Innovation Insights

Embedding a circular economy approach in the built environment

With thanks to the Innovation Portal's lead partner

Introduction

Imagine a world where...

- Property investors own no physical assets
- Demolition does not exist
- Manufacturers are selling services not products
- Construction materials are leased
- Buildings are restoring the natural environment.

Our Vision is of a built environment at the heart of a circular economy – where waste is eliminated and materials retain value long after their original use

So how can we embed a circular economy approach in our built environment?

This was a question raised during a Challenge Definition Workshop - a workshop designed to identify the most pressing and pertinent challenges facing our sector.

To tackle it, UKGBC launched the Innovation Portal - an online platform designed to provide an open forum to crowdsource solutions to some of the industry's biggest challenges. It also provides a platform to connect innovators with investors and match them with companies interested in progressing their innovation.

These pages document a range of the innovations identified through the Portal, and explore a range of practical and inspirational case studies in applied innovation. The ideas covered contribute in different ways to a more sustainable built environment whether through efficient materials use, design for deconstruction, retrofit, etc.

Draw on them for your own business advantage, customer benefit or supply chain improvement.

To find out more about the UKGBC step by step innovation process, and the help it provides, look at the Sustainable Innovation Manual.

About the Innovation Portal

In 2017 UKGBC brought together some of the brightest minds in the built environment to work on a programme of open innovation: Innovation Lab.

Through a process designed and facilitated by UKGBC and Switch On, the insight and idea generation was driven by lead partners Canary Wharf Group, Landsec and M&S. The lead partners worked collaboratively over a 12-month period coalescing around six face-to-face workshops to identify challenges and co-create solutions. These lead partners brought a wealth of experience and insight on the built environment as well as a real appetite to think differently and work together to challenge the status quo.

The Innovation Portal is a natural progression from this programme - designed to open up the innovation process beyond a faciliated workshop format and brought to the mainstream. Anyone can sign-up to the portal to submit a solution, and these can be anything from concept-stage innovations to market-ready products and services in response to challenges as defined by our members.

Mapping Innovations

The Innovation Portal process identified four manageable challenges all related to the circular economy:

- **Deconstruction and adaptability:** how can we make the most of buildings that already exist?
- **Reusing materials:** how can we make the most of materials used in existing buildings?
- **Retrofit:** how can we modernise outdated services with ease?
- **Resources and waste:** how can we reduce waste associated with construction and refurbishment?

UKGBC then called for innovators to offer details of their product or service, its development stage, and how it would contribute to a circular economy.

Selection criteria

Over 30 innovations were contributed to the Portal and reviewed through the following criteria.

1. How does it contribute to solving the challenge of embedding a circular economy within the built environment?
2. How does it approach the four problems identified?
3. What development stage is it at: concept, prototype, pilot, market ready?
4. How does it challenge business as usual, or offer a breakthrough solution?
5. Does it contribute to UKGBC's vision of a sustainable built environment?
   - Mitigating and adapting to climate change
   - Eliminating waste, maximising resource efficiency
   - Embracing and restoring nature and promoting biodiversity
   - Optimising health and wellbeing
   - Creating long-term value for society, and improving quality of life.

One of UKGBC's core aims is to build the capacity of the industry to innovate and last year our Innovation Lab brought together over 50 organisations to tackle a single challenge.

But our members have asked us to think bigger and cast the net wider. The scale and ambition of the innovation our industry needs cannot happen behind closed doors. The Innovation Portal will democratise the conversations we're having and throw open our challenges to the possibility of solutions being identified from an unlikely source, or from beyond our industry altogether.

Alastair Mant, UKGBC

Challenge

01

Maximising Resources & Reducing Waste

Construction and demolition waste accounts for approximately 25-30% of all waste arising in the EU.

How can we reduce the amount of waste created, and maximise the resources used, during construction and refurbishment?

Tip The Scale

CONCEPT

SUSTAINABLE INNOVATION SPRINT WINNER

Intelligent Waste Solutions

What's the elevator pitch?

Tip the Scale will streamline your property development business, reducing your costs and improving financial performance. Through data collection, analysis and reporting of waste generated from your construction processes, Tip the Scale will provide business intelligence to reduce refuse and project your organization in to a more sustainable future .

The Problem: Construction and demolition waste accounts for approximately 25-30% of all waste arising in the EU. Despite the volume of resources lost during construction, there is no clear data indicating the exact source of the problem and thus the waste cannot proactively be reduced. Developers need to know what materials are disposed, where they were to be used and why they were disposed.

The Solution: Through an easy-to-use digital interface placed next to each skip, site workers will be able to quickly record details on each item discarded, including the name of the item, its intended use and reason for disposal. The skip will then weigh the waste in order to establish the quantity discarded and Tip the Scale 's software will record the data directly onto our cloud-based information system. Our consultants will conduct data analysis to advise your design teams on solutions to achieve meaningful waste reductions on future projects and automated reports can be accessed by site managers.

Tip the Scale is targeted at mid-sized developers who currently do not segregate waste, and design and build contractors who do segregate waste, but do not have access to data providing the reasons for the waste.

