SOLARIMPULSE FOUNDATION

90+ CASES FROM 40+ COUNTRIES
ACROSS THE FULL BUILDING LIFECYCLE

Catalogue of Climate Solutions for Buildings

UN environment programme

Global Alliance for Buildings and Construction

Catalogue of
Climate Solutions
for Buildings

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Foreword
Bertrand Piccard

Over the past years, identifying more than 1,600 solutions to protect the environment has helped prove that the ecological transition is not a burden but an opportunity. Yet innovation alone is not enough. What truly matters now is implementation: deploying these solutions at scale where they can deliver measurable impact.

This Catalogue marks the next step in that journey. It showcases concrete examples of technologies and projects already transforming how we design, construct, and operate buildings across six continents. Each use case demonstrates that change is not only possible, it is happening today. Together, they form a compelling picture of a sector ready for large-scale transformation.

Buildings and construction represent a major share of global emissions but also one of the greatest opportunities for progress. By presenting real-world deployments, this Catalogue aims to inspire confidence, accelerate replication, and show policymakers, investors, and practitioners what success looks like in practice.

True change will come when these proven solutions become the norm rather than the exception. That requires collaboration across public and private sectors, supported by forward-looking regulation and financing that reward efficiency, circularity, and innovation.

The solutions gathered here are not abstract ideas; they are evidence. Evidence that we already have the tools to decarbonise our built environment, improve lives, create jobs, and build a cleaner and more resilient future. What remains is the courage to deploy them.

Bertrand Piccard
Founder and President of the Solar Impulse Foundation

Foreword
Gulnara Roll

The built environment contributes to 37 per cent of global CO_2 emissions and 34 per cent of energy demand worldwide. While progress in decarbonisation and energy efficiency have been achieved–largely through renewables and clean technologies–this progress remains uneven, and outpaced by rapid construction growth in regions like Asia and Africa.

To drive transformative change in the buildings sector, private actors and governments must adopt energy-efficient solutions through a coordinated approach. Large enterprises and governments can set benchmarks, while small and medium-sized enterprises (SMEs) require targeted support to actively participate in this transition. Cities, often at the forefront of the climate shift, are crucial in piloting innovative policies that can later be scaled nationally.

Due to the fragmented nature of the building sector's value chain, collaboration is vital. Coordinated efforts among key stakeholders enhance affordability, competitiveness, and sustainable growth. Systemic changes, especially climate-specific solutions, need reinforcement through enabling frameworks–such as aligned regulations, procurement policies, financial incentives, and capacity-building initiatives.

The UNEP-hosted Global Alliance for Buildings and Construction (GlobalABC), a leading global platform dedicated to achieving a zero-emission and resilient building sector, has facilitated the adoption of the Declaration de Chaillot by over sixty national governments, and coordinates the Buildings Breakthrough, operating under the Breakthrough Agenda. In collaboration with the Solar Impulse Foundation, a frontrunner in deploying energy-efficient solutions, we are advancing these shared priorities with an array of committed partners.

The Buildings Breakthrough offers a powerful opportunity to accelerate progress towards a resilient, zero-emission future. Through global collaboration, innovation, and decisive action, we can transform the sector and ensure climate goals are met through informed decisions and resilient building practices.

Gulnara Roll
Head of the Global Alliance for Buildings and Construction (GlobalABC) Secretariat

DEPLOYMENT

Deployment: Priority Action B4 of the Buildings Breakthrough

With proven technologies already available to decarbonise buildings, Priority Action B4 of the Buildings Breakthrough focuses on accelerating their deployment worldwide. The goal is to move from ambition and planning to visible, on-the-ground transformation of the built environment

Scaling up solutions means putting muscle behind what already works: technologies that are already market ready, economically viable, and adaptable to diverse climates and contexts. Innovation in cleantech has raced ahead like a high speed train, yet deployment still lags at the station, held backy by fragmented regulations, limited financing, supply chain gaps, and uneven technical know-how. Addressing these challenges is essential to drive large-scale change in how buildings are designed, constructed, operated, and renewed.

This Catalogue shows what is already possible today. While not exhaustive, it presents a selection of real-world examples from five continents that are proven, scalable, and replicable. Covering the entire building lifecycle across design, construction, use, and end-of-life, it highlights technologies and approaches that are already delivering measurable results in different markets and conditions. Throughout the chapters, these solutions and use cases are complemented by examples of the enabling environment – including policies, financial mechanisms, and initiatives – that favour the deployment of the types of solutions presented.

By focusing on implementation, Priority Action B4 builds confidence among governments, industry, and civil society that the transition is attainable. The cases presented here demonstrate that large-scale deployment is no longer a distant horizon but a sunrise already visible in cities and communities around the world. With the right policy, financial, and technical support, these solutions can become the global standard for sustainable buildings – practical, economically viable and planet-positive.

LEADING

The Solar Impulse Foundation's Role in Priority Action B4

As the lead organisation for Deployment under Priority Action B4, the Solar Impulse Foundation bridges the gap between solutions that exist and the conditions required for their adoption, mobilising its global network of innovators, adopters, and experts to advance practical climate action in the built environment

The Foundation engages directly with adopters – public authorities, developers, corporations – helping them see clean technologies not as risky experiments but as smart investments. Through curated resources, peer-to-peer dialogues, and real-world use cases, it ensures that stakeholders see these solutions as not only environmentally necessary but also economically viable and operationally feasible.

Through workshops, peer-learning sessions, and collaborative research, the Foundation helps ideas travel – ensuring that lessons learned in one country can take root and rise elsewhere. This federating approach transforms isolated successes into a shared architecture of progress. The result is a growing ecosystem of actors who speak the same language of deployment – across policy, finance and technology – and wish to multiply impact.

By coordinating efforts across policy, technology, and finance, the Solar Impulse Foundation helps Priority Action B4 move from theory to implementation. Its guiding principle is clear: solutions exist, they are ready for market, and they must now be deployed at scale to decarbonise the built environment.

A FEDERATING APPROACH TO LANDING B4

To accelerate deployment under the Buildings Breakthrough initiative, the Solar Impulse Foundation convened three virtual Workshops, bringing together a wide range of stakeholders (from public and private sectors, from civil society. These sessions became construction sites of collaboration – participants shared experiences, discussed challenges, and explored best practices tailored to their specific contexts. The workshops aimed to generate practicable insights that can be implemented in various settings. The following document will provide a sample of these insights, along with concrete outcomes from the workshops, to offer actionable guidance for stakeholders.

FEDERATING

The Members Behind Priority Action B4

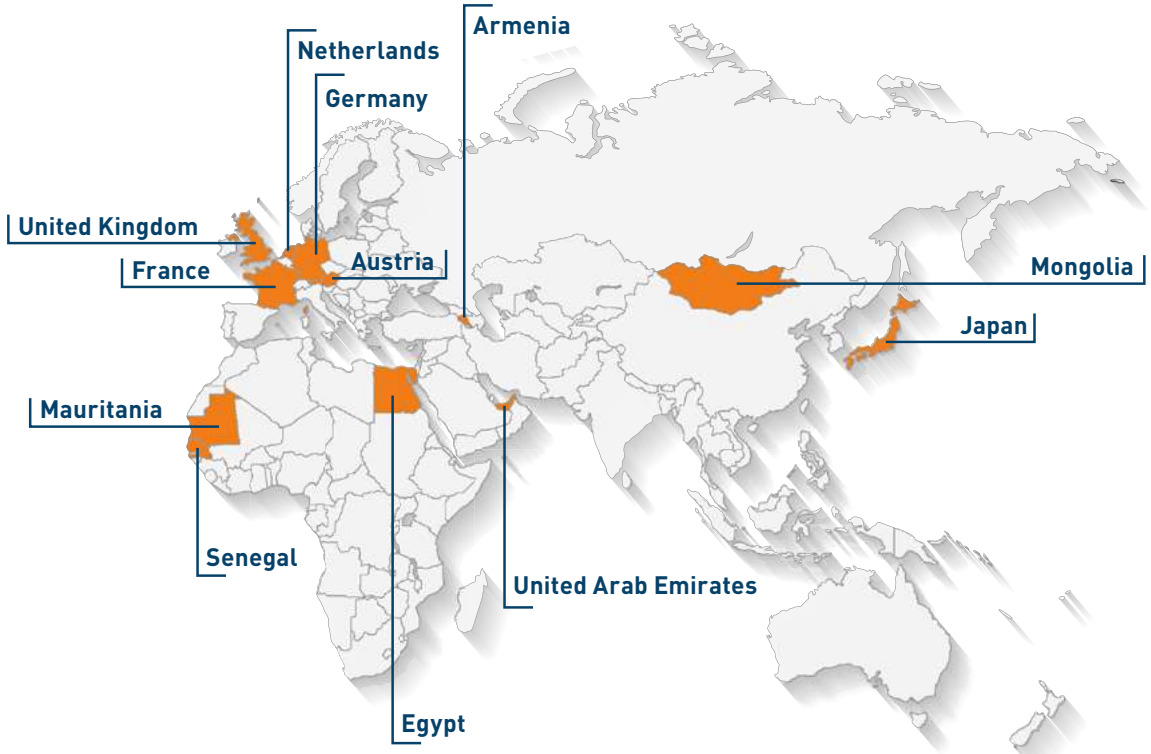
A coalition of global experts, governments, and organisations laying the foundations for large-scale solution deployment in the built environment

The **Priority Action B4 working group** unites, countries, companies and initiatives around one shared goal: to turn building decarbonisation from ambition to deployment. This multi stakeholder approach brings together the full construction chain of change – policy, technology, finance and advocacy.

Member countries in the working group provide essential policy frameworks, regulatory support, and pilot programmes that set the tone for global progress. These national efforts are critical in shaping local and global policy environments conducive to the large-scale deployment of sustainable technologies and solutions.

Private sector partners and NGOs play a complementary role by contributing both high-tech and low-tech solutions, financing mechanisms, and collective advocacy. Together, they share real-world use cases and best practices, creating replicable models for decarbonisation. This collaboration focused on deployment leverages each member's strengths, from policy and technology to financing and advocacy, to catalyse action across the built environment globally.

By combining insights with action, the **Priority Action B4** group is building a global platform where knowledge becomes implementation, and climate ambition becomes built reality.



12 MEMBER COUNTRIES

Armenia Urban Development Committee

Egypt Ministry of Housing, Utilities and Urban Communities

Austria Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology

France Ministry for Ecological Transition and Territorial Cohesion

Germany Federal Ministry for Housing, Urban Development and Building (BMWSB)

Japan Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

Mauritania Ministry for Environment and Sustainable Development (MEDD)

Mongolia Ministry of Construction and Urban Development & Ministry of Environment and Tourism

Netherlands Ministry of the Interior and Kingdom Relations; Construction and Energy Department

Senegal Ministry for Environment and Sustainable Development

United Arab Emirates Ministry of Energy and Infrastructure

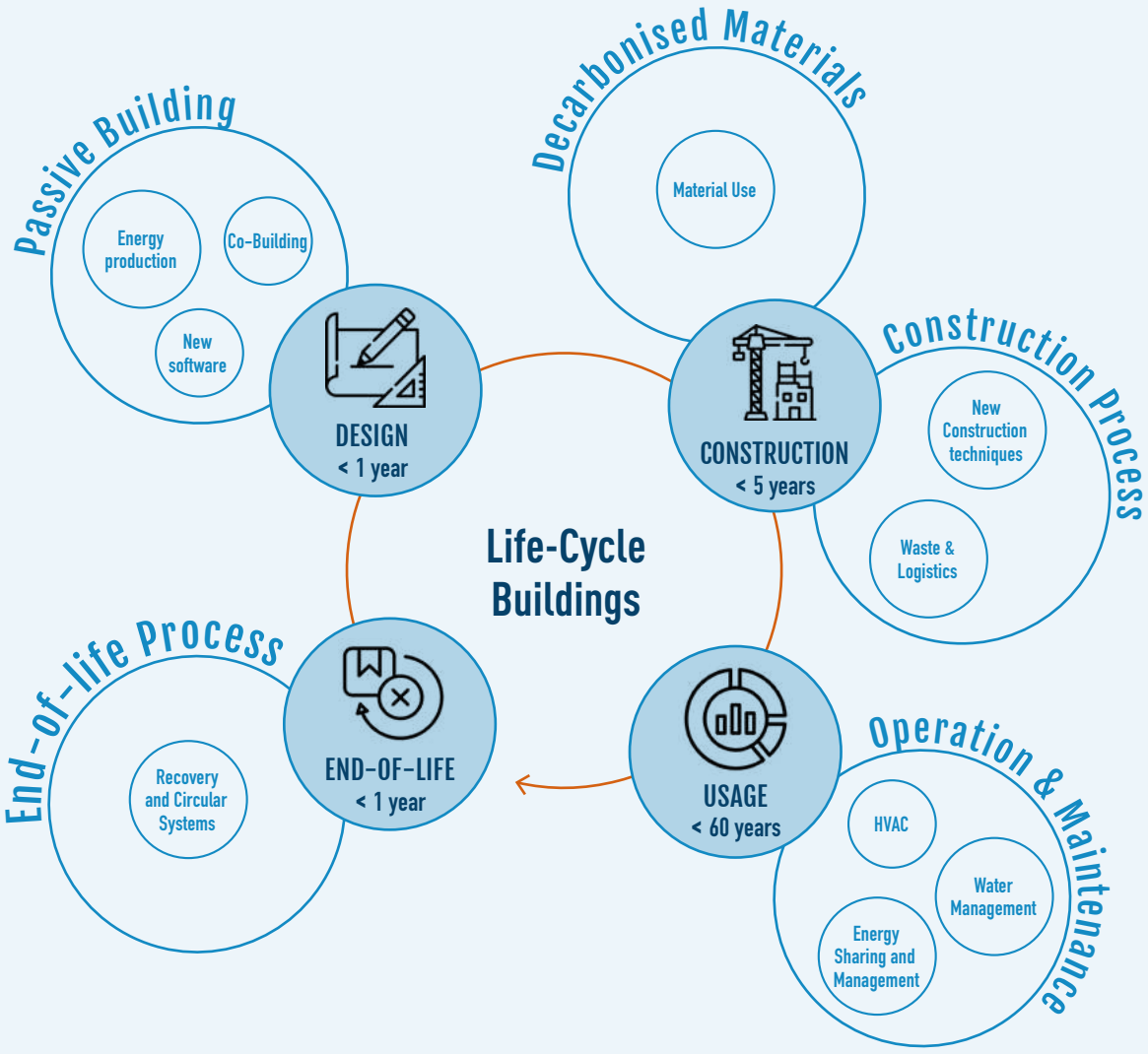
United Kingdom Department for Energy Security and Net Zero & Department for Business, Energy and Industrial Strategy

6 MEMBER NGOS

Solar Impulse Foundation | WBCSD | World Green Building Council | World Resources Institute | C40 Cities | Global Building Data Initiative

INVITED PRIVATE SECTOR STAKEHOLDERS:

ADEO | Bouygues | BNP Paribas | Engie | Schneider Electric


Passive Building
Energy production
Co-Building
New software
Decarbonised Materials
Material Use
Construction process
New Construction techniques
Waste & Logistics
Operation & Maintenance
HVAC
Water Management
Energy Sharing and Management
End-of-life Process
Recovery and Circular Systems
DESIGN
< 1 year
CONSTRUCTION
< 5 years
USAGE
< 60 years
END-OF-LIFE
< 1 year
Life-Cycle Buildings

FRAMEWORK

From Design to Disposal: A Life-Cycle Approach

Navigating sustainability challenges through innovative solutions across every phase of the building life-cycle

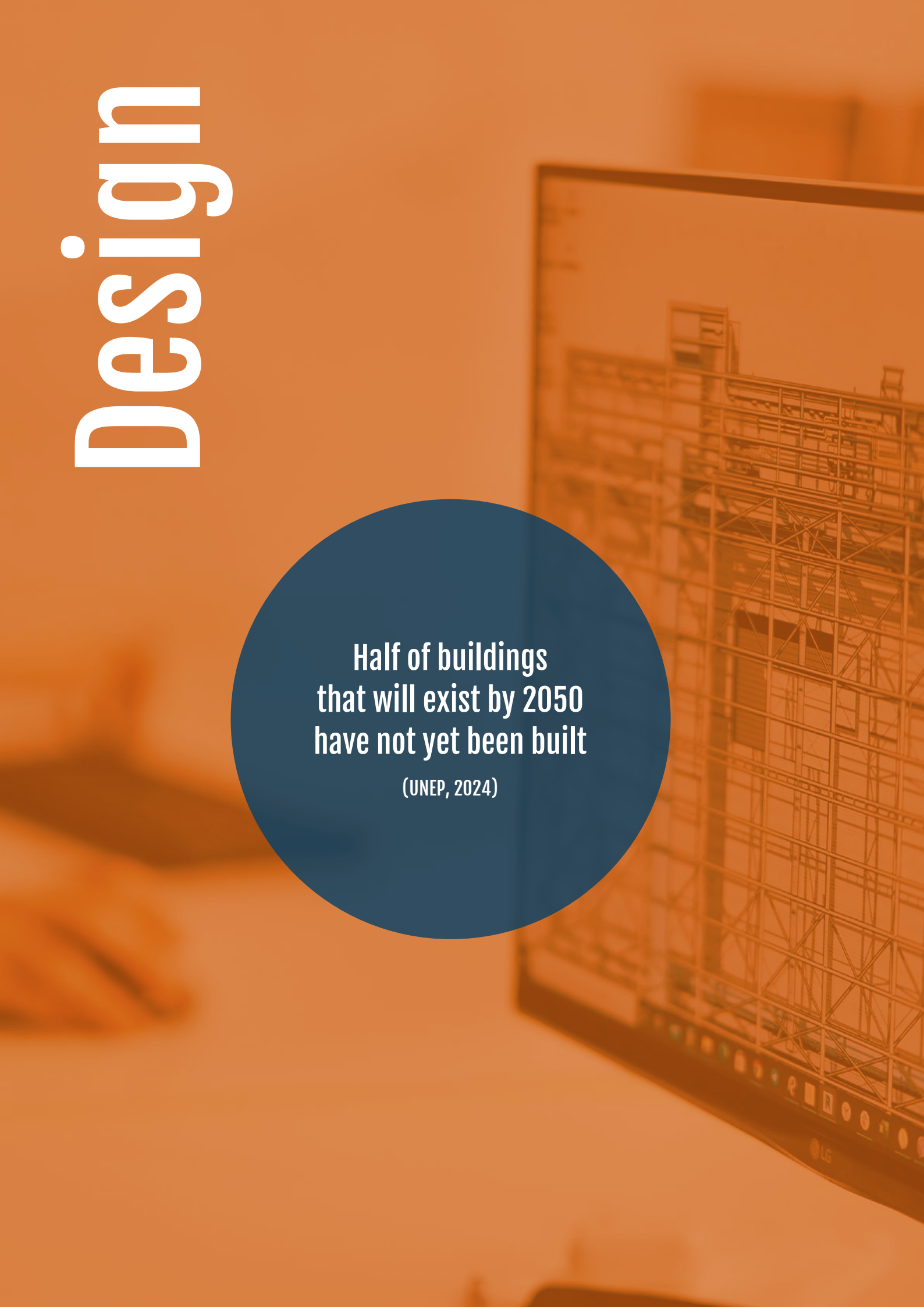
The Priority Action B4 group operates under a comprehensive life-cycle framework aimed at enhancing the sustainability of buildings from design to end-of-life. This framework reflects the understanding that climate impact is not confined to a single stage of a building's existence but is shaped by decisions made throughout its entire lifespan. It therefore encompasses four interlinked phases – **design, construction, usage, and end-of-life** – ensuring that sustainability principles guide every action, from material choice and building systems to maintenance and reuse.

At the heart of this framework are **five pillars** that define how sustainability is embedded in practice: **passive building design, decarbonised materials, sustainable construction processes, efficient operation and maintenance, and circular end-of-life strategies.** Together, these pillars underpin the **10 thematic chapters** of the Catalogue, which demonstrate how innovation is advancing across key areas such as low-carbon construction materials, energy production and management, HVAC and insulation, and water reuse.

The **Catalogue of Climate Solutions for Buildings** illustrates this framework in action, presenting concrete examples from around the world that prove climate-aligned construction is already achievable and scalable. Each case study highlights how coordinated progress across the lifecycle can deliver measurable reductions in emissions, resource use, and operating costs while improving resilience, affordability, and well-being.

As the group evolves, this life-cycle framework will continue to expand, incorporating new technologies, policy developments, and lessons from deployment on the ground. By continuously refining the framework and documenting real-world progress, the Buildings Breakthrough aims to turn the built environment into a cornerstone of the global transition toward a sustainable, circular, and climate-resilient future.

Design

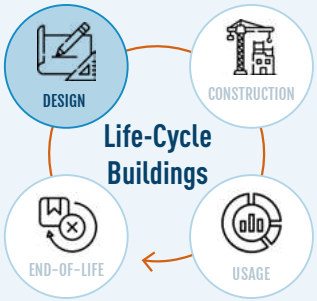


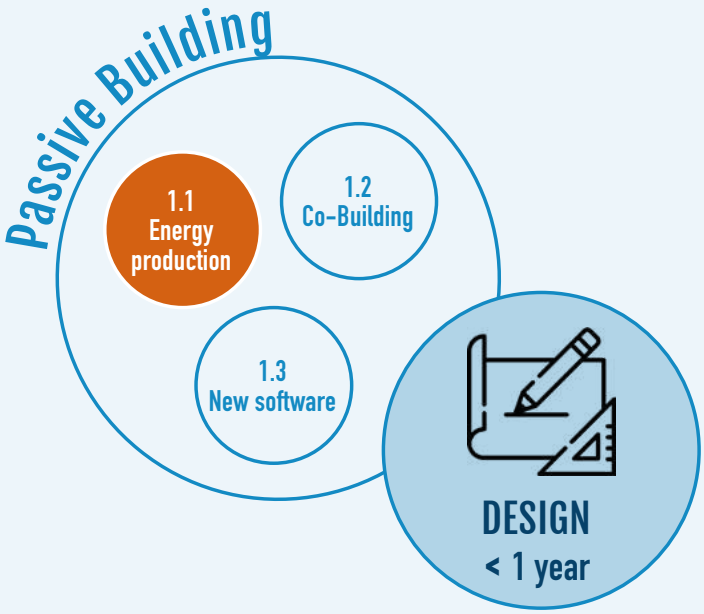
Half of buildings
that will exist by 2050
have not yet been built

(UNEP, 2024)

Design is where the foundations of sustainability are set.

Decisions made before construction determine how a building will be used, maintained, and adapted over time. Architects, engineers, and planners have the greatest leverage at this stage to cut lifecycle emissions, guide material choices, and optimise performance. Given that a significant share of the buildings that will exist in 2050 have yet to be built, design must address both new and existing stock. Early integration of passive design, renewables, and material circularity reduces operational and embodied carbon while improving comfort. Digital tools such as Building Information Modelling (BIM), Life Cycle Assessment (LCA), and simulation software now enable teams to model impacts and optimise decisions, making the design phase central to achieving low-carbon, resilient, and cost-effective buildings.





> 1.1 Energy Production

Designing buildings as energy producers rather than passive consumers is one of the most transformative shifts available today. Rooftops, façades, and underground structures offer underused surfaces that can host renewable energy generation. The IEA notes that electricity already accounts for 35 percent of building energy use and is set to rise as electrification accelerates (IEA, 2024). Integrating solar photovoltaics, building-integrated photovoltaic (BIPV), solar thermal, or shallow geothermal directly into design reduces reliance on fossil-based grids, cuts emissions, and supports resilience. In emerging economies, distributed generation provides affordable and reliable access where infrastructure is weak. It helps reduce peak loads and enables participation in smart grids. With falling technology costs and new financing models, energy production at the building scale is increasingly accessible for both new construction and retrofit, redefining how buildings interact with energy systems.

CHALLENGE

Expanding renewable generation through building design

Integrate rooftop PV, BIPV, solar thermal, shallow geothermal, and storage into new builds and retrofits

OBSERVATIONS

Buildings play a growing role in clean energy production, with technologies such as rooftop and façade-mounted photovoltaics, solar thermal collectors, and shallow geothermal systems increasingly integrated into design. These systems enable buildings to act as micro power plants, reducing grid dependence and supporting resilience. Architectural integration of solar energy, once limited to flagship projects, is now becoming standard in residential, commercial, and public buildings. Coupled with improved building envelopes and smart energy management, on-site generation can significantly cut operational emissions and energy costs.

OBSTACLES

Adoption is constrained by high upfront costs, limited technical expertise, and regulatory uncertainty over grid connection and metering. In many countries, outdated building codes and a lack of incentives discourage the integration of on-site renewables. For urban settings, structural limitations, shading, and complex ownership arrangements can make installation difficult. In emerging markets, access to finance and supply chain maturity remain key barriers to scaling.

OPPORTUNITIES

Falling technology costs, net metering schemes, and building energy performance regulations are accelerating investment in on-site renewables. Integrating solar and geothermal systems at the design stage lowers installation costs and maximises output. Cities and developers are increasingly adopting energy-positive building standards, while public procurement and certification schemes can drive mainstream adoption. Combining renewable generation with energy storage and digital monitoring creates a pathway toward net zero and resilient building portfolios.

Integrating Geothermal Panels into Paris Housing

Paris, France
Since 2025

The Story

Enerdrape has completed its first French project in partnership with Paris Habitat, one of France's largest social housing providers, and CIEC (ENGIE Solutions). In a residential complex in Paris' 11th arrondissement, 145 of Enerdrape's prefabricated geothermal panels were installed across underground surfaces, covering 145 m². Connected to a 25 kW heat pump, the system delivers 70 MWh of renewable energy each year, significantly reducing reliance on fossil fuels. The installation was completed in just three months, without any drilling, showcasing the speed, flexibility, and minimal disruption of Enerdrape's technology. For the 72 housing units, this represents not only an environmental gain but also a tangible example of how urban buildings, especially those outside district heating networks, can rapidly adopt clean energy solutions. This project marks a pivotal milestone in accelerating renewable heat integration into dense city environments.

Solution Spotlight

Enerdrape develops the first available modular, and scalable geothermal panel technology that allows turning any new or existing underground infrastructure into a renewable source for the heating and cooling of buildings. By offering energy professionals and building owners a low-carbon, cost-competitive, and easy-to-install solution to avoid CO_2 emissions associated with thermal energy supply and increase the use of on-site renewables, Enerdrape fosters the decarbonisation of the building sector.

Efficiency Gains

Environmental

- **Covers 25% of hot water needs with renewable geothermal energy**
- **Avoids 15 tonnes of CO_2 emissions per year**

Economic & Social

- **Produces 70 MWh of renewable energy each year**
- **Lowers heating operational costs through renewable energy integration**
- **Maintains resident comfort throughout the retrofit process**

How was it Financed?

The project was fully funded by Paris Habitat as part of a broader retrofit of the building's heating system. Enerdrape's solution was integrated into the project by CIEC (Engie Solutions), the operator in charge of heating, who sourced the panels from Enerdrape and delivered the turnkey installation.

Enablers and Challenges

The enabling factors are a strong collaboration with CIEC, whom they trained and supported during technical integration, laying the foundation for a lasting partnership. Paris Habitat, with ambitious decarbonisation goals and openness to innovation, was quickly identified as the ideal pilot partner to deploy Enerdrape's solution in France. A key challenge was decarbonising a dense urban site not connected to district heating. Enerdrape enabled access to local geothermal heat directly on the building footprint. Installation also had to be managed with minimal disruption, ensuring building operations and resident comfort were maintained throughout the retrofit process.

Net-Positive Energy Design

Santiago, Chile
Since 2024

The Story

In 2024, Santiago became home to Latin America's first certified Net Zero Energy and Carbon building: the Burgos Building. Developed by Tecton Inmobiliaria with architectural design by Izquierdo Lehmann and sustainability consulting from EBP Chile and Switzerland, the project sought to demonstrate that net zero is achievable in a region with no prior certified examples. The 1,941 m² mixed-use building, combining offices and housing, integrates passive strategies with renewable generation. A rooftop array of 37 solar panels generates 33,239 kWh annually, exceeding the building's 25,289 kWh consumption. Structural timber stores over 200 tonnes of CO_2, while thermal insulation achieves three times the Chilean norm. By achieving net-positive energy performance and significant carbon storage, Burgos provides a replicable pilot for Chile's legally binding 2050 carbon neutrality target.

Solution Spotlight

The Burgos Building integrates advanced passive house principles with local construction practices. It features triple-standard insulation, solar control glazing, and an airtight envelope. Renewable energy is provided by 20.35 kWp of rooftop solar PV, complemented by heat recovery ventilation, efficient lighting systems, and high-performance chillers. Structural timber was chosen both for durability and for its carbon storage capacity, aligning with international Minergie certification standards adapted to Chilean conditions.

Efficiency Gains

Environmental

- **Net-positive energy: 33,239 kWh produced vs. 25,289 kWh consumed annually**
- **Over 200 tonnes of CO_2 stored in timber structure**
- **Lifecycle emissions 37% below RIBA 2025 targets**

Economic & Social

- **Proof of cost-effective private sector financing model**
- **Reduced energy bills and operational costs**
- **Supports Chile's climate targets with replicable standards**

How was it Financed?

The project was financed by raising private capital, with Inmobiliaria Burgos SpA as a shareholder. The project was supported without any public or private incentives. The project was financed by Tecton Inmobiliaria with private investment from the Basler Familie.

Enablers and Challenges

Delivery was enabled through strong collaboration between developer, architects, and EBP consultants. Applying Swiss Minergie standards, adapted for Chile, ensured rigorous certification. Ambitious climate policy provided momentum, while integrating passive and renewable systems with local materials created a cost-effective model.

ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Expanding Access to Distributed Solar through Balcony Systems in Vietnam

The Balcony Solar Systems (BSS) project, supported by GIZ under Germany's develoPPP programme, demonstrates how small plug and play photovoltaic units can support Vietnam's transition to distributed renewable energy. Drawing on Germany's success, where more than one million balcony systems have been installed, the initiative brings together seven German and Vietnamese companies to pilot the approach and develop the technical, regulatory, and market frameworks required for wider deployment.

Vietnam's rapid urbanisation and rising electricity demand have increased the need for household level clean energy options, yet existing policies mainly support large rooftop and utility scale projects. The BSS project addresses this gap through the installation of 100 balcony solar systems in Ho Chi Minh City. Each unit's performance, safety, and cost effectiveness are monitored in real time to generate data on energy generation, household savings, and grid interactions, informing future standards and incentive schemes.

The project also explores business models such as leasing arrangements and local assembly to make adoption more affordable. In parallel, the consortium is engaging public authorities on safety certification, consumer awareness, and integration with national energy planning.

By combining demonstration, data collection, and policy dialogue, the project builds the foundations for citizen driven distributed solar in urban environments. Scaled nationally, it could unlock hundreds of megawatts of additional solar capacity, strengthen grid resilience, and empower households to contribute directly to Vietnam's energy transition.

Deploying Façade-Integrated Solar Heating

Bruges, Belgium
Since 2024

The Story

At its 1,000 m² workshop, UIMM Bruges aimed to significantly reduce gas consumption and comply with environmental standards (Tertiary Decree/RE2020). To achieve this, a solar thermal energy recovery solution, R' Booster, was installed across 220 m² of the façade. AirBooster's software was used to predict the façade's energy production and size the system precisely. The installation, completed without disrupting workshop activities, now provides high-performance heating in winter, night cooling in summer, and improved air quality. A real-time monitoring screen displays system performance.

