CreativeDenmark

Designing the irresistible circular society



Inside this white paper

Circular by design
Recycling, upcycling and designing for disassembly

Business models for a circular economy
Enabling scalable innovations and mission-driven partnerships

Human-centred neighbourhoods
Demonstrating circular solutions across buildings, resources and biodiversity

BLOX HUB Danish Design Centre DAC Danish Architecture Center

creativedenmark.com

Designing the irresistible circular society

Version 1.0 – September 2021

Front page photo
Daniel Rasmussen, Copenhagen Media Center

Editor in chief
Creative Denmark

Steering committee
BLOXHUB Jakob Norman-Hansen, jnh@bloxhub.org
Danish Architecture Center Bjarne E. Jensen, bej@dac.dk
Danish Design Centre Malene Jung, maj@ddc.dk
Danish Design Centre Matilde Holm, mho@ddc.dk

Steering committee

Danish Design Centre

Case contributors

Chapter 1 – Designing circularity and value chains
Lendager Esben Pedersen, ep@lendager.com
Stykka Rasmus Daniel Taun, rasmus@stykka.com
Wild Studio Rosa Nøss Bendixen, rosa@wildstudio.dk

Chapter 2 – Upscaling and circular business models
GXN Innovation Kåre Stokholm Poulsgaard, ksp@3xn.dk
Danish Technological Institute Katrine Hauge Smith, khs@teknologisk.dk
Aalborg University Stefan Christoffer Gottlieb, scg@build.aau.dk
Aalborg University Christian Koch, christiank@build.aau.dk

Chapter 3 – Renovation for circularity and life cycle assessments
GXN Innovation Kåre Stokholm Poulsgaard, ksp@3xn.dk
Transition Rasmus Jakobsen, rasmus@transition.nu
Søndergaard Kasper Sørensen, ks@soendergaard.dk
Enemærke & Petersen Anders Strange Sørensen, aso@eogp.dk

Chapter 4 – Circular by design – design for disassembly
Arcgency Mads Møller, moller@arcgency.com
KALK Rasmus Kjøng Jørgensen, rasmus@kalk.dk
Tom Rossau Tom Rossau, tr@tomrossau.dk

Chapter 5 – Circular cities and neighbourhoods
Boligkontoret Århus Erik Frehr, ef@bk-aarhus.dk
AART architects Johanne Mose Entwistle, jme@aart.dk
REFLOW Copenhagen Business School, Cristiana Parisi, cp.om@cbs.dk
Peter Kjær Architects Peter Kjær, pkj@peterkjaer.as

Chapter 6 – Stations for recycling
Vejle Municipality Lisbet Wolters, liwol@vejle.dk
Næste Niels Jakubiak Andersen, nja@neaste.dk
Vandkunsten Architects Anne-Mette Manelius Greisen, am@vandkunst.dk

Chapter 7 – Urban nature and biodiversity
Habitats Rasmus Vincentz, rasmus@habitats.dk
SLA Rasmus Astrup, ras@sla.dk
By & Havn Jan Bruun Jensen, jbj@byoghavn.dk

Chapter 8 – Designing for behavioural change
Dansk Retursystem Heidi Schütt Larsen, hsl@dansk-retursystem.dk
Too Good To Go Jamael Kudratt, jkudratt@toogoodtogo.com
Almenr Lars Lundbye, lars@almenr.dk

Chapter 9 – Product as service
Continued Fashion Vigga Svensson, vs@continued.fashion
Skagerak Mia Møgelgaard, mia@skagerak.dk
Fischer Lighting Lars Elmvang, lel@fischer-lighting.com

Chapter 10 – The future of the circular society
BLOXHUB Lotte Christina Breengaard, lcb@bloxhub.org
Danish Design Centre Oskar Stockholm, osk@ddc.dk
BLOXHUB New European Bauhaus, Anne-Mette Hyveled, amh@bloxhub.org

For more information
To order copies of this white paper or receive information about other relevant publications, please contact Creative Denmark at info@creativedenmark.com

Copyright Creative Denmark 2021

Executive summary

The shift to a circular economy has become an important part of the green transition puzzle – in Denmark as well as globally. In contrast to the take-make-waste linear model, a circular economy is regenerative by design. It aims to gradually decouple growth from finite resource consumption and explore opportunities for reducing, reusing and recycling. To accelerate the shift, we need to find ways for circularity to become compelling and convincing. This calls for excellent design, new narratives, ethics, aesthetics and art within the built environment.