Archiblox

https://www.archiblox.com.au

MARKET READY

Carbon Positive Prefabricated Houses

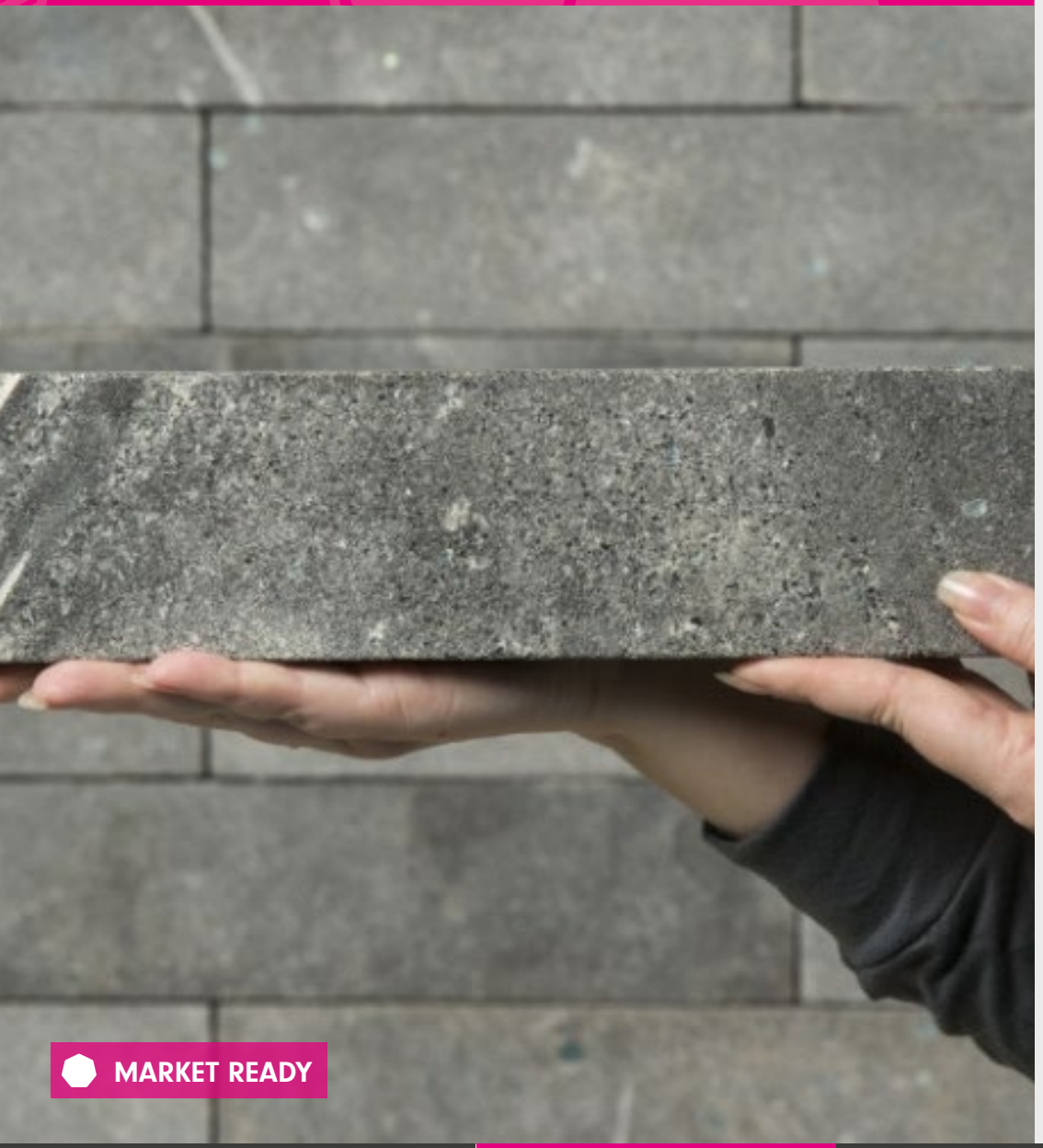
What's the elevator pitch?

Archiblox has incorporated best design practices to create modular prefabricated houses that are carbon positive and feature multiple green technologies.

Archiblox's Carbon Positive House offers easy, quick and resource efficient construction with a minimal environmental footprint. When in place, the homes generate more electricity than they use. Energy efficiency is achieved with the use of natural heating and cooling techniques, such as in-ground cool tubes and insulating green roofs. Sliding and edible garden walls, which are used to block or allow sunlight to heat the indoor space, are also an option. The houses are water efficient, using water-smart appliances, rainwater harvesting and drought tolerant plants.

bioMASON

https://biomason.com/



MARKET READY

Growing Bricks with Bacteria

What's the elevator pitch?

bioMASON's technology uses microorganisms to grow biocement™ based construction materials which are produced in ambient temperatures using locally available materials, without fuel for firing the material. bioMASON enables savings in energy costs and zero carbon emissions.

The manufacture of concrete, one of the most energy intensive materials, uses limestone shale converted into Portland cement through high-heat processes. Global cement production in 2008 amounted 2.8 billion tons, with equivalent quantities of CO2 released into the atmosphere. Both concrete and clay manufacturing include energy intensive processes for raw material extraction, transportation, and fuel sources for heating kilns.

The cement industry accounts for approximately 5% of global carbon dioxide emissions. bioMASON grow materials by employing microorganisms to grow cement.

The process of growing bricks is similar to hydroponics- whereby units mixed with the microorganism are fed an aqueous solution to harden the bricks to specification. Traditional bricks are formed in brick units and then fired for hardening.

bioMASON's process simply eliminates the need for firing by replacing the curing/hardening process with the formation of biologically controlled structural cement.

Join the Pipe

www.join-the-pipe.org

MARKET READY

#Refill #Reuse #Reduce

What's the elevator pitch?

