildings and work smarter
Digital twins can support a more efficient use of space. Review whether you can adapt layouts and spaces, or change the use to better optimise the space.

Combine data with expertise
Date alone is not enough. Complexity demands both data-driven tools and expert dialogue to support strategic decision making.

Stop wasting time
Save up to 80% of your time by improving data management. Different formats for data, concepts, measurements and systems is a challenge, so striving for a common lexicon is vital. Database structures, such as BIM, are needed with a 'dictionary' flexible enough to bridge the various terms in use.

Be forward-looking and collaborate
Current best practice is not enough in a changing world. The ongoing development of tools is rapid and disruptive. Organisations and businesses should look to the future and move from copying best practices to creating next practices for sharing knowledge, tool and reference projects. Collaboration and access to existing information encourages value creation. Irrespective of how powerful the tools are, a siloed organisation risks missing out on the creative added value that collaboration brings.

About the Authors

Feel free to contact us with your questions and thoughts.
Email: urbaninsight@swecogroup.com

Alastair Carruth works in Sweco's Environment and Planning Division in Malmö, Sweden. He has contributed to a range of projects aimed at the acceleration of the circular economy, including support to small and medium-sized businesses and public sector organisations in the implementation of new business models, development of municipal and regional strategies for the circular economy, and the quantification and mapping of existing resources for the improved application of circular models. He has also provided help to organisations in the practical aspects of resource management such as transport and storage, understanding waste management regulatory requirements, standards and certification requirements and creating markets and services for reused and recycled materials. He has also worked in infrastructure construction with environmental management.

Photo: Anna Thorbjörnsson

Elise Grosse is Head of Sustainability at Sweco Architects in Sweden. She holds a Master's degree in architecture, is a certified IBN Building Biologist, and is currently a part-time PhD student in co-creation. In her research, she develops approaches to collective intelligence processes to increase sustainability in projects. Elise has an international background (Dominica, Berlin and Los Angeles) and an extensive international network of people sharing her interests. Her ingenuity, great initiative and strong belief in working for a more sustainable world have made her an expert at facilitating teams to develop new partnerships for a sustainable built environment and innovative solutions through co-creation among consultants with different perspectives. She has a special interest in the interaction between digital tools and a group´s creativity and is convinced that such approaches can solve our common existential challenges. She works at the forefront of business development for the sustainable built environment, initiating R&D projects, supporting next practices, leading organisational development, giving keynote speeches and moderating conferences.

SWECO CONTRIBUTORS: Sweco Sweden: Johann Nimmermark, Environment and Planning Division, Martin Kalén, Digital Services Division, Moa Hamré, Environment and Planning Division, Steve Brown, James Manfield, Architects Division, IT Management Division, Emma Danielsson, Energy and Industry Division,Fredrik Toller, Architects Division, Linda Hurtig, Architects Division, Mathias Näll, Architects Division, Karen Hurtig, Architects Division,Petr Bocharnikov, Architects Division, Anna Hessle, Architects Division, Ulf Ranhagen, Architects Division, Adam Sjödin, Architects, Patrik Waaranperä Jean-Simon, Environment and Planning Division,Matilda Rehn, Architects Division, Arvid Nelehag, Environment and Planning Division, Charlie Gullström, RnD Architects Division, Anders Neregård, Architects Division, Björn Skoogh, Digital Services Division, Ewa Buhr Berg, Architects Division, Maria Parent Trovik, Architects Division,Daan Cedergren, Architects Division, Karin Larsson, Environment and Planning Division, Ida Björling, Environment and Planning Division, Amanda Borneke, Buildings Division, Martin Sjöström, Digital Services Division,Anders Ekberg, Buildings Division, Emma Sterner Oderstedt, Sweco Group, Jonathan Eriksson, Illustrator. **Sweco UK:** Andy Krebs, Buildings Division, Doug Marsh, Advisory and Planning Division, Matthew Mapp, Buildings Division, David Jackson, Advisory and Planning Division. **Sweco Netherlands:** Douwe Huijsman, Transportation and Mobility Division, Geert van Bakel, Water and Energy Division, Enrico Moens, Urban Planning and Environment Division, Ernst van Zuilen, Transportation and Mobility Division, Nayan Herath, Water and Energy Division,Erwin Jacobs, Water and Energy Division. **Sweco Belgium:** Ray Jacobsen, Energy Division. **Sweco Finland:** Mirka Lumma, Gaia, Mia Andelin, Administration Division. **Sweco Denmark:** Christian Torp, Communications Division.

OTHER contributors Catharina Belfrage, Head of Sustainability, Handelsbanken, Sweden. Erik Stenberg, Associate Professor, School of Architecture, KTH Royal Institute of Technology. Lukas Ljungquist, Sustainability strategist and Research and Development Coordinator, City of Stockholm. Mia Edofsson, Chief Sustainability Officer, Akademiska hus