Solution Spotlight

Because the sun sits low on the horizon in winter, façades collect twice as much energy as roofs. The R' Booster® solution takes advantage of this by circulating outdoor air behind the building's metal cladding, which heats up on contact with the metal. The warmed air is then either injected directly into the building through the ventilation system or directed to one or more heat pumps to improve their coefficient of performance and overall efficiency. With this approach, the system delivers an energy yield of 790 W per square metre, around four times higher than that of photovoltaic panels.

Efficiency Gains

Environmental

- **Cuts greenhouse gas emissions by 77%, avoiding 23 tonnes of CO_2 equivalent annually**
- **Maintains a stable indoor temperature between 16 and 22°C year-round**
- **Reduces reliance on air conditioning through free cooling**

Economic & Social

- **Provides 120 kWc capacity**
- **Saves 4.5 MWh per month in winter**
- **Reduced energy bills by 77% during winter 2024–2025 while maintaining comfort**
- **Improves air quality, confirmed by UIMM employees**

How was it Financed?

The solution was financed through private investment from UIMM, with a projected payback period of 6.2 years. It is also available as a service model, requiring no upfront investment.

Enablers and Challenges

The project succeeded thanks to a low-tech solution that was simple to install and quickly profitable, enabling adoption with minimal disruption. The system's simplicity and reliability were decisive factors. The main challenge was delivering the collected air to a distant area of the workshop, which required careful design and integration. Overcoming this ensured both efficiency and comfort.

> *"We have halved our energy costs and enhanced the well-being of our teams. Air Booster exceeds our economic and environmental expectations."*
>
> **François Hotte**, Head of UIMM Bruges

Building Affordable Passive House Units in Innsbruck

Innsbruck, Austria
2019-2022

The Story

Between 2019-2022 , the City of Innsbruck, through its municipal housing agency Innsbrucker Immobilien GmbH & Co KG, delivered over 180 social housing units built to Passive House standards according to PHI. Supported by long-term financing from the European Investment Bank (EIB), the project aimed to integrate ultra-low-energy design into affordable rental housing. Developed in collaboration with certified Passive House designers and local construction firms, the initiative sought to prove that high performance, comfort, and energy efficiency could be delivered at scale without compromising affordability.

Solution Spotlight

The buildings exceed Near-Zero Energy Building (NZEB) thresholds by over 20%, incorporating ultra-insulated walls, airtight building envelopes, triple-glazed windows, and mechanical ventilation systems with heat recovery. These Passive House components minimise heat loss, ensure a constant indoor climate, and significantly reduce reliance on active heating systems.

Efficiency Gains

Efficiency Gains

- **Reduces heating energy demand by 20–40% compared with NZEB baselines**
- **Delivers average energy savings of around 14 kWh/m² per year**
- **Improves building performance and lowers overall emissions**

Economic & Social

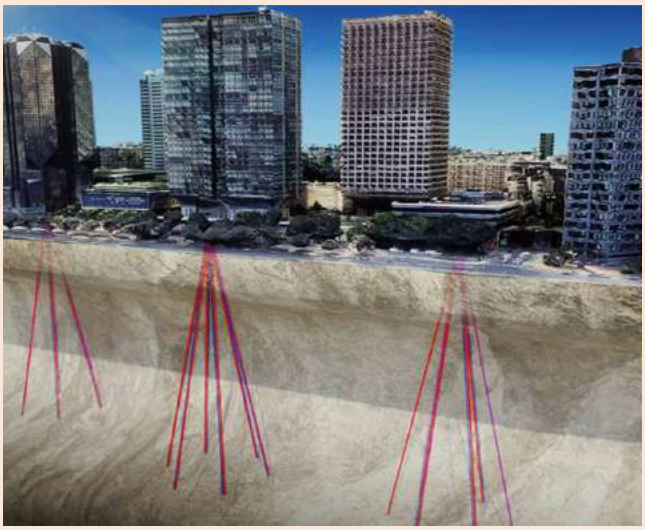
- **Cuts tenant heating costs by up to €250 per year per unit**
- **Enhances indoor air quality and thermal comfort for occupants**
- **Increases property value and long-term affordability through reduced operational expenses**

How was it Financed?

The project was funded with support from the EIB, which provided low-interest, long-term loans. Despite a 3–6% incremental cost over conventional builds, the lifecycle cost is offset by reduced operational expenses and increased affordability for tenants.

Enablers and Challenges

EU policy alignment, particularly the 2018 Energy Performance Directive, and strong municipal leadership created a favourable framework. The use of modular Passive House design allowed streamlined scaling, and competitive public tenders helped engage the local market. Key challenges included managing noise and vibration during construction and ensuring airtightness quality through dedicated installer training.



Harnessing Geoenergy for Sustainable Heating and Cooling

France
Since 2020

The Story

Founded in 2019 within SLB, Celsius Energy leverages SLB's expertise to innovate geothermal heating and cooling for buildings, aiming at building decarbonisation. Since installing the first system at a SLB campus near Paris in 2020, Celsius Energy has completed over 15 systems, including a 7,600m^2 corporate headquarters renovation. This project, featuring a ground-source heat pump, surpassed the client's energy-saving goals, showcasing geoenergy's role in reducing carbon footprints and boosting energy efficiency.

Solution Spotlight

Celsius Energy's system integrates a borehole heat exchanger (BHE), connected heat pump plant room, and a digital energy management system. The inclined BHE geometry minimises surface space requirements, making it ideal for constrained sites. Digital solutions allow for comprehensive monitoring and optimisation of energy use throughout the system's lifecycle.

Efficiency Gains

Environmental

- **Reduces carbon emissions by up to 95% compared to traditional heating and cooling systems**
- **Local, reliable source of energy**
- **Long-life installation (50+ years)**
- **Reduces stress on the electricity grid**

Economic & Social

- **Reduced headquarters' energy consumption by 73%**
- **Reduced energy bill by 52%**
- **Enhances occupant comfort during heat waves**

How was it Financed?

The client funded the project, supported by government funding for up to 30% of costs. Celsius Energy's partners also contribute through Energy-as-a-Service (EaaS) financing.

Enablers and Challenges

Key factors included Celsius Energy's space-efficient BHE design, collaboration with the construction team, and government funding, enabling efficient project completion within eight months.

©Unsplash – Hasnan Monir

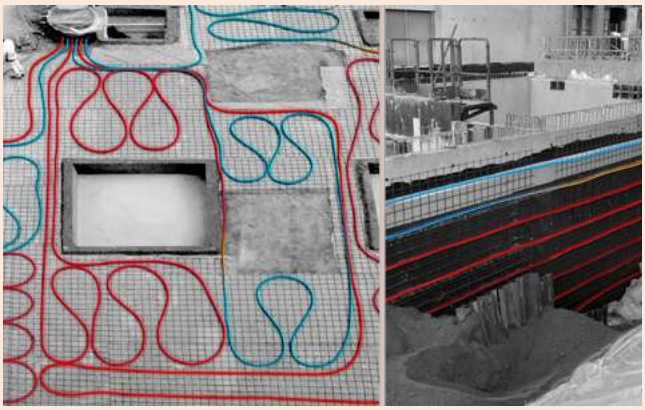
ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Growing Rooftop Solar Access for Households in India

Launched in February 2024, *PM Surya Ghar: Muft Bijli Yojana* is a national programme designed to make rooftop solar accessible and affordable for Indian households. With an investment of around USD 9 million, the scheme targets 10 million homes and offers up to 300 units of free electricity per month to each participating household. By combining direct subsidies with low-interest loans, the initiative addresses the key barriers to adoption: high upfront costs, complex procedures, and limited access to trusted installers.

Through a one-stop online portal, families can apply for solar systems, select certified vendors, and receive real-time updates on approvals, installation, and subsidy disbursement. State electricity companies (DISCOMs) are responsible for inspection, grid connection, and verification, creating a transparent and standardised process across India's diverse states. By mid-2025, over one million homes had already been solarised, supported by more than 50 USD' in government subsidies. The programme is expected to generate an additional 30 GW of rooftop solar capacity and cut around 720 million tonnes of CO_2 emissions over its lifetime. It also strengthens domestic manufacturing and installation industries, creating local jobs and improving grid resilience by decentralising energy generation.

PM Surya Ghar demonstrates how a large-scale, policy-driven model can unlock household-level renewable energy production in a rapidly growing economy. By combining financial incentives, digital tools, and regulatory coordination, India is turning millions of homes into clean energy producers, showing how government-backed design and delivery systems can drive the mass deployment of distributed renewables.



Energy Geostructures: Foundations for Low-Carbon Heating and Cooling

Switzerland
2021-2024

The Story

Energy Geostructures by GEOEG is implemented in places such as Lausanne (EPFL campus) and Prilly-Malley (Insula SA) in Switzerland. It uses geostructures (foundations and subsurface structural elements) as geothermal heat exchangers. They serve as heat source/sink for buildings' heating, domestic hot water, and cooling, integrating with ground-source heat pump systems. Because structural foundations are always required, this dual use reduces extra excavation, material usage, and embodied emissions. The solution achieves substantial emission cuts compared with conventional gas boilers or air conditioning.

Solution Spotlight

The *Energy Geostructures* Solution proposes a system for heating and cooling individual buildings or urban districts using underground infrastructures. This technology consists of allocating to any concrete structure in contact with the ground an additional function as a geothermal heat exchanger in addition to its initial role as a structural element. The technology has been implemented in a number of projects, with the advantage of meeting most or all of a building's energy needs with a renewable geothermal resource.

Efficiency Gains

Environmental

- **Reduces environmental impact by up to 60% compared with conventional gas-fired boilers and air conditioning systems**
- **Lowers emissions, mitigating human health risks, and reducing resource depletion**

Economic & Social

- **Generates cost savings of approximately USD 30/m²/year compared with conventional fossil fuel–based heating and cooling systems**
- **Enhances thermal comfort while reducing operational energy costs for occupants and building owners**

How was it Financed?

These projects are built by GEOEG with institutional or private partners (e.g. Insula SA). Returns of investment come via saved energy costs and reduced fuel usage. GEOEG received support from BCV Foundation and SPEI Vaud, while additional revenues come from completed remunerated projects.

Enablers and Challenges

Enablers include the ability to combine structural and thermal functions within the same foundations, growing regulatory pressure to reduce operational carbon, and the inherent availability of subsurface space in urban projects. Key challenges remain, such as increased design complexity, higher upfront investment, and the need for ongoing monitoring to ensure efficient underground heat exchange and long-term system performance.

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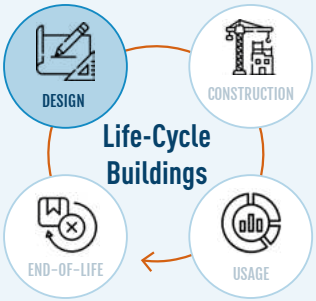
ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

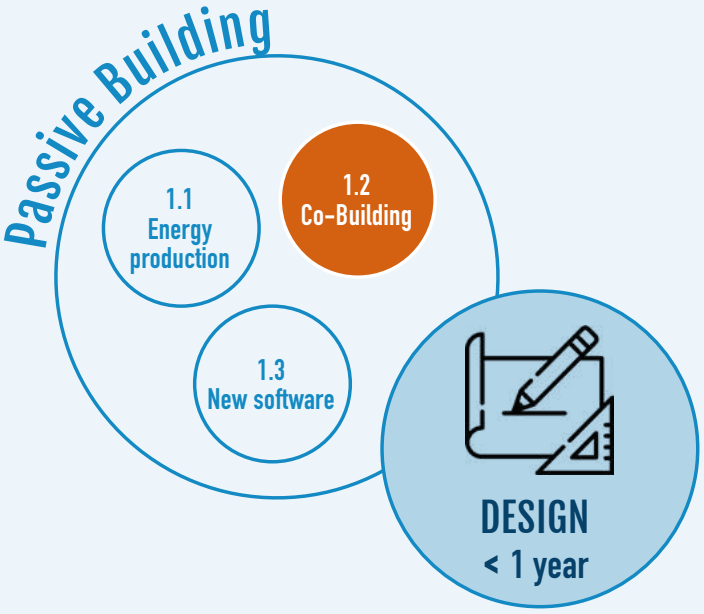
Advancing a Just Energy Transition in South African cities

In South Africa, where electricity generation is still dominated by coal, cities are taking proactive steps toward a just transition to clean energy. Cape Town was a frontrunner with its Small-Scale Embedded Generation (SSEG)programme, launched in 2014, enabling households, businesses and institutions to install rooftop solar PV or small wind systems and feed surplus power into the municipal grid. This decentralised approach empowers consumers to become "prosumers", strengthening energy security and reducing fossil fuel dependence.

In the absence of national legislation on small-scale generation and feed-in tariffs, Cape Town created its own framework with bi-directional metering, standardised tariffs and automated billing systems. The city also partnered with the South African Photovoltaic Industry Association (SAPVIA) and local NGOs to train solar installers, offering subsidies of 75% for men and 100% for women to build an inclusive local workforce.

By 2019, over 2,000 systems were connected, avoiding more than 77,000 tonnes of CO_2. Continued municipal advocacy has helped shape clearer national regulations and inspired similar initiatives across other metros. By 2020, nearly 60 cities allowed distributed generation, with over 40 introducing application processes and more than 30 SSEG tariff regimes. South Africa's major cities continue sharing knowledge and advancing just transition efforts through C40 Cities and local partners, showing how local innovation and leadership can drive a resilient, decentralised and low-carbon energy future.





> 1.2 Co-Building and Participative Design

Co-building, also referred to as participative design, recognises that sustainable housing is not solely a technical challenge but also a social one. Involving communities directly in design and decision-making ensures that projects reflect local needs, cultural values, and climatic conditions, while improving long-term durability and affordability. Participatory housing models empower residents to contribute their skills and knowledge, use local materials, and expand homes incrementally in ways that suit their circumstances. Such approaches strengthen acceptance and ownership of social housing and urban regeneration projects, enhancing both their effectiveness and longevity. Importantly, co-building also supports climate adaptation – for example, through community-led mapping of passive cooling, shading, or water-management strategies. By aligning technical design with local insight and shared responsibility, participative design combines environmental performance with resilience and social equity.

CHALLENGE

Aligning design with community needs while ensuring sustainability

Use participatory workshops, integrate vernacular techniques, and prioritise affordability and local resources

OBSERVATIONS

Community-led design consistently results in higher satisfaction, stronger social ties, and better long term maintenance. In regions vulnerable to climate impacts, projects drawing on vernacular and climate responsive techniques such as elevated housing in flood prone areas improve resilience. NGOs and donor agencies increasingly promote participatory models. In cities with high development pressure, co design improves acceptance of affordable housing and regeneration projects, reducing opposition and strengthening trust between residents, authorities, and developers.

OBSTACLES

Co-building requires additional time and resources, which developers may perceive as costly. Institutional planning systems often lack mechanisms to formally include communities. Technical professionals may not have training in participatory processes, and residents may lack the expertise to assess technical proposals. In lower income settings, financial limits constrain what communities can achieve even with participation. Reluctance from developers or authorities to cede decision making power can further restrict participatory approaches.

OPPORTUNITIES

Participatory design strengthens social licence and creates more adaptable housing. By encouraging incremental expansion and shared resources, co building can lower costs and reduce environmental impacts. Donors and public funders often prioritise projects with community ownership, creating financing opportunities. Coupling participatory workshops with digital tools enables evidence based yet locally appropriate design. Scaling these approaches through public procurement could mainstream inclusive design, embedding social sustainability across diverse contexts.

Participatory Planning for Upgraded Housing in Kigali

Kigali, Rwanda
Since 2023

The Story

The Mpazi Rehousing Project is an in-situ upgrading scheme in the Gitega Sector, Nyarugenge District, Kigali. Rather than relocating residents far away, the project replaces informal, flood-prone housing with new blocks on or near the original site, preserving community ties. The plan foresees nine blocks to house 1,100–1,500 households. The first "demonstration block" provided 26 units, and further blocks are under development. As of May 2025, 172 families have been allocated new homes among 688 units completed, bringing the total to roughly 793 units when combined with earlier housing. The project is integrated with Rwanda's broader Rwanda Urban Development Project II (RUDP II), supported by the World Bank, to improve infrastructure, sanitation, and access to services in upgraded neighborhoods.

Solution Spotlight

The approach emphasises participatory planning: existing landowners contribute land or are compensated, and layouts (typologies, communal spaces) are co-designed with residents. Housing is delivered alongside infrastructure upgrades – roads, drainage, sanitation, water supply, and utilities – which reduce flood risk and improve public health. Construction uses modest-cost materials adapted to the local climate and topography, and is phased to allow continuity of community life while minimising environmental disruption.

Efficiency Gains

Environmental

- **New drainage and infrastructure reduce flooding and soil erosion**
- **Higher quality housing lessens exposure to hazards and helps prevent disaster-related displacement**
- **Improved services (water, sanitation, waste management) reduce pollution risks and strengthen resilience**

Economic & Social

- **172 households have already been resettled, maintaining land claims and reducing vulnerability**
- **Residents report greater safety, more durable housing, and improved wellbeing**
- **Local jobs created in construction and infrastructure upgrades, strengthening skills and income**
- **Preserves community networks and livelihoods by avoiding full displacement**

How was it Financed?

Funding is a mix of public investment and development financing. The City of Kigali has secured funds for the first four building blocks, with additional support through RUDP II, financed by the World Bank.

Enablers and Challenges

The project has been enabled by strong government leadership, alignment with Kigali's master plan, and integration with existing programmes such as RUDP II. Community buy-in was achieved through participatory design and compensation for landowners, while World Bank financing ensured delivery. Challenges include keeping housing affordable, managing land compensation fairly, and ensuring financial sustainability at scale. Risks of gentrification and exclusion of original residents persist, while technical issues like terrain and drainage, combined with the need for close coordination across agencies, add further complexity.

Enabling Incremental Social Housing

Iquique, Chile
Since 2003

The Story

In the early 2000s, 93 low income families lived in an informal settlement on a 5,000 m² site in central Iquique. With land values three times higher than typical social housing budgets, rehousing seemed impossible without relocation to peripheral areas. Commissioned under the Chile Barrio and Vivienda Social Dinámica sin Deuda programmes, Elemental, led by Alejandro Aravena, developed a radical solution: build "half a good house" that residents could complete over time. Within the available subsidy of US $7,500 per household, 93 modular homes were delivered between 2003 and 2004 at US $204 per m². The strategy reduced demolition waste by upgrading existing living conditions on site, limited urban sprawl by preserving centrality, and provided long term durability. By 2017, every unit had expanded, often doubling in size and improving both resilience and value.

Solution Spotlight

Each two storey dwelling was delivered as an expandable half house, including essential services: kitchen, bathroom, stairs, and utility connections. An open structural frame provided capacity for future extensions without demolition. Homes were arranged around semi private courtyards to maintain density and reduce land consumption while offering shared outdoor space. The expandable model reduced the need for new land and resources, extended building lifespans, and avoided the environmental costs of peripheral relocation. This design created adaptable housing that conserved materials while allowing families to expand sustainably.

Efficiency Gains

Environmental

- **Reduced embodied carbon by building only the essential half-house initially**
- **Central location curbed urban sprawl and transport-related emissions**
- **Incremental construction with locally available materials reduced overall emissions and waste**
- **Adaptability avoided demolition/rebuild cycles, extending lifespan**

Economic & Social

- **Property values often doubled within one year of expansion**
- **Enabled families to invest progressively in construction**
- **Preserved access to jobs, schools, and healthcare, supporting social mobility**
- **Strengthened community ties through participatory design and shared courtyards**

How was it Financed?

The project was financed through Chilean housing subsidies (~US $7,500 per family), Chile Barrio, and municipal support. By constructing only half a house, government funding stretched further, while residents financed extensions incrementally, reducing upfront costs and enabling long-term affordability.

Enablers and Challenges

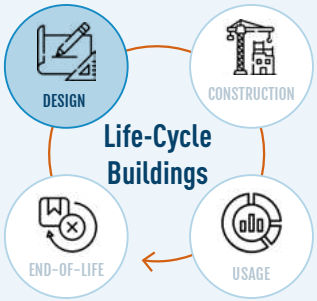
Strong co-design with residents built trust and ownership. The compact typology, expandable structure, and shared courtyards enabled density and resilience. Policy support through Chile Barrio provided land and subsidies. This alignment of design, governance, and community engagement made the incremental model viable and replicable.

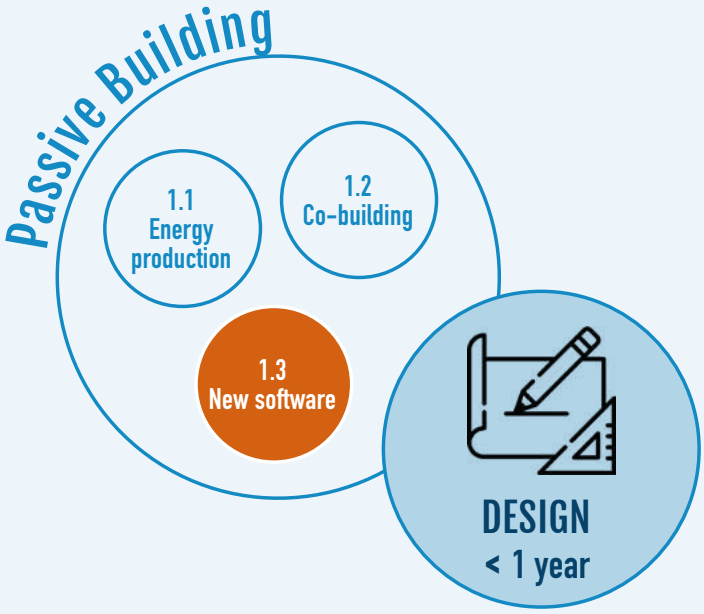
ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Scaling Low-Energy Homes through a Delivery Model in Tajikstan

By involving homeowners, builders, and local institutions in each stage of delivery, the Low-Energy Consumption (LEC) house programme in Tajikistan applies the principles of participatory design to energy-efficient housing. Led by the NGO Geres, the programme coordinates technical assistance, incentives, and partnerships across the construction chain. A critical enabler has been the collaboration with financial institutions such as Arvand and the First Microfinance Bank, which developed specialised "green loans" to help households finance the higher upfront costs of efficient construction. Homeowners are supported with information on the benefits of LEC houses, while Building Design Institutes and the Scientific Research Institute of Construction and Architecture provide certified blueprints to ensure technical quality.

Construction companies and material suppliers are directly engaged to deliver houses that meet performance standards. To encourage compliance, the programme uses incentive mechanisms such as cash bonuses for households that adhere to certified designs. By aligning financial, technical, and construction actors under one delivery model, the programme has scaled from two to nine districts and inspired replication in Kyrgyzstan. This ecosystem of finance, design, training, and incentives shows how coordinated governance can turn energy-efficient housing from a niche innovation into a mainstream practice in rural areas with high energy poverty.





> 1.3 New Software for Optimisation and Simulation

Digital platforms now allow design teams to quantify impacts, test scenarios, and avoid costly mistakes before construction begins. Building Information Modelling, Life Cycle Assessment, and digital twins enable the optimisation of energy, material use, and whole-life carbon from the earliest stages of planning. The IEA estimates that building energy intensity must fall by 35 percent by 2030 to align with a net-zero pathway (IEA, 2023). Simulation tools reveal cost and carbon savings early, improve collaboration across disciplines, and support compliance with tightening regulations. In the Global North, mandates for BIM and LCA are standardising sustainable design practices. In the Global South, open-source and low-cost platforms create opportunities to leapfrog directly to efficient, low-carbon construction. By linking software insights with participatory design, projects can deliver outcomes that are technically robust, socially inclusive, and environmentally ambitious.

CHALLENGE

Harnessing digital tools to optimise building design and reduce emissions

Adopt BIM, LCA, and simulation platforms, train practitioners, and integrate into procurement

OBSERVATIONS

Digital tools such as Building Information Modelling (BIM), Life Cycle Assessment (LCA), and digital twins are increasingly shaping how projects are planned and delivered. In advanced markets, their widespread use reduces costs and errors while enabling early scenario testing and whole-life carbon optimisation. In emerging economies, accessible and low-cost platforms supported by development partners demonstrate strong potential to improve energy performance and material efficiency. When integrated across the entire project lifecycle, these tools provide consistent data for decision-making, enhance collaboration among stakeholders, and deliver measurable emissions reductions.

OBSTACLES

High licensing costs and lack of technical capacity restrict use in many regions. Interoperability remains a major hurdle, with data often locked into proprietary formats. Small and medium-sized firms struggle with training and resources, limiting widespread uptake. In low- and middle-income contexts, access to reliable local material and climate data is poor, reducing accuracy of simulations.

OPPORTUNITIES

Mandates for BIM and LCA in public procurement are creating new markets for skilled providers. Open-source platforms and training initiatives can expand access in the Global South. International partnerships transfer knowledge and improve interoperability. Digital twins extend benefits into operation, enabling predictive maintenance and performance guarantees. Mainstream adoption of these tools could reduce lifecycle emissions, lower costs, and transform the design stage into a decisive climate lever.

Using EDGE to Design Efficient Buildings in Emerging Markets

Global (notably India, Vietnam, Kenya)
Since 2015

The Story

EDGE (Excellence in Design for Greater Efficiencies) is a free, web-based design software and certification system created by the International Finance Corporation (IFC) to help architects, developers, and governments design resource-efficient buildings. Targeted at emerging markets with limited technical capacity, EDGE models the energy, water, and embodied energy performance of building designs, comparing alternatives and estimating incremental costs and payback periods. It has now been applied in over 100 countries and underpins a growing portfolio of certified green buildings across Africa, Asia, and Latin America.

Solution Spotlight

EDGE uses local climate and cost data to calculate potential resource savings and identify cost-effective efficiency measures such as insulation, shading, or efficient HVAC. Buildings achieving at least 20% savings in energy, water, and embodied energy in materials can obtain EDGE certification from GBCI or Sintali.
The platform is freely accessible online and linked to local green building councils.

Efficiency Gains

Environmental

- **Typically ≥ 20% reduction in energy and water consumption**
- **Embodied carbon reductions vary depending on material choices and context**

Economic & Social

- **EDGE allows users to estimate incremental costs and payback periods**
- **Certification can enhance building marketability and value**
- **Builds local technical capacity through accessible data and online training**

How was it Financed?

EDGE was developed and financed by IFC under its Green Buildings Market Transformation Programme, with donor support from SECO and UKAID.

Enablers and Challenges

Strong IFC support and integration with local certification schemes drive uptake. Challenges include the need for continual calibration of local datasets and limited design capacity in smaller firms.

Using AI to Plan Building Decarbonisation

Europe
Since 2023

The Story

Resolia, a consulting firm specialised in energy planning, has become a driving force for district heating in Belgium, where less than 1% of heat is supplied by heat networks. Similar to many firms and utilities, Resolia's process of conducting feasibility studies was a costly bottleneck: energy engineers would spend months manually collecting data on thousands of buildings using spreadsheets and static maps, often losing competitive public tenders due to the time-consuming process.

> ***"We were basically doing 'data archaeology' on every new project. By the time we had solid data, the tender window was closing."***
>
> **Florine Thiry,** Energy Engineer at Resolia.

By adopting Urbio since 2023, Resolia was able to ditch the old planning playbook and go digital. They now instantly access nationwide building energy data, identify ideal building targets without the need for door-to-door prospection, and design viable network layouts in minutes with AI, catalysing over €90 million in total investment for low-carbon heating.

Solution Spotlight

Urbio replaces the manual prospection and design steps of district heating projects with a data-driven approach. The platform provides instant, nationwide building energy data through digital twins. It also captures the expert knowledge of engineers in AI-powered "Action Plans", allowing teams to efficiently apply proven strategies to new projects. This allows companies to generate scenarios and make go/no-go decisions in minutes, significantly accelerating project lifecycles and de-risking multi-million-euro investments.

Efficiency Gains

Environmental

- **Potential to avoid several gigatonnes of CO_2e in Europe by 2050 compared with current pathways**
- **Data accuracy up to 98% improves targeting and reduces misinvestment**

Economic & Social

- **Payback times shortened by 15-35% through optimised recommendations**
- **Planning time cut by up to 95%, enabling teams to deliver more projects**

How was it Financed?

Urbio originated from academic research at EPFL and is supported by venture capital. It operates as a commercial scale-up, licensing the platform to utilities, consulting firms and district heating developers, with revenues generated from software subscriptions and project-based fees.

Enablers and Challenges

Development is underpinned by strong technical expertise in energy and data science, investor support, and university networks. Challenges include variable availability and quality of data across regions, uneven regulatory frameworks for decarbonisation, and the need to build local capacity to act on AI-driven recommendations.

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Scaling Climate-Responsive Building Design through India's BEEP Programme

India
Since 2011

The Story

India's Building Energy Efficiency Project (BEEP), a joint initiative of the Bureau of Energy Efficiency (BEE) under the Ministry of Power and the Swiss Agency for Development and Cooperation (SDC), supports energy-efficient and thermally comfortable building design across India. Implemented in collaboration with CEPT University, BEEP develops design guidelines, tools, and capacity-building programmes to help architects and developers integrate passive and climate-responsive strategies into residential and commercial buildings. Since its launch in 2011, the project has contributed to the development of Eco-Niwas Samhita (ENS), India's energy conservation code for residential buildings, and has supported its dissemination and training. By adapting design guidance to local materials, construction practices, and climates, BEEP helps make performance-based design more accessible to Indian practitioners.

Solution Spotlight

BEEP provides simplified design tools and guidelines that allow users to estimate indoor comfort and potential energy savings from passive measures such as orientation, shading, insulation, and natural ventilation. These tools have been used to design climate-responsive housing prototypes and demonstration buildings in diverse Indian climates. The project also engages architects, developers, and state authorities to integrate energy efficiency into building approvals and training programmes.

Efficiency Gains

Environmental

- **Demonstration projects under BEEP have achieved up to 25–40% reductions in energy demand through improved building envelope design**
- **Reduced electricity demand in hot and composite climates helps lower stress on regional power grids**

Economic & Social

- **Demonstration projects show that incremental design costs can be minimal, with energy savings recovering costs within short timeframes**
- **Improved indoor comfort benefits occupants, particularly in low-income housing with limited access to cooling**

How was it Financed?

The project is funded by India's Ministry of Power through the Bureau of Energy Efficiency (BEE) and the Swiss Agency for Development and Cooperation (SDC), with technical input from CEPT University and other Indian research partners.

Enablers and Challenges

Strong institutional support from the Ministry of Power and alignment with national energy codes have facilitated adoption and replication. Challenges include limited local data for performance modelling, varying levels of awareness among smaller developers, and uneven enforcement of energy codes across states.

Accelerating Retrofit Pathways with AI

Switzerland
Since 2024

The Story

FREO, a leading European real estate manager, adopted Optiml's AI-powered retrofit planning platform to accelerate decarbonisation across its portfolio. In Switzerland, the software was first applied to an office building with ambitious sustainability targets. Using digital twins and energy simulations, Optiml modelled renovation scenarios that balanced cost and emissions. The selected strategy cut projected capital expenditure by 30% while accelerating CO_2 reductions by 70%, integrating renewable energy, natural materials, and smart ventilation systems.

Solution Spotlight

Optiml's Decision Intelligence platform uses AI, digital twins, and engineering-grade energy simulations to create investment strategies and retrofit pathways for buildings and portfolios. It optimizes IRR and asset value, avoids stranding, and ensures Net Zero compliance, enables scalable planning across geographies and asset classes, even with limited data, and integrates easily with existing tools.

Efficiency Gains

Environmental

- **>70% operational CO_2 reduction through optimised retrofit scenarios**

Economic & Social

- **>30% Capex savings compared to consultant baselines; >90% cost and effort savings versus spreadsheets**
- **Faster, more reliable decision-making reduces project delays and supports healthier indoor environments**

How was it Financed?

Adoption was managed through a commercial purchase order, offering a rapid payback period thanks to cost reductions and positive ROI.