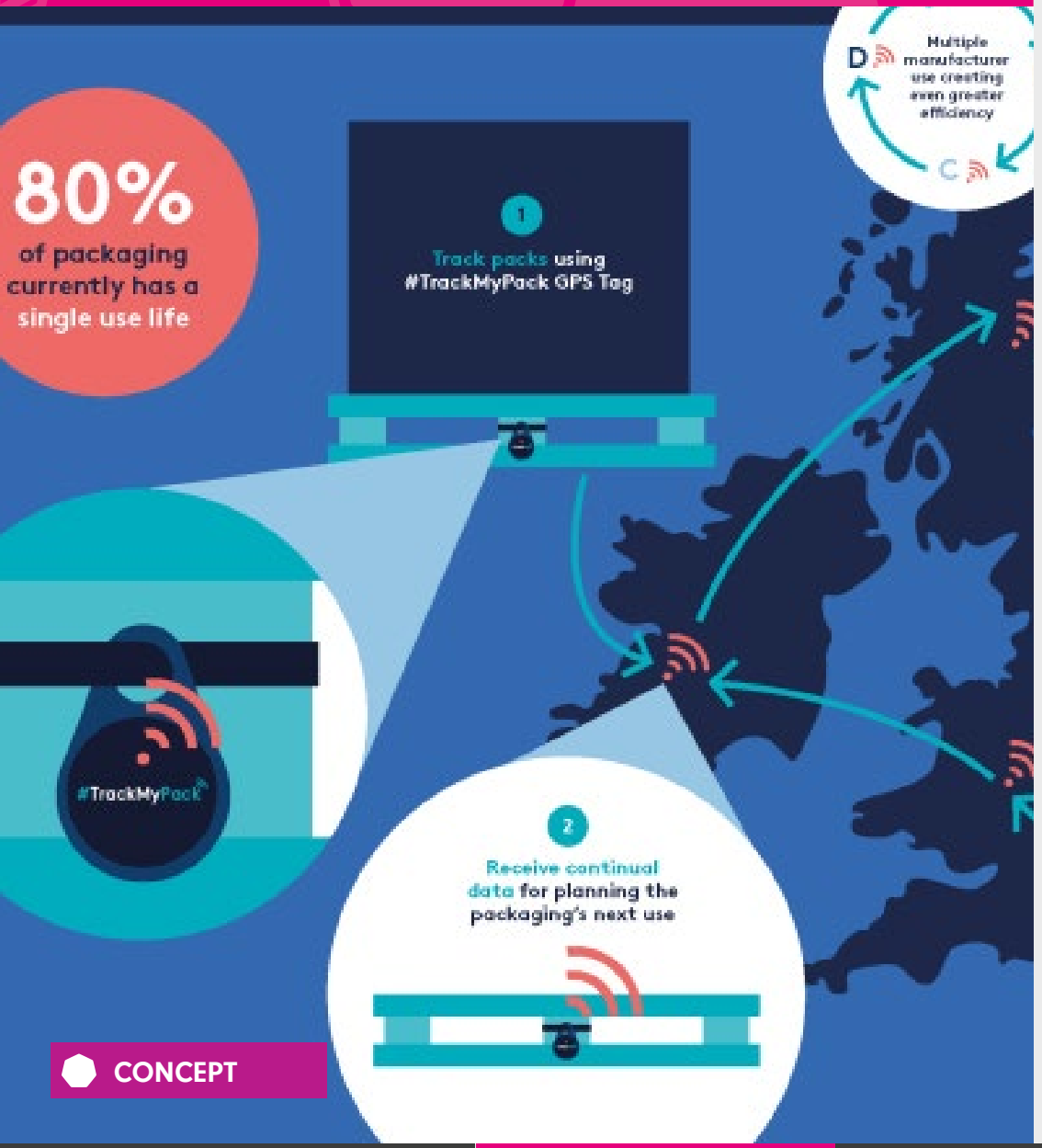
The damage that single-use plastic is having on our environment is now well documented, undeniably catastrophic and the demand for change is now clear. Change, however, requires a solution that is integrated into the built environment so it becomes part of the fabric of our daily lives. Change cannot happen unless the environment is equipped.

The idea is simple, yet effective; Integrate a network of Refill Stations throughout our built environment so a convenient, easy and attractive sustainable solution to drinking water becomes the norm.

There are nowhere near enough and they are often difficult to use (especially to fill a bottle) and are often found hiding in corners somewhere.

Join the Pipe have designed refill stations (for indoor and outdoor use) with style, functionality and sustainability in mind. They believe their refill stations are different because they are very easy to install and maintain, are robust, sustainable and also aesthetic. They want Refill Stations that are not only practical but also look good so they enhance a space, stand out and thus attract people to use them. Having a plain, uninspiring refill station in the corner is outdated, we need to make it attractive, easy and visible for people to #Refill #Reuse #Reduce (Maximise the environment's tap water and drink in the most sustainable way).

#TrackMyPack



CONCEPT

Reducing packaging waste

What's the elevator pitch?

As the market evolves at an ever increasing pace, with developments in technology as well as resource cost increases we believe that the old take make dispose model is no longer economically viable for packaging.

We realised that we need a lower cost, hassle free, reusable, low impact packaging solution; we have also realized that technology is available to deliver differently. So we have created "#trackmypack" which ultimately will offer a reusable traceable packaging service creating an intelligent industry solution which no longer relies on single use materials.

So what's this going to look like? Imagine a pallet, now imagine it has a GPS tag on it, which enables it to be traced, collected and bought back to be reused for a second, a third and fourth life.

This is an active data point applied to existing mainstream transit, allowing understanding of the flows of packaging and building a case to design better, more robust packaging destined for multiple uses, with the guarantee and proven track record of getting that material back.

Imagine no longer having to send shrink wrap, bearers and other disposable materials onto your customer's site, giving them a waste to dispose of.