What if waste was never created in the first place? What if the economy was built on using things rather than using them up? What if we could not only protect but actively improve the environment? As part of shared initiatives within the circular economy agenda, BLOXHUB, Danish Architecture Center, Danish Design Centre and Creative Denmark present this white paper. Not only to address the above questions, but to also add a fourth: what if we designed an irresistible circular society where circularity is a clear-cut choice – both in business models and for end consumers?

The circular principles

Based on the three pioneering principles for a circular economy put forward by the Ellen MacArthur Foundation, this white paper explores new opportunities and concrete solutions that (1) design out waste and pollution, (2) keep products and materials in use and (3) regenerate natural systems. Framed by insights from academic researchers, directors and leading voices within circularity, this white paper showcases Danish circular solutions from designs, buildings, production methods and circular business models with real impact.

From resource loops to circular communities

Inspired by the mission and angles of action developed through the BLOX & the Confederation of Danish Industry (DI) facilitated Danish-led bid for the New European Bauhaus, this white paper is divided into three main sections:

- Resource loops and zero waste
- City(nature), resilience and biodiversity
- Social values and communities

The first section explores value chains, circular business models, renovation and ways to design for disassembly. The second presents solutions for large-scale circular neighbourhoods with local resource centres and integrated urban nature. The final section showcases designs for behavioural change and scenario tools for envisioning the circular society of 2050.

The circular future starts today

With the aim of generating knowledge, supporting new solutions, leveraging global networks, and supporting Danish and international companies toward circular practices, this white paper is an invitation. The circular transition requires innovative thinking and partnerships across borders. For circularity to become irresistible, we need to build communities, innovative partnerships and alliances – and we hope to start today.

Index



Case

Bringing circular economy to the high-rise

P. 18

←

Case

Employing Design for Disassembly as a key principle

P. 32

→





Case

Circular retail platform for systemic change

P. 64

←

Preface

Designing a greener tomorrow 6
Morten Bødskov

The circular economy has captured our imagination – and the shift has begun 7
Joe Iles

Resource loops and zero waste

01 **Designing circularity and value chains** 10
From linear to circular

02 **Upscaling and circular business models** 16
The circular game is on

03 **Renovation for circularity and life cycle assessments** 22
Preventing the loss of valuable resources

04 **Circular by design – Design for Disassembly** 28
Design for Disassembly is pivotal and proves successful when designed for people

City(nature), resilience and biodiversity

05 **Circular cities and neighbourhoods** 36
Large scale circularity

06 **Stations for recycling** 42
Handling of waste as a valuable resource

07 **Urban nature and biodiversity** 48
Now is the time for radically new ways of approaching cities, landscape design and nature

Social values and communities

08 **Designing for behavioural change** 56
Changing human behaviour means challenging existing behaviour

09 **Product as a service** 62
Decoupling value creation from resource consumption

10 **The future of the circular society** 68
If you can imagine it, you can design it

Designing a greener tomorrow

Danish design is a proud tradition to Danes. Artisans and craftsman in all walks of life permeate the entirety of Danish society and it offers us a powerful tool to accelerate the green transition and maintain our position as a global green leader.

Craftsmanship and creative thinking is a cornerstone in Danish society. Many homes in Denmark have a little wooden monkey from Kay Bojesen tucked away somewhere. Everything from lighting to dining chairs and the buildings themselves carry a long tradition of Scandinavian design and Danish artisanship.

At the core of it is the idea of combining practicality and aesthetics. To use creativity to solve complex problems. To design durable, useable, and liveable designs that look simple and yet elegant and interesting.

This philosophy reflects Danish society and Danish thinking. Often times Danes are perceived as aloof and distanced. Cool and unapproachable. But that couldn't be further from the truth. We just appreciate when things work and are pleasing without being flashy. We encourage and enable creativity, innovation and collaboration across sectors and industries – all in the name of design that works, on all levels.