Enablers and Challenges

Enabled by strong climate commitments and FREO's expertise in sustainable real estate. Challenges included fragmented data, stakeholder alignment, and initial scepticism over AI's reliability in retrofit planning.

Automating Whole Life Carbon Compliance in Building Planning

UK

Since 2025

The Story

The Planning Application Carbon Evaluation and Reduction (PACER) platform was developed by Preoptima in collaboration with Westminster City Council and 36 other UK local authorities, supported by Innovate UK. It is the first tool to embed Whole Life Carbon (WLC) compliance checks directly into planning application reviews. Local Planning Authorities (LPAs) currently lack the resources and expertise to rigorously review WLC assessments, leading to missed opportunities for reducing carbon emissions at the design stage across building types including offices, residential, schools, retail, and universities. PACER addresses this by digitising the review process, enabling officers to flag non-compliance and push for lower-carbon alternatives before construction, demolition, or retrofit begins.

Solution Spotlight

PACER automates the review of WLC assessments, benchmarking applications against policy requirements and industry standards. The platform provides standardised submission and review workflows, clear case officer guidance, and a central portal for applicant communication. It also generates insights to inform future planning policy.

By acting as a technical co-pilot, PACER empowers officers to intervene before construction by questioning material and assembly choices, flagging high-carbon design elements, and pushing back on non-compliance.

Efficiency Gains

Environmental

- **Projected to save ~7,100 tCO_2e annually in Westminster through streamlined enforcement of WLC policy requirements**
- **Early interventions – such as challenging the use of carbon-intensive materials, requiring alternative assemblies, or adjusting retrofit versus demolition decisions – secure carbon reductions before projects break ground**

Economic & Social

- **Reduces review costs and reliance on consultants by automating compliance checks; supports more efficient resource use in planning departments**
- **Builds capacity and technical confidence within planning teams; improves consistency across authorities and helps embed low-carbon decision-making into planning**

How was it Financed?

Funded by Innovate UK's Net Zero Living Programme and piloted with Westminster City Council. Future rollout will be financed through annual licensing models and potential national funding streams.

Enablers and Challenges

PACER was made possible by strong policy drivers such as the Greater London Authority's Policy SI 2 and Scotland's NPF4, along with co-design with end-users and collaboration between public and private partners.
Key challenges included inconsistent WLC assessment formats, uneven policy maturity across authorities, and budget constraints. These were addressed through flexible workflows, engagement with case officers, and a clear value case for adoption.

AI-Powered Carbon Analysis for Building Design

North America

Since 2025

The Story

C.Scale was created as a spinout from EHDD, a leading sustainable architecture practice, to shift the design process from focusing on energy alone to addressing whole life carbon. The platform was developed to solve a recurring challenge: carbon assessments are often costly, slow, and introduced too late to influence design. In 2025, C.Scale launched its tool combining architectural expertise with artificial intelligence and machine learning models. It allows project teams to measure carbon footprints early and identify the most impactful pathways for decarbonisation. In just six months, the software has been used on more than one thousand projects, representing over one hundred million square feet of construction, with forty per cent of projects setting quantified carbon reduction targets.

Solution Spotlight

C.Scale applies artificial intelligence and machine learning models to generate whole life carbon assessments covering operational, embodied and refrigerant emissions, even when only limited early stage data is available. Users – including architects, engineers and owners – explore carbon reduction scenarios at the whole building, assembly, and product level, and lock in savings as decisions are documented and quantified throughout the project lifecycle.

Efficiency Gains

Environmental

- **Embodied carbon reductions of up to 40% and operational carbon reductions up to 80% can be achieved at cost parity – if these solutions are identified early**

Economic & Social

- **Streamlined modelling reduces analysis costs by up to ten times compared with conventional approaches**
- **Expands access to carbon analysis for all project teams, increasing demand for low carbon products and strengthening sector wide capacity**

How was it Financed?

C.Scale raised early stage investment from North American venture capital firms focused on climate technology.

Enablers and Challenges

Enabled by decades of architectural practice, cross disciplinary expertise in software and data science, and close engagement with practitioners. Challenges included overcoming industry inertia, limited standardisation of carbon data, and maintaining affordability. These were addressed by keeping license costs low and developing a data based business model to maximise positive impact.

Optimising Energy Performance with VadiMap Software

Shawinigan, Canada
Since 2025

The Story

La Maison Eureka, an addiction treatment centre in Québec, prioritised improving the sustainability of its building's energy performance while working within strict budget limits. Using vadiMAP's streamlined process, the centre began with an online questionnaire that generated a tailored prescription report. This identified the most suitable subsidies and shaped a complete energy transition plan. The project delivered a comprehensive upgrade: roof refurbishment, attic insulation, new heating and cooling systems, LED lighting, a smart kitchen hood, and the installation of a nanogrid. Supported financially by PBCVI, Hydro-Québec, and Énergir, the initiative maximised efficiency while remaining affordable. Today, La Maison Eureka enjoys lower energy costs, greater energy independence, and real-time monitoring of performance – achieved in far less time and at lower cost than traditional renovation approaches.

> ***"Before construction, vadiMAP supported Maison Eurêka in translating its social values into sustainable energy choices. During the work, it helped implement tailored technologies focused on energy efficiency, autonomy, and reliability."***
>
> **France Bouffard,**
> General Manager at Maison Eurêka

Solution Spotlight

vadiMAP's platform relies on its NanoGrid Simulation Engine (NGSE™) and advanced algorithms to provide actionable energy insights. From the initial questionnaire, a digital twin was created to map scope 1 and 2 emissions. vadiMAP then delivered prescription reports and updates showing the most effective efficiency and renewable energy measures. Once implemented, simulated outcomes were compared with live data through an online dashboard, enabling continuous tracking. Multiple intuitive interfaces made the platform an accessible hub for vadiMAP's technologies, products, and services.

Efficiency Gains

Environmental

- **Reduced annual carbon footprint by 9.7 tCO_2e (19%)**

Economic & Social

- **Lowered annual energy costs by USD 16,700 (37%)**
- **Ensured 7.5 hours of backup power during outages**

How was it Financed?

The total investment of CAD $900,000 combined the centre's own funds with a CAD $691,000 public grant from the Canadian government.

Enablers and Challenges

The project required determined financial engineering and coordination among 10 stakeholders. Once funding was confirmed, a close partnership between La Maison Eureka and vadiMAP enabled smooth orchestration with contractors and firms, ensuring timely and effective delivery.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Indonesia's Green and Affordable Housing Programme

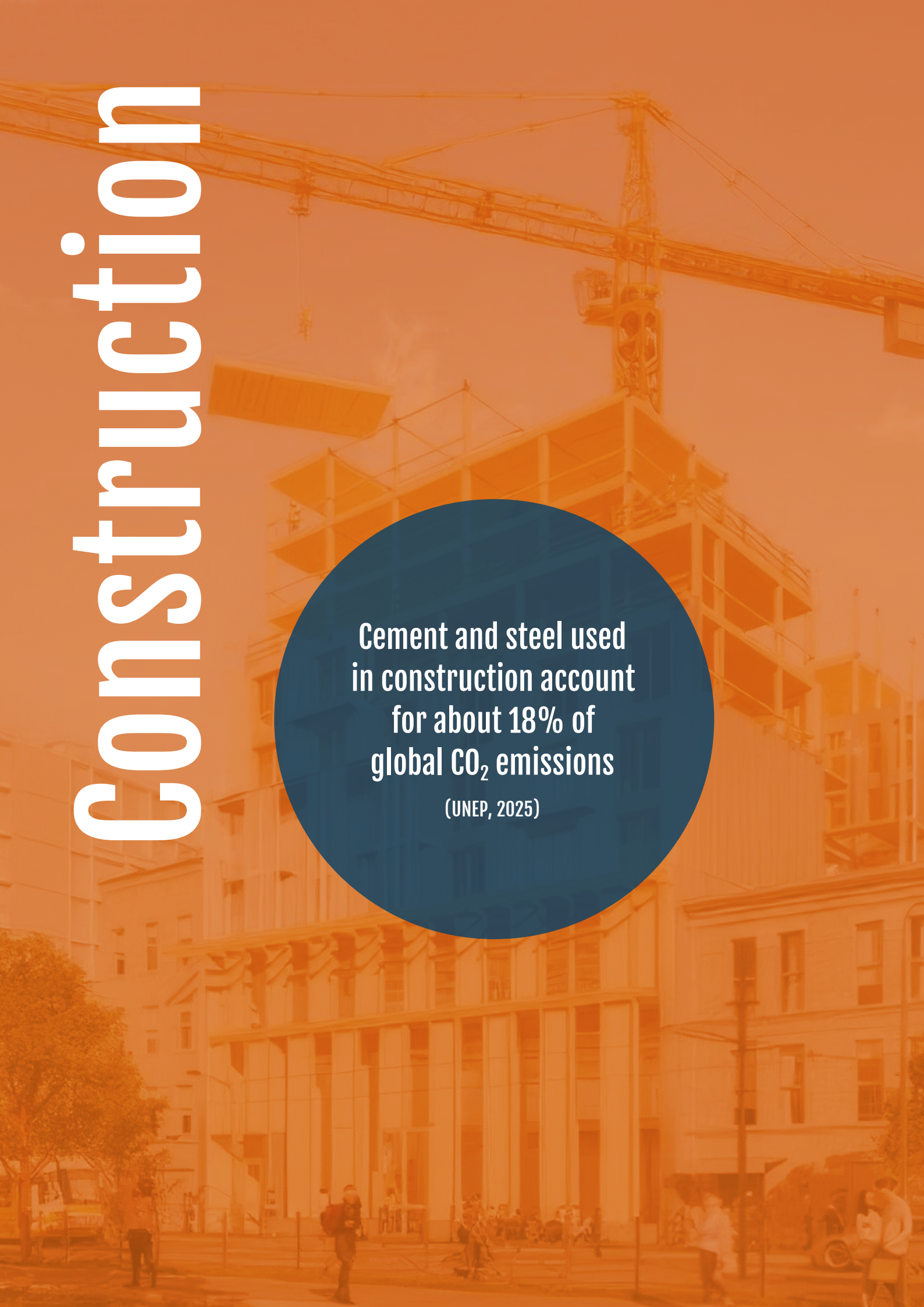
Indonesia's Green and Affordable Housing Programme, developed by the government in partnership with the International Finance Corporation (IFC), supports the deployment of sustainable construction techniques in the country's rapidly growing housing sector. The initiative aims to deliver 10,000 certified green housing units through the adoption of the EDGE (Excellence in Design for Greater Efficiencies) building standard, integrating climate-appropriate design, efficient materials, and renewable energy systems into new construction.

The programme provides technical assistance and capacity building for developers, local authorities and financial institutions to assess climatic conditions, energy use, and technology options suited to Indonesia's tropical context. It also introduces financial incentives, such as subsidised certification and advisory services, to reduce upfront costs and encourage developers to apply resource-efficient design and modern construction methods, including prefabricated and modular components.

By combining certification, finance and technical guidance, the programme has created an enabling environment where green building practices become commercially viable. It aligns public policy objectives with market demand, encouraging private developers to scale up sustainable housing delivery.

The Green and Affordable Housing Programme shows how coordinated action between government, finance institutions and the private sector can accelerate the deployment of new construction techniques. By linking regulatory standards, technical expertise and investment support, it helps embed efficiency, affordability and climate resilience into mainstream housing development.

Construction

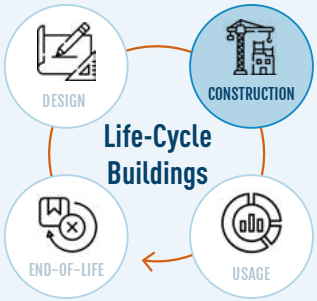


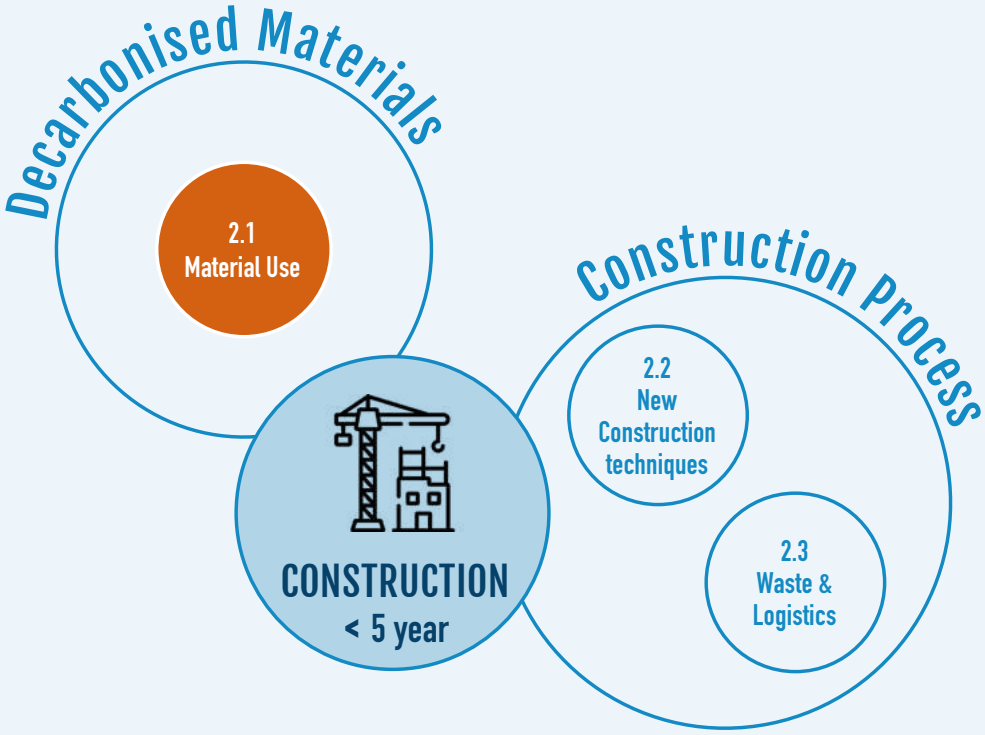
Cement and steel used in construction account for about 18% of global CO_2 emissions

(UNEP, 2025)

The construction phase is where the performance of a building truly takes shape.

This is when design intentions become physical systems such as HVAC, energy management, water and waste infrastructure that define long-term efficiency.
Choices made during construction determine not only embodied emissions and material use but also the effectiveness of installed technologies and resource flows.
Efficient site management, coordinated supply chains, and early integration of smart systems can greatly reduce waste, energy use, and costs. From AI-driven HVAC retrofits to heat recovery and water reuse, solutions deployed at this stage ensure that buildings operate as designed: efficient, resilient, and ready to share or recover energy and resources throughout their lifetime.





> 2.1 Material Use

Embodied emissions from materials such as cement, steel, aluminium, and glass account for a substantial share of the total carbon footprint of buildings. Cement production alone is responsible for more than 7% of global energy and process CO_2 emissions, while iron and steel together release around 2.8 gigatonnes of CO_2 each year (IEA, 2024). Demand for these high-impact materials is expected to grow further with continued urbanisation. At the same time, lower-carbon alternatives are emerging. Concretes incorporating industrial by-products are entering the market, engineered timber and bamboo store carbon while substituting energy-intensive materials, and recycled metals reduce reliance on virgin resources. Cleaner manufacturing powered by renewable energy, electrified kilns, and carbon capture technologies is beginning to scale. Improvements in logistics, including prefabrication hubs and route optimisation, also help cut emissions. Decarbonising construction materials is therefore essential to reducing embodied carbon, aligning supply chains with national climate targets, and building resilient markets for low-carbon products.

CHALLENGE

Cutting embodied carbon from construction materials

Use low-carbon options and cleaner supply chains

OBSERVATIONS

Markets are diversifying. Engineered timber, bamboo, low-carbon concrete, and recycled-content metals are increasingly available in many regions. Environmental Product Declarations and upcoming product passport systems in the European Union are improving transparency and comparability (European Commission, 2024). Local sourcing and prefabrication can shorten supply chains and reduce emissions. Industrial pilots in cleaner cement and steel production are showing early progress, and public procurement initiatives are starting to recognise embodied carbon in materials.

OBSTACLES

Adoption remains uneven. Certification and warranty processes can slow uptake, and the availability of innovative materials varies across markets. Cost premiums still affect low-carbon and bio-based products in many regions. Cleaner manufacturing depends on reliable access to renewable energy, which is not yet universal. Fragmented logistics and limited coordination add costs and emissions, reducing confidence among contractors and investors *(IEA, 2024).*

OPPORTUNITIES

Public procurement policies that set embodied carbon limits can create stable demand and help scale production. Incentives for industrial innovation in carbon capture, electrification, and material substitution can accelerate progress. Bio-based systems such as engineered timber provide both carbon storage and faster assembly. More coordinated logistics platforms can cut costs and emissions. Stronger disclosure requirements improve market transparency, helping clients and developers choose low-carbon options and supporting a faster shift to cleaner, more resilient supply chains.

LC3 Cement in Colombia: Pioneering Low-Carbon Construction

Rioclaro, Colombia
Since 2020

The Story

LC3 (Limestone Calcined Clay Cement) is a groundbreaking low-carbon cement solution developed in Switzerland, that has been making strides in Colombia since 2020. Cementos Argos, one of Colombia's top cement producers, led the way in implementing this technology, which replaces a significant portion of clinker with calcined clay and limestone. The initiative aimed to curb the construction sector's reliance on high-emission Portland cement.

Solution Spotlight

LC3 reduces the clinker content in cement, cutting CO_2 emissions by up to 40%.
By utilising locally available raw materials, LC3 minimises production costs while maintaining the structural integrity of traditional cement.

Efficiency Gains

Environmental

- **Reduces CO_2 emissions by 30-40% compared to conventional cement production**

Economic & Social

- **Utilises local materials**
- **Lowers production costs**
- **Supports local jobs while promoting sustainable construction practices**

How was it Financed?

The LC3 project in Colombia was funded through private investment from Cementos Argos.

What Made It Possible?

Several factors enabled the success of LC3 in Colombia. First, Cementos Argos invested heavily in research and development to ensure the material met local regulations and technical demands, supported on the scientific work developed by École Polytechnique Fédérale de Lausanne (EPFL) and others working on LC3. Lastly, LC3's use of abundant local materials – limestone and clay – made it a cost-effective alternative for builders, facilitating its acceptance in the market.

Grass-Based Insulation Panels

Belgium, Switzerland, France
Since 2018

The Story

Gramitherm has pioneered industrial-scale insulation panels made from natural grass fibres, offering a renewable alternative to mineral wool and synthetic foams. Through a patented thermoforming process, underutilised grass – abundant across Europe - is transformed into durable boards with strong thermal and acoustic performance. Pilot projects in Belgium, Switzerland, and France demonstrate that Gramitherm products can lower operational energy use while also sequestering carbon within the material itself. Independent tests confirm a thermal conductivity of 0.040 W/mK, comparable to conventional insulation. At building scale, heating and cooling demand is reduced by up to 30%, while lifecycle assessments show a net negative carbon footprint.

Solution Spotlight

Locally sourced grass is pressed and shredded into fibres before undergoing a patented hot-air bonding process that locks them into rigid boards without added formaldehyde. Panels are recyclable, provide Class E fire resistance, and are fully compostable at end of life. With high dimensional stability and resistance to pests, they integrate easily into standard construction methods. Retailing at around €20/m² for 200 mm thickness, Gramitherm is competitive with mineral wool on lifecycle costs.

Efficiency Gains

Environmental

- **~1.5 kg CO_2-eq stored per kg of insulation**
- **No dedicated cultivation: only grass waste is used (roadsides, wetlands, regional parks), requiring no fertiliser or irrigation**
- **Heating and cooling demand reduced by up to 30%**

Economic & Social

- **€20/m² for 200 mm thickness; lifecycle costs lower than mineral wool thanks to durability (50+ years)**
- **Reduced replacement needs cut long-term capital expenditure**
- **Valorises biomass waste, supports biodiversity, and creates local jobs through regional sourcing**
- **Enhances indoor comfort and acoustic quality for more than 50 years**

How was it Financed?

Gramitherm was financed by private investors with support from European eco-innovation programmes. Commercial projects are typically funded through client capital expenditure, with costs offset by lower operational energy bills and certification credits.

Enablers and Challenges

Policy momentum on low-carbon construction and recognition by green building certifiers have supported Gramitherm's market entry. Partnerships with municipalities secure a steady supply of raw material. Key challenges include scaling production to meet large orders and overcoming buyer reluctance in markets dominated by low-cost mineral wool and polystyrene. Proven performance in early projects is helping build confidence and speed adoption.

ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Creating Local Supply Chains for Bio-Based Building Materials

Concrete remains one of the world's most carbon-intensive materials, responsible for around 7% of global CO_2 emissions. Reducing its footprint requires systemic change that connects agriculture, research, and construction. The Circular B I/O project, led by the German Federal Institute for Materials Research and Testing (BAM) with partners including Meru University of Science and Technology, SRH University, Star Kids Initiative, UNEP, and GIZ, is pioneering this approach in Kenya.

The initiative develops circular, bio-based supply chains that replace conventional cement inputs with renewable materials derived from agricultural residues. Building on pilots in Ghana and a proof-of-concept house in Nigeria, the Kenya programme tests how local waste such as cassava peels, maize cobs, sugarcane bagasse, rice husks, coconut shells, and invasive plants like water hyacinth can be transformed into biopolymers, bio-aggregates, bio-cement, and biochar. AI-supported systems help process this waste into consistent, year-round supply chains for construction.

By linking farmers, manufacturers, and builders, the project reduces dependence on imported cement, cuts embodied carbon by more than 40%, and supports rural livelihoods. Its cascading production model maximises resource efficiency while mobile units lower logistics costs. Through knowledge transfer and policy engagement, the Circular B I/O project is demonstrating how cross-sector collaboration can create regional ecosystems capable of scaling low-carbon materials across Sub-Saharan Africa.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

From Mining Waste to Building Blocks in the DRC

In the Democratic Republic of Congo (DRC), where cement production remains one of the largest sources of construction-related emissions, a new initiative is demonstrating how buildings can be developed using locally available, low-carbon materials. Led by Okapiland SARL and Architect Climat Action DRC, the programme promotes non-cementitious construction through on-site demonstration and capacity building. Since 2024, it has delivered more than 600 metres of rammed earth fencing and is developing 45 eco-villas that showcase the potential of regional resources to replace imported, carbon-intensive materials.

Beyond construction, the initiative is building a domestic supply chain for sustainable materials. Over 225 professionals, including scientists, engineers, and local builders, have been trained in advanced techniques such as stabilised rammed earth and geopolymers produced from mining tailings, quartz sand, and metakaolin. These materials have a carbon footprint up to 60% lower than traditional cement and, in some cases, can even sequester carbon dioxide. By transforming mining by-products into durable, low-emission building components, the project reduces waste and strengthens local economic resilience.

Financed by private investors and the Congolese diaspora across the USA, Canada, the UK, and the EU, the initiative combines technical expertise with local knowledge to enable replication and scale. Although challenges remain, including limited policy support and market awareness, the model illustrates how local production networks, training, and community investment can align to deliver affordable, climate-resilient housing suited to regional conditions.

Bamboo-Based Composite Shear Wall (CBSW) System

Philippines, Vietnam, and Indonesia
Since 2016

The Story

The construction industry contributes significantly to CO_2 emissions and generates substantial construction waste from conventional building methods. The CBSW system aims to provide durable, affordable, sustainable and earthquake- and typhoon-resilient housing, appropriate for tropical developing countries worldwide.

Solution Spotlight

Key practitioners include architects, engineers, contractors, and researchers from organisations including Arup, Asociación Colombiana de Ingeniería Sísmica, Base Bahay, Coventry University, INBAR and Proyecto Nacional de Bambu. The CBSW system employs bamboo and timber to create shear walls codified in international building codes for high-risk seismic and typhoon areas. To date, over 4,000 homes have been constructed worldwide, demonstrating its effectiveness and versatility.

Efficiency Gains

CO_2 Emissions

- **Approximately 45-55% lower than conventional masonry or reinforced concrete housing**

Cost

- **Comparable costs to conventional materials, with potential savings in specific projects**

Sustainability

- **Utilises locally sourced bamboo and timber, bolstering local economies while reducing environmental impact**

How was it Financed?

The project was funded through various governmental organisations, NGOs and educational institutions, with ongoing efforts to secure funding for further research and development.

What Made It Possible?

The project has involved international collaboration among many stakeholders. The project succeeded through international collaboration among various stakeholders, focusing on several key activities: conducting full-scale structural and earthquake testing to ensure resilience, performing life cycle assessments (LCAs) to measure environmental impacts, and actively involving local communities in the design and construction phases to ensure both suitability and acceptance. Additionally, the development of international standards for the CBSW system aims to promote broader adoption and standardisation globally.

Reducing Material Use with Dramix Steel Fibres

Jena, Germany
Since 2024

The Story

Zeiss Hightech location in Jena, Germany, embarked on a significant expansion, adding 110,000m² of working space. The expansion required highly specialised construction techniques to meet demanding requirements, such as vibration-absorbing floors, clean rooms with crane systems, and other advanced technical facilities. In collaboration with STATIX GmbH, Bekaert's Dramix® 5D steel fibers were chosen to reinforce the industrial mat foundation and elevated transfer slab.
These steel fibers offered a more efficient and durable alternative to traditional reinforcement, enhancing the construction process while reducing materials and time.

Solution Spotlight

Dramix® 5D steel fibres enhance concrete performance mainly by reducing cracking and increasing resistance and, consequently, the load capacity. When used alongside traditional rebar, these fibres optimise concrete structure, leading to improved durability and efficiency. This technology reduces material use and emissions through faster installation, making it a sustainable choice for modern construction projects.

Efficiency Gains

Environmental

- **Reduced use of traditional reinforcement by up to 50%, decreasing steel consumption**
- **Reduced CO_2 emissions through more efficient construction practices**

Economic

- **Accelerated construction timeline, leading to significant time and cost savings**
- **Optimized material usage, lowering overall project costs**

How was it Financed?

The Zeiss Hightech facility in Jena was fully funded by Zeiss, with a total project budget of approximately €350 million.

What Made It Possible?

Collaboration with STATIX GmbH and Bekaert's expertise in steel fibre reinforcement were key. On-site support and a custom design solution helped address complex structural needs, ensuring faster execution and optimal results.

ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

The Rwanda Institute for Conservation Agriculture Programme

The Rwanda Institute for Conservation Agriculture (RICA) exemplifies a transformative approach to deploying sustainable building solutions, emphasising local materials and fostering a circular economy in the construction sector. By engaging 90% of its 1200 person workforce from the Bugesera district, RICA not only stimulates local economic growth but also empowers communities through targeted training in natural building techniques, effectively deploying these solutions on a large scale. After construction cooperatives continue to use these skills on projects throughout the country.

The project has successfully addressed the cultural stigma surrounding natural materials, demonstrating their viability and aesthetic potential in high-quality construction. In partnership with government entities, MASS Design Group, the architect and engineers for the RICA project, contributed to the development of the Adobe Building Code, creating a regulatory framework that legitimises earth construction. This initiative enables builders to access loans for sustainable projects, facilitating the deployment of eco-friendly practices across the region.

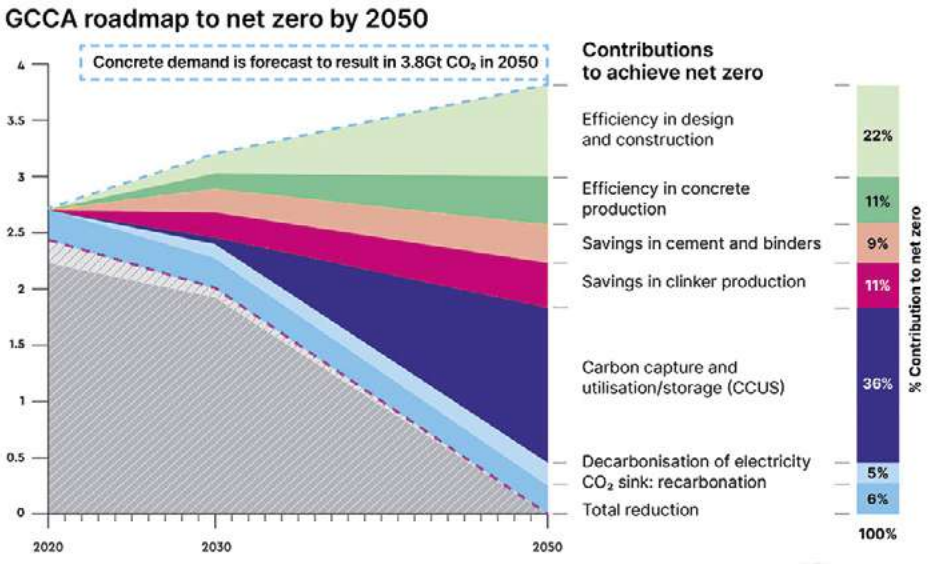
Additionally, the integration of 58% female leadership within the construction workforce promotes gender equity and supports the deployment of inclusive development solutions. RICA serves as a model for future initiatives, showcasing how sustainable building practices can be effectively implemented to benefit both the environment and local communities in Sub-Saharan Africa.

The GCCA Concrete Roadmap

The Global Cement and Concrete Association (GCCA) Concrete Roadmap is a strategic plan to decarbonise the global cement and concrete industry by 2050. It outlines key steps for reducing carbon emissions across the value chain, from material production to construction practices. The roadmap encourages collaboration between governments, industry leaders, and financial institutions to create favourable conditions for scaling low-carbon solutions. This includes setting supportive policies, providing financial incentives, and establishing clear industry standards. By fostering this enabling environment, the roadmap helps ensure that innovative technologies and sustainable practices can be deployed effectively and at scale. It provides the structure necessary for the cement and concrete sectors to meet global climate targets and transition toward net-zero emissions.

Building Demand for Low-Carbon Materials: Germany's Climate-Friendly Construction Incentives

Climate-friendly and durable construction products must not only be developed, but also demanded and used. One way to support introduction and market transformation is through funding programmes that provide financial support for the design and construction of low carbon buildings. Through their performance-oriented and technology-open approach, they stimulate the demand for low-carbon products. There is an example of this in Germany. The funding programme KFN "Climate-friendly new construction" is part of the federal funding programme. The programme is aimed at projects for the construction of new residential and non-residential buildings. "Climate-friendly" here means buildings, comply with strict requirements for limiting greenhouse gas emissions in the whole life cycle, including embodied carbon. Compliance must be proven with a life cycle assessment result.
The funding is provided through low-interest loans. In order to achieve the goals of climate protection by means of sustainable construction, there are extended requirements. Compliance with these requirements is checked by a QNG-certificate (Quality Seal for Sustainable Building) to be presented.



Turning Cardboard Waste into High-Performance Insulation

France
Since 2023

The Story

IPAC was founded in Belgium to address both construction sector emissions and the underutilisation of cardboard waste. Each year, large volumes of cardboard packaging are discarded despite being clean, abundant, and easy to process. IPAC developed an insulation system that transforms this waste into high-performance, circular building materials.
A pilot production line was established to produce insulation boards for residential and commercial projects, demonstrating strong thermal and acoustic properties alongside a competitive cost profile. By revalorising cardboard waste, IPAC provides a scalable pathway to reduce landfill pressure and substitute high-carbon conventional insulation materials.

Solution Spotlight

IPAC insulation boards are made entirely from recycled cardboard fibres, bonded through a low-energy, non-toxic process. The panels are durable, vapour-permeable, and easy to install in both new builds and retrofits. With a thermal conductivity of ~0.038 W/mK, the system performs on par with mineral wool or synthetic insulation while carrying a substantially lower environmental footprint.