Water Monsters

CONCEPT

A Mobile Drinking Fountain for London

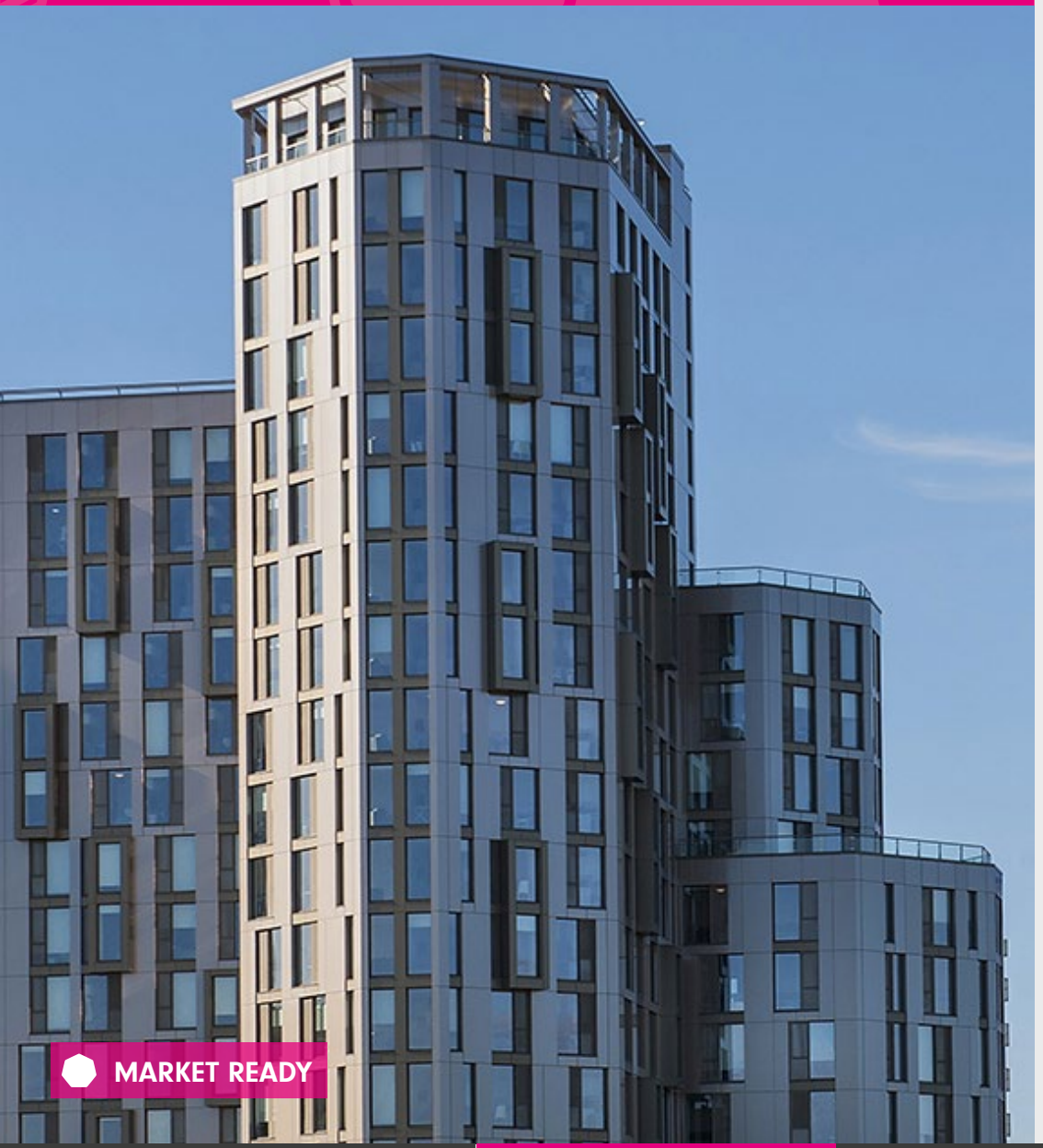
What's the elevator pitch?

Water Monsters are mobile drinking fountains, conceived as part of the #OneLess Design Fellowship to help venues, retailers, events and places across London to tackle single-use plastic water bottles. The Monsters are designed for a range of urban venues and outdoor environments – an immediate and economical alternative to the installation of costly stationary fountains. Watch this DIF film to find out how the Monsters collect drinking water from existing fountains and taps, which they can later dispense to thirsty people on their route and encourage the uptake of refillable bottles.

Beyond hydrating the capital, Water Monsters function as a living campaign to engage people, ease stigma around tap water and normalise refill culture.

Vision Modular Systems

http://visionmodular.com



MARKET READY

Automated volumetric 3D structural modules for various applications

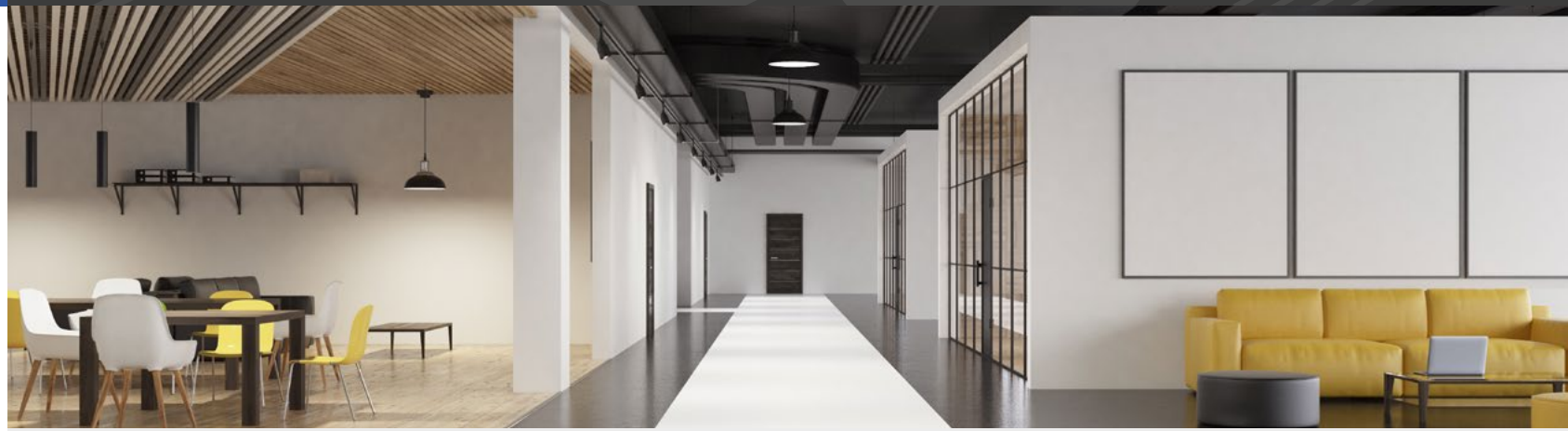
What's the elevator pitch?