The world now has set new standards for what design should be able to do. And Danish designers aim to be at the vanguard of these challenges as well. Denmark is among the global leaders when it comes to sustainable solutions and a circular economy is an important part of our mission to be a green lighthouse in uncharted waters.

By employing creative thinking and methods, we can drive the circular transition forward to the benefit of citizens' everyday life and businesses' competitive advantages. Creativity opens up new solutions and products, creating an energy that can be channeled into the green transition of our society.

The creative industries in Denmark are a strong part of the Danish Economy and have seen substantial growth in export over the last 10 years. Their export can help solve some of the environmental challenges facing the world today. The potential of the creative industries will only increase in the coming years. And Danish creative industries are well suited to grasp these potentials. Green transition, recycling and upcycling, lateral thinking and circular thinking are all strong suits for Danish creatives and artisans.

This white paper illustrates how many of these positions hold massive potentials for Denmark. For growth and businesses, but also for intelligent solutions and processes for a more sustainable future.

In short: we need a more sustainable world and we need businesses on board. Creative thinkers are a key to achieving just that.



Morten Bødskov
Danish Minister for Industry, Business and Financial Affairs

The circular economy has captured our imagination – and the shift has begun

To unleash the full potential of the idea of circular economy, we need to embrace design at many levels: from the practising designers to the many people who influence design; from tools, frameworks and methods to iconic stories of circular design.

Much of the conversation around a circular economy has focused, understandably, on our current global predicaments: mounting waste, polluted nature and diminishing biodiversity to name a few. These urgent problems are stimulating the crucial exploration of the circular economy, a framework for systemic solutions and the transformation that tackles these global challenges.

What is often missed from the conversation are the factors that can pull us towards realising this vision and the enthralling stories of innovations that challenge our current linear model. For this reason alone, this white paper is a valuable addition to the discourse. The theme of the "irresistible circular society" is present not just in the title, but throughout, and captivates us with a positive vision of the future that can be built – if we choose to.

With its many stories and examples, the authors show that while the transition to a circular economy is underway, it is essential to leverage design to accelerate the shift and generate deep, distributed benefits. To some, this conjures images of making new things out of waste. But, as this white paper shows, designing for the circular economy – what we call circular design – is actually a much bigger idea.

Everything around us is designed, whether it's called "design" or not. Physical products, services that provide things we want and need, and the systems in which they all sit – these are all designed. In the process of creation, upstream decisions determine how things work and whether they become just another part of our current linear model, or whether they help make our world increasingly circular and regenerative. That is why the design stage – and the people and skills found there – is so encapsulating and powerful. By harnessing this power and applying the principles of a circular economy, we can steer towards more positive outcomes.

This circular design approach can help us invent better products and services, while making radical changes accessible to people. It can help us navigate the fog of ambiguity that comes with complex change. It can help us develop new processes and facilitate collaboration – within and between organisations.

Another strength of design is creating compelling visions and identifying the steps needed to make them real. This makes the circular economy an irresistible opportunity. The circular economy does not exist yet, but the very idea has captured the imagination of people who want to build a better future.

This is something the authors of this publication have demonstrated beautifully. For something to be irresistible, you first need to bring it to life. This white paper brings the idea of a circular society to life and encourages us to use our ingenuity and creativity to make it a reality.