Efficiency Gains

Environmental

- **Each tonne of cardboard revalorised avoids ~3 tonnes of CO_2 emissions compared to incineration**
- **Thermal conductivity of 0.038 W/mK reduces heating and cooling demand by up to 25%**
- **100% recyclable at end of life, supporting circular construction**

Economic & Social

- **Production costs are competitive with conventional insulation (€12–18/m²)**
- **Localised sourcing reduces transport costs and emissions**
- **Job creation through regional recycling and manufacturing facilities**
- **Improved occupant comfort and indoor air quality due to vapour-permeable design**

How was it Financed?

IPAC's development has been supported by private investment combined with European and regional circular economy programmes. Early pilot projects have demonstrated market viability, enabling the company to seek expansion financing and partnerships.

Enablers and Challenges

Enabling factors included access to steady cardboard waste streams from logistics and retail sectors, supportive European circular economy policy, and partnerships with research institutions for product testing. Challenges remain in scaling production, achieving wide-spread certification, and competing with entrenched, low-cost insulation materials.

Reusing Plastic Waste in Concrete Formworks

Monterrey, Mexico
Since 2025

The Story

To improve formwork durability, reusability, and concrete finishes, Postensa, a leading Latin American precast company, implemented Polycrete by WAS Co in constructing Torre Rise, set to become the tallest tower in Latin America. The project uses 500 formworks, each incorporating 30 kg of recycled plastic, totalling 15 tonnes. Polycrete, made from recycled polypropylene, replaces phenolic plywood for forming concrete in retaining walls, slabs, and core walls. The technology addresses rapid deterioration, swelling from water exposure, and high maintenance needs. Field testing confirmed superior durability, handling, moisture resistance, and surface quality.

Solution Spotlight

Polycrete by WAS Co is a reusable formwork panel made from 100% recycled polypropylene. Its smooth, non-porous surface minimises adhesion, reducing cleaning time and labour. Unlike plywood, it resists water, chemicals, and deformation, allowing multiple reuse cycles. Lightweight and easy to cut, it adapts to conventional anchoring methods while reducing timber use, waste, and embodied carbon.

Efficiency Gains

Environmental

- **3× longer lifespan than phenolic plywood**
- **Avoids ~1.2 tonnes/month of phenolic board waste**
- **100% recycled polypropylene**
- **No swelling or water absorption**

Economic & Social

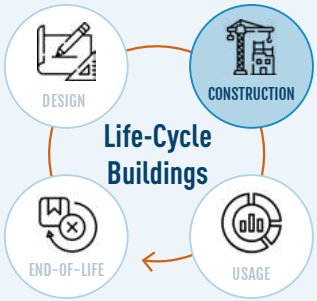
- **25–30% cost savings over phenolic boards**
- **Faster turnover = lower labour costs**
- **ROI in 3–4 reuse cycles**
- **Safer handling; reduced exposure to dust, moisture, and splinters**

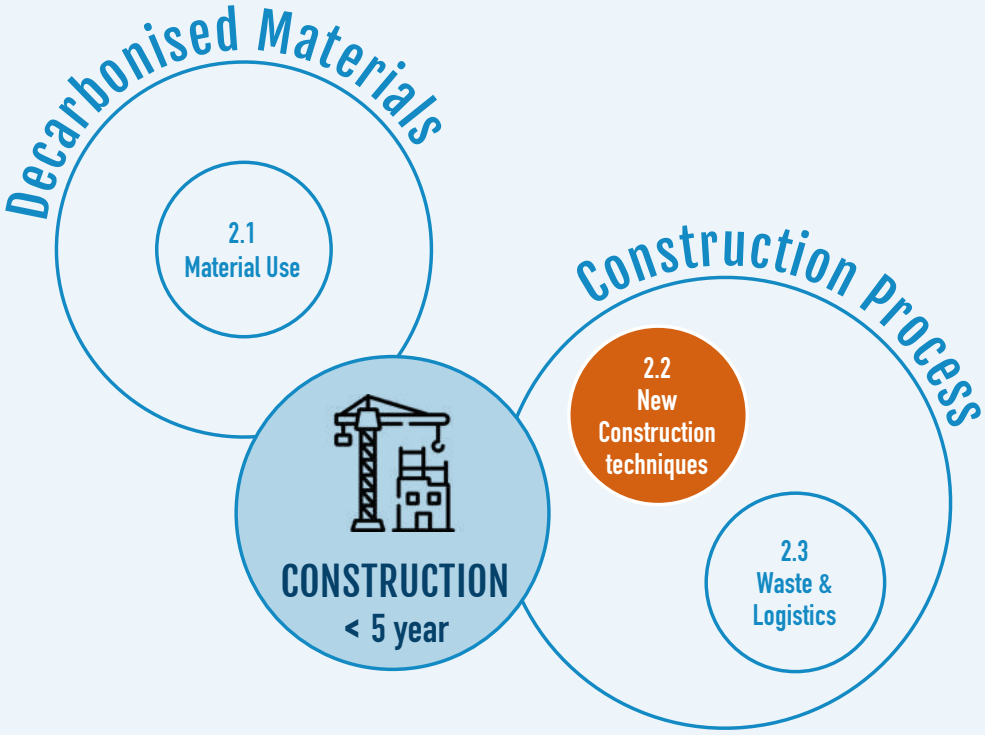
How was it Financed?

Privately financed by Postensa under its innovation and sustainability strategy. WAS Co supplied the panels under a commercial trial agreement.

Enablers and Challenges

Collaboration between WAS Co and Postensa enabled installation and performance evaluation. Technical support, training, and inspections ensured proper use. Initial challenges included panel flexibility and anchoring adaptation, resolved through adjustments and field feedback.





> 2.2 New Construction Techniques

Modern construction methods are transforming how buildings are delivered by improving efficiency, quality, and safety while cutting waste and emissions. Prefabrication and modular approaches allow work to be completed in controlled environments, reducing errors and material losses. Serial retrofit models make it possible to renovate buildings quickly and deeply, often without displacing occupants. Mass timber construction combines strength with carbon storage, offering rapid assembly and lower embodied emissions. Emerging techniques such as 3D printing are expanding options for affordable, low-waste housing and adaptable designs. These approaches can reduce costs over time through shorter construction schedules, higher precision, and longer building lifespans. Yet, adoption remains constrained by traditional practices, regulatory barriers, and insurance limitations. Scaling these innovations is essential to meet growing construction and retrofit demand while delivering resilient, affordable, and climate-aligned buildings.

CHALLENGE

Accelerating adoption of modern methods

Scale modular, prefabricated, and digital approaches

OBSERVATIONS

Factory production increases precision, reduces rework, and improves working conditions. Modular and prefabricated systems shorten delivery, reducing labour demand and costs. Serial retrofit approaches standardise whole-building upgrades, making outcomes predictable. Mass timber stores carbon while delivering rapid assembly and healthier indoor environments. These methods demonstrate that emissions and waste can be significantly reduced while construction becomes faster, safer, and more cost-effective.

OBSTACLES

Wider adoption is constrained by upfront costs for factory retooling and training. Insurance, building codes, and warranty frameworks often lag behind innovation, creating uncertainty. Global supply of engineered timber and low-carbon products remains limited. Smaller firms may lack the capacity to adopt modern techniques or invest in digital tools, slowing uptake. Cultural familiarity with bespoke on-site work also reinforces reliance on conventional approaches.

OPPORTUNITIES

Public procurement valuing lifecycle outcomes de-risks early adoption. Digital twins and performance guarantees standardise delivery and reduce uncertainty. Linking modern methods with local manufacturing and workforce development builds jobs and resilience. Demonstrating success in public housing, schools, and offices creates visibility and trust, encouraging private developers. Scaling serial retrofit programmes can also deliver emissions savings while tackling affordability and energy security challenges.

Delivering Finland's Largest Mass Timber Office with Prefabricated Systems

Helsinki, Finland
Since 2024

The Story

Katajanokan Laituri, Stora Enso's head office in Helsinki, shows how prefabricated timber systems can deliver large-scale, low-emission buildings without compromising design. At 23,000 m², it is Finland's largest mass timber office, framed in just seven months. The building uses Stora Enso's Sylva™ modular timber kit, combining cross-laminated timber (CLT) and laminated veneer lumber (LVL) to reduce embodied carbon, streamline assembly, and store carbon long-term. Biophilic design, flexible mixed-use spaces, and digital tools were integrated to reduce waste and improve accuracy. Engineered for a lifespan of 100 years or more, the building is designed for repurposing rather than demolition, avoiding redevelopment emissions. By storing 6,000 tonnes of CO_2 and cutting upfront emissions by over a third, Katajanokan Laituri offers a replicable model for climate-aligned urban development.

Solution Spotlight

The Sylva™ kit-of-parts enables prefabrication, just-in-time delivery, and rapid assembly. Renewable CLT and LVL from sustainably managed Nordic forests replace carbon-intensive materials while sequestering carbon for at least a century. Prefabricated components improve precision, minimise waste, and support safer construction on tight urban sites. The modular system allows architectural flexibility and replication across climates and building types. Digital planning tools ensured schedule accuracy, reduced uncertainty, and coordinated stakeholders for reliable delivery.

Efficiency Gains

Environmental

- **35% reduction in upfront carbon emissions vs. a concrete-framed reference (A1–A5)**
- **27% reduction in whole-life carbon despite complex ground conditions**
- **6,000 tonnes of CO_2 sequestered in timber for at least 100 years**
- **100% PEFC-certified wood with zero material waste through cascading use**

Economic & Social

- **Timber frame completed in seven months with two-day schedule accuracy**
- **Prefabrication and 171 just-in-time deliveries reduced labour, storage, and disruption**
- **Faster build accelerated occupancy and return on investment**
- **Circular design avoids demolition and lowers redevelopment costs**

How was it Financed?

Privately financed by Varma Mutual Pension Insurance Company, with Stora Enso and Anttinen Oiva Architects as development and design partners.

Enablers and Challenges

Delivery was enabled by collaboration between investor, developer, and architects, supported by digital tools and prefabricated systems. Challenges included adapting mass timber to a marine site exposed to sea level rise, addressing complex ground conditions, and coordinating logistics for precision prefabrication in a dense urban setting.

Building Climate-Adapted Homes with Nubian Vaults

Louga and Matam regions, Senegal
Since 2017

The Story

Not a new technique per se, however this project combines low carbon building techniques with land restoration to address population growth, limited resilient infrastructure, and extreme heat in rural Senegal. In the regions of Louga and Matam, where summer temperatures often exceed 40°C, Nubian Vault construction methods are being applied to deliver durable and climate adapted housing. The technique uses locally available clay without cement or steel, reducing embodied emissions and improving indoor comfort. Alongside housing, sustainable land management practices such as composting, controlled grazing, windbreaks, live hedges, and agroforestry are restoring degraded areas. Together these measures avoid greenhouse gas emissions, sequester carbon, and build resilience in communities vulnerable to climate change. By linking sustainable construction with ecosystem restoration, the project demonstrates how integrated rural interventions can simultaneously provide shelter, cut emissions, and support livelihoods.

Solution Spotlight

Two integrated approaches are used. The Nubian Vault technique creates durable housing with earthen vaults formed from clay, requiring no cement or steel, and delivering strong thermal performance in hot climates. Alongside this, sustainable land management applies composting, land protection, tree planting, and other soil conserving methods to rehabilitate degraded land. The combination provides climate adapted shelter and supports ecosystem recovery, showing how building design and land practices can be aligned to reduce emissions and improve livelihoods.

Efficiency Gains

Environmental

- **77.2 tCO_2e avoided in project constructions in Louga and Matam**
- **303.3 tCO_2e avoided in 15 co-financed Nubian Vault projects**
- **14,383,426 tCO_2e sequestered through sustainable land management in Louga and Matam, including co-financing with PROGEDE**

Economic & Social

- **Improved thermal comfort in high heat conditions, reducing cooling needs**
- **Restored land productivity supports rural livelihoods and food security**
- **Local capacity building for technicians and workers on Nubian Vault and land practices**

How was it Financed?

Financing was provided by the Global Environment Facility, UNEP, and the Government of Senegal, with parallel co-financing from civil society, PROGEDE, ANEV, the private sector, and other government partners.

Enablers and Challenges

Enablers included broad stakeholder mobilisation, synergies with ANEV, DEFCCS, local NGOs, UNEP technical support, and experience sharing through study visits and steering committee engagement. Challenges involved ensuring supply of suitable sealing materials, strengthening technical training, raising community awareness for correct use, and scaling through state led programmes.

Documenting Underground Works with EasyScan

Luxembourg
Since 2024

The Story

Underground utilities require precise documentation to ensure safety, reduce disruptions, and support long-term planning. Traditional processes in Luxembourg involved repeated site visits, manual drawings, and lengthy surveys, which slowed progress and increased resource use. In 2024, the national utilities distribution network introduced EasyScan by Syslor to digitise this process. Using a GNSS receptor linked to a mobile app and web interface, crews now create reliable 3D trench records directly integrated into GIS systems. The approach cuts unnecessary travel, reduces waste, and provides accurate as-built plans that improve coordination across teams. The result is faster project delivery, lower emissions, and improved safety, with reliable records that also help prevent damage to existing networks during future works.

Solution Spotlight

EasyScan converts simple smartphone videos into precise digital models of underground works. These 3D records can be shared instantly with surveyors and planners, eliminating manual drawings and extra site visits. Integration with GIS and augmented reality applications allows real-time validation and easier detection of unexpected objects. By streamlining workflows, EasyScan reduces fuel use, greenhouse gas emissions, and site disruptions while ensuring that accurate data supports safer, more efficient, and more resilient public infrastructure.

Efficiency Gains

Environmental

- **Around 9 tCO_2e saved per worksite (Carbone4 estimate for a Paris region project)**
- **Reduced surveyor travel lowers fuel use and emissions**
- **Accurate digital plans support long-term avoidance of re-excavation**

Economic & Social

- **20% fewer utility damages through accurate positioning and reliable records**
- **Improved safety by reducing unexpected encounters with underground assets**
- **Faster execution and fewer disruptions for local communities**

How was it Financed?

The project was financed through the customer's innovation budget as part of efforts to modernise utility network management.

Enablers and Challenges

Adoption succeeded thanks to the tool's simplicity, which made it usable by non-specialists. Close collaboration with client ensured integration into existing systems. Early challenges included adapting workflows to digital methods, addressed through training and alignment with operational practices.

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Scaling Net Zero Retrofits with Prefabricated Elements

Germany and Europe-wide
Since 2017

The Story

Serial retrofit is an industrialised renovation approach that brings existing buildings to net zero energy performance. Pioneered in the Netherlands, it is now expanding across Europe, with Germany as proof of concept via the German Energy Agency (dena). The model integrates digital planning, prefabricated elements, and rapid on-site installation to deliver efficient, affordable upgrades. Residents remain in place while façades, roofs, and energy systems are installed within weeks. Financing mechanisms redirect energy savings and maintenance budgets, enabling cost-neutral retrofits over time. Serial Retrofit Market Development Teams (MATs) operate at varying stages across EU Member States, with growing interest in new teams. Positioned for mass-market uptake, serial retrofit offers a proven pathway for Europe's Renovation Wave and replication across the European building stock by 2045.

Solution Spotlight

The retrofit package combines a prefabricated building shell, integrated technologies, and smart systems. Off-site production enables precise, standardised elements tailored to each building. Installation is rapid, often completed within weeks, minimising disruption for residents. The approach targets an 80–90% reduction in energy demand and cost-neutral financing by redirecting existing energy and maintenance budgets. Aligning digitalisation, prefabrication, and policy support creates a scalable pathway to decarbonise millions of buildings globally.

Efficiency Gains

Environmental

- **Energy demand reduced by 80–90%, cutting emissions and advancing climate goals**
- **Renovation time cut from months to weeks, reducing waste and local disturbance**
- **Supports Europe's Renovation Wave with large-scale global replication potential**

Economic & Social

- **Aims for cost-neutral financing through redirected energy and maintenance budgets**
- **Minimises social disruption as residents remain in place, fostering inclusivity and ownership**
- **Expands access to net zero performance for social housing, multi-family, and public buildings**

How was it Financed?

Successful MATs rely on sustained backing. In Germany, the Federal Ministry for Economic Affairs and Energy (BMWE) supports the national MAT beyond the first 20,000 units, scaling impact into a multi-billion-euro market. European-level programmes reinforce EU-MATs.

Enablers and Challenges

National policies embed industrialised retrofit into regulation and funding. MATs bridge public, private, and civil society actors, ensuring neutrality and market adoption. Challenges include scaling from early adopters to mass market, addressing regulatory complexity, and expanding supply chains to maintain affordability.

Delivering Low-Carbon Façades with EnveoVent

United Kingdom, Ireland, and Europe
Since 2024

The Story

Saint-Gobain developed EnveoVent, a prefabricated ventilated and insulated complete wall system designed to speed up construction whilst reducing environmental impact. Suitable for all types of new build low-rise buildings, it combines a structurally robust closed frame timber panel with high-quality insulation and both internal plasterboard and a choice of external finishes. The system has been thoroughly tested to guarantee thermal, acoustic and fire resistance performance. Off-site production minimises on-site waste and simplifies logistics, supporting faster project delivery and delivering on the finished building's as-designed performance through improved quality control. EnveoVent was created through collaboration across four Saint-Gobain brands, combining expertise in gypsum, insulation, mortars, and structural systems.

Solution Spotlight

EnveoVent is a lightweight, prefabricated complete wall system that enables low-carbon construction at pace. Manufactured offsite, the complete façade unit provides tested thermal, acoustic and fire resistance performance, and can easily be designed to meet airtightness and ventilation requirements. Its 2D panelised construction helps developers to build better homes faster - addressing housing demand while reducing labour requirements and construction timelines.

Efficiency Gains

Environmental

- **High thermal performance (U-value 0.13–0.16 W/m²K) exceeds the Future Homes Standard, reducing ongoing in-use carbon.**
- **Embodied carbon calculated to be 21%* lower than an equivalent brick and block masonry 3 bedroom detached home – over 10,000kg CO_2 (*without biogenic carbon)**
- **Minimal on-site waste due to prefabrication**

Economic & Social

- **Offsite construction enables up to 30% faster installation, reducing project costs and borrowing periods**
- **Light construction is up to 50% lighter than traditional construction, reducing the depth of required foundations (and therefore also reducing time on site)**
- **Provides a comfortable environment for occupants through superior thermal and acoustic performance, as well as safety and peace of mind through thoroughly tested fire resistance performance**
- **Minimises health and safety risks on site through consolidated deliveries and coordinated logistics**

How was it Financed?

Developed internally by Saint-Gobain, with collaboration from British Gypsum, Isover, Weber, and Scotframe.

Enablers and Challenges

Key enablers included Saint-Gobain's integrated expertise and extensive testing, supported by a three-stage process (feasibility, costing, layout study). Challenges centred on integrating advanced façade technologies and adapting off-site solutions within diverse projects, requiring close collaboration between engineering teams and contractors.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Driving the Transition to Electric Construction Equipment

New York City is taking bold steps to decarbonise one of the hardest-to-abate segments of the built environment: construction machinery. Construction sites are among the city's largest sources of local air pollution, with diesel-powered machinery producing high levels of fine particulate matter (PM2.5) and greenhouse gas emissions that harm both workers and nearby residents. Recognising this, New York City launched an initiative in 2024 to accelerate the transition toward all-electric construction equipment, working closely with industry, other cities, and international partners through the C40 Clean Construction Programme.

With C40's support, New York convened peer cities across the United States – including Los Angeles and San Francisco – to form the North American Electric Construction Coalition, announced in September 2024. The coalition members signed a joint declaration committing to promote the use of zero-emission machinery through collective procurement, market engagement, and pilot testing. This coordinated demand signal aims to reshape the construction equipment market by scaling up production and lowering costs.

Building on this momentum, New York City has launched a pilot programme to test electric excavators, loaders, and compressors in real operating conditions. Equipment manufacturers lend machinery for two to six months while city agencies collect performance, safety, and cost data to inform future procurement standards.

By aligning local policy, public procurement, and industry collaboration, New York City is demonstrating how municipal action can spark a market shift toward clean, quiet, and low-emission construction sites – creating healthier communities and setting a new standard for urban sustainability.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Vietnam's National Technical Regulation on Energy-Efficient Buildings

Vietnam's National Technical Regulation on Energy-Efficient Buildings (QCVN 09:2017/BXD) establishes mandatory energy performance standards for new construction and major renovations, ensuring that efficiency is embedded from the earliest stages of building design. The regulation applies to buildings with a gross floor area above 2,500 m², including offices, hotels, hospitals, schools and residential developments.

The code defines minimum technical requirements for the building envelope, ventilation and air-conditioning systems, lighting, and electrical equipment, aiming to reduce energy demand and operational emissions. It takes a performance-based approach, allowing architects and engineers to meet energy targets through different design choices, material selections and construction methods. This flexibility encourages the adoption of climate-responsive design and improved construction practices without prescribing specific technologies.

To support implementation, the Ministry of Construction, with assistance from the United Nations Development Programme (UNDP) and international partners, has introduced training programmes and compliance tools to build capacity among local authorities, designers and contractors. These efforts strengthen enforcement and ensure that the regulation translates into practical outcomes on construction sites.

By embedding measurable energy performance requirements into building regulation and pairing them with capacity-building initiatives, Vietnam has created an enabling environment for scaling up efficient design and construction. The code drives innovation in materials and techniques while establishing a consistent national benchmark for sustainable building development.

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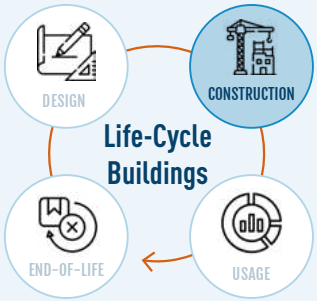
ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

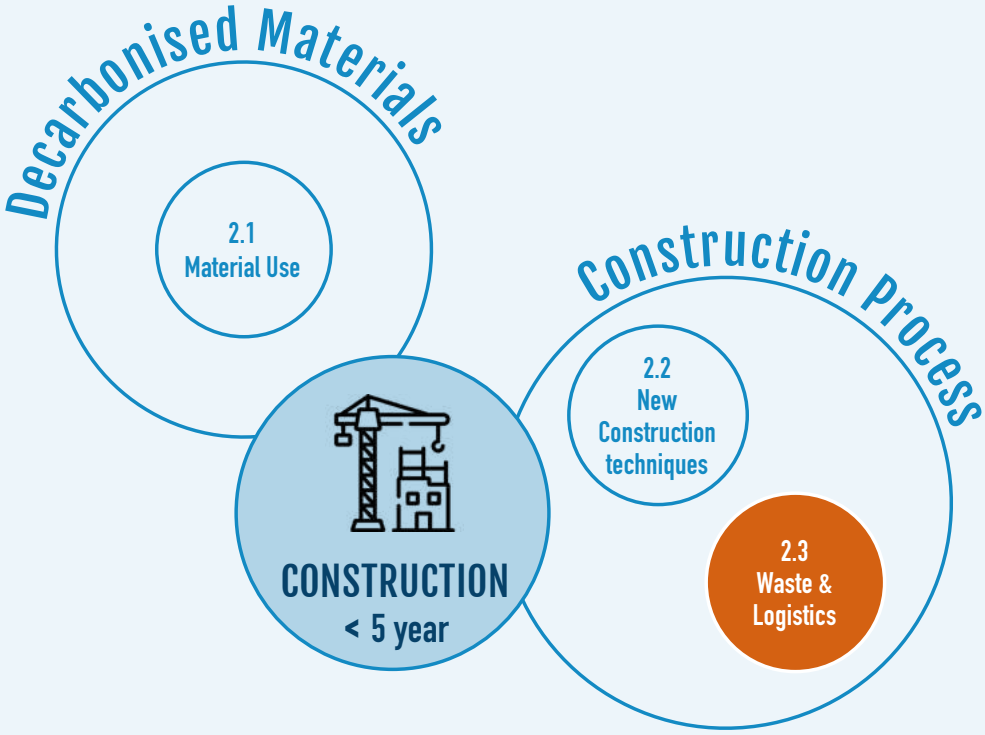
Kenya's Affordable Green Housing Initiative

Kenya's Affordable Green Housing Initiative links the government's housing policy with national sustainability goals by requiring green building certification for affordable housing developments under the "Big 4" Agenda. Through collaboration between the State Department for Housing and Urban Development, the Kenya Green Building Society (KGBS) and the International Finance Corporation (IFC), developers are encouraged to apply the EDGE (Excellence in Design for Greater Efficiencies) standard to ensure that new homes use less energy, water and materials.

This policy framework has created a clear market signal for sustainable construction practices. Certification under EDGE provides measurable performance targets that guide builders in adopting efficient materials, passive design features and resource-saving construction methods suited to Kenya's diverse climates. The initiative also promotes knowledge transfer through training and guidance materials developed by KGBS, helping public and private actors integrate efficiency into project design and delivery.

By embedding resource-efficiency standards into national housing delivery and partnering with industry bodies to support compliance, the Kenyan government has established the institutional and technical foundation for widespread adoption of green construction techniques. The approach aligns policy, certification and market demand, demonstrating how regulatory clarity and collaboration can accelerate the deployment of sustainable building solutions at scale.





> 2.3 Waste & Logistics

Construction and demolition waste is the largest waste stream in many regions. Large volumes of reusable materials still end up in landfill due to weak data systems, limited material separation, and fragmented markets. Inefficient logistics further add emissions and costs, as uncoordinated deliveries cause congestion, delays, and wasted fuel. These inefficiencies undermine productivity and increase project risks. Emerging solutions are helping address these challenges. Digital tracking platforms improve transparency of material flows and create opportunities for reuse. Shared logistics hubs and cooperative delivery systems reduce duplication, while route optimisation and just-in-time planning help cut congestion. Low-emission machinery and hybrid or battery-supported site power also reduce fuel use. Better coordination between logistics and waste management is key to lowering emissions, reducing costs, and improving productivity across construction projects.

CHALLENGE

Reducing waste and transport emissions

Apply digital tracking and circular logistics

OBSERVATIONS

Digitalisation strengthens compliance and reveals reuse potential. Waste tracking platforms and secondary material marketplaces improve visibility. Shared logistics hubs streamline operations, and route optimisation reduces unnecessary trips. Just-in-time deliveries cut congestion, while low-emission equipment reduces reliance on diesel. Cities adopting coordinated construction logistics report reduced emissions, shorter project timelines, and less disruption to surrounding communities.

OBSTACLES

Data quality is inconsistent, especially where suppliers rely on manual records. Recycling infrastructure is uneven, limiting reuse options. Weak enforcement of diversion rules reduces compliance. Contractors may resist new systems due to training needs or fees. Smaller firms often lack digital capacity to engage with waste platforms or shared hubs, slowing uptake and leaving material recovery potential untapped.

OPPORTUNITIES

Mandatory diversion rates, landfill taxes, and reporting requirements raise baseline performance. Low-cost SaaS platforms reduce barriers for contractors. Shared logistics hubs and coordinated deliveries cut emissions and save costs. Route optimisation improves scheduling and predictability. Public procurement mandating circular practices creates steady demand for secondary materials, helping private developers to adopt reuse and recycled products with confidence and consistency.

Tracking Materials and Waste with AI

United Kingdom
Since 2018

The Story

Qflow was founded in 2018 by civil engineer Brittany Harris and environmental scientist Jade Cohen to address inefficiencies in how construction projects track materials and waste. Traditionally, material deliveries and waste transfers were logged using paper notes, prone to error and delay. Qflow digitises this process by allowing site teams to photograph documents, which are then processed by AI to create accurate, real-time datasets.
This enables contractors and developers to manage compliance, track and verify materials on site, measure embodied carbon, and identify reuse opportunities without disrupting existing workflows. The platform has been deployed on major projects across the UK and USA, including HS2, Canary Wharf Group, and Scottish Power. To date, Qflow has processed over 870,000 material and waste movements, diverted significant waste from landfill, delivered substantial cost savings, and avoided more than 262,636 tonnes of CO_2e emissions.

Solution Spotlight

Qflow's SaaS platform uses artificial intelligence to extract and analyse data from delivery and waste transfer notes in real time. By removing the need for manual data entry, it improves accuracy and frees up construction site staff. The system provides transparent reporting, quality control, and carbon accounting, enabling contractors to achieve construction excellence whilst reducing Scope 3 emissions and complying with ESG requirements. Qflow integrates seamlessly into existing supply chain processes without new hardware, making it an accessible solution for projects of any size.

Efficiency Gains

Environmental

- **Avoided 262,636 tonnes of CO_2e through waste reduction and improved material efficiency**
- **Increased waste diversion from landfill across multiple projects with 107,968 tonnes of avoided waste**

Economic & Social

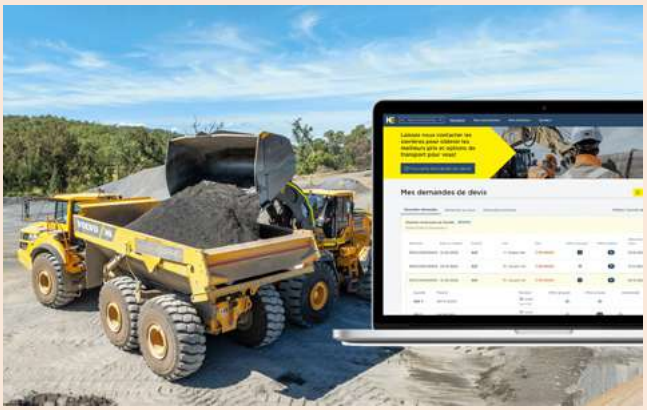
- **Average annual saving of £221,000 per project**
- **£22M saved for our clients since 2018**
- **90% reduction in time spent on reporting tasks**
- **Improved data quality supports better decision-making and compliance**

How was it Financed?

Qflow is delivered through a subscription-based SaaS model, paid from contractor and developer operational budgets. No hardware or capital expenditure is required, ensuring rapid, low-barrier adoption.

Enablers and Challenges

Adoption was driven by the cost of material mismanagement, UK net zero policies, public procurement requirements, and client demand for efficiency and compliance. Enablers included user-friendly design and construction expertise. Challenges centred on initial site scepticism, a lack of industry digitisation and inconsistent supplier data quality, requiring onboarding support and standardised processes.



Digital Platform Optimising Aggregate Supply

France
Since 2020

The Story

Aggregates such as sand, gravel and crushed stone are essential for construction, yet their supply chain is highly fragmented and inefficient. In France, Rockease by Colas launched a digital platform to streamline how construction companies source and manage deliveries of aggregates. By digitising procurement and logistics, the platform reduces costs, transport emissions, and administrative complexity. Construction firms can compare suppliers in real time, optimise delivery schedules, and track compliance. This has proven particularly valuable for small and medium contractors that often lack the resources to negotiate bulk rates or manage multiple suppliers. By making the aggregate market more transparent and accessible, Rockease by Colas lowers costs while also contributing to emissions reductions. The model demonstrates how digital tools can bring efficiency to heavy, carbon-intensive construction inputs.

Solution Spotlight

Rockease by Colas provides an online marketplace and logistics platform where contractors can source aggregates, compare offers, and manage delivery. The system integrates order tracking, digital invoicing, and route optimisation. By consolidating procurement and digitising communication, Rockease by Colas reduces administrative burden and avoids unnecessary truck trips. The platform also enables data collection on volumes and emissions, helping contractors report and comply with sustainability requirements. It is scalable to other countries with fragmented supply chains.

Efficiency Gains

Environmental

- **Reduction in truck journeys through route optimisation and consolidated deliveries**
- **Lower emissions from fewer empty returns and shorter distances travelled**

Economic & Social

- **Contractors report cost savings of up to 10–15 percent on aggregate**
- **Time savings through simplified order and invoicing processes**
- **Improved market access for smaller firms**

How was it Financed?