In modular construction up to 70% of the value of the project is in manufactured components that are delivered 'just in time' to site. The off-site construction process leads to considerable sustainability and site organisational benefits, such as:

- Significantly smaller carbon footprint than traditional construction methods due to the speed of construction resulting in the overall project being delivered at least 40% quicker than traditional construction.
- Reduced storage and hire charges.
- Construction work on site is inherently dangerous. With the Vision Modular System, processes can be carried out in more controlled and comfortable factory conditions where safety requirements can be more easily met and policed, and healthy and comfortable working conditions are more readily maintained.
- Reduced waste and landfill charges, and more opportunities for recycling. There is 90% less waste produced on site over traditional build.
- Greater recycling of materials in factory conditions by partnering with specialist waste reduction advisors and employing specialist waste management contractors.

Challenge

02



Driving Retrofit

Existing buildings in Europe will still make up 60% of built stock in our towns and cities in 2050, with 40% of current domestic stock across Europe having been constructed before 1960 when energy-related building regulations were in their infancy.

How can we enable a more strategic approach to the repair, modernisation or replacement of built environment services?

Q-Bot

www.keetonsandcollett.co.uk

MARKET READY

A robotic device that lowers insulation costs

What's the elevator pitch?

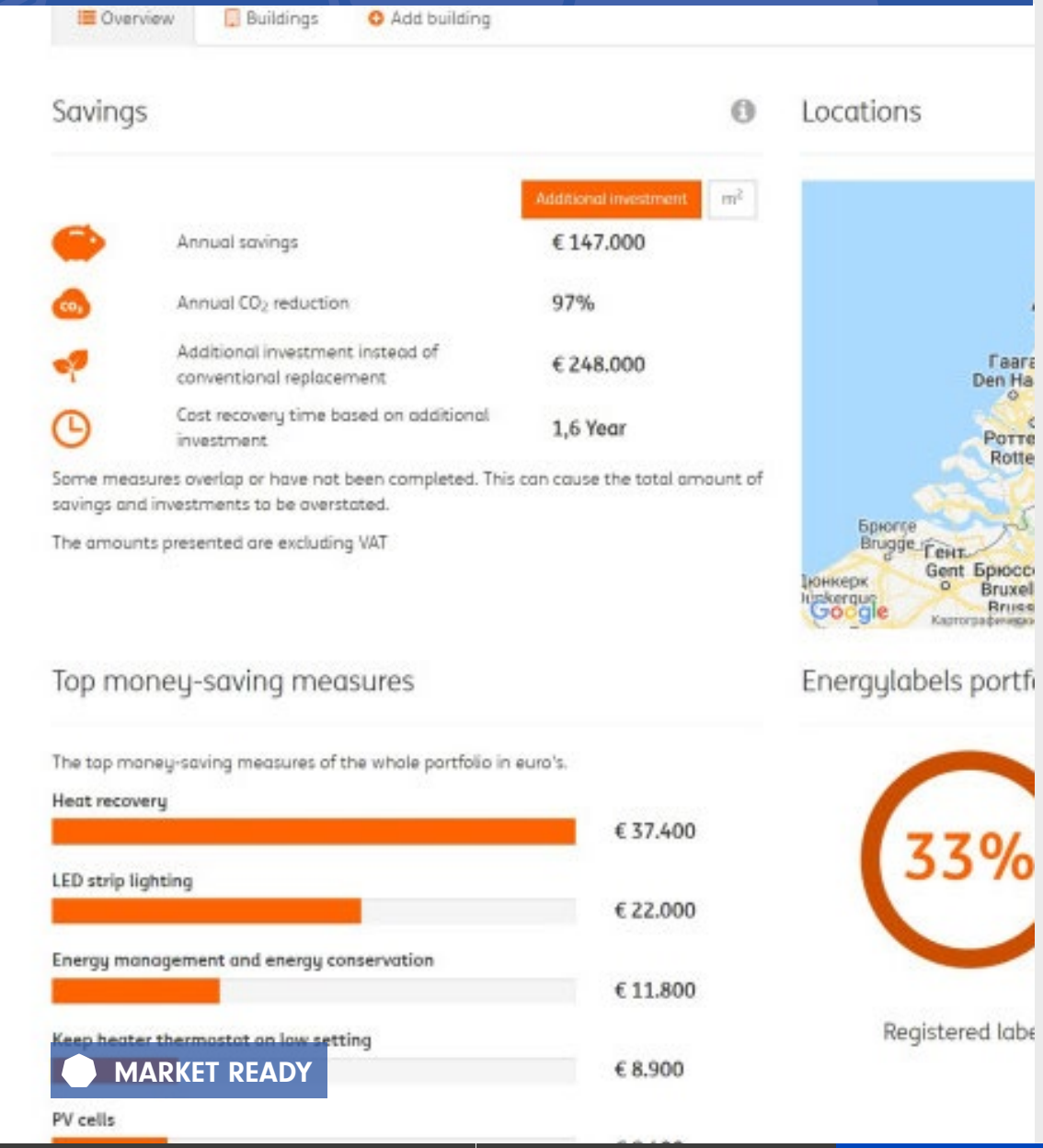
Q-Bot provides warmer, better homes by insulating cold and draughty floors. A layer of insulation hidden beneath the floorboards means a much cosier home and a pleasant surprise when the energy bill arrives.

Q-Bot does this by using robotic devices that can remotely apply insulation without needing to rip the building apart. To ensure quality, dynamic 3D maps are created, verifying the installation and allowing easy identification of faults or hazards.

Q-Bot's intelligent tools allow operators to safely go where no person has gone before, extending their senses and reach. By removing the direct link between operator and tool, Q-Bot will help make human capabilities limitless.

CFP Green Buildings

https://cfp.nl/en/



MARKET READY

Immediate assesment of your building

What's the elevator pitch?

CFP Green Buildings partners with companies and individuals to make their buildings more sustainable. It is carried out via online tools where owners or tenants can upload its buildings and get an instant assessment of the building in terms of efficiency, energy consumptions etc. and list of measures to achieve sustainability goals (specific labels, certifications etc.). The tool is intuitively friendly and easy to use. Apart from this, there is a number of different advisory services to assist with sustainability goals.