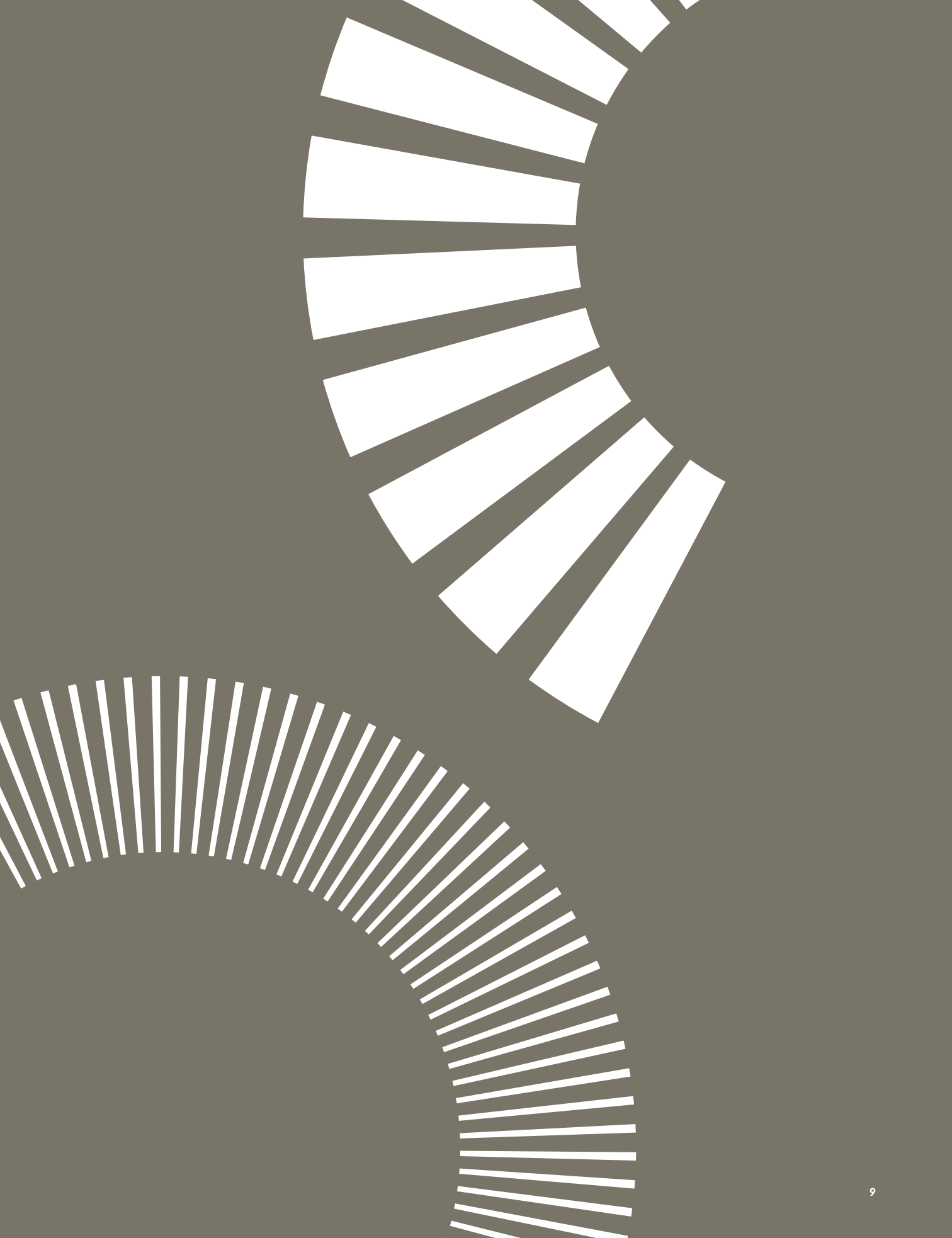


Joe Iles
Circular Design Programme Lead,
Ellen MacArthur
Foundation

Section 1

Resource loops and zero waste

Circular by design
Impact through life cycle assessments
Bridging academia and business



Designing circularity and value chains



Camilla Haustrup Hermansen
Chair, Danish Design Centre

From linear to circular

Design is a key factor in enabling a more sustainable use of materials and resources.

The transition from a linear to a circular economy is one of the most important imperatives of our time, a transition that requires new ways of designing, producing and consuming. Globally, resource extraction and processing account for 90% of biodiversity loss and water stress, and the production and consumption of materials account for almost half of global greenhouse gas emissions. In other words, conventional mitigation strategies such as switching to renewable energy and enhancing energy efficiency will only bring us halfway to carbon neutrality in 2050. A circular economy and improved resource efficiency hold significant potential to complement these efforts. A circular approach to production and consumption not only reduces carbon emissions and pollution, but also increases competitiveness and innovation. In short, it makes our companies, economies and societies more regenerative and resilient for the future.

The Danish solutions

Today, Danish solutions within waste, water and the circular economy are already well recognised around the world. This puts Denmark in a unique position to drive this change and commit ourselves to contribute with our strong capabilities in creative thinking, design, innovation and partnership building. We must keep joining forces and bring forward all the green, climate-friendly and circular solutions, which will reduce carbon emissions in Denmark and inspire the rest of the world to follow.