Rockease was originally developed by a startup and was acquired by the Colas Group in November 2023. The platform operates on a subscription-based revenue model, ensuring full transparency and independence from fluctuations in material prices, which remain determined by producers and subject to applicable taxes.

Enablers and Challenges

Key enablers include robust digital infrastructure and a fragmented supply market driving demand for transparency and efficiency. Challenges lie in scaling across diverse regulations, building reliable supplier partnerships, and overcoming the industry's slow digital adoption. Backed by Colas' extensive network of clients and partner producers, and strengthened by their legal independence as a subsidiary, they are well positioned to drive growth beyond Colas' core market.

Reducing Diesel Use for Record-Breaking Cranes

Ghent, Belgium
Since 2023

The Story

At the Wyckaert construction site, three tower cranes were deployed to build an above-ground car park for UZ Gent, Ghent University Hospital, providing 1,794 parking spaces. The site hosted two record-breaking machines: the heaviest tower crane in the Benelux, with a 10.5-tonne hoisting capacity on a 60-metre jib, and the tallest tower crane in Ghent, reaching 83 metres under the hook. Supplying these cranes with power posed a major challenge. Initially, a 700 kVA diesel generator was used to feed all three cranes, consuming around 840 litres of diesel per day. Neargrid replaced this setup with a 60 kVA diesel generator supplemented by two Neargrid Force units. This hybrid approach reduced diesel use to just 120 litres per day, drastically cutting fuel consumption and lowering emissions while maintaining reliable crane operation.

Solution Spotlight

Neargrid Solutions developed a mobile battery system that enables construction sites to draw on the electricity grid and minimise reliance on diesel generators. The Green Box power booster can fully replace diesel generators where grid connections are available, or optimise generator use when they remain necessary. Unlike many battery systems, the Green Box does not rely on lithium-ion technology, offering technical and economic advantages in terms of durability and performance. This system allows heavy equipment such as tower cranes to operate efficiently with far lower fuel use and emissions.

Efficiency Gains

Environmental

- **Reduced diesel consumption by 600 litres per day**
- **Saved around 1,608 kg of CO_2 emissions per day**

Economic & Social

- **Daily savings of USD 534, equal to USD 12,844 per month or USD 143,000 per year**
- **Improved site conditions through lower noise and reduced exhaust fumes**

How was it Financed?

The project was privately financed, with the customer purchasing the battery unit for use across their construction sites as part of operational investments.

Enablers and Challenges

Adoption was enabled by Neargrid's demonstration of efficiency gains compared with conventional large diesel generators. The combined use of a smaller generator and mobile battery system proved significantly more effective, showing clear performance benefits that encouraged the customer's uptake.

Coordinating Logistics and Waste Management with New Flow

Alzette Belval, France
Since 2022

The Story

New Flow, developed by VALOPREST, was introduced in 2022 at Alzette Belval under the National Interest Operation. It integrates logistics management, material libraries, concierge services, and waste handling at construction and rehabilitation sites. Through the VALO' cooperative, companies implemented shared facility management, administrative support, and coordinated waste sorting to improve efficiency. The aim was to streamline on-site processes: managing waste, sorting materials, and coordinating deliveries, while reducing landfill and incineration. By providing centralised services, New Flow offered a practical approach to managing material flows, improving recovery rates, and lowering environmental impacts.

Solution Spotlight

New Flow combines a digital logistics platform with material libraries and shared services. It includes an app, administrative assistance, and waste source-separation engineering. This integrated system. ensures better sorting of materials, coordinated logistics, and reduced waste. More material is reused or recycled, while disposal volumes and associated emissions are minimised.

Efficiency Gains

Environmental

- **Waste recovery increased from ~45% to ~80%**
- **Transport emissions and disposal energy use reduced through improved sorting and lower landfill volumes**

Economic & Social

- **Service delivered at comparable cost to conventional logistics and waste services**
- **New jobs created, including inclusive HR roles**
- **Return on investment achieved from year six**

How was it Financed?

New Flow is managed by VALOPREST, a cooperative structure supported by public-interest operations and private partners. Revenues are generated through service fees covering logistics, waste, and management activities at participating sites.

Enablers and Challenges

Enablers included strong local governance, cooperative organisation among firms, regulatory requirements for waste recovery, and shared infrastructure. Challenges centred on scaling beyond pilot projects, encouraging behaviour change among contractors, covering sorting infrastructure costs, and coordinating a wide range of stakeholders.

Modernising Construction Logistics with Digital Twins

France
2025–2027

The Story

Construction sites typically rely on fragmented delivery and assembly of small components, creating inefficiencies, congestion, and unnecessary emissions. In dense renovation projects, limited space makes these inefficiencies even more acute, hindering the adoption of low-carbon solutions and the reuse of materials. BEAM CUBE, commissioned by ALTYN Groupe and leading international construction or supply firms, is addressing this with REGEN3TIQ4, a digital transformation initiative starting in September 2025. The project integrates digital logistics and regional prefabrication hubs to modernise supply chains, cut transport impacts, and accelerate modular and off-site construction. Using a Living Virtual Twin for real-time scenario planning and lifecycle asset management, the system enables coordinated operations across contractors, suppliers, and public bodies. Designed as a scalable model rather than a pilot, REGEN3TIQ4 aims to transform industry practices and halve logistics-related environmental impacts.

Solution Spotlight

REGEN3TIQ4 applies a digital twin platform for real-time planning of construction logistics and site organisation. It synchronises deliveries, prefabrication, and installation across multiple actors while supporting territorial planning for land use, emissions, and resource management. By connecting decentralised manufacturing and regional hubs, the system reduces material redundancy, transport emissions, and inefficiencies. The Virtual Twin enables consistent ESG compliance and carbon monitoring while supporting modular, low-carbon construction. This creates a shared digital infrastructure that improves productivity and coordination across the construction sector, from large contractors to SMEs.

Efficiency Gains

Environmental

- **25–35% reduction in transport emissions and material waste**
- **Minimum 35% cut in embedded and operational emissions through prefabrication**
- **Faster delivery cycles and real-time carbon monitoring**

Economic & Social

- **Up to 40% reduction in logistics and construction costs**
- **30% faster project delivery, enabling quicker rollout of affordable housing**
- **Renovation rate increase of around 25%**
- **Productivity gains for SMEs and local suppliers**
- **Stronger collaboration between construction actors and local authorities**

How was it Financed?

The initiative is privately financed through the commercial rollout of BEAM CUBE's logistics and planning solutions, with R&D supported by France's Research Tax Credit. Future phases may also use green bonds, state funds, and ESG-aligned capital.

Enablers and Challenges

Key enablers include engagement with local government, a strong market case, and modular logistics systems that SMEs can adopt affordably. The main challenge is shifting stakeholders from ad-hoc site management to structured, factory-like operations, requiring procurement changes and wider acceptance of off-site preparation.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Strengthening Circular and Sustainable Construction in Colombian Cities

Colombia's two largest cities, Bogotá and Medellín, are leading national efforts to accelerate the shift toward circular and low-carbon construction through coordinated action across municipal, regional, and national levels. Recognising that construction accounts for a growing share of urban emissions and material use, both cities have developed frameworks that align innovation, regulation, and industry collaboration.

In Bogotá, the city launched Bogotá Circular in 2022 as an innovation forum bringing together local businesses, academia, and public agencies to co-develop viable circular business models. Building on its success, the initiative expanded in 2024 into Bogotá Región Circular through a partnership with the regional government, extending its reach to neighbouring municipalities. These efforts complement new regulatory measures, including an updated construction and demolition waste management decree and a law on eco-urbanism and sustainable construction adopted in 2023. Together, they form a robust foundation for a circular urban economy.

Medellín has developed a Sustainable Construction Manual to guide developers in using low-carbon and circular materials, while working with the metropolitan area to establish a public policy on sustainable construction. At the national level, Medellín's expertise has informed the Colombian Chamber of Construction (CAMACOL) in developing a National Roadmap for Sustainable Construction and the CAMACOL Verde platform, which connects private and public actors to exchange data, tools, and good practices.

By combiing regulatory progress with innovation ecosystems, Bogotá and Medellín illustrate how cities can drive the transformation of construction markets and align local practice with national decarbonisation goals.

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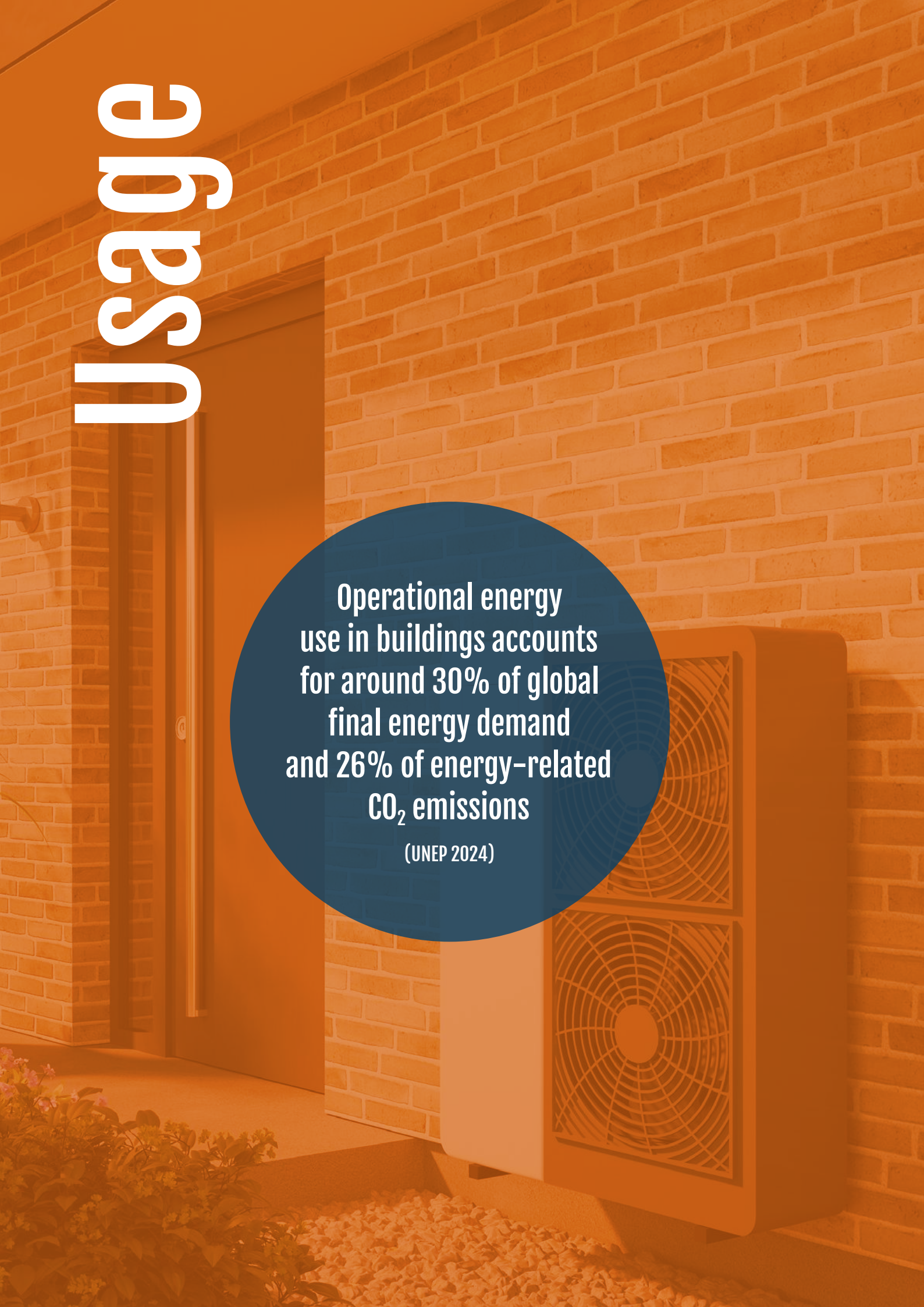


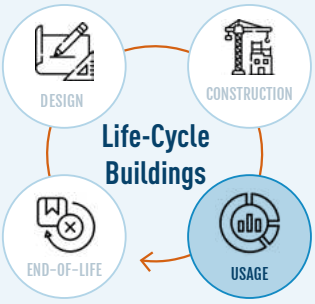
Operational energy use in buildings accounts for around 30% of global final energy demand and 26% of energy-related CO_2 emissions

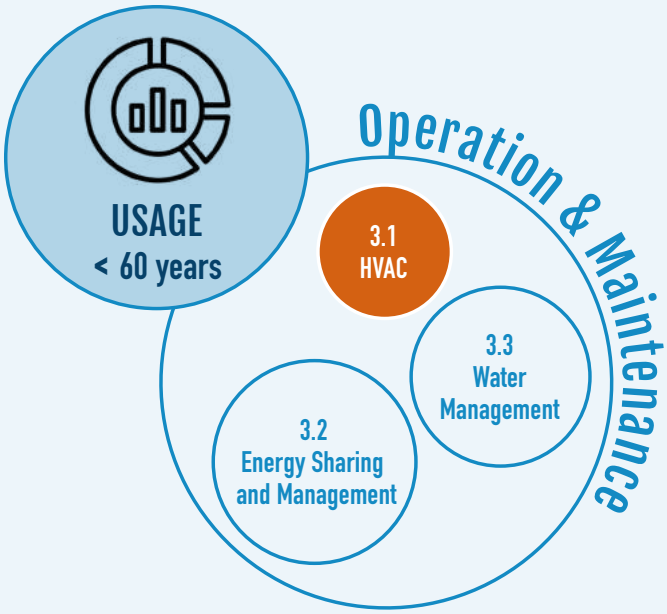
(UNEP 2024)

Once a building is in use, its daily operation becomes the main driver of environmental impact.

Heating, cooling, lighting, appliances, and water management together account for the majority of lifecycle emissions and costs. How efficiently these systems are run, how appliances are chosen, how water is conserved and reused, and whether buildings can share or store energy, all strongly influence long-term performance.

Solutions in this phase range from advanced digital optimisation tools to practical, low-cost measures, reflecting the diversity of building contexts worldwide. Interventions during usage not only cut emissions but also improve affordability, health, and comfort for occupants, making this phase central to the transition to sustainable buildings.





> 3.1 HVAC and Insulation Systems

Heating, ventilation, air conditioning, and insulation determine how efficiently buildings use and retain energy during operation. Globally, cooling demand is the fastest-growing end use in buildings, rising by around 4% per year (IEA, Tracking Cooling 2024). This trend highlights the urgent need for efficient HVAC systems and high-performance insulation to reduce emissions, lower costs, and maintain comfort in a changing climate. Across regions, combining passive and active approaches is proving most effective. High-efficiency heat pumps, district energy systems, and advanced insulation materials are transforming energy performance, while reflective surfaces, shading, and natural ventilation help manage rising temperatures with minimal energy input. Together, these measures strengthen resilience to extreme weather and grid disruptions while improving indoor comfort and accelerating building decarbonisation.

CHALLENGE

Enhancing energy efficiency through better HVAC systems and insulation

Adopt efficient HVAC, improve envelopes, combine passive and active measures, and retrofit insulation

OBSERVATIONS

Heating, cooling, and ventilation together account for over 40% of global buildings' energy use (IEA, 2024). Upgrading to efficient HVAC systems and improving insulation can cut heating and cooling demand by up to 50% in many climates (IEA, 2023). Heat pumps are expanding rapidly, supported by incentives in multiple markets. Passive measures such as cool roofs and natural ventilation remain effective in hot climates and are increasingly applied in temperate ones. Retrofitting older buildings with insulation is among the most cost-effective interventions, offering major benefits for bills and comfort.

OBSTACLES

High upfront costs for efficient HVAC equipment and advanced insulation remain a barrier. Weak or inconsistent building codes also limit adoption. In hot regions, inefficient air conditioners are often chosen for their lower upfront price, locking in higher electricity demand. Awareness of passive strategies is uneven, while in colder regions, the large share of historic building stock makes retrofits complex and costly without financial or policy support.

OPPORTUNITIES

Opportunities include stronger building codes, subsidies for heat pumps and insulation, and accessible financing for retrofits. Passive strategies such as reflective roofs, shading, and natural ventilation can be scaled affordably in many contexts, while advanced products gain traction where incentives and labelling schemes are in place. Combining HVAC upgrades with insulation retrofits maximises efficiency gains, while district heating and cooling networks offer scalable solutions in dense urban areas.

Reducing Heat Stress with Reflective Roofing

Dakar, Senegal
Since 2019

The Story

CoolRoof France's initiative in Dakar, Senegal, began in 2019 with the aim of providing low-cost, energy-efficient cooling solutions to vulnerable communities. Senegal's hot climate exacerbates energy consumption for cooling and contributes to severe heat stress, especially for low-income households and public facilities. CoolRoof partnered with local NGOs and community groups to install reflective coatings on rooftops, reducing the heat absorbed by buildings and enhancing thermal comfort. This simple yet effective solution is easily deployable and requires no skilled workforce, drastically reducing the need for mechanical cooling in urban areas. Over 200 rooftops have been coated, improving living conditions for thousands of residents.

Solution Spotlight

CoolRoof is a reflective, solar-resistant coating that is applied to rooftops. This reduces indoor temperatures by up to 6°C, cutting the need for fans or air conditioning and thus lowering energy costs for households. It's an affordable, scalable solution that can be applied to both new and existing structures.

Efficiency Gains

Environmental

- **Reduces energy consumption for cooling by up to 30%, lowering overall carbon emissions**

Economic & Social

- **Decreases electricity costs for low-income families, reduces heat-related health issues, and enhances comfort within public buildings (e.g. schools and hospitals)**

How was it Financed?

The project was funded through a combination of local government support, international climate funds, and private contributions from CoolRoof's partners. This mix of financing helped scale the project rapidly across Dakar's urban areas.

What Made It Possible?

Several enabling factors contributed to the success of CoolRoof in Senegal. First, strong partnerships with local NGOs ensured community buy-in and effective on-the-ground implementation. Public awareness campaigns helped residents understand the benefits of the technology, and government support facilitated the roll-out of coatings in public buildings. Furthermore, the scalability of the CoolRoof solution, combined with the availability of local materials and workforce, ensured that the project could be implemented quickly and cost-effectively.

National Programme for Efficient Cooling in the UAE

United Arab Emirates
Since 2023

The Story

The Efficient Cooling Programme was launched in the UAE to tackle the rising demand for sustainable cooling solutions. With cooling systems accounting for about 60% of the nation's energy use, the program aims to enhance cooling technologies and promote District Cooling (DC) and Efficient Cooling (EC) systems. Its primary goals include reducing energy consumption and CO_2 emissions while supporting the UAE's sustainability targets. By retrofitting existing buildings and implementing DC systems in new developments, the program aims to achieve significant energy savings of 27 TWh and water savings of 38 Mm^3 by 2050.

Solution Spotlight

To address high cooling energy demand, the programme promotes advanced district cooling systems utilising innovative cooling storage, recycled water, and time-of-use (ToU) tariffs. New regulations will support the integration of DC and EC systems in both new constructions and retrofits. Stakeholder engagement, including government support, ensures a unified approach to energy efficiency.

Efficiency Gains

Environmental

- **Cooling energy demand is expected to fall by up to 38% in key emirates by 2050**
- **CO_2 emissions are anticipated to decrease by over 2 million tonnes each year**
- **The phase-out of harmful refrigerants such as CFCs will improve air quality**
- **District and efficient cooling systems are projected to cover 19% of the built environment by 2050**
- **Advanced cooling technologies will help reduce noise pollution by up to 30%**

Economic & Social

- **Energy savings are projected to reach 27 TWh and water savings 38 Mm^3 annually by 2050, leading to significant cost reductions and improved resource efficiency**
- **Quieter and more efficient cooling systems will enhance urban comfort and contribute to better quality of life in dense areas**

How was it Financed?

The program introduces financial incentives like ToU tariffs and explores financing mechanisms for retrofitting existing buildings, leveraging public and private partnerships.

What Made It Possible?

Successful implementation relies on collaboration between public and private sectors, a DC regulatory framework implemented in 2019 with the most recent 'Water Management in District Cooling Plants' policy, and public awareness campaigns that highlight the benefits of district cooling. This coordinated effort fosters the adoption of efficient cooling solutions throughout the UAE.

Improving Thermal Comfort through Rural Housing Retrofit

Chin and Meikhtila Regions, Myanmar
2014–2024

The Story

Geres has worked in Myanmar since 2014 to address energy poverty and poor housing conditions. Retrofit measures were introduced in 83 homes in Chin State and 10 pilot homes in Meikhtila. Solutions included ventilated double roofs, insulation, and airtight construction. These measures improved thermal comfort, reduced fuelwood consumption, and lowered smoke exposure. The double roof consists of two layers separated by an air gap, reducing heat loss in winter and overheating in summer. Transparent sheeting can be swapped for reed in hot months to provide shade. Training for local artisans ensured correct installation and created skills for replication.

Solution Spotlight

A passive ventilated double roof adapted to Myanmar's climate. In winter, insulation and airtightness cut fuel demand. In summer, the layered design prevents overheating, with removable sheeting creating shaded outdoor space. Affordable, replicable, and resilient, this retrofit improves comfort and reduces energy use.

Efficiency Gains

Environmental

- **3–5°C indoor temperature gains in winter**
- **Lower firewood demand helps reduce deforestation**
- **Reduced environmental impact from lower fuel use**

Economic & Social

- **20–30% annual heating fuel savings**
- **Artisan training created local skills and income**
- **Savings support shared-financing models for scaling**
- **Improved indoor air quality reduced smoke-related health risks**
- **Stronger thermal comfort improved wellbeing**
- **Community-led maintenance ensured ownership and long-term use**

How was it Financed?

Funded by the Fondation pour le Logement. Early pilots were fully subsidised to demonstrate benefits and build community trust. Cost-sharing models are now being tested within wider rural development programmes, including EU-funded activities in Meikhtila.

Enablers and Challenges

Geres' expertise in passive housing, community mobilisation, and training for local builders enabled successful rollout. Challenges included material sourcing in remote areas, adapting designs to local practices, scepticism toward non-traditional methods, and security risks in intervention zones.

Building with Passive Solar Verandas in Central Asia

Afghanistan and Tajikistan
2004-2020

The Story

Geres piloted Passive Solar Verandas in Afghanistan's Central Highlands in 2004, introducing low-cost sunspaces that improved comfort in harsh winters while cutting fuel use. More than 6,000 verandas were installed in Bamyan and Maidan-Wardak, with over 10,000 additional units self-replicated by households, mainly in Bamyan and Kabul. These south-facing extensions, known locally as gulkhone or "sun houses", quickly became a valued feature of housing. Geres trained over 500 artisans, embedding the practice in markets and creating livelihoods. The approach later expanded into Kabul and northern Afghanistan with microfinance, and was tested in Tajikistan with local adaptations. Passive solar design now forms part of Geres' broader portfolio on energy poverty and resilience in Central Asia.

Solution Spotlight

Passive Solar Verandas are extensions oriented south or southwest, built with affordable, locally available materials. Acting as sunspaces, they trap solar energy to raise indoor temperatures by 10–15°C, creating a multifunctional living area while reducing reliance on wood and coal. In summer, transparent sheeting can be replaced with reed or shading to avoid overheating. This flexible design improves comfort, reduces deforestation, and lowers air pollution, particularly in mountainous regions, while remaining accessible to low-income households.

Efficiency Gains

Environmental

- **Indoor temperatures raised by 10–15°C, reaching ~20°C**
- **Heating fuel savings of 5–30% annually**
- **Reduced reliance on wood and coal lowers deforestation and emissions**
- **Potential 30–60% energy savings when combined with other measures**

Economic & Social

- **Market-based adoption with households covering 80–100% of costs**
- **Microfinance schemes enabled uptake in urban areas**
- **Artisan training created income opportunities and strengthened economies**
- **6,000 verandas installed, with at least 10,000 self-replications**
- **Improved health from reduced smoke exposure**
- **Greater resilience and wellbeing in cold communities**

How was it Financed?

Financing combined household investment with donor support. Families typically covered 80–100% of costs, with subsidies used only for pilots. In Kabul, microfinance schemes supported adoption, while agencies such as AFD, the EU, and foundations sustained scaling. Subsidies were phased out as the solution became self-sustaining.

Enablers and Challenges

Enablers included Geres' research-action process that refined designs, performance monitoring, and manuals. Training of 500+ artisans and community engagement secured replication. Adaptability to local materials enabled transfer to Tajikistan. Challenges included sourcing materials in remote mountainous areas, maintaining construction quality at scale, and tailoring solutions to diverse housing practices.

Heating and Cooling with Groundwater at Bonn's Climate Tower

Bonn, Germany
2016–2025

The Story

To accommodate 330 new workplaces for the United Nations, the Federal Office for Building and Regional Planning commissioned a new high-rise in Bonn. Construction began in 2016, and the building was handed over in February 2022. Known as the Climate Tower, it was built to the passive house standard and certified Gold under Germany's Sustainable Building Assessment System (BNB). Central to its design is a groundwater-based energy concept, providing both cooling and heating through passive use of Rhine water and high-efficiency heat pumps. This ensures zero on-site CO_2 emissions and cuts primary energy demand by over 50% compared with a gas-heated reference.

Solution Spotlight

The tower's system relies on shallow groundwater wells. Rhine water remains 12–17°C year-round, enabling passive cooling in summer. In winter, two heat pumps use the water as a reliable heat source, even in very cold weather. Because the water is discharged directly back into the river, absorption wells are unnecessary. This design reduces technical complexity while providing an efficient, low-carbon energy supply for occupants.

Efficiency Gains

Environmental

- **Primary energy demand is more than 50% lower than a reference gas-heated building**
- **Zero on-site CO_2 emissions from heating and cooling**
- **Reduced dependence on fossil fuels through renewable groundwater use**

Economic & Social

- **Long-term operational savings from reduced energy consumption**
- **Lower maintenance compared to complex absorption well systems**
- **Public investment delivers durable infrastructure with predictable operating costs**
- **330 additional UN workplaces created in a climate-friendly building**
- **Demonstrates leadership in sustainable federal construction**
- **Contributes to Bonn's role as a hub for international climate policy**

How was it Financed?

The Climate Tower was financed entirely with public funds on behalf of the federal government. The Institute for Federal Real Estate (BImA) serves as developer, owner, and operator, ensuring long-term stewardship. The investment reflects Germany's commitment to sustainable, high-performance public buildings.

Enablers and Challenges

Key enablers included the building's immediate proximity to the Rhine, which allowed groundwater to be used efficiently, and the integration of this energy concept into the BNB certification process. These factors ensured alignment with high sustainability standards. Challenges involved securing regulatory approval for groundwater use and mitigating risks that wells may deliver less water during operation than expected, which could impact long-term energy performance.

Turntide Smart Motor Systems Generate Savings in London

London, United Kingdom
2023-2024

The Story

JLL was tasked by a client to reduce costs and emissions from HVAC operations at a London site. Following a site survey, Turntide Smart Motor Systems were selected and installed in partnership with Future Motors. A Monitoring & Verification system was deployed to collect energy data from three existing motors over six weeks, providing a baseline for comparison. After installation, motors were replaced on air handling units where older units had reached end of life, ensuring improved reliability as well as efficiency. The upgrade delivered energy savings far above projections, cutting carbon emissions significantly. The client also sought a future-ready system that could integrate with air quality sensors, enabling demand-driven operation that induction motors could not achieve.

Solution Spotlight

Turntide Smart Motor Systems replace traditional induction motors in HVAC rooftop units and other building applications. They use advanced electronics and software controls to optimise power usage and efficiency. Designed for seamless integration into existing infrastructure, they offer a practical, low-disruption upgrade for commercial buildings. By reducing wasted energy, Turntide motors deliver substantial savings while maintaining comfort and reliability.

The system is adaptable, with potential to integrate smart controls such as occupancy or air quality sensors for further optimisation.

Efficiency Gains

Environmental

- **Achieved 346,776 kWh energy savings vs 208,000 kWh proposed**
- **Exceeded carbon savings target: 73 tonnes avoided vs 43.8 tonnes proposed**
- **Delivered best-in-class efficiency, reducing energy demand and emissions**

Economic & Social

- **Payback period of under two years, providing strong ROI**
- **Improved reliability by replacing end-of-life motors**
- **Reduced operational costs through lower energy use**
- **Future-ready design allows integration with air quality sensors**
- **Maintains comfort and air quality for occupants**
- **Demonstrates scalable innovation in commercial building upgrades**

How was it Financed?

The project was financed privately by the client, with JLL managing delivery in partnership with Future Motors. Turntide provided the technology, ensuring performance exceeded both proposed energy and carbon savings.

Enablers and Challenges

Enablers included the innovative motor design, which integrates seamlessly into existing HVAC rooftop units, allowing for practical upgrades with minimal disruption. Reliable monitoring and verification demonstrated performance gains and secured client confidence. Challenges involved coordinating installation while maintaining building operations and ensuring the system could meet both immediate efficiency goals and future flexibility needs.

AI HVAC Retrofit Slashes Treptower's Energy Footprint

Berlin, Germany
2022–2024

The Story

In March 2022, PATRIZIA SE, a European real estate investment company, partnered with DABBEL to optimise the energy performance of the iconic Treptower building in Berlin. The 23,200 m² high-rise, powered by electricity and district heating, faced growing pressure to align with net-zero objectives and rising energy costs. DABBEL's AI-based software was implemented to autonomously control HVAC operations without requiring hardware upgrades or tenant disruption. The result: energy consumption dropped by 33%, leading to savings of over 2.8 million kWh and 965 tonnes of CO_2. The collaboration showcases how intelligent, software-driven retrofits can transform legacy buildings into sustainability frontrunners.

Solution Spotlight

DABBEL's AI overlays existing building automation systems to enable predictive HVAC control. The software leverages thermodynamic modeling, occupancy trends, weather forecasts, and system performance data to make thousands of real-time adjustments each month. At Treptower, this resulted in dynamic control across heating systems, chilled beams, cooling towers, and air-handling units, achieving deep decarbonisation without CapEx-heavy retrofits.

Efficiency Gains

Environmental

- **1,929,257 kWh energy savings per year**
- **635 tonnes CO_2 reduction per year**

Economic & Social

- **USD 211,333 in cost savings per year**

How was it Financed?

The implementation followed a SaaS model with zero upfront investment. Costs were covered through a fixed annual fee based on building area, fully offset by the energy savings achieved.

Enablers and Challenges

DABBEL was able to remotely integrate with Treptower's building management system (BMS) via VPN, perform a Pre-Check analysis, and begin AI-driven optimisation within weeks, without any hardware upgrades. The software autonomously adjusted HVAC operations, delivering energy savings quickly. Several challenges had to be carefully managed: Treptower's mixed-use layout meant balancing different HVAC demands across office and exhibition spaces, while maintaining occupant comfort. Additionally, aligning the AI control strategies with the building's legacy infrastructure required precise coordination with the existing BMS provider.

Converting Low-Temperature Industrial Heat into Clean Power

Klaipeda, Lithuania
Since 2024

The Story

NEO GROUP, one of Europe's leading PET resin and polyol manufacturers, partnered with EPC firm Termolink and Climeon to recover waste heat from its Klaipeda plant. Resin production generates steam as a byproduct, creating a constant flow of low-temperature heat that previously dissipated unused. In 2024, Climeon's HeatPower 300 system was installed to capture this energy and convert it into electricity for on-site use. The solution reduces dependence on grid power, lowers energy costs, and cuts the plant's environmental footprint. By integrating seamlessly with existing infrastructure, the project supports NEO GROUP's long-term energy and climate strategy while demonstrating how waste heat can be transformed into reliable, renewable power.