Phoebus Energy

http://www.phoebus-energy.com

MARKET READY

Energy savings from retrofitting air-conditioners

What's the elevator pitch?

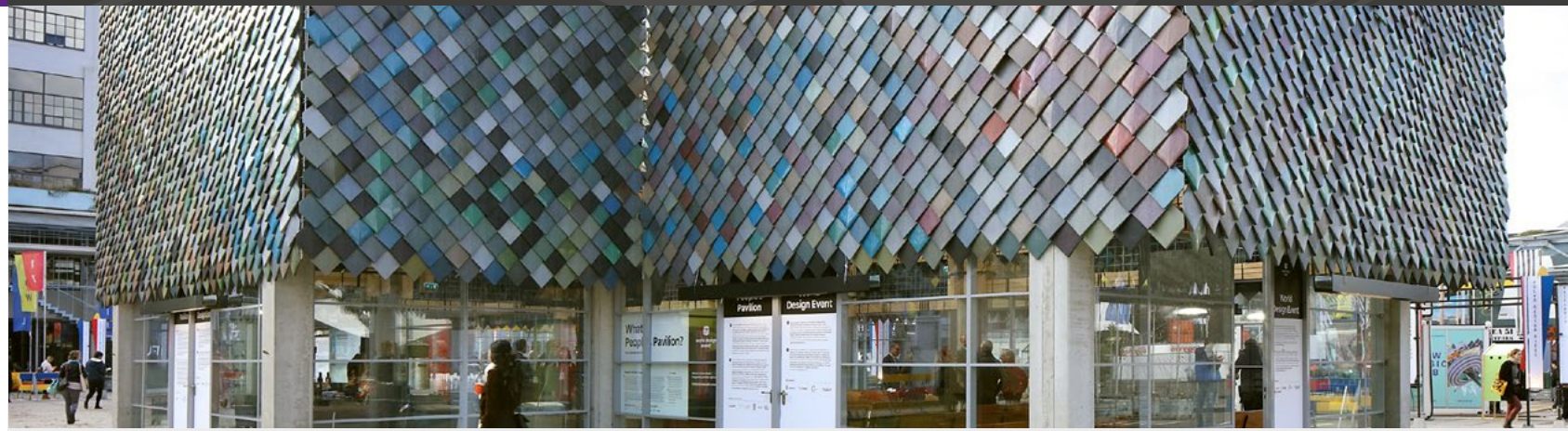
This retrofit system utilizes unused thermal energy from existing air-conditioning systems to reduce and optimize energy use for heating and cooling water by up to 70%.

Hot water in many commercial facilities is normally supplied via central boilers that are powered by fossil fuels, while air cooling is provided by electric air-conditioning systems. Phoebus Energy has developed a self-contained water heat pump, which takes unused and excess thermal energy from existing air-conditioning systems and transfers it to the hot water systems. This thermal energy heats water that can then be used in showers, pools and kitchens in large commercial sites, such as hotels, hospitals, sports centers and nursing homes.

The Phoebus Energy retrofit solution works with existing heating and cooling systems and saves 50% to 70% on energy expenses, according to the company. The system intelligently optimizes energy transfers between the systems based on data from sensors which collect data every 60 seconds. The data is processed in real time on a cloud-based system that optimizes how to produce the required heating and cooling at the lowest possible cost.

Challenge

03



Reusing Materials

The construction and operation of the built environment consumes 60% of all materials in the UK, while in Europe, 2.7 billion tonnes of waste was generated in 2010, and only 40% was reused, recycled, composted or digested.

How can we maximise the useful life of materials contained within buildings?

CollectEco

http://www.collecteco.co.uk

MARKET READY

From Waste to Social Value

What's the elevator pitch?

Charities, schools, NHS trusts and other not for profit organisations are feeling the pinch as their funding tightens. Often these good causes are spending money on kit that construction projects are putting into skips on site.

All projects have an element of reusable kit on site, whether it be the strip out of furniture, fixtures and fittings from an office block to pallets, excess materials and shuttering on a project that's still in the ground. Donating this kit to good causes that need it is a win, win, win: it's great for the environment, it's great for connecting with the community and it's great for business (this page isn't long enough to cover the business benefits, but suffice to say being seen as the good guys helps attract and retain staff, differentiates your proposal and helps get your project's neighbours on side!!!).

Collecteco works with businesses to donate reusable materials, furniture and equipment to good causes. We hold "wishlists" from good causes across the UK that allow us to quickly and efficiently match-up supply of kit from clients with demand from good causes.

At present we are only scratching the service with regards to the potential supply of reusable kit from sites and demand for good causes significantly outstrips supply from clients' sites.

We are seeking to work with more organisations to explore what they are already doing and how we can get more reusable kit to the good causes that desperately need it.

ECOR

https://ecorglobal.com

MARKET READY

Construction Products Made from Waste

What's the elevator pitch?

ECOR is a commercialized cellulose-based material made from natural and man-made waste that can be used to manufacture a wide range of construction products.

ECOR is a flexible and multi-use material for construction, interior design and furniture-making. It is made from cellulose fibers, an abundant material found in urban, agricultural and forest waste. Waste materials such as cardboard, wood and by-products from agriculture are combined with water, and then heated and pressurized to make ECOR products. The material can also be recycled into new products after use and contains no chemicals, petroleum or other additives.

The current ECOR manufacturing facility processes 1,250 tons of waste per year, and there are three more large facilities planned which will collectively convert a total of 37,500 tons per year.

Urban Mine

http://urbanmineplatform.eu

LOOKING TO SCALE

Understanding the value of waste products

What's the elevator pitch?

Currently limited to vehicles, batteries and electronic waste, the Urban Mine Platform is an initiative by Prospecting Secondary Raw Materials in the Urban Mine and Mining Wastes (ProSUM) designed to build awareness and quantify the availability of valuable materials ripe for scrap mining.