Design and rethinking are key

Design is a key factor when it comes to delivering the sustainable growth of the future. Around 80% of a product's environmental footprint is locked in at the design phase – if not more. It is therefore crucial that designers have a circular mindset in everything they do and pursue.

Bringing stakeholders together to co-create new strategies for a more regenerative circular economy is vital. This calls for new public-private partnerships, where stakeholders can actively shape new systems, enabling more responsible production and consumption. Meanwhile, many more companies need to increase their use of recycled materials, introduce new types of materials, allow reuse models, design for increased recyclability and create products with longer life cycles while reducing waste. There has never been a better time to rethink existing business models and to come up with new, innovative, truly circular business models. The future is circular.



Photography: Rasmus Hjortshøj – Coast

The radical pioneers of circular construction

Lendager implements upcycled building materials in their design process and has won a number of esteemed design awards by doing so.

Contributor
- Lendager

In collaboration with
- Lendager UP
- The Footprint Company

If you want to design with sustainable materials, you are confronted with two main challenges: the materials are unavailable and the clients do not want to pay more for sustainability. Lendager, however, has discovered that using upcycled materials does not have to cost more. Their building products, developed from recycled material, are often cheaper than new comparable products, even in the initial product loop. Rarely are they more than 10% more expen-sive, and with an increased production volume, they can be 50-70% cheaper.

Their company UP works with design, material mapping, material innovation and material manufacturing through partnerships. With this approach, the investors can find out exactly how much concrete, glass and steel a build-ing contains, what these materials are worth, and how they can be recy-cled or reused. Often, the investors can make a better profit with circular construction.

The upcycled materials can either be invisible or a recognisable part of the design. The residents at Resource Rows in Copenhagen, for example, know precisely where the bricks in their building came from. This allows them to develop a much closer relationship with their home than they would in another new build.

Photography: Stykka



Planet positive products

The construction-tech startup Stykka has developed a digital carpentry platform that produces net positive, built-in furniture for the building industry.

Contributor

– Stykka

Contributing 40% of global energy-related CO_2 emissions and 30% of global landfill waste, construction plays a significant role in our planetary crisis and is by far the most polluting sector. Stykka is a Danish startup on a mission to make the construction industry part of the solution by providing circular, built-in interiors that are designed to last a lifetime.

Stykka has built a digital carpentry platform, digitalizing the whole process from design to production to maintenance. Every design is made from high-quality wood from sustainable forests and is linked to a digital maintenance platform, allowing for easy repairs. Everything is designed for disassembly and worn-out parts can be recycled through Stykka's recycling scheme, where old fronts are being swapped for "new" upcycled ones.

Stykka has utilised technology and digital fabrication to minimise waste, lower costs and localise production. The profits are then invested in better material, which makes for longer-lasting products and reduces carbon emissions.



Photography: Wild Studio

Does plastic have a soul?

Nobody likes plastic. It is a symbol of cheapness, waste and overconsumption. That is what made Wild Studio want to work with it: the challenge of reversing the perception of the material through design.

Contributor
– Wild Studio

Wild Studio asks how mountains of waste and floating islands of plastic can be seen instead as a colourful, precious raw material just waiting to be collected and turned into something new.

In designs by Wild Studio, the former life of the material is visible on the surface like a beautiful reincarnation of something already part of our lives. The studio proposes that the closer the process of recycling is to a user's own life and body, the more it adds value to the material. Each shred of used plastic contains a story of human life, like the toothbrush, the shampoo bottle and the ice cream box. "We give it soul through our own stories," says Wild Studio.

Wild Studio is uniquely placed in terms of collaborations with a closed-loop agenda and functions as the design link between the industry, the consumer and the contributor. The loop enables municipalities, institutions and larger companies to integrate their waste strategy with Wild Studio's design concept. In collaborations, they are able to tell unique stories from each place. Imagine having signature outdoor furniture in a university courtyard made from plastic waste from the laboratories inside? It is a new opportunity to strengthen identity through recycling.



Upscaling and circular business models



Torben Klitgaard
CEO, BLOXHUB

The circular game is on

How to develop a circular society: when power and passion join forces.