Solution Spotlight

The HeatPower 300 system uses the Organic Rankine Cycle (ORC) to generate clean electricity from heat as low as 75–105°C. Its compact and modular design makes it suitable for retrofits in industrial sites with limited space. Fully automated, it adjusts to varying heat flows, delivering consistent power. The system is commercially proven and helps industry reduce emissions with existing resources.

Efficiency Gains

Environmental

- **2,700 MWh of renewable electricity generated annually**
- **290–320 tonnes of CO_2 emissions avoided per year**
- **Efficient reuse of waste heat otherwise released into the environment**

Economic & Social

- **Up to USD 350,000 in avoided grid electricity purchases annually**
- **Reduced exposure to fluctuating energy prices**
- **Strengthened long-term competitiveness through lower operating costs**
- **Improves energy security for industrial operations**
- **Reinforces NEO GROUP's sustainability leadership in circular production**
- **Demonstrates replicable solutions for other industries with untapped waste heat**

How was it Financed?

The project was co-financed by NEO GROUP and supported by Lithuanian government subsidies through APVA. This mix of private investment and public funding accelerated adoption and highlighted the importance of policy support.

Enablers and Challenges

Enablers included NEO GROUP's commitment to sustainability, Lithuanian government support for clean energy, and Climeon's proven technology. Termolink provided critical expertise for integration and delivery. A key challenge was installing the HeatPower 300 on the top floor of a 27-story building, requiring a crane lift through the façade. With Termolink's support, it was managed successfully, and Climeon has since adapted its platform to simplify future retrofits.

Demand-Controlled Ventilation in a Commercial Office

London, UK
Since 2024

The Story

Transport for London (TfL), one of the city's largest landowners, has been using demand control ventilation (DCV) to cut energy use and emissions across its office portfolio. At its 25,000 m² Stratford office, smart sensor technology was deployed to adjust HVAC operation in real time based on occupancy. The project delivered 12% savings in energy use, equivalent to 140 tonnes of CO_2 annually, and reduced operating costs by USD 245,000 per year. Beyond financial and environmental benefits, the project also increased equipment lifespan and improved user comfort. These results demonstrate the role of DCV as a scalable, quick-payback solution for large office buildings.

Solution Spotlight

TfL adopted LightFi's patented demand control ventilation system, which uses long-range occupancy counting sensors to detect devices (phones, laptops) and infer real-time building use. These signals, combined with wireless air quality sensors, allow the HVAC system to automatically match ventilation levels with occupancy. The system is easy to install, requires no invasive retrofits, and offers a typical payback period of around one year.

Efficiency Gains

Environmental

- **12% reduction in building energy consumption.**
- **140 tonnes of CO_2 avoided each year**
- **More efficient ventilation reduces unnecessary energy use**

Economic & Social

- **USD 245,000 annual operating cost savings.**
- **Over 800,000 kWh saved annually at a single site**
- **Extended HVAC equipment life and reduced maintenance needs**
- **Improved indoor comfort through real-time ventilation adjustment**
- **Occupants gain access to local environmental data**
- **Supports organisational sustainability goals with visible outcomes**

How was it Financed?

The project was fully financed by TfL, supported by LightFi's innovation developed with backing from the UK Department for Energy Security and Net Zero. Demonstrated savings strengthen the business case.

Enablers and Challenges

Strong leadership from TfL's management team enabled successful deployment. Collaboration between landlords and tenants is vital in multi-let buildings to fully capture the benefits. Challenges often arise from legacy HVAC systems and control strategies, which may require adjustment. However, these modifications can be integrated within the DCV project, providing quick returns and strengthening the case for adoption.

Recovering Heat from Water-Chilled Cooling Systems

Ireland
Since 2023

The Story

Symphony Energy's HVAC engineers sought to improve the efficiency of water-chilled cooling systems, which are widely used in commercial buildings. They developed the Symphony Cycle, a process that repurposes existing installations with 4-pipe fancoils so that, in winter, free cooling is provided while simultaneously generating free heating for incoming fresh air. This transforms conventional seasonal HVAC operation, cutting energy demand for both cooling and heating without requiring new equipment. Patented across regions with average winter temperatures below 15°C, Symphony Cycle demonstrates how existing infrastructure can be reprogrammed for greater efficiency. By challenging established methods, Symphony Energy created a low-cost solution with immediate application across climates and building types.

Solution Spotlight

Symphony Cycle applies to water-chilled systems that use a cool coil in the Air Handling Unit combined with 4-pipe fancoils or chilled beams. The process is implemented entirely in software, by adding code to the Building Management System following licence instructions. No physical modifications are needed, and the result is significant wintertime energy savings for cooling and heating with minimal disruption to existing operations.

Efficiency Gains

Environmental

- **Operates for up to 80% of the year in UK climates**
- **Cuts total annual HVAC energy use by an average of 15%**
- **Maximises efficiency of existing building equipment without new materials**

Economic & Social

- **Annual licence priced at 50% of calculated savings ensures guaranteed ROI**
- **Reduces energy bills by lowering both heating and cooling demand**
- **Extends useful life of existing HVAC infrastructure**
- **Maintains comfort by ensuring steady air temperatures**
- **Since the solution is fully implemented by software, it eliminates the need for disruptive system replacements**
- **Provides a replicable, low-cost pathway to efficiency in diverse building types**

How was it Financed?

Development was financed by Symphony Energy's R&D budget. Building owners adopt the solution via an annual licence, priced against calculated savings for their location, creating shared incentive for performance.

Enablers and Challenges

Enablers included the adaptability of existing chilled-water systems and the minimal intervention required, relying only on new BMS code rather than hardware changes. Challenges involved the legal complexity of patenting a process rather than a product, and the technical difficulty of building a reliable savings calculator across varied climates, building types, and operating profiles.

Smart Heatwave Response in Schools

Poissy, France
Since 2020

The Story

In summer 2020, the City of Poissy, in the greater Paris region, faced a challenge increasingly common across Europe: how to keep classrooms comfortable during intensifying heatwaves without resorting to energy-intensive air conditioning. Rising temperatures and worsening urban heat island effects made classrooms stifling, undermining students' concentration and teachers' working conditions. To address this, the municipality launched a heatwave action plan. Over three years, and scheduled during school holidays, 15 public schools were retrofitted with 616 motorised ZIP exterior window blinds. This straightforward intervention turned windows from heat traps into temperature regulators, ensuring comfort while preserving daylight and minimising reliance on mechanical cooling.

Solution Spotlight

The solution combined ZIP exterior blinds with Somfy motorisation. The fabric design delivers summer comfort while maintaining natural light and visibility. Each blind is motorised and controlled by teachers via remote control, ensuring ease of use without disrupting lessons. The system also allows future centralised automation without further construction.

Efficiency Gains

Environmental

- **70% reduction in air conditioning use and heating consumption cut by up to 30%**
- **Classrooms 5.1°C cooler compared with old manual blinds**
- **Indoor temperature held below 27°C during a 39°C heatwave, 12°C cooler than outside**

Economic & Social

- **CAPEX USD 950,000 (USD 63,300 per building) with ~4-year payback**
- **301,000 kWh/year avoided compared with equivalent air conditioning (Alterea Energies measurement)**
- **Annual savings of USD 235,000 in energy and maintenance (excluding installation)**

How was it Financed?

At the time, the city relied entirely on its own funds, as no subsidies were available. Today, Somfy is a partner in the EduRenov programme (Banque des Territoires), financing upgrades in 10,000 schools by 2027.

Enablers and Challenges

Success was enabled by a holistic approach to comfort and efficiency. Solar protection and automation let managers optimise light and temperature without energy-hungry cooling, delivering measurable yearly savings.
The project improved visual comfort, reduced glare, noise, and health impacts, and relied on proven technologies and a trusted installer network to support community adaptation.

Istya and Dalkia Deliver AI-Driven Healthy Buildings

Paris, France
Since 2024

The Story

In preparation for the Paris 2024 Olympic Games, Istya deployed its AI-driven building solution across 1,500 m² of the Olympic Village, in partnership with Dalkia (EDF Group).
The system relied on artificial intelligence and a network of sensors to continuously monitor indoor air, including carbon dioxide, volatile organic compounds and fine particles, and to automatically adjust ventilation to actual needs. This approach ensured that air inside the building remained consistently healthier for occupants, even during periods of high outdoor pollution. Measurements demonstrated reductions of up to 90% in fan energy use while improving all indicators of air quality.
The solution generated substantial carbon and cost savings while also reinforcing well-being by limiting exposure to external pollution peaks. Building on this success, Istya extended its 'Heritage' program to bring the same technology to other territories, creating long-lasting environmental and social value.

Solution Spotlight

Istya uses artificial intelligence to transform how buildings monitor and control air quality. Unlike traditional systems, their generalised models do not need heavy retraining for every new site, making adoption faster and lighter. Virtual sensors, built on real sensor data, replicate the function of physical devices while reducing the amount of hardware required. This lowers costs and the carbon footprint of installations. By combining smart sensing with predictive control, ventilation adapts in real time, reducing energy use by up to 90% and ensuring that indoor air stays healthier, even during outdoor pollution events.

Efficiency Gains

Environmental

- **Up to 90% reduction in fan energy consumption**
- **Lower greenhouse gas emissions from building operations**
- **Fewer physical sensors required thanks to AI-based virtual sensing, reducing hardware footprint**

Economic & Social

- **Return on investment in less than two years.**
- **Reduced installation and maintenance costs through minimised hardware**
- **Indoor air quality consistently healthier than outdoors, even during pollution peaks**
- **Improved well-being, comfort, and health protection for occupants**
- **Demonstrates how technology developed for global events can leave a lasting legacy, contributing to both climate and health goals for communities**

How was it Financed?

The project was financed by Dalkia (EDF Group) as part of its operational investment for the Olympic Village.

Enablers and Challenges

The project was made possible through Istya's ability to turn real-time data into predictive insights, using AI and virtual sensors to optimise ventilation. The system was deployed efficiently, proving that cleantech can deliver scalable impact in high-profile environments like the Olympic Games. Deploying the solution in the Olympic Village required ensuring interoperability with existing building infrastructure, fine-tuning ventilation control parameters, and validating new virtual sensors.

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Mapping Heat to Enable Passive Cooling

Chennai, Tamil Nadu, India
Since 2023–2024

The Story

With over 7 million people and one of the world's highest urban densities, Chennai faces intensifying heat stress. Between 1990 and 2020, built-up areas grew by more than 250 percent, raising land surface temperatures by 1.5–3°C during the day and 2–4°C at night. To address this, the Swiss Agency for Development and Cooperation and UNEP launched the BeCool project with state agencies and research organisations. Over 12 months, the team deployed remote sensing, temperature monitoring, and socio-economic surveys to map the urban heat island effect. The study identified 100 hotspots, screened 20 for microclimate analysis, and now guides passive cooling strategies to cut demand and improve resilience.

Solution Spotlight

BeCool combines high-resolution GIS mapping with passive cooling strategies. The assessment produced a detailed understanding of heat stress across Chennai's land uses, enabling targeted application of low-cost, scalable solutions including cool roofs, natural ventilation, shading, reflective pavements, and trees. By linking scientific analysis with planning guidance, the project equips city planners and developers to integrate sustainable cooling into new developments and retrofits, reducing energy demand and emissions.

Efficiency Gains

Environmental

- **Reduction of local ambient temperatures by 1.5–3°C**
- **Surface temperature drops up to 12°C with reflective/shading measures**
- **Cooling demand cut by 10–20%**
- **Lower GHG emissions from avoided cooling**

Economic

- **Lower energy bills for households and businesses**
- **Reduced heat-related morbidity by 15–30%**
- **Supports resilience planning in one of India's fastest-growing cities**

How was it Financed?

BeCool was funded through a multi-donor framework led by SDC and UNEP, with philanthropic and development partners. UNEP sponsored monitoring instruments, while government partners contributed technical inputs and in-kind support.

Enablers and Challenges

The project benefited from strong support across agencies including the Department of Environment, Chennai Metropolitan Development Authority, and State Planning Commission. Expertise from national and international experts, UNEP sponsorship of monitoring systems, and effective coordination secured government buy-in. Challenges included the time-intensive process of collecting accurate high-resolution data due to weak public data systems and the high costs of instruments, which required external funding.

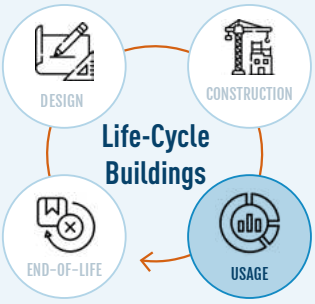
Enabling the deployment of sustainable solutions

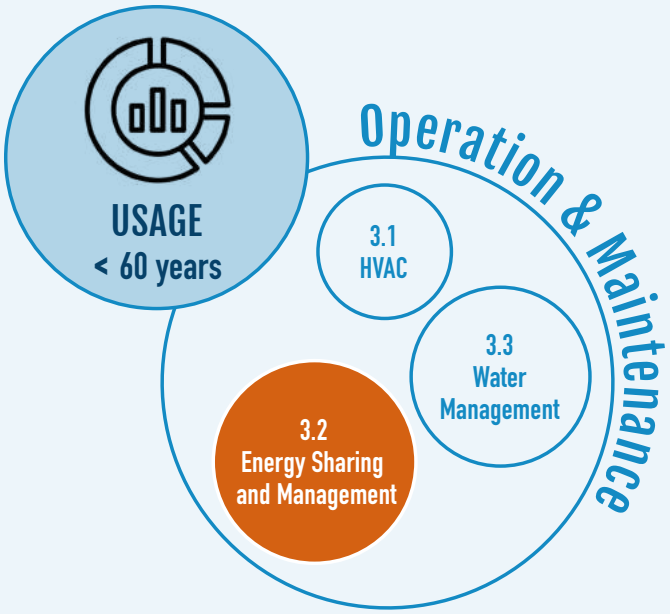
Germany's Funding Programme for the Installation of Heat Pumps

The Kreditanstalt für Wideraufbau (KfW) supports the installation of climate-friendly heating systems in Germany, through a public funding programme. Individuals, housing and real estate companies as well as municipalities are eligible to apply. In addition to heat pumps, the funding program also includes solar thermal systems, biomass heating systems and hydrogen-capable heating systems. The funding amount varies depending on the applicant group and measure, but the basic funding amounts to 30% of the total eligible costs for all of them. In addition, there can be various bonuses. The funding is provided through direct financial grants, and low-interest loans can also be used in addition. Climate-friendly heating systems are economical in the long term and actively contribute to climate protection through lower greenhouse gas emissions.

UK Overheating Standards and Their Role in Deployment

The UK's Chartered Institution of Building Services Engineers (CIBSE) is a professional engineering association for the built environment sector. CIBSE brings together leading scientific and professional expertise to develop guidance and technical memoranda to inform and support design of healthy, resilient and energy efficient buildings. These technical memoranda and guidance play an important role in promoting energy-efficient practices in building design and operation, by outlining best practice approaches for designers and practitioners to follow. Indeed one recent example is CIBSE's guidance on assessment of overheating (TM59) which was built upon in the new Approved Document O of Building Regulations introduced in 2021 to prevent the risk of summer overheating prioritising passive measures. In this way CIBSE can leverage the expertise of professionals and experts in the field to facilitate a smoother transition to sustainable practices within the built environment.





> 3.2 Energy Sharing and Management

As buildings move towards electrification, optimising how energy is shared and managed has become essential. Digital management systems, microgrids, and peer-to-peer trading platforms can balance supply, lower peak demand, and make renewable power more effective. Electricity already represents around 35 percent of building energy use, a share expected to rise as heating, cooling, and appliances are increasingly electrified (IEA, 2023). In mature markets, advanced systems integrate rooftop solar, batteries, and district networks into intelligent grids that can cut emissions while reducing costs. In emerging contexts, microgrids and community-based sharing models are providing reliable access to clean energy where central grids remain limited. Together, these approaches enable households, businesses, and communities to act as both producers and consumers of power. Energy sharing and management therefore reduce costs, strengthen resilience, and support the transition to renewable energy worldwide.

CHALLENGE

Optimising energy use through sharing and smart management

Deploy microgrids, storage, demand response, and peer-to-peer energy trading

OBSERVATIONS

Smart systems can lower peak demand by up to 20 percent, stabilising grids and cutting bills (IEA, 2023). Microgrids in underserved areas provide dependable electricity and support local businesses. In advanced markets, peer-to-peer trading pilots are expanding through digital platforms. Integration of batteries, rooftop solar, and smart meters allows households and companies to manage consumption, share surplus power, and build resilience against fluctuating energy prices.

OBSTACLES

Policy and regulation often lag behind technological advances, restricting energy trading and decentralised models. Upfront investment for batteries and advanced control systems remains high, limiting adoption among smaller users. Technical expertise is needed to operate and maintain microgrids effectively. Some utilities resist decentralisation that reduces central revenue. In urban contexts, integrating new systems with ageing grid infrastructure can be complex, slowing the pace of adoption despite clear benefits.

OPPORTUNITIES

Governments are increasingly updating frameworks to support local energy trading and community energy. Falling battery costs and the spread of digital platforms are improving affordability. In advanced economies, demand response programmes cut costs for consumers and utilities. In emerging markets, donor-backed microgrids and storage projects are scaling rapidly. Combining renewables, storage, and sharing models provides both environmental and economic benefits while fostering more resilient, decentralised energy systems.

Optimising Building Performance with Automated Control Systems

Multiple Sites, UK
Since 2022

The Story

EQUANS, in partnership with VIVO, has installed industry-leading Building Energy Management Systems (BEMS) across UK military bases to support the MOD's Net Zero and Energy Resilience goals. An audit identified that high-energy plant items required upgrades. Consequently, EQUANS and VIVO launched an ambitious programme of hardware upgrades to the BEMS, yielding considerable energy and carbon savings while improving military personnel's workplace experience and wellbeing. Additionally, a reduction in reactive maintenance visits has led to operational savings. Currently, 14 sites are complete, with around 80 total upgrades planned across the UK over three years.

Solution Spotlight

The smart BEMS optimises energy usage by integrating with a building's infrastructure, such as heating, ventilation, and air-conditioning (HVAC) systems. The system collects live energy consumption data that is graphically represented, enabling a holistic view of each building across the estate in real time. This allows operatives to make informed data-driven decisions regarding energy usage and facilitates augmentations to plant operation. Data analytics providing anomaly detection ensure that sites remain optimised, maintaining energy resilience. The BEMS's open protocol architecture accommodates future expansions for new use cases, such as IoT, enhancing interoperability of sensors, devices, and BEMS to increase energy efficiencies and carbon savings.

Efficiency Gains

Environmental

- **Decarbonisation of estate because of reduction in energy usage**
- **Remote monitoring and maintenance**

Economic & Social

- **Energy Savings between 20-40%**
- **Extended plant asset lifecycle**
- **Predictive maintenance**
- **Reduction in maintenance costs**
- **Increased occupant comfort and experience for service personnel**

How was it Financed?

The initiative is funded by the Defence Infrastructure Organisation (DIO) as part of the £1.6 billion Future Defence Infrastructure Services (FDIS) Programme. EQUANS provided a clear business case supporting a strong return on investment through reduced energy bills alongside benefits from plant efficiency and resiliency.

What Made It Possible?

Leveraging EQUANS's technical expertise, VIVO Defence, in partnership with EQUANS, was successfully awarded the opportunity as part of the FDIS programme.

Digitalising Building Operations to Unlock Energy Savings

Germany
2023–2025

The Story

Germany's residential building stock is predominantly older and inefficient, driving high energy use and emissions. To address this, PAUL Tech, a German greentech company founded in 2017, develops and operates digital energy management systems designed to optimise building performance. Since 2023, with investment support from Solas Capital, the company has been deploying its proprietary PAUL Performance technology across multi-family housing portfolios, already supporting 160,000 residential units. In 2025, PAUL launched its enhanced PAUL Net Zero offering and secured financing for about 36,000 residential units. With a pipeline targeting around 20,000 units by year end, installations for roughly 6,700 units are already complete.

Solution Spotlight

PAUL Tech's systems use IoT sensors installed in heating, water, and energy systems to collect operational data in real time. This data is analysed by AI-driven algorithms to optimise performance, improve hydraulic balancing, and reduce energy waste. The PAUL Performance solution enhances existing systems without hardware replacement, while the PAUL Net Zero upgrade replaces fossil-fuel heating with heat pumps, supported by optimised control strategies and, where applicable, integration with solar power.

Efficiency Gains

Environmental

- **20–30% reduction in final energy demand with PAUL Performance**
- **Over 60% reduction in final energy demand when upgrading to PAUL Net Zero with heat pumps**

Economic & Social

- **Verified savings create a strong basis for performance-based financing**
- **Reduced heating costs for tenants through efficiency and electrification**
- **Improved thermal comfort and system reliability for residents**
- **Supports large-scale decarbonisation of residential portfolios**

How was it Financed?

The model removes upfront investment barriers for building owners. Systems are installed, operated, and maintained by PAUL Tech, which recovers costs via shared savings or tenant energy bills. Financing for PAUL Performance is secured through long-term debt instruments provided by Solas Capital, with risk-sharing mechanisms supported by institutions such as the European Investment Bank (EIB), making large-scale retrofits financially viable.

What Made It Possible?

Success is enabled by compatibility with legacy building systems, verified performance data that supports financing, and partnerships with financial institutions for scaling. Challenges include the high capital intensity of PAUL Net Zero requiring innovative financing solutions, and the need to rapidly expand installation capacity to meet growing demand.

Expanding Energy Access with Mesh-Grids

Nigeria, Haiti, Philippines, Cambodia
2018–2025

The Story

Okra Solar, an Australian cleantech company, partnered with distributed energy service companies and NGOs including Renewvia, Creeds, ENGIE Energy Access and Havenhill Synergy in Nigeria, Alina Eneji in Haiti, and electric cooperatives in the Philippines to deliver modular solar mesh-grids to unelectrified villages. To date, more than 8,500 households have been connected.

Solution Spotlight

The Okra Pod, a smart controller installed at each household, integrates solar panels and batteries with metering, billing, charge control, and IoT connectivity. Using a hub-and-spoke topology, higher-demand users such as shops or mills share surplus power with neighbouring households over low-voltage DC cables, which are cheaper than traditional mini-grids. The modular design allows networks to expand as demand grows.

Efficiency Gains

Environmental

- **Displaces fossil-fuel generators for productive loads**
- **Improves utilisation of decentralised solar and battery systems**

Economic & Social

- **Reduces cost per connection by up to 40% compared with mini-grids**
- **Enables local enterprises such as shops, mills, and water pumping**
- **Surplus energy from hubs supports more users and increases revenue**
- **Expands access to reliable renewable power with 98% uptime**
- **Provides energy for health centres and community services**

How was it Financed?

Projects use blended finance combining climate funds, national electrification programmes, and private equity and debt. In Nigeria, the 2025 DARES programme provides a $300 per-connection grant for eligible communities.

What Made It Possible?

Plug-and-play design, low-voltage distribution, and local maintenance agents underpin success. Challenges include access to local currency finance and stimulating appliance uptake to maximise demand.

Smart Optimisation of a Commercial High-Rise

Chicago, United States
Since 2023

The Story

A 1.4 million square foot high-rise in Chicago required a comprehensive upgrade from pneumatic controls and a monitoring-based commissioning platform to a smarter, more efficient system. The client, supported by an experienced on-site team, sought to reduce energy costs, improve tenant comfort, and showcase the property as a leading example of smart building innovation. JLL deployed its Smart Building Platform to digitise operations and deliver real-time optimisation across the building.

Solution Spotlight

JLL installed 1,000 wireless pneumatic stats to digitise perimeter zones and integrated its Smart Building Platform with Cypress and Schneider automation systems. Cloud-based optimisation was applied to the central plant, enabling efficient 3,500-tonne operations, automated night purges using outdoor air, and night setback routines informed by zone-level analytics. The platform tracked energy savings through event-specific impacts, linking detection of an issue with its correction, and automated annualised reporting.

Efficiency Gains

Environmental

- **Generated over 100 automated work tickets to resolve energy conservation and operational issues**

Economic & Social

- **Secured $350,000 in utility rebates from combined projects**
- **Delivered $175,000 in annualised savings with a 14-month payback**
- **Increased asset value and earned industry awards**
- **Enhanced tenant experience through improved temperature, humidity, and air quality**

How was it Financed?

The project was financed privately by the client, with rebates further supporting the business case. Demonstrated annualised savings created a rapid payback and strong justification for the investment.

What Made It Possible?

JLL's Smart Building Platform compatibility with both legacy pneumatic systems and modern automation platforms enabled a smooth transition without requiring a full BMS replacement. Collaboration between JLL's optimisation team and the on-site facilities staff ensured rapid adoption and measurable results. A core challenge was digitising older infrastructure at scale while maintaining occupant comfort, which the flexible integration of wireless controls helped overcome.

The NEST: A Connected Building Driving Energy Efficiency

Dubai, United Arab Emirates
Since 2025

The Story

In Dubai, UAE, Schneider Electric has launched its first site under the Impact Buildings Program, showcasing how commercial real estate can lead decarbonisation. The new building, named The NEST, is over 10,000 m², accommodates more than 1,000 employees, and houses a Global Innovation Hub and Training Center. It leverages Schneider Electric's EcoStruxure™ portfolio (including Building Operation, Power Monitoring Expert, Building Data Platform, and Planon Integrated Workplace Management) to integrate electrification and digitalisation ("Electricity 4.0") into its core. Compared to its previous facility in the same region, The NEST targets a 47% reduction in energy consumption and aims to cut 600+ metric tonnes of CO_2 emissions annually. With evolving standards and occupant expectations, the project sets a benchmark for intelligent, connected, and sustainable buildings.

Solution Spotlight

Schneider Electric's Impact Buildings Program deploys its EcoStruxure suite, software, hardware, services, to optimise building operations, power systems, and data analytics. These solutions interoperate to monitor energy use in real time, automate energy savings, improve occupant comfort, and support predictive maintenance.

At The NEST, technologies like Planon's facility management tools and Digital Building Operation platforms are harnessed to shape both performance and user experience.

Efficiency Gains

Economic

- **Cuts energy consumption by ~47% relative to the previous local Schneider Electric site**

Environmental & Social

- **Reduced CO_2 emissions by 600+ metric tonnes/year, helping meet regional and corporate decarbonisation goals**
- **Improved occupant experience through smart façades, flexible working areas, and enhanced connectivity**
- **Serves as a training and innovation centre, boosting skills development and local capacity in sustainable building technologies**

How was it Financed?

The project is entirely funded by Schneider Electric (private sector), using company capital for development and deployment of its own technologies. As a flagship site, it also functioned as both investment in infrastructure and a marketing & R&D showcase.

What Made It Possible?

Schneider Electric's strong internal commitment to sustainability, the readiness of its EcoStruxure technology stack, robust digital infrastructure for close performance monitoring, and alignment with UAE climate and economic policies. Key challenges involved the complexity of integrating multiple systems, ensuring consistent performance data and operational adjustments to meet energy savings targets, securing user acceptance of new technologies, and managing upfront implementation costs along with staff training for effective adoption.

Light BMS for Small and Medium-Sized Buildings

Rennes, France
Since 2025

The Story

Equans Pilot was developed as part of Innos du FM, a collaborative innovation programme led by Equans Services Bâtiments & Infrastructures. Created in partnership with Smart & Connective, the goal was to design a simple and cost-effective remote energy management system for small and medium-sized tertiary buildings, which are often excluded from advanced optimisation due to cost. Following a first deployment at the Equans branch in Rennes, the system demonstrated immediate potential to reduce energy consumption, deliver real-time monitoring, and prepare buildings for energy flexibility.

Solution Spotlight

Equans Pilot is a light Building Management System (BMS) based on IoT technology. Connected devices manage heating, cooling, lighting, and other systems, communicating via Zigbee or Z-Wave protocols with a central controller called CEOS. Data is consolidated in a secure cloud-based BMS, which is configurable, remotely accessible, and easy to deploy without heavy works. Key features include simplified installation, real-time supervision with alerts, and smart controls that optimise operations through automated scenarios.

Efficiency Gains

Environmental

- **33% reduction in electricity consumption achieved in the first month at Rennes**
- **Improved ability to prepare sites for energy flexibility**

Economic & Social

- **30–50% more affordable than traditional BMS solutions**
- **Reduced energy bills provide quick returns on investment**
- **Remote supervision ensures greater reliability for local teams**
- **Improves comfort while providing accessible, intuitive energy management**

How was it Financed?

Development of Equans Pilot was supported through time allocated within the Innos du FM programme. The first installation was directly financed by the Rennes Agency Director, demonstrating a lean, local approach to piloting innovative technologies.

What Made It Possible?

The solution benefited from collaboration between Equans' operational teams, its Energy & Carbon Performance division, and Smart & Connective's flexible technology. This partnership allowed rapid, secure deployment tailored to small and medium-sized buildings. Scaling remains the key challenge: adapting the system to multi-site portfolios with diverse needs and supporting local teams to achieve consistent performance across larger networks.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Mass-Scaling Energy Efficiency with European Institutions

Across Europe, small and medium-sized enterprises (SMEs) form the backbone of the economy – yet most remain locked out of the energy transition. High upfront costs, limited expertise, and fragmented financing have slowed the adoption of proven energy-saving technologies. To change this, the European Investment Bank (EIB) Group, the European Commission, and the Solar Impulse Foundation have launched a major financing initiative to help more than 350,000 European SMEs cut energy use and costs.

By combining EIB-backed credit lines, EU guarantees, and other financial instruments, the initiative aims to unlock €17.5 billion in investment across Europe. Part of this initiative will focus, lead by EIB with the support of the Solar Impulse Foundation, and financial intermediaries, will focus on "Energy Efficiency-as-a-Service" business models, where companies can access efficiency improvements without major capital expenditure. Instead of buying new equipment, SMEs pay for the energy savings achieved, turning efficiency into a measurable and financeable service. This approach removes adoption barriers, channels private finance into smaller projects, and accelerates the deployment of market-ready solutions – from high-efficiency lighting and heating systems to smart energy management tools. Beyond direct savings, it strengthens Europe's competitiveness, supports local service providers, and builds resilience to volatile energy prices.

By bridging innovation, finance, and implementation, the partnership demonstrates how policy-driven financial instruments can turn efficiency into a service industry. It represents a scalable blueprint for mobilising capital toward the decarbonisation of Europe's vast SME sector – proving that smarter financing models can make energy efficiency both accessible and unstoppable.

Dalian Pioneers China's First Large-Scale Flow Battery Energy Storage System

Dalian, China
Since 2022

The Story

In 2022, Dalian launched China's first large-scale flow battery energy storage system (BESS), featuring an initial capacity of 100MW/400MWh, with plans to expand to 200MW/800MWh. This system addresses a critical challenge in the renewable energy transition: efficiently storing intermittent energy to align supply with fluctuating demand. By harnessing excess energy generated from wind and solar, the flow battery converts electrical energy into chemical energy during optimal generation periods. This stored energy is then converted back into electricity during peak demand, stabilising the grid and enhancing energy reliability. Dalian's project sets a precedent for cities globally to explore large-scale energy storage solutions and advance grid decarbonisation.

Solution Spotlight

Dalian's flow battery energy storage system is the largest of its kind globally, designed to stabilise the grid and facilitate a higher integration of renewable energy sources.

Efficiency Gains

Environmental

- **Enhanced grid efficiency by balancing energy supply and demand**
- **Increased renewable energy usage, reducing greenhouse gas emissions**

Economic & Social

- **Stabilised energy prices by alleviating peak demand pressures**
- **Improved energy reliability for businesses and households**
- **Created new job opportunities in the local energy sector**

How was it Financed?

The project was developed by the Dalian Institute of Chemical Physics and manufactured by Dalian Rongke Power. Investments were garnered from public and private sources, including the Chinese National Energy Administration, underscoring a commitment to advancing clean energy technologies.