Given a smartphone alone contains approximately 40 critical raw materials, with a concentration of gold 25 to 30 times that of the richest primary gold ores, there's a decent incentive. And it's better for the planet too, as the researchers estimate that mining discarded tech for gold would have a carbon footprint 80% smaller than primary mining operations.

"Three years in the making, this consolidated database is the world's first 'one stop shop' knowledge data platform on CRMs in waste products - easy to access, structured, comprehensive, peer-reviewed, up-to-date, impartial, broad in scope, standardised and harmonised, and verifiable," said Pascal Leroy, secretary general of the WEEE (waste electronic and electric equipment) Forum in a statement.

BAMB Materials Passport

https://www.bamb2020.eu

Materials Passport Platform Prototype

+ Add Product

Products

Name

Accoya® Wood

Acrovyn® 4000

Ahrend Balance Desk

AirMaster®

Aluminium Door Furnitu

Armstrong Ultima+

Axia 2.0 Office Chair

PILOT

Buildings as Material Banks

What's the elevator pitch?

The new BAMB Materials Passports platform will fill a gap in the marketplace by providing a 'one-stop-shop' to describe Circular Economy value across the building cycle, especially for using and re-using components and materials, and reducing generation of waste.

A main aim is to support transition of the building industry from linear to circular by letting users identify value potential throughout the building cycle, from planning and construction through occupancy, repairs, renovations, repurposing and decommissioning, and by providing a continuous capacity to track component and materials quality & modifications.

The platform also connects individual products to their use in buildings. As part of that it includes a capacity to describe materials health. A large body of studies suggests that healthier buildings improve productivity and are one of the main economic benefits of knowing what's in your building.

The Materials Passports Platform, currently a prototype forming the core of a materials passport system, is ready for testing by industry partners!

The members of the BAMB consortium invite companies that manufacture building materials and products, to use the platform to start developing Materials Passports.

Challenge

04

Facilitating Deconstruction & Adaptability

40% of construction output is associated with building refurbishment, creating on average 14 cubic metres of waste per 100m2 of refurbished floor space in commercial buildings.

How can we ensure that the built assets we have are fit for use in the future?

SharED

CONCEPT

SUSTAINABLE INNOVATION SPRINT RUNNER-UP

Maximising the use of school space for local community benefit

What's the elevator pitch?

School buildings are only in use for a small portion of the year, and schools are increasingly strapped for cash. Local communities often need spaces for activities such as classes, markets, fairs, and so on, but need this at low cost.

This is where sharED comes in: an online platform that advertises out of hours school spaces for community use, providing an income for schools, and an affordable way of accessing amenity space for local communities. Schools can post the types of spaces they have available, along with costs and hours of availability. Local people can then search the platform by type, cost, and location, to find something appropriate to their needs.

Modular Aquaponics

https://flanaganlawrence.com/project/modular-aquaponics/

IN DEVELOPMENT

An integrated modular vertical agricultural system

What's the elevator pitch?

Architects Flanagan Lawrence, in partnership with Bristol Fish Project, Useful Simple Trust and LetUs Grow, have created a design concept for an aquaponics farm that fits to the side of south facing shed walls. The farm uses the excess heat from the building to power the system, making it completely off grid. As the water required for the system can be recirculated, it is vastly more efficient way of using water to create fresh produce..

Modular soilless (water centric) growing systems are touted to use 10% of the normal water to grow the same amount of plants. Soilless growing provides an excellent intervention into urban metabolism to reduce losses of urban wastewater, recapturing and recycling heat, nutrients and using waste streams as an input for more productive processes (circular economics). The key limitation to the widespread uptake of modular soilless growing is gaps in what can be automated / outsourced and how can this be integrated into the architectural module? Drainage, irrigation, environmental control, solenoids, harvesting, seeding, packing, processing – every part must be refined, integrated to some extent if this is to be the

WikiHouse

https://wikihouse.cc

LOOKING TO SCALE

An open source project to reinvent the way we make homes

What's the elevator pitch?

WikiHouse is being developed by architects, designers, engineers, inventors, manufacturers and builders, collaborating to develop the best, simplest, most sustainable, high-performance building technologies, which anyone can use and improve.

The aim is for these technologies to become new industry standards; the bricks and mortar of the digital age.

The Mission:

- To put the design solutions for building low-cost, low-energy, high-performance homes into the hands of every citizen and business on earth.
- To use digitisation to make it easier for existing industries to design, invest-in, manufacture and assemble better, more sustainable, more affordable homes for more people.
- To grow a new, distributed housing industry, comprising many citizens, communities and small businesses developing homes and neighbourhoods for themselves, reducing our dependence on top-down, debt-heavy mass housing systems.