The need for a circular economy is becoming so obvious, there is no need to argue about it anymore. Instead, our focus can be dedicated on how to prepare for success and develop solutions that work. But this requires addressing co-existing and sometimes contradictory societal systemic dynamics at work. How do we tackle policy constraints while ensuring that the circular innovation drivers, which feed on passion and creativity, flourish? We need to integrate two different gameplays to make this happen. We suggest a deeper look into how the power game, with all its policy, and the passion game, with all its ideation force, can combine into successful, scalable circular innovations.

The power game

The right policies, business models, procurement systems, tendering and standardisation are all prerequisites in a circular economy. The planning and building of our cities are assigned to a rule book of power and bureaucracy that need to take seriously, discuss and challenge. This will allow us to work smarter and in better unison to incentivise the circularity that heightens the quality of life for all of us. But the rule book is not the innovative driver that generates solutions.

The passion game

The real triggers for a successful circular economy are found in the creative, innovative and passionate enablers that show themselves when developing new ways of recycling and cascading. We need to organize everyone to join the discussions, commit, collaborate and execute. Supporting this type of mission-driven partnership across sectors is a key motivation for BLOXHUB: to create a platform for unlocking joint innovations that can develop scalable circular solutions. Here, designers, tech startups and architects work closely, creatively and respectfully together with policy makers and investors towards a more sustainable future.

The obvious choice is global and circular

For solutions to matter and have a substantial impact, they have to be “born global” and not just work in a local context. Science and practice must connect and collaborate even further. Research is needed to even more effectively provide input to commercially viable ideas. This is our motivation for inviting global commercial partners, research institutions and policy makers to collaborate and invest their skills and resources to address both the challenges and the possibilities within the circular economy.



Photography: GXN Innovation

Bringing circular economy to the high-rise

Designed to be net zero carbon in both construction and operation, 2 Finsbury Avenue will be a flagship development for high-end office design, as well as an exemplar of circular design for high-rise buildings.

Contributor
- GXN Innovation

In collaboration with
- 3XN Architects
- British Land
- Ramboll
- Adamson Associates
- Atelier Ten
- Sweco
- DP9
- Core Five
- Gardiner & Theobald
- Sir Robert McAlpine
- Arup

2 Finsbury Avenue is located at the largest pedestrianised neighbourhood in Central London. The project consists of a 12-storey podium with a 35-storey East Tower and 20-storey West Tower. The design team, led by 3XN Architects and sister company GXN Innovation, are applying pioneering principles from the circular economy to ensure long-term flexibility, prolonged building life, and that waste and resource footprints of the project are minimal.

The 2 Finsbury Avenue design team has developed innovative approaches to the building's structural system to minimise waste and embodied carbon. Flexibility is ensured by enabling new tenants to remove or relocate floors within strategically placed soft spots at different levels of the building. The design of these soft spots utilises Design for Disassembly principles to ensure that they are easy to reconfigure without disturbing ongoing use of the building. Upcycling of components from two existing buildings on-site is applied as a framework for innovative thinking around reuse of materials, thereby saving carbon while providing a strong brand for 2 Finsbury Avenue.

Photography: Danish Technological Institute



Construction made circular

Circle Bank is a three-year-long Grand Solution project aimed at creating a digital platform that can accelerate circular construction. The ambition is to outcompete linear construction by 2030.

Contributor

- Danish Technological Institute

In collaboration with

- University of Southern Denmark
- Lejerbo
- Middelfart Municipality
- Roskilde Municipality
- Danica Ejendomme

In recent years, innovation in circular construction and small-scale experiments have provided a glimpse of a more circular future. However, it is still more efficient, cheaper and faster to build using a traditional linear approach. The development and implementation of Circle Bank will create an integrated, scalable and cost-effective circular value chain able to outcompete the linear construction practice on market terms by solving the existing research and market challenges:

- Lack of method to quantify the environmental/social value
- Lack of decision support tool to guide building owners through circular choices
- Fragmented value chains, making design of new buildings with secondary building materials and components inefficient
- Uncertain and fluctuating supply of secondary building materials and components
- Uncertain technical/environmental quality

The overall goal of Circle Bank is to create a value hub where documented value and quality resources can be exchanged to support circular economy in the building sector. The platform will work as a circular decision support tool for building owners and other actors in the industry.