What Made It Possible?

Planning, design and construction of the project took six years before the system was finally connected to the grid in 2020. The technology, developed by the Dalian Institute of Chemical Physics, was approved by the Chinese National Energy Administration in 2016, and is aligned with the national government's goals to expand the use of new energies to decarbonise energy supply.

Stockholm's BECCS Plant: Carbon-Negative Heat and Power

Stockholm, Sweden
Since 2021

The Story

Stockholm's Bio-energy with Carbon Capture and Storage (BECCS) project, set to begin operations in 2028, aims to remove greenhouse gases while providing clean energy to the city's district heating network. By utilising sustainably sourced biomass residues, such as sawmill and paper production waste, the plant will generate heat and power for residents. It captures CO_2 from flue gases and stores it underground in deep geological formations, with an expected removal of nearly 8 megatonnes of carbon dioxide within the first decade. As the first deployment of this technology in the region, Stockholm's BECCS project is laying the groundwork for a Carbon Capture and Storage (CCS) value chain in Northern Europe.

Solution Spotlight

The BECCS plant will burn biomass residues to produce renewable energy while capturing and storing carbon dioxide, supporting Stockholm's sustainability goals.

Efficiency Gains

Environmental

- **Expected removal of nearly 8 megatonnes of CO_2 over ten years**
- **Supports the decarbonisation of Stockholm's energy grid through renewable biomass**

Economic & Social

- **Provides a reliable and sustainable heat and power supply**
- **Reduces air pollution, fostering a cleaner urban environment**
- **Creates jobs in the operation and maintenance of the BECCS facility**

How was it Financed?

The project secured €180 million from the European Union Innovation Fund and is bidding for state aid from the Swedish Energy Agency through a reverse auction process. Additionally, the company is selling Carbon Dioxide Removal credits (CDRs) to businesses ahead of their 2030-2035 net-zero targets.

What Made It Possible?

Stockholm Exergi combined two established technologies: Carbon Capture and Storage (CCS) and bio-fuelled Combined Heat and Power (CHP). Initial feasibility was tested at a smaller facility, supported by the Swedish Energy Agency. Subsequent EU funding was awarded due to the project's innovative nature and alignment with sustainability objectives. Engaging local communities through public surveys ensured community support.

Harnessing Energy: Montgomery County's Microgrid for Sustainable Infrastructure

Montgomery County, USA
Since 2024

The Story

Montgomery County leads in sustainable infrastructure with the David F. Bone Equipment Maintenance and Transit Operations Centre, the largest renewable energy-powered transit depot in the U.S. The facility will include a 5.65 MW microgrid with solar power, battery storage, electric bus charging, and a hydrogen electrolyser. Supporting 200 hydrogen fuel cell electric buses by 2035, the depot reduces emissions and ensures continuous operations during outages, setting a new standard for sustainable transit infrastructure.

Solution Spotlight

Advanced construction methods integrate energy-efficient design and renewables across five operational buildings. The microgrid powers electric bus charging and optimises depot energy use, enabling grid independence. This model highlights the role of renewable energy in decarbonising transit and construction sectors.

Efficiency Gains

Energy Savings

- **Facilitates a shift to renewable energy, significantly reducing reliance on fossil fuels for building and operational needs**

CO_2 Emissions

- **Anticipated reduction of 4,000 metric tons of CO_2 emissions annually, demonstrating the effectiveness of integrating sustainable practices within the construction sector**

Fleet Transition

- **Supports 200 zero-emissions buses, contributing to improved air quality and alignment with green building standards**

Job Creation

- **Generates local employment opportunities through training programmes related to the project's construction and ongoing operations**

How was it Financed?

Utilising an Energy as a Service (EaaS) model, the project mitigates upfront capital costs, providing predictable operating expenses and performance guarantees. This approach promotes sustainable building practices without imposing financial burdens on the County.

What Made It Possible?

Collaboration among Montgomery County officials, AlphaStruxure, and utility partners has been pivotal to the project's success, setting a benchmark for future infrastructure initiatives that synergise energy sharing and management in both transit and construction.

Smart Energy Optimisation in Brussels' Rogier Tower

Brussels, Belgium
Since 2022

The Story

The Rogier Tower in Brussels became a flagship for Equans' decarbonisation strategy, aiming to balance occupant comfort with deep energy optimisation in a complex, multi-tenant high-rise. Equans Digital BeLux implemented a new Building Management System (BMS) combined with OptimiZ, an intelligent energy management system. By centralising data, enabling real-time anomaly detection, and introducing daily energy quotas, the system empowered operators to act immediately and track progress through transparent dashboards. Control logic shifted from weather-based inputs to occupancy and indoor comfort, delivering a 44% reduction in gas and cooling electricity consumption in only six months.

Solution Spotlight

OptimiZ functions as a vendor-agnostic analytics layer on top of any BMS. Using open protocols, it ingests building data and applies rules plus machine learning heuristics to detect inefficiencies such as simultaneous heating and cooling, misaligned schedules, or faulty actuators. These inefficiencies, termed "Sparks," trigger recommendations for corrective action. Deployed in the cloud or on-premises, OptimiZ provides dashboards to track KPIs and energy budgets, stabilising comfort while cutting waste.

Efficiency Gains

Environmental

- **44% reduction in gas and cooling electricity consumption during H2 2022**
- **Gas savings of up to 883,947 kWh (44.4% reduction, depending on reference model)**
- **Electricity (cooling) savings of 85,643 kWh (29.4% reduction)**
- **Potential for ~40% annual energy savings through sustained optimisation**

Economic & Social

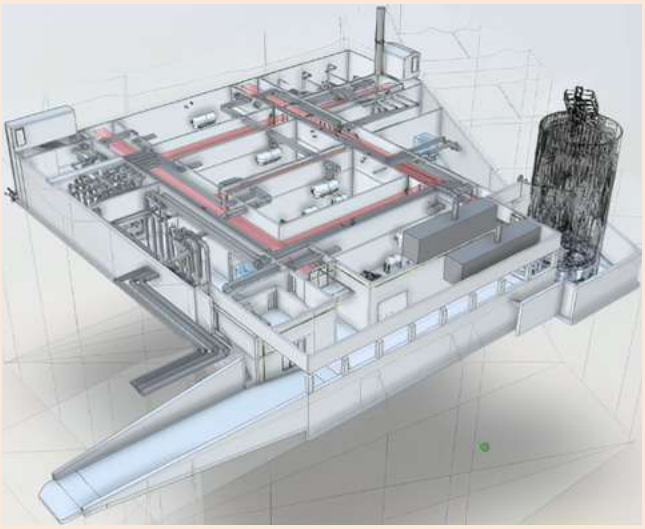
- **Financial savings of up to €53,101 on gas and €18,086 on electricity (using average market prices)**
- **Energy prices are indicative and may vary, but the results confirm rapid payback and long-term operational savings**
- **Quantified reductions strengthen the building owner's efficiency strategy**
- **Improved indoor comfort through occupancy-driven controls**
- **Increased transparency for tenants via dashboards and reporting**

How was it Financed?

The works were financed directly by the building owner as part of a long-term energy efficiency strategy. Equans built the business case on verified 44% energy reductions, highlighting strong financial returns and CO_2 reduction potential.

What Made It Possible?

The project leveraged Equans' decades of expertise in building automation and technical services. Open-protocol BMS integration, centralised dashboards, and flexible cloud/on-prem deployment enabled fast deployment. Close collaboration with the owner and a data-first approach ensured rapid adoption. Challenges included unifying diverse building systems, shifting cultural norms from weather- to occupancy-based control, and maintaining tenant comfort while pursuing ambitious energy and carbon reductions.



Using CO_2 Networks to Decarbonise District Heating

Fribourg, Switzerland
2025-2026

The Story

Between 2025 and 2026, Groupe E, the Fribourg utility company, is partnering with ExerGo and others to decarbonise its water-based district heating network. The project uses ExerGo's CO_2 system to capture ambient energy from the river La Sarine and deliver it to large heat pumps that replace fossil-based sources. Three main advantages support implementation. First, the compact design reduces deployment time and cost, avoiding the challenges of laying large water pipes. Second, the natural height difference between the river and the heat pumps allows the fluid to circulate without pumps, saving an estimated EUR 6 million in electricity costs over the system lifetime. Third, CO_2 is used as a natural refrigerant without additives or lubricants, ensuring compatibility with sustainable resource use.

Solution Spotlight

ExerGo's CO_2 Thermal Network is a compact, closed-loop system that transports renewable and waste heat from local sources such as rivers, lakes, geothermal reservoirs, or industrial processes. It integrates with existing HVAC systems and its bidirectional two-pipe design balances heating and cooling demand in real time. This makes it a scalable and cost-effective option for dense urban areas.

Efficiency Gains

Environmental

- **Enables efficient transport of ambient and waste heat into the thermal grid, displacing fossil fuels**
- **Expected to produce 55 GWh of heat annually, avoiding ~11,000 tonnes of CO_2eq per year compared with fossil generation**

Economic & Social

- **Pump-free circulation via the thermosyphon effect eliminates electricity use for fluid movement**
- **Long-term savings of at least EUR 6 million in electricity costs**

How was it Financed?

This industrial-scale project is financed by GroupeE, a Swiss utility company that is developing multiple district heating projects in Switzerland. In 2024 alone, GroupeE invested more than USD 75 million in district heating projects.

What Made It Possible?

The project succeeded thanks to a client open to innovation and able to objectively evaluate ExerGo's solution, paired with a dedicated ExerGo team that seized the opportunity to join an already-launched project and champion its unique approach. Key implementation challenges included managing supply chains, coordinating planning and deployment with partners and subcontractors, and ensuring project financing and guarantees were in place.

> ***"Thanks to ExerGo's innovative solution, Groupe E is continuing the expansion and transformation of the Fribourg district heating network. This pioneering installation enables us to strengthen our capacity while reducing operating costs and ensuring a clean, competitive energy supply for the community."***
>
> **Timothée Demierre,**
> Responsable de Projets d'Affaires, Groupe E

ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Energy Performance Contracts Driving Measurable Decarbonisation

As a global leader in low-carbon energy and services, ENGIE has pioneered the use of Energy Performance Contracts (EnPCs) across Europe to accelerate the transition towards energy efficiency and carbon neutrality. ENGIE applies Energy Performance Contracts (EnPCs) to guarantee energy, carbon and cost savings while managing performance risk on behalf of clients. Through this model, ENGIE ensures measurable, long-term results by combining technological excellence with financial reliability.

A flagship example is the Energy and Environmental Performance Contract signed in 2025 with the Indre-et-Loire Department (CD 37), the first of its kind in France to integrate energy efficiency, water management and biodiversity preservation. Covering 68 public buildings (86,000 m²) over 8.5 years, the contract guarantees a 28.8% reduction in energy use, a 38.6% cut in CO_2 emissions and a 12.6% saving in water consumption.

ENGIE and its partners are deploying 740 energy efficiency actions, including heat pumps, photovoltaic systems and geothermal solutions, supported by real-time digital monitoring via the ENGIE PREDITY platform. In parallel, 620 biodiversity actions (habitat creation, surface de-sealing, intelligent water metering) demonstrate that energy and environmental performance can reinforce each other.

By combining guaranteed results, data-driven monitoring and shared value creation, ENGIE's EnPC approach shows that performance-based models can accelerate public sector decarbonisation while enhancing local resilience and comfort.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Accelerating Building Retrofits in Melbourne

Commercial buildings are responsible for nearly 60% of Melbourne's total greenhouse gas emissions, making retrofitting one of the city's most powerful tools for achieving net zero by 2040. Recognising that local governments in Australia hold limited formal powers over building standards, the City of Melbourne launched the Retrofit Melbourne plan in 2024 to mobilise collaboration across government, finance, and industry. The initiative aims to increase the pace of deep energy retrofits in mid-tier commercial buildings from just seven per year to at least 80 retrofits annually by the end of the decade.

The plan combines advocacy, partnership, and market development. It calls for stronger financial and regulatory frameworks at the state and national levels to make building upgrades more accessible and economically viable. To support capacity-building and knowledge exchange, Melbourne works closely with C40 Cities, which connected it with peers including Copenhagen, Washington D.C., and New York City, all fellow signatories to the C40 Net Zero Carbon Accelerator. These exchanges helped shape Melbourne's retrofit strategy and align it with international best practice.

Melbourne is also collaborating with Sydney and asset managers through a peer forum to share insights on overcoming barriers to decarbonisation. Its advocacy contributed to updates in the Australian National Construction Code, to be implemented in 2024, which strengthens energy performance requirements.

By fostering alignment across jurisdictions and industries, Retrofit Melbourne demonstrates how cities can lead market transformation from within their existing mandates, building momentum for large-scale decarbonisation of the built environment.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

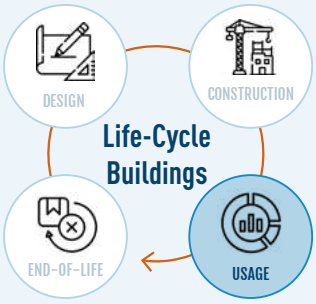
Botswana's Rooftop Solar and Net Metering Programme

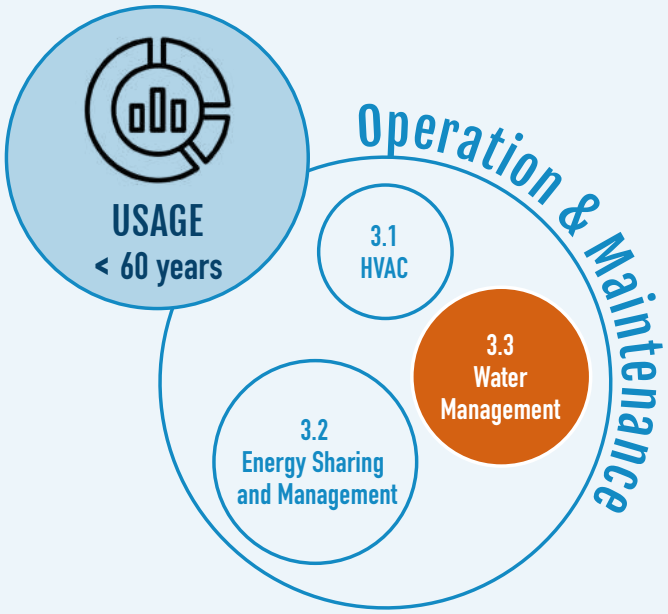
Botswana's Rooftop Solar Programme, launched in 2020 by the Botswana Energy Regulatory Authority (BERA) and the Botswana Power Corporation (BPC), established the country's first net metering framework to accelerate distributed renewable energy generation. The regulation enables households, businesses and industries to install rooftop or ground-mounted solar photovoltaic (PV) systems and export excess electricity to the national grid.

The programme set an initial capacity limit of 10 megawatts, with 2 MW reserved for residential users and 8 MW for commercial and industrial installations. It defines technical standards for safe interconnection, establishes a transparent approval process, and allows excess generation to be credited to the user's account and rolled over across billing periods, with compensation for any remaining credit after 12 months. This structure encourages investment in small-scale renewables while maintaining grid stability.

By allowing consumers to generate and share clean energy, the policy creates the conditions for prosumer participation and supports more flexible, efficient energy management at the building level. It also stimulates local markets for solar installation, maintenance and equipment supply.

Botswana's rooftop solar framework demonstrates how clear regulation and grid access can unlock decentralised renewable deployment, reduce peak demand, and build capacity for future expansion of smart energy systems. It serves as a practical example of how policy can turn buildings from passive energy users into active contributors to a more sustainable and resilient electricity network.





> 3.3 Water Management

Water demand in buildings is rising with urbanisation, placing increasing stress on regions already facing scarcity. Efficient management through low-flow fixtures, rainwater harvesting, digital monitoring, and greywater reuse reduces both water consumption and the energy required for pumping and treatment. The Global Status Report for Buildings and Construction 2025 highlights water efficiency as a key enabler for climate resilience in the built environment. Solutions range from affordable decentralised systems that provide safe water in underserved areas, to advanced digital platforms that monitor usage and optimise savings across large building portfolios. Nature-based systems further expand the options by safely reusing water through constructed wetlands and green infrastructure. Water-efficient buildings lower utility costs for occupants, strengthen resilience during droughts, and reduce pressure on municipal networks. Integrating water and energy measures provides additional synergies, since heating and treating water is a major source of energy demand in buildings.

CHALLENGE

Reducing water demand and improving resilience in buildings

Integrate monitoring and control platforms, install rainwater harvesting, implement greywater reuse systems, and adopt low-flow fixtures

OBSERVATIONS

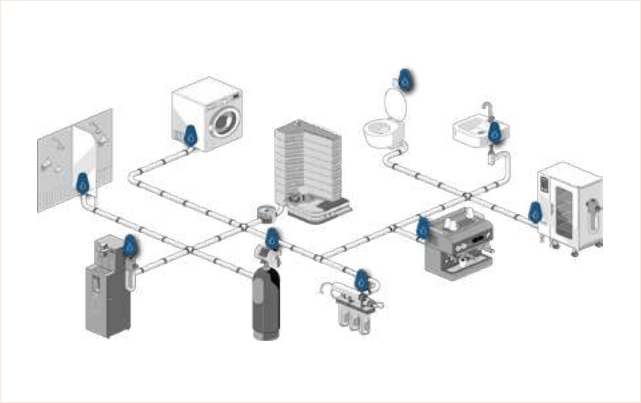
Digital monitoring improves leak detection, optimises usage, and ensures accountability across large portfolios. Rainwater harvesting provides supplementary supply for irrigation and non-potable uses. Nature-based systems treat and reuse greywater safely. Case studies show significant utility savings where these measures are applied. Integration with energy systems further reduces emissions by cutting heating and treatment needs.

OBSTACLES

Barriers include upfront costs for installing reuse systems and monitoring platforms. In many regions, regulations restrict reuse due to health and safety concerns. Maintenance requirements can deter households and building managers. Awareness of benefits remains low among developers and occupants. In lower-income contexts, affordability of advanced systems is a challenge, while municipal infrastructure is not always designed to integrate effectively with decentralised or nature-based solutions.

OPPORTUNITIES

Governments and municipalities are introducing incentives for water-saving fixtures, monitoring systems, and reuse technologies. In water-scarce regions, decentralised and nature-based solutions improve resilience and attract donor support. Certification schemes increasingly reward water efficiency and integrate digital monitoring. Growing awareness of the water–energy nexus strengthens investment in technologies that reduce both demand and emissions. Affordable modular systems also provide scalable solutions for underserved communities, delivering cost savings and improved resilience.



Reducing Waste Through Smart Water Management

United Kingdom
Since 2024

The Story

Sainsbury facilities face a huge water consumption per supermarket without having the ability to identify the source of wastes. Droople's approach was to target restrooms for staff and customers. Droople's technology demonstrated significant water savings in a trial at Sainsbury's Bicester supermarket starting December 2024. This real-world application underscores the platform's capacity to deliver measurable impact, reinforcing Droople's commitment to sustainability and efficiency. Droople's technology demonstrated significant water savings in a trial at Sainsbury's Bicester location, reducing water consumption in hand basins by 12.83% and in toilets by 25.09%.

Solution Spotlight

Droople is pioneering the future of water management through its IoT and AI-powered Water Intelligence Platform beyond the main meter in Buildings. By digitising over 100 billion offline water assets, including sanitary ware, treatment systems, and appliances, Droople enables real-time monitoring, preventing water damage, predictive maintenance, and automated consumable procurement.

Efficiency Gains

Environmental

- **Cold water CO_2 savings = 451,500 kg CO_2 /5 years or 90'300 kg CO_2/year**
- **Hot water CO_2 savings = 1,935,000 kg CO_2/5 years or 387'000 kg CO_2/year**

Economic & Social

- **Reduced water consumption and waste in hand basins by 12.83% and in toilets by 25.09% at Sainsbury's Bicester supermarket without losing in comfort**
- **Reduced energy consumption related to the hot water use of the same percentage of 37%**
- **732'088 liters of water savings per year per supermarket**
- **Projecting these results across 600 Sainsbury's stores over five years translates to a potential saving of 2.15 billion liters of drinking water – equivalent to over 870 Olympic swimming pools**

How was it Financed?

Provided as a hardware as a service model where the client pays a yearly subscription of USD 213/year per device installed with access to the software. This deal has been facilitated by the Swiss Export Risk Insurance (SERV) as it was part of a deal executed abroad with a company based in the UK. SERV can finance this contract in many years with a very low interest rate.

What Made It Possible?

The pilot was made possible through close collaboration between the local salesperson, the customer, and the Droople team in Switzerland. The salesperson defines the pilot scope, gathers technical information, and coordinates execution, while the Swiss team coaches the customer's team and provides "train-the-trainer" sessions to ensure long-term autonomy. Key challenges included customers lacking technical staff for plumbing work, which required either engaging a local partner or sending their plumbing partner on-site to guarantee proper installation.

Recycling Greywater in Hospitality

Brussels, Belgium
Since 2023

The Story

Opened in September 2023, the IHG Voco™ Brussels City North Hotel has set a new benchmark for sustainable hospitality in Europe. Located next to the Living Tomorrow Innovation Campus, the 92-room hotel integrates Hydraloop's decentralised greywater recycling system as part of its sustainability and circular water strategy. Shower and bath water from 58 rooms is collected, treated, and reused onsite for toilet flushing and garden irrigation, reducing dependence on municipal water supply. The installation – comprising a Hydraloop Cascade of five H600 units with a Polisher – saves over 1.2 million litres of potable water annually while cutting wastewater discharge by up to 40%. This project demonstrates how hotels can combine guest comfort with cutting-edge resource efficiency in urban developments.

Solution Spotlight

Hydraloop's compact, IoT-enabled water recycling systems treat greywater from showers and baths using a patented process that combines sedimentation, flotation, dissolved air flotation, foam fractionation, and UV disinfection – without filters or chemicals. The treated water meets certified quality standards for reuse in toilets and landscaping. Fully automated and self-cleaning, the Hydraloop Cascade system ensures consistent performance, minimal maintenance, and data-driven monitoring through smart connectivity, making it ideal for high-occupancy buildings such as hotels and residential complexes.

Efficiency Gains

Environmental

- **1,212,000 litres of water saved annually ≈ 35–40% reduction in potable water use)**
- **30–40% reduction in wastewater discharge**
- **Lower energy demand for transport and treatment of municipal water**

Economic & Social

- **€6,335 annual savings on water costs**
- **Compact system (14.4 m²) fits easily into building design**
- **Contributes to IHG's "Journey to Tomorrow" sustainability targets and green certification goals**

How was it Financed?

The system was financed directly by the hotel developer within the construction budget, supported by incentives from the Brussels-Capital Region for water-efficient technologies and aligned with IHG's corporate sustainability framework.

What Made It Possible?

Supportive regional policies on water reuse, IHG's sustainability leadership, and Hydraloop's compact certified design enabled seamless integration. Collaboration among the developer, contractor, and technology provider ensured technical reliability and regulatory compliance.

Demonstrating the APOC Wastewater Reuse System in the Mediterranean

Blanca (Spain), Zaghouan (Tunisia), Tripoli (Lebanon)
2022–2025

The Story

Reclaimed wastewater is increasingly recognised as a valuable non-conventional water source in water-scarce Mediterranean regions. To address local challenges of cost-effective treatment and reuse, the AquaCycle project introduced the eco-innovative APOC system, designed by the Centre for Research and Technology–Hellas (CERTH). APOC combines anaerobic digestion, constructed wetlands, and solar treatment to process urban wastewater with minimal energy and operational costs. Demonstration plants were installed in Spain, Tunisia, and Lebanon, with the Murcia site operational since 2022. The system has been validated as sustainable, low-cost, and culturally adaptable for small to medium-sized communities.

Solution Spotlight

The APOC system integrates natural and low-energy processes to produce clean water for reuse, biogas for energy, and solid digestate for fertiliser. Its design emphasises simplicity, local material use, and compatibility with community skills.

Efficiency Gains

Environmental

- **Achieves full removal of pathogens and contaminants of emerging concern**
- **Provides renewable fertiliser from anaerobic digestate**
- **Reduces CO_2 emissions by using solar energy and natural processes**

Economic & Social

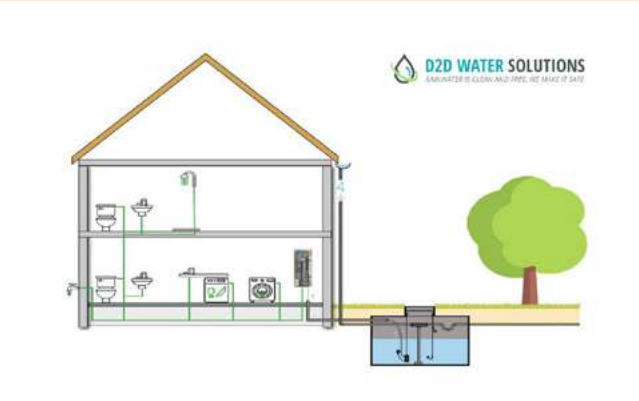
- **Cuts operational expenditure by more than 60% compared with aerated systems**
- **Requires less capital investment than centralised sewerage for small–medium communities**
- **Promotes sustainable sanitation adapted to local skills and conditions**
- **Supports biodiversity through carefully designed wetlands, which also attract visitors**

How was it Financed?

The project was funded through the European Union's ENI CBC Mediterranean Sea Basin Programme *(Grant A_B41_0027_AQUACYCLE)*.

What Made It Possible?

Multidisciplinary expertise in anaerobic systems, wetlands, and solar treatment enabled robust design and demonstration. ICT-based training tools and participatory methods guided stakeholders on system design, siting, and reuse planning, culminating in the creation of the Mediterranean Wastewater Reuse Alliance. Implementation faced disruptions from the Covid-19 pandemic, Lebanon's ongoing crises, and political instability in Tunisia.



From Rain to Tap: Off-Grid Water Solutions

Belgium
Since 2024

The Story

Founded in the Netherlands with expertise in ultra-filter membranes originally developed for hospitals, Drop2Drink created its first unit to produce potable water from rainwater. With the vision of making clean water accessible and building climate resilience, the company turns rainwater into a resource, enabling up to 100% savings on municipal supply. This vision became reality for a Belgian farmer through a collaboration with Drop2Drink and local water authority De Watergroep. Facing the challenge of 40,000 homes in Flanders without mains water, De Watergroep launched a tender for decentralised potable water solutions. Drop2Drink's unit was chosen as the most cost-effective and user-friendly option. Today, the farmer and his family live fully off-grid for water, meeting all daily needs through rain filtered by the system.

Solution Spotlight

The Drop2Drink Unit is a decentralised, plug-and-play water filtration system for households and SMEs. Certified by the World Health Organisation and tested by leading water companies, it delivers 100% microbiologically safe drinking water on demand. Rainwater is stored in a tank, then pumped through micro and ultrafilters, carbon, and a UVC unit. Durable and economical, the system provides a reliable source of clean water, helping communities gain safe access.

Efficiency Gains

Environmental

- **Enables buildings to become water-neutral, supplying up to 100% of drinking needs from rainwater**
- **Eliminates plastic bottle use for drinking water, reducing plastic pollution**
- **Cuts emissions by up to 20% through reduced water transport, treatment, and bottled water production**

Economic & Social

- **In countries like Germany, harvesting just ~2% of annual rainfall could meet all domestic needs**
- **Filters out microplastics down to 0.01 micron, preventing them entering consumption and wastewater**

How was it Financed?

D2D Water Solutions is financed by parent company VTE Smarter Solutions and the EU VIDA Project. In the farmer case, the facility was supported by De Watergroep before the farmer purchased the full system.

What Made It Possible?

Impact was driven by partnerships with technology providers, EU-certified component suppliers, and diverse pilot projects. The modular design, plug-and-play installation, and cloud monitoring enabled rapid deployment, while WHO certification built trust for scaling. Market adoption faced challenges such as demand for turnkey systems, storage and pumping partnerships, and regulatory variation across countries. The solution is easier to apply in single-family homes, but first large-scale housing projects are now underway.

Rainwater-Based Green Infrastructure

France (Paris, Versailles, Lyon, Istres)
Since 2020

The Story

Source Urbaine, a French startup founded in 2020, develops modular units that collect, store, treat, and reuse rainwater in urban settings, while integrating vegetation and passive cooling via evapotranspiration. These systems divert runoff from rooftops walkways or streets, reducing stormwater loads on drainage systems and helping fight urban heat islands by providing local cooling and vegetation. Each unit is modular to fit every aspect of the project such as technical constraints, local weather, existing biodiversity and are implemented by municipalities, developers, or urban planners. The first installations date back from 2018 and still haven't been watered.

Solution Spotlight

A unit combines a planted surface with a waterproof reservoir that captures rainwater from roofs or paved surfaces. Stored water is gradually supplied to vegetation or reused for non-potable purposes. The vegetation provides cooling and biodiversity benefits, while integrated sensors enable semi-autonomous operation.

Efficiency Gains

Environmental

- **Reduces runoff and pressure on sewer systems**
- **Cools local microclimates via evapotranspiration (-2.1° UTCI outdoors during heatwaves)**
- **Supports biodiversity through green urban surfaces**
- **Capacity to collect pollution from rainwater to naturally break it down**

Economic & Social

- **Lowers flood mitigation and drainage costs**
- **Improves urban comfort and wellbeing**
- **Self-sustaining installations that don't require watering throughout the year (up to 3 months of water reserves)**
- **Modular design reduces installation and retrofit costs**

How was it Financed?

Typically financed by municipalities, urban planners, or developers as part of public works or adaptation projects. Supported by public incentives and references from major construction firms (Bouygues, Eiffage, Colas and Vinci).

What Made It Possible?

Supportive urban climate policies, modular design, and partnerships with large construction firms have facilitated adoption and credibility. However, site-specific constraints, coordination with utilities, maintenance of vegetation, and varying municipal regulations on stormwater reuse remain key challenges to wider deployment.

Turning Wastewater into a Resource

Bangalore, India
Since 2024

The Story

Residential apartments in Indian cities like Bangalore are at a crossroads in reusing treated wastewater from existing Sewage Treatment Plants (STPs). Typically, treated water only meets standards for toilet flushing and gardening. Emmanuel Heights is one such complex facing the challenge of managing excess treated water, while exploring sustainable reuse within regulations.
To address this, BOSON White Water installed an 11-stage tertiary treatment system downstream of the existing STPs. The system recovers up to 60,000 litres of potable-quality water daily, which is then supplied to industries, ensuring consistent, high-grade water for processing without adding pressure on freshwater resources.

Solution Spotlight

BOSON White Water is an advanced tertiary treatment plant with 8-stage pre-treatment, high-yield membrane filtration, and state-of-the-art disinfection, ensuring water consistently meets BIS potable standards.
The fully automated system, integrated with IoT-based real-time monitoring, tracks performance and quality remotely. Each batch is tested, and a slip is provided with every delivery. Industries and commercial users benefit from reliable water for cooling towers, boilers, laundries, and electroplating, replacing the variable and unsustainable groundwater supplied by private vendors.

Efficiency Gains

Environmental

- **Each year, 21 million litres of treated wastewater are safely converted into high-quality potable water at Emmanuel Heights Apartment**

Economic & Social

- **Emmanuel Heights saves INR 80,000/month on wastewater disposal through avoided tanker use for excess STP-treated water**

How was it Financed?

BOSON White Water funded the system at Emmanuel Heights and oversees operation and maintenance via its IoT-based monitoring system.

What Made It Possible?