References

1) IPCC. (2021). IPCC 6th Assessment Report 2021. https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/ https://www.ipcc.ch/2022/02/28/pr-wgii-ar6/
2) CGRi. (2021). The Circularity Gap Reporting Initative: a global score for circularity 2021. https://www.circularity-gap.world/2021
3) European Environment Agency (2021). Construction and Demolition Waste in a Circular Economy. https://www.eea.europa.eu/publications/construction-and-demolition-waste-challenges
4) Interreg Europe (2021). Construction and Demolition Waste Generation in the EU. https://projects2014-2020.interregeurope.eu/smartwaste/news/news-article/11804/construction-demolition-waste-generation-in-the-eu/
5) European Commission. (2020). A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0662&rid=5
6) Sweco calculation
7) Hållbar Utveckling Skåne. (2022). Circular Buildings. https://www.hutskane.se/circular-builders/
8) Peters, M. Oseyran, J. Ribeiro, A. (2016). BAMB Value Network by Phase, BAMB Buildings – as Material banks Consortium. Taken from https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf
9) CCbuild. (2022). CCbuild. https://ccbuild.se/
10) Loopfront. (2022). Återanvänding av byggmaterial – enkelt och lönsamt. www.loopfront.com/sv/produkt
11) Madaster. (2022). https://madaster.com/
12) LogTrade. (2022). LogTrade. https://www.logtrade.se

This Urban Insight by Sweco report is a call for action. We took action by co-creating insights for how we can transform towards greater circularity through better data and information. This is a selection of current development. The real value of this report is generated by the informed actions of the many contributors who co-created this insight report. We hope to inspire more circular value creation.

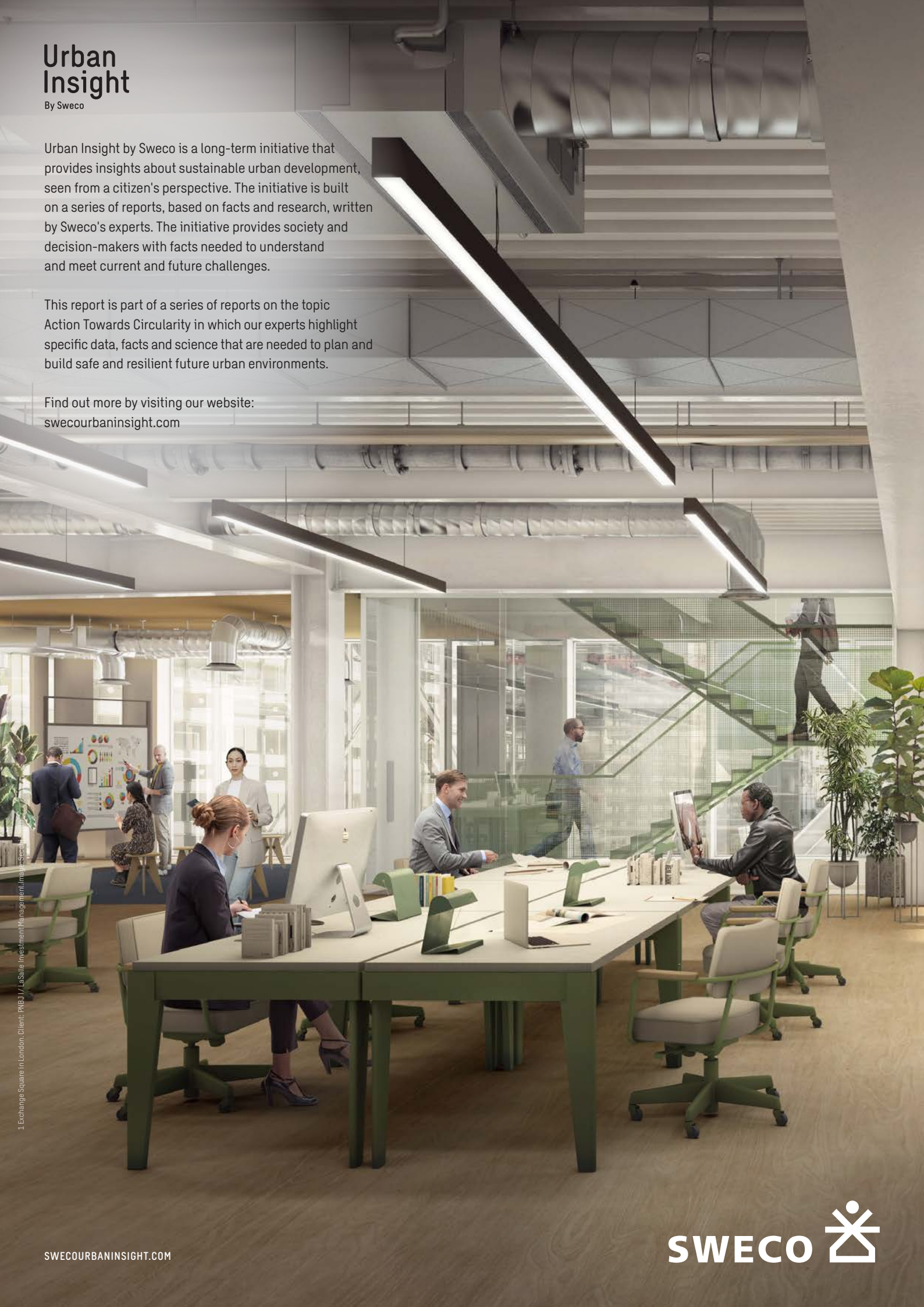
Urban Insight

By Sweco

Urban Insight by Sweco is a long-term initiative that provides insights about sustainable urban development, seen from a citizen's perspective. The initiative is built on a series of reports, based on facts and research, written by Sweco's experts. The initiative provides society and decision-makers with facts needed to understand and meet current and future challenges.

This report is part of a series of reports on the topic Action Towards Circularity in which our experts highlight specific data, facts and science that are needed to plan and build safe and resilient future urban environments.

Find out more by visiting our website:
swecourbaninsight.com



1 Exchange Square in London. Client: PNBJ / LaSalle Investment Management. Image: Sweco

SWECOURBANINSIGHT.COM

SWECO