Climate Tile

https://www.tredjenatur.dk/en/portfolio/climatetile/

PILOT READY

Teaching the world how to walk on water

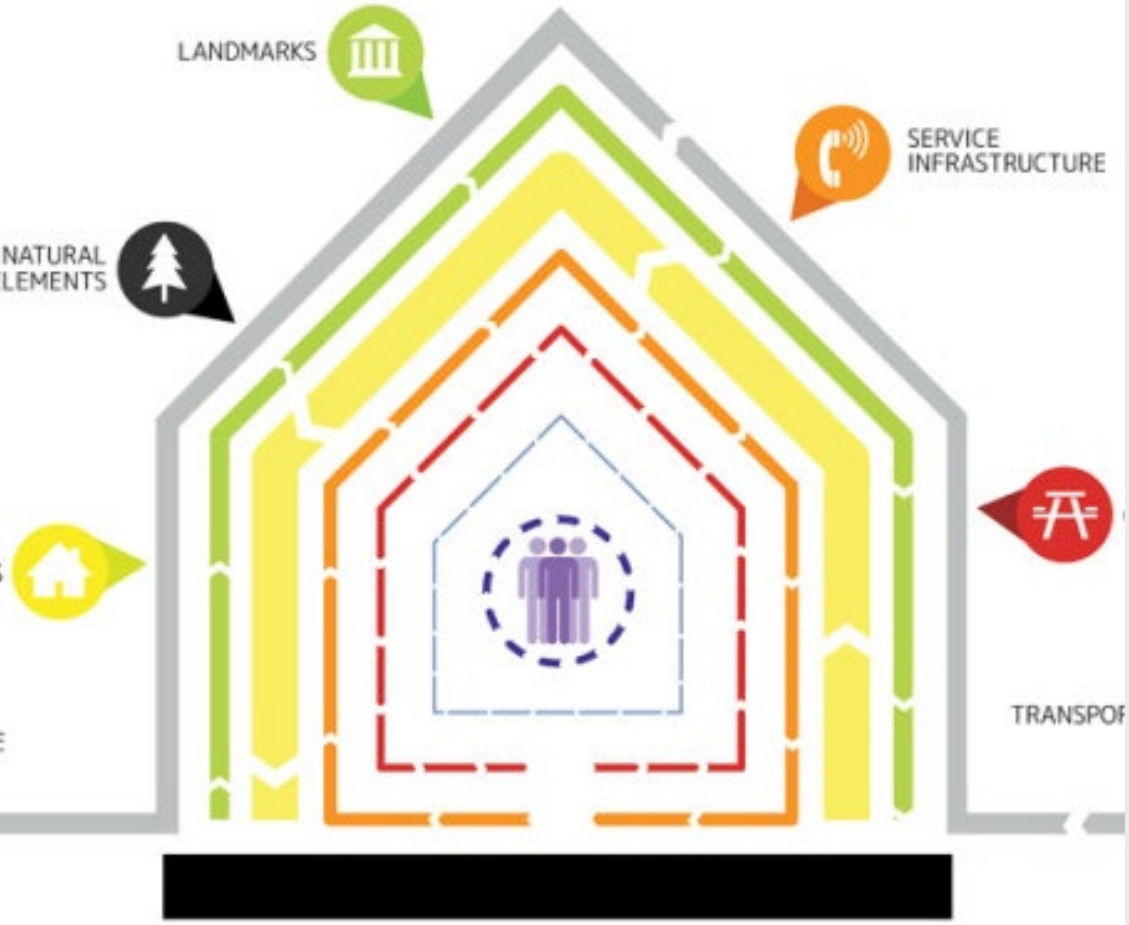
What's the elevator pitch?

The Climate Tile is at the head of a new type of innovative climate solutions for dense cities. The solution utilises the climate changes positively in the development of the cities that are more robust, eventful and sustainable.

The Climate Tile reintroduces the natural water circuit in the existing cities. By collecting rainwater from roofs and sidewalks, we can make the water a resource while the risk for damages coursed by the rain are reduced. We use the water in the best possible way as a positive supplement to the city's drainage system. Doing this, the flow of water to the existing sewers is reduced significantly and thereby create savings on for example new facilities and expansions of the existing water management in the cities.

The water is directed primarily to the surrounding plant holes where the plants will get nutrition from the water. The water will later on evaporate the water from the crown. This means that a substantial part of the water is consumed while the remaining part of the water seeps through the soil under the plants. The natural water circuit is redressed in the city by this simple process. The climate tile manages the rainwater from the roof and sidewalks. The water from the sidewalks is led through holes in the tiles where the water is transported to a fascine unite by integrated pipes. The fascine unite can manage the water in connection to storage, delay, diversion and percolation.

Tools for thinking about, designing for and implementing adaptability



MARKET READY

What's the elevator pitch?

The Adaptable Futures group at Loughborough University is finishing a four year research project on designing for adaptability. The project unpacks adaptability in detail looking at the complex web of dependencies that induce, hinder, and accommodate change. The research asks what can we learn from history – how have buildings been designed for adaptability and how have they been appropriated? It highlights layers, time, and context as primary dimensions regarding adaptability. As a stakeholder – what strategies, tools, and guidance can one use to supplement their motivations? The instruments provide a finer grain when thinking about adaptability clarifying how different types of change occur over different scales of time and within different layers of the building. The unravelling of change begins to provide insights for imagining plausible scenarios when building for an unpredictable future. Several questions must be asked to thoroughly investigate to what extent they are relevant in the given project and context – allowing different building types to change in different ways.

Office 3.0

https://carloratti.com

MARKET READY

A digitally-augmented workspace that can adapt to users' needs

What's the elevator pitch?

Open plan and flexible workspaces are becoming more prevalent, but the environmental preferences are difficult to cater for, with most workspaces employing a one-size-fits-all environment for large open areas. The Office 3.0 design principles allow for all user preferences to be catered for, reducing energy use and increasing user comfort.

Architecture firm Carlo Ratti's refurbishment of the Agnelli Foundation's headquarters in Turin employs devices and building services connected via the Internet of Things that enables a personalised heating, cooling and lighting system that can follow occupants around the building.

The building is littered with sensors that monitor different sets of data, including the location of the building's occupants, temperature, CO2 concentration, and the availability of meeting rooms. Building occupants can set their preferences for a variety of metrics via a supplied smartphone app, which then communicates with the building management system (BMS) to adjust environmental conditions as the user moves around the building.

From insight to action

UKGBC hope that these examples will inspire action on the design, construction, and operation of buildings that embraces the circular economy model, to create a built environment that promotes wellbeing, offers social value, reduced energy use, and encompasses nature.

What you can do:

- Show this document to colleagues, clients and suppliers, as a snapshot of innovation today.
- Follow up on the innovations. Implement trials of the products and services.
- Feedback to innovators what works and what could be improved to aid application at scale.
- Tell us at UKGBC about your innovation. The UKGBC site and Innovation Portal will host it.
- Share other innovations with us that deliver against these four challenge areas.

And finally…

These pages cover innovations available today. Tomorrow's ideas and innovations are up to you. Consult the *Sustainable Innovation Manual*, work through the framework and contribute to a sustainable future.

UKGBC offers no commercial endorsement of individual solutions mentioned.

The selected examples are provided as a source of inspiration, and we do hope that you follow up with the innovators to find out more.

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