The business model evolved through iterations, starting with supplying commercial properties and expanding through logistics partnerships. Early challenges included social stigma around reusing recovered water, infrastructure and transport limitations, and the need to build customer trust in a consistent supply. Collective decision-making in apartments has also slowed rapid scale-up of installations.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

Indonesia's Technical Assistance Grants for Water and Energy Efficiency in Housing

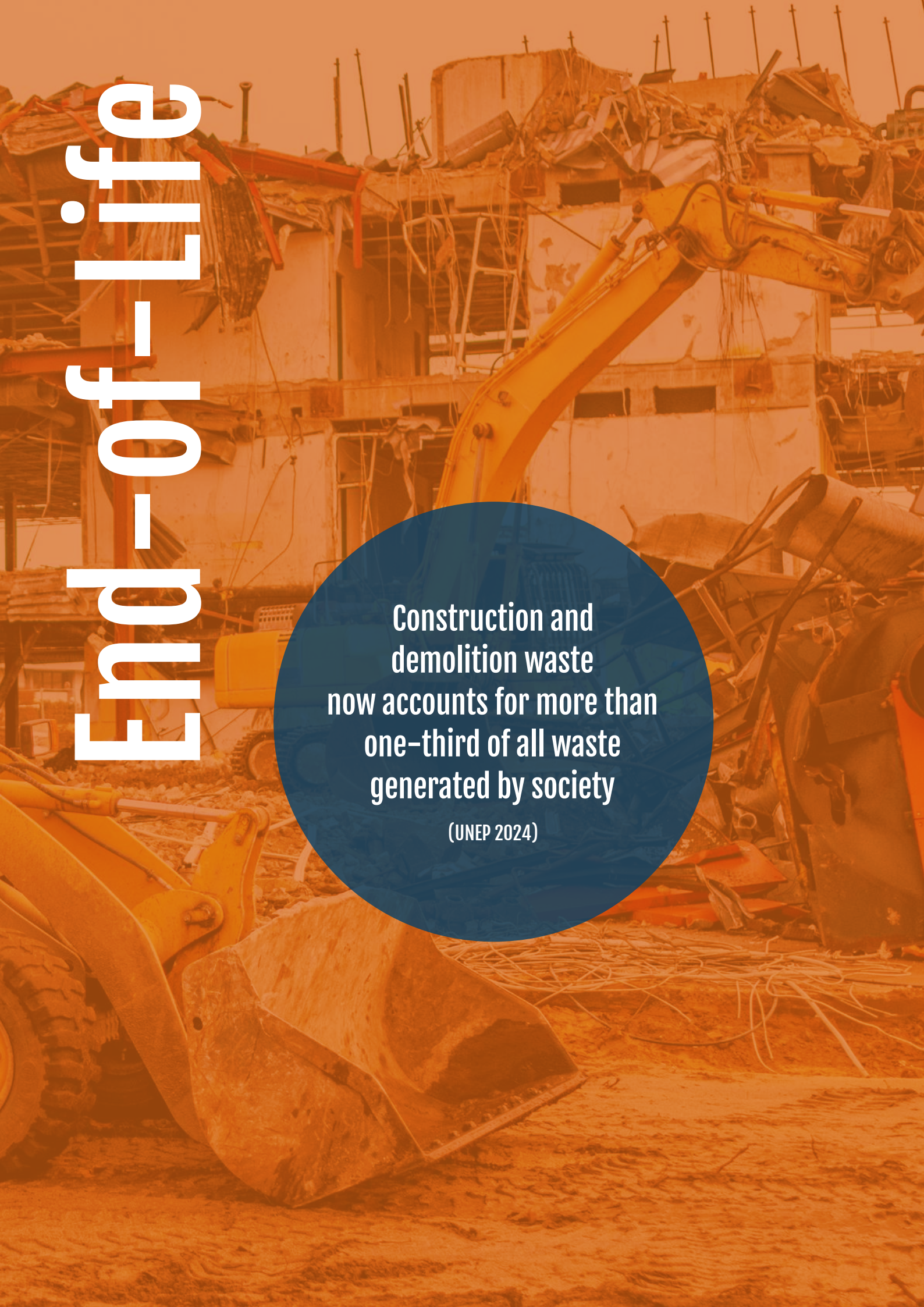
Indonesia's government, with support from the International Finance Corporation (IFC), has developed a housing programme that embeds water and energy efficiency into residential construction. The initiative provides technical assistance grants that help developers assess climatic conditions, building use patterns, and technology options suited to Indonesia's tropical environment. These assessments enable the integration of renewable energy systems, efficient appliances, and water management measures such as rainwater harvesting, low-flow fixtures, and greywater reuse.

The grants also support developers seeking EDGE green building certification, reducing upfront costs and demonstrating the financial viability of sustainable housing. By linking policy incentives with certification and technical support, the programme encourages the uptake of practical water-saving technologies across Indonesia's fast-growing housing sector.

This policy has created an enabling environment where water-efficient design becomes part of standard construction practice. Developers are guided to adopt technologies that lower both water and energy consumption, while maintaining affordability for low- and middle-income households. The integration of water management into national housing delivery also strengthens resilience to drought and water scarcity, key challenges in many Indonesian regions.

By combining technical guidance, financial support, and performance-based certification, Indonesia's approach demonstrates how targeted policy instruments can scale the deployment of efficient water management solutions in the building sector and promote long-term sustainability in housing development.

End-of-Life



Construction and demolition waste now accounts for more than one-third of all waste generated by society

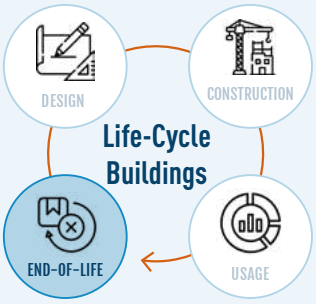
(UNEP 2024)

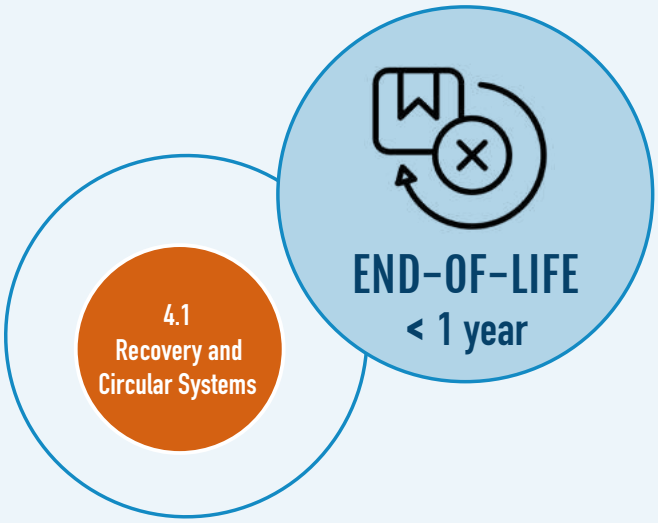
What we take apart is as important as what we build.

Buildings do not simply vanish when their use ends. How they are dismantled, what happens to their materials, and how wastewater or other discharges are managed all carry lasting environmental consequences. End-of-life practices determine whether a building's legacy is one of waste and emissions, or of circular recovery and resource efficiency.

This phase explores solutions that reduce embodied carbon, recover valuable materials, and ensure safe treatment and reuse of water and waste streams. By embedding circular principles into demolition, treatment, and logistics, buildings can become reservoirs of resources rather than sources of pollution.

End-of-Life





> 4.1 Recovery and Circular Systems

End-of-life solutions take many forms, but all aim to close material and resource loops. Digital mapping platforms enable municipalities and contractors to catalogue and exchange materials before demolition. Research projects demonstrate how concrete, steel, and other structural elements can be designed for disassembly and reintroduced into new construction. Water treatment systems show how wastewater from buildings can be reclaimed, purified, and reused for non-potable applications, turning a liability into a resource. Reverse logistics and take-back schemes extend responsibility to manufacturers, ensuring building components are returned, recycled, or repurposed at the end of use. Together, these innovations demonstrate that the end of a building's life can be a new beginning for its materials and resources.

CHALLENGE

Closing resource loops at the end of a building's life to minimise waste, emissions, and pollution

Plan for disassembly, recover and reuse materials, install decentralised water treatment, and implement take-back and reverse logistics schemes

OBSERVATIONS

Construction and demolition waste now accounts for more than one-third of all waste generated by society. With effective planning and design, much of this material can be recovered and reused (UNEP. 2024).Digital platforms are linking supply and demand for secondary products. Decentralised water systems cut loads on municipal plants, recover nutrients, and provide non-potable water for flushing or irrigation. Reverse logistics is expanding in regions with established formal recycling and take-back schemes for insulation, flooring, and furniture, while in many other contexts informal repair and resale markets already play a central role.

OBSTACLES

Sorting materials on site adds cost and time, and reuse is sometimes restricted by regulation or safety concerns. Secondary markets are uneven, and informal systems lack safety and efficiency. Water treatment faces cost and maintenance barriers, while cultural resistance can limit uptake. Reverse logistics struggles with collection infrastructure, weak incentives for producers, and low consumer awareness.

OPPORTUNITIES

Policies mandating embodied carbon reductions are driving demand for certified secondary materials. Donor programmes and training improve recovery practices, while digital tools enable tracking and build confidence in reuse. Modular treatment systems and stronger extended producer responsibility regulations expand circularity. Supporting informal markets creates jobs and affordable products while reducing waste.

Cradle-to-Cradle (C2C) Approach for Reinforced Concrete Elements

Berlin, Germany
Since 2023

The Story

Germany's construction industry generates significant CO_2 emissions from production and construction of new reinforced concrete buildings. Demolition produces large amounts of mineral waste, some of which is recycled, while much is used as road fill or dumped. This research project, led by Universität der Künste Berlin, introduces a method to salvage reinforced concrete elements from buildings marked for demolition, reusing components in new structures. This approach allows reinforced concrete elements to function structurally in new buildings, contributing to a Cradle to Cradle (C2C) approach.

Solution Spotlight

The focus is on in-situ concrete buildings, where components must be cut for reuse, a more complex process than for precast elements. A digital tool aids in planning with salvaged concrete, generating a component catalogue for new builds and a guide with design, construction, and legal recommendations for projects using recycled concrete elements.

Efficiency Gains

Environmental Benefits

- **Reusing reinforced concrete elements can mitigate CO_2 emissions by up to 36% compared to using new concrete, according to a building-level case study (excluding HVAC)**
- **Avoidance of new cement and steel production, preventing significant greenhouse gas emissions**
- **Reduction of mineral construction waste through the reuse of existing building materials**
- **Approx. 33% reduction in the use of primary resources**
- **Preservation of raw materials that would otherwise be extracted for new reinforced concrete production**

Waste Reduction

- **Reuse of building fabric significantly reduces the need for new materials and minimises construction waste**

How was it Financed?

The project was funded by the German Federal Institute for Research on Building, Urban Affairs, and Spatial Development on behalf of the Federal Ministry for Housing, Urban Development, and Building under the "Zukunft Bau Forschungsförderung" programme.

What Made It Possible?

The project was carried out in the period from 2022 – 2024. It was assigned to the field of basic research. A trial with specific project partners on a specific building is currently being prepared.

Scaling Material Reuse: Cyneo's Innovation in Circular Construction

Vitry-sur-Seine, France
Since 2022

The Story

Each year in France, the construction industry generates 46 million tonnes of waste, with 80% having potential for reuse, yet only 1% is repurposed. Bouygues Construction aims to address this challenge through Cyneo, a network of technical centres designed to scale the reuse of construction materials. Launched at the Ardoines site in Vitry-sur-Seine, the first centre spans 2,700 m², and future centres are planned across France. Cyneo serves construction suppliers, project managers, local authorities, and associations focused on circular economy practices, creating a platform to foster material reuse, reduce waste, and promote more sustainable building practices.

Solution Spotlight

Cyneo technical centres offer production, storage, prototyping, and display spaces for reused materials. The centres also provide insurance, legal frameworks, and training.
A digital platform connects suppliers and consumers of reused materials, streamlining the development of reuse channels.
Cyneo aims to mobilise key players in the construction sector while raising awareness of sustainable practices.

Efficiency Gains

Environmental

- **Reduced carbon footprint in the construction industry thanks to the reuse of construction materials**
- **Driving construction industry players to a more circular model (eco-conception)**

Economic & Social

- **Supporting young companies and startups who propose innovative solutions for circular economy in the construction sector**
- **Direct and indirect job creation**
- **Financial gains by optimising the value of construction materials**
- **Sharing best practices among industry stakeholders**

How was it Financed?

Cyneo is funded through Bouygues Construction and supported by public funding from regional authorities and ADEME, the French Agency for Ecological Transition. The initiative combines private expertise and public backing to expand its operations and is expected to achieve financial independence as it grows.

What Made It Possible?

The initiative's success is underpinned by Bouygues Construction's leadership and partnerships in the circular economy.
Key enablers include a strong network, scalable models, and the ability to showcase tangible benefits to industry stakeholders.

Turning Demolition into Opportunity: Roskilde's Circular Approach

Roskilde, Denmark
Since 2023

The Story

Roskilde Municipality in Denmark, home to almost 100,000 people, uses Upcycling Forum's digital Material Mapping and Exchange Platform to manage reusable materials from municipal renovation and demolition projects. By creating a clear overview of material flows early, the municipality repurposes components such as doors, lighting, and façade elements in new construction, reducing CO_2 emissions and procurement costs. Since demolition occurs regardless, reclaimed materials are effectively free, lowering project budgets. The platform also supports compliance with upcoming LCA and selective demolition regulations, while improving coordination across departments and transparency in reuse efforts. The result is a more resource-efficient building process, reduced waste costs, and a measurable contribution to climate goals.

Solution Spotlight

The Material Mapping and Exchange Platform is a cloud-based tool to accelerate large-scale reuse in construction. It enables owners, municipalities, and developers to identify reusable materials from demolition, renovation, and industrial waste streams early in planning. Features include mobile-enabled registration, CO_2 reduction calculations, and secure data sharing. By making reusable materials visible earlier, the platform allows architects and contractors to integrate them into designs, ensuring compliance while reducing environmental impact and project costs.

Efficiency Gains

Environmental

- **180 tonnes CO_2 saved by reusing materials from a single demolition project**
- **Enhanced transparency and reporting for ESG and climate strategies**

Economic & Social

- **85% reuse rate achieved, avoiding costs for new materials and waste handling**
- **Free reclaimed materials add value and lower budgets**
- **Improved collaboration and faster project approvals**

How was it Financed?

Funded through the municipality's sustainability budget with a license to Upcycling Forum's platform. Savings on procurement and waste handling quickly offset the investment. Since demolition must happen regardless, reclaimed materials are free, further reducing costs and adding tangible value.

What Made It Possible?

Implementation was enabled by strong political support for circular construction, early stakeholder involvement, and training of municipal staff. A pilot project demonstrated CO_2 savings and cost benefits, securing commitment for rollout across projects. Challenges included aligning workflows, ensuring early access to data, and adapting procurement to reused materials. These were addressed through process mapping, clear guidelines, and close collaboration between project managers, architects, and contractors.

The Pavilion MANAL: A Living Laboratory for Sustainable Construction

Horw, Switzerland
Since 2004

The Story

The Pavilion MANAL in Horw, Switzerland, is more than an exhibition space, it is a proof of concept and an experimental prototype that unites sustainability with circularity. Built almost entirely from reused construction waste and excavation material, it challenges conventional practices in the construction industry. At its core, the structure features the world's first application of 35 m^3 of Oxacrete Oulesse® concrete, a cement-free, low-CO_2 material produced from demolition waste. Complementing this are 10 m^3 of stabilised poured-earth Oxacrete® Nossim and Oxabloc compressed-earth blocks, created with 15 m^3 of Oxabrick® Loko, which together form the pavilion's arches and walls. Reclaimed tunnel slabs define the layout and serve as flooring, while a wooden ring beam and steel cables enhance stability, distribute loads efficiently, and reduce overall material use. Developed by an interdisciplinary team of architects, engineers, material scientists, and industry partners, the pavilion operates as both a built showcase of low-emission construction and a living laboratory for research, teaching, and scaling sustainable solutions.

Solution Spotlight

The Oulesse® binder incorporates reused mixed demolition waste, such as recycled concrete or brick, along with a blend of mineral salts. Oulesse® is used for the production of concrete for diverse applications, effectively reducing embodied emissions by eliminating the need for traditional cement. Despite its cement-free composition, Oulesse® maintains a strength development comparable to conventional cementitious binder systems.

Efficiency Gains

Environmental

- **Cement-free**
- **Up to 60% CO_2 reduction compared to convential cement used in concrete**

Economic & Social

- **Enables reuse of demolition waste, creating additional value from resources that would otherwise be discarded**

How was it Financed?

MANAL was supported by an interdisciplinary coalition of public and private partners, sponsors, and climate funds.

What Made It Possible?

The MANAL Pavilion is the result of intensive collaboration with researchers, architects, engineers, and industry. Open dialogues created a space to integrate the ideas of all those involved. Particularly pleasing: The Lucerne University of Applied Sciences and Arts (HSLU) agreed to host the pavilion on its campus for two years as part of a research project. The constant evolution of Oxara's products forced the team to rethink design and planning. What began as a design for a single material evolved into a complex structure using three different Oxara materials. The project started with small, prefabricated elements and ended up as a pavilion with a variety of elements.

Excavated Material Recovery & Reuse Platform

Paris, France
Since 2021

The Story

Hesus Store is a platform developed by HESUS and commissioned by the City of Paris in 2021 to optimise the flow of excavated materials from construction and demolition sites. The initiative was part of the City's efforts to reduce waste generated by the Suchet Stadium construction project in the 16th arrondissement. By evaluating the site's soil in advance, the platform enabled the reuse of 860 m^3 of soil in land development projects in Joinville-le-Pont and Villeneuve-le-Comte (Île-de-France), out of a total potential of 2,000 m^3. Hesus Store efficiently matches material supply and demand across different sites; for instance, soil excavated from one location can be repurposed for landscaping or fill at another, instead of being treated, transported, and discarded as waste. The service facilitates the recovery and reuse of soils and other materials, either on-site or nearby, significantly reducing disposal requirements and the need for new material procurement.

Solution Spotlight

Hesus Store provides a marketplace / matching service to pair excavated material supply and demand across projects. It offers real-time analysis of reuse options, improves transparency, and optimises logistics of material reuse. It captures material availability, reuse potential, transport costs, and regulatory requirements to reduce waste and emissions.

Efficiency Gains

Environmental

- **Increase in waste recovery rates up to ~82% on construction sites**
- **Reduction in CO_2 emissions linked to construction site operations by ~50%**

Economic & Social

- **Primary material consumption can be reduced by 100% in cases**
- **Savings of ~30% on waste management costs**

How was it Financed?

Hesus Store is operated by HESUS, a private greentech company. It works with municipal authorities (e.g. City of Paris) and construction firms. Funding comes from platform fees and partnerships.

What Made It Possible?

Regulatory pressure to reduce waste, need for cost savings on material disposal, capacity to match supply and demand. Challenges: ensuring material quality compliance, coordinating between multiple stakeholders, transport and treatment costs for reuse, local regulatory constraints.

Using AI to Enable Circular Construction in Austria

Austria
2024–2028

The Story

KRAISBAU is Austria's flagship circular construction R&D project, running from 2024 to 2028 with USD 4.7 million in federal funding. Led by the Circular Economy Forum Austria in partnership with the Austrian Green Building Council, it brings together more than 30 partners including research institutions, construction companies, and technology providers. The project develops artificial intelligence tools that analyse existing buildings using satellite data and 3D point cloud scans to create detailed material inventories, identify reusable components, and automate recyclability assessments. Demonstration sites across Austria validate solutions for material flow optimisation, component reintegration, and lifecycle assessment automation. Knowledge transfer is embedded through training programmes, fact sheets, and roadmaps to enable broad adoption across the industry.

Solution Spotlight

By combining AI with satellite imagery and 3D scanning, KRAISBAU turns demolition into a circular process where materials are systematically recovered, classified, and reintegrated into new projects. This reduces waste, saves raw resources, and positions construction waste as a valuable input stream for future building.

Efficiency Gains

Environmental

- **Cuts CO_2 emissions by up to 36% compared to conventional demolition and new construction**
- **Prevents about 33% of primary resource consumption through material recovery**
- **Reduces construction waste sent to landfill by up to 60%**
- **Saves embodied energy equal to 40–50% of new material production**

Economic & Social

- **Lowers material costs by 25–35% through systematic recovery and reuse**
- **Creates new revenue streams from recovered materials (USD 59–94 per tonne)**
- **Speeds up project timelines by 20–30% through automated assessment**
- **Generates 15–20 local jobs per 10,000m² of building stock analysed**
- **Trains 500+ professionals annually in circular economy practices**
- **Builds industry acceptance of digital tools for sustainability**

How was it Financed?

Funded by the Austrian federal government (USD 4.7 million, ~80%) with the remainder provided by consortium partners.

What Made It Possible?

KRAISBAU thrives on cross-sector collaboration and AI innovation, supported by national R&D funding. Partnerships with research institutes and companies enable integration of advanced technologies with practical applications. Challenges include aligning diverse stakeholder priorities, adapting AI to existing construction processes, and balancing technical innovation with economic feasibility.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

France's Extended Producer Responsibility (EPR) Scheme for Construction and Demolition Waste

The scheme represents a pioneering policy framework for the end-of-life phase of buildings, designed to accelerate the deployment of circular and recovery-oriented solutions. Introduced under the Anti-Waste and Circular Economy Law, the scheme makes producers of construction materials financially and operationally responsible for managing the waste generated by their products once a building reaches the end of its life.

This approach has created a robust enabling environment by internalising end-of-life costs and driving eco-design across the construction sector. Producers contribute through mandatory eco-fees that are modulated according to criteria such as recycled content, repairability, reuse potential and the absence of hazardous substances. These eco-modulated incentives encourage manufacturers to design materials and components that can be easily recovered, reused or recycled, stimulating innovation in low-impact construction products. The scheme also established a nationwide network of collection points and free take-back services, managed by Producer Responsibility Organisations (PROs) such as Valobat and Ecomaison. This infrastructure simplifies access to waste recovery facilities for builders and demolition firms, making material sorting and recycling a cost-effective default practice.

By embedding accountability throughout the value chain, France's EPR system translates circular economy principles into practical deployment mechanisms. It supports the scale-up of material recovery industries, fosters markets for secondary resources, and ensures that sustainable construction and deconstruction solutions become not only technically viable but economically attractive.

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ENABLING THE DEPLOYMENT OF SUSTAINABLE SOLUTIONS

National Circularity Assessment Framework for Buildings

The National Circularity Assessment Framework for Buildings, developed by GlobalABC, the One Planet Network, UN-Habitat, and UNOPS, with support from the Government of Finland, provides a practical tool for governments to integrate circular economy principles into national building policies and regulations. The framework helps countries assess how materials, resources, and waste are managed throughout the building life cycle, with a specific focus on end-of-life recovery and reuse.

It offers a structured methodology and key performance indicators to evaluate national progress on circularity, covering areas such as material efficiency, waste prevention, design for disassembly, and recycling capacity. By mapping the current policy landscape and identifying regulatory gaps, the tool enables policymakers to design measures that improve material recovery, promote reuse markets, and reduce construction and demolition waste.

The framework also supports inter-ministerial coordination across housing, environment, and industry departments, ensuring that circularity objectives are embedded into building codes, procurement standards, and urban planning policies. Through pilot projects and capacity-building workshops, countries can apply the framework to develop tailored national roadmaps – for example, the Arab Region Roadmap on Buildings and Construction (2020–2025) was built using this methodology.

By providing a clear analytical structure and implementation pathway, the framework acts as an enabling environment instrument for scaling up circular construction practices and establishing policies that make material recovery and reuse a mainstream component of building end-of-life management.

Scaling Sustainable Solutions

Pathways to Deployment

WORLD RESOURCES INSTITUTE
Roxana Slavcheva
Global Lead for Built Environment

Financing the Transition to Net-Zero and Resilient Buildings

Mobilising finance and reforming business models are central to accelerating the transition toward net-zero, climate-resilient buildings. WRI's research shows that incremental improvements will not suffice. The sector must shift from fragmented, project-based financing to integrated investment strategies that unlock capital at scale and support coordinated action on energy efficiency, resilience, and affordability.

Innovative financial instruments –such as green mortgages, performance-based contracts, concessional loans, and blended finance – are vital to de-risk investment and attract private capital. Embedding decarbonisation and resilience criteria within these mechanisms ensures financial flows align with long-term climate goals.

Public policy must complement these efforts through fiscal incentives, building performance standards, and carbon pricing that send clear, stable signals to investors.

Business models in construction and real estate must also evolve. Developers and owners should move beyond short-term cost optimisation toward life-cycle value creation, recognising the financial benefits of lower operating costs, improved occupant well-being, and reduced climate risks.

Partnerships between governments, financial institutions, and industry can mainstream these approaches through demonstration projects, disclosure standards, and aggregation platforms that transform small-scale retrofits into bankable portfolios. By aligning investment and business incentives with climate outcomes, the buildings sector can unlock new value streams while delivering inclusive, affordable, and resilient built environments worldwide.

C40 CITIES
Helen Dugmore
Manager Energy and Buildings

Harmonising National Policies with Local Actions

Cities are home to the majority of the world's population as well as the greatest concentrations of buildings and infrastructure. Therefore, regardless of the level of government at which building decarbonisation policies and programmes are developed, implementation in this sector will primarily take place in cities.

As the form of government closest to the people, cities are also well-placed to assess and respond to the needs of local residents, ensuring that building decarbonisation actions are viable, equitable, and inclusive.

In addition, cities worldwide are already leading the way in developing, testing and implementing decarbonisation solutions for buildings and construction – including adopting whole-life carbon approaches, developing codes and standards for new construction and retrofit programmes to decarbonise existing building stock, rolling out neighbourhood-scale interventions and testing new technologies. National and local governments should work together to share existing knowledge and co-design

policies and programmes that work at the local level but can be scaled across national and regional contexts for greater impact.
As we look to accelerate building decarbonisation in the coming years, national governments will play a critical role in creating enabling environments (including through access to finance) for cities to expand their impact as implementers in their local contexts.

WORLD GREEN BUILDING COUNCIL
Audrey Nugent
Director of Global Advocacy

Building the Transition

To deliver on the goals of the Paris Agreement, we must accelerate the deployment of policies, finance, and technologies that enable buildings to be decarbonised, resilient, and equitable. Building the Transition is the World Green Building Council's flagship global initiative to make this transformation happen. It mobilises over 85 national Green Building Councils and 48,000 member organisations to turn ambition into action – co-creating national roadmaps, strengthening regulatory frameworks, and driving market mechanisms that scale measurable climate impact.
As the delivery vehicle for our 2025–2027 strategy, Building the Transition translates global commitments into national implementation. Through its three interconnected pillars – Align, Partner, and Scale– the initiative aligns shared 2030 goals for energy, emissions, and circularity, builds partnerships that unite governments, businesses, and civil society, and accelerates the adoption of solutions across regions and sectors. By fostering collaboration between public and private actors, it ensures that the tools for change– policies, finance, and innovation – work together to unlock deployment at speed and scale. Heading into COP30, our call is clear: Leading businesses are ready – now governments must embed these solutions across the sector to achieve progress at scale. At COP30 we're calling on governments and businesses to be bold on buildings. To turn climate promises into action that builds resilience, lowers bills, protects communities and creates thriving economies.

SOLAR IMPULSE FOUNDATION
Jean Constantinesco
Managing Director Political Affairs

Efficiency: The Compass for a Sustainable Transition

To decarbonise the built environment, efficiency is about more than cutting energy use – it's about achieving more with fewer resources. Efficiency in energy, materials, building design, and business models must guide every decision. It's the fastest, most cost-effective way to cut emissions while maintaining economic resilience.

Today, our economies still rely on outdated industrial-era practices, created for a time of unchecked resource use. Now, we need solutions that maximise resources, minimise waste, and foster sustainable growth. Existing efficient technologies and designs already let us construct buildings using fewer materials, lower energy demands, and reduce lifecycle costs.

But true innovation means going beyond technology. We must rethink business models to make efficiency accessible and attractive. "As-a-service" models, where companies sell use rather than ownership, create incentives to provide maximum service quality rather than more units. Servitisation is one way to embed efficiency into daily practices.

To accelerate adoption, policies and market incentives must prioritise efficiency. By aligning political frameworks with new business models and tech advances, we can create systemic change, building a decarbonised environment that not only meets climate goals but also unlocks economic potential for future generations.

WHAT'S NEXT

From Mapping Solutions to Igniting Change

The Catalogue proves one fundamental truth: the tools to decarbonise and climate-proof the built environment are not a distant dream – they are already in our hands and making a real impact

Like seeds planted across continents, these practical solutions are sprouting everywhere – cutting emissions, boosting resilience, and delivering economic and social value from bustling cities to remote communities. The next challenge is no longer identifying what works, but scaling it. Moving from sparks of success into a global wildfire of change.

This publication builds confidence, brick by brick. It shows that a low-carbon, resource-efficient buildings sector is within reach, today. But also technology alone will not pave the way. Like the gears of a well-oiled machine, policy frameworks, financial tools, and collaborative partnerships must mesh seamlessly allow proven approaches to thrive.

Looking ahead, the path forward for the Buildings Breakthrough community is clear and actionable:

- **Replicate proven solution blueprints across diverse regions, adapting to local contexts**
- **Connect innovators with policymakers and financiers, building bridges where ideas meet resources**
- **Accelerate collaboration through shared learning and co-created strategies**

The examples featured here serve as a foundation for all three.

The Catalogue of Climate Solutions for Buildings is therefore both a compass and a call to arms – a reminder that progress is already underway, and that the transformation of the built environment is achievable when ambition turns into coordinated action. The time has come to move from blueprints on paper to buildings that breathe sustainability – turning promise into performance, one project at a time.

> Glossary

CIRCULAR ECONOMY
A system aimed at eliminating waste and continually reusing resources, crucial for reducing the environmental impact of the building life cycle.

DECARBONISATION
The process of reducing or eliminating carbon emissions, particularly in building materials, construction, and operation phases.

EFFICIENCY
Maximising output while minimising input by optimising resources and processes for sustainable solutions in cleantech.

EMBODIED CARBON
The total carbon emissions associated with the production of building materials, from raw material extraction to manufacturing, transport, and installation.

ENABLING ENVIRONMENT
The combination of policies, financial incentives, infrastructure, and cultural factors that support the successful deployment of sustainable solutions.

GREEN BUILDING STANDARDS
Guidelines and certification systems (e.g., LEED, BREEAM) that encourage environmentally responsible construction and design practices.

LIFE-CYCLE ASSESSMENT (LCA)
A method used to evaluate the environmental impacts associated with all the stages of a building's life, from material extraction to demolition and disposal.

LOW-CARBON MATERIALS
Building materials, such as low-carbon cement or recycled aggregates, that have significantly reduced embodied carbon emissions.

NET-ZERO
A goal or standard where the total amount of carbon emissions released is offset by actions that remove or reduce carbon in the atmosphere.

OPERATIONAL CARBON
The emissions resulting from the energy consumption of a building during its use phase, including heating, cooling, and electrical systems.

PASSIVE DESIGN
Architectural techniques that leverage natural resources, such as sunlight and wind, to heat, cool, and ventilate buildings without relying heavily on mechanical systems.

REPLICABILITY
The ability of a solution to be applied in different contexts or regions while maintaining its effectiveness.

RESILIENCE
The ability of buildings and infrastructures to adapt to and recover from adverse events such as extreme weather, while maintaining functionality.

RETROFITTING
The process of updating existing buildings with new technologies and materials to improve energy efficiency and reduce environmental impact.

SCALABILITY
The capacity of a solution to be expanded or implemented on a larger scale without losing effectiveness or efficiency.

SMART GRIDS
Electricity networks that use digital technology to monitor and manage the distribution of energy more efficiently, integrating renewable energy sources and supporting energy sharing.

Catalogue of Climate Solutions for Buildings

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