Photography: : Chris Barbalis

Community building for resource economic construction

The circular economy entails fundamental changes in the supply, demand and allocation of resources. The research project by Aalborg University provides knowledge on how to shape market structures in support hereof.

Contributor

- Aalborg University

In collaboration with

- Realdania
- BLOXHUB
- Enemærke & Pedersen
- WSP Denmark
- Knauf
- Arkitema
- Chalmers University of Technology

Community Building for Resource Economic Construction is a Realdania financed research project that aims at understanding and contributing to the shaping of market structures for construction based on circular economy principles.

The project takes as its starting point that the construction industry's current market and institutional structures pose a major barrier to the transition towards the circular economy. The industry is characterised by fragmentation and misalignment between the interests of individual actors and common societal concerns.

Against this background, the project examines how rules and social norms for sustainable use of resources can be established through collective action and partnerships between private companies, public organisations, and research institutions. The project follows the efforts in the BLOXHUB's 'Circular Built Environment' community, focusing on studying and co-creating mechanisms and business models that support the upscaling of circular solutions and the shaping of a market for circular construction.



Renovation for circularity and life cycle assessments



Harpa Birgisdottir
Professor and Head of Research Group on Sustainability of Buildings,
BUILD Aalborg University

Preventing the loss of valuable resources

As one of the most resource-heavy industries, the field of architecture has great potential to make an impact by going circular. By preserving buildings through renovation and reusing existing building structures, valuable resources are kept in the loop and substantial environmental benefits are ensured.

Buildings are responsible for a large share of the environmental challenges today, both in terms of resource use, environmental impacts and waste generation. Therefore, the preservation of materials that have already been invested in the built environment is a very important task.

Life Cycle Assessment

The use of Life Cycle Assessment (LCA) in the design phase of building projects is a relatively new but important discipline for architects and engineers. LCA is a method that is used to evaluate resource use and environmental impacts of buildings. LCA can be used to calculate the environmental impacts of a building project and to identify where in the project the impacts are highest and how they can be reduced with different design strategies, choice of materials and optimisation of material used. This moves the focus from only optimising the energy consumption in a building to optimising the entire lifecycle, covering both materials and operational energy use. Recent Danish analysis of 60 building cases for new construction show that the embodied impacts related to material use can make up to 75% of the total climate impacts of buildings.

This new discipline – LCA – is gaining importance due to the introduction of requirements of climate impacts of buildings in regulation. In Denmark, new regulations based on LCA are taking place from 2023. The requirements are 12 kg CO_2-equivalents per m^2 building per year, with a more ambitious voluntary CO_2-class of 8 kg CO_2-equivalents per m^2 building per year. This will bring enhanced focus on the climate impacts of materials used for new buildings. With a massive emphasis on preservation and renovation of the existing building stock, the focus on using LCA to evaluate the environmental impacts of renovation projects is expected to increase in the new future.

Clever preservation and renovation are key

Energy consumption in buildings makes up about 28% of the global greenhouse gas emissions, while production of building materials makes up about 11%. The reason why renovation is key to the green transition of the building sector is twofold. Firstly, energy renovation can decrease the operational energy use. Secondly, preserving the value of the existing buildings by renovation and maintenance can ensure that materials stay at their highest value in the loop inside the built environment.

However, energy renovation strategies have to be chosen with care. They have to focus on the embodied carbon invested in materials now in order to achieve savings of emissions related to operational energy. Recent Danish analysis shows that the variation of the environmental payback time varies a lot for different renovation strategies. Therefore, the use of LCA is key in evaluating environmental benefits.

Demolition with care

In some cases, and due to different reasons, the demolition of buildings cannot be avoided. Production of building materials contributes to one tenth of the global greenhouse gas emissions. One important way to reduce this is to make sure that valuable materials keep their highest value when demolished. Several Danish studies exist that show the environmental benefits of demolition for reuse.



Photography: GXN Innovation

Upcycling social housing from the 1960s and 70s

Reuse of concrete structures is a prerequisite for the mitigation of climate change. However, scaling direct reuse of concrete involves major challenges, which Ressource Blokken seeks ways to overcome.

Contributor
- GXN Innovation

In collaboration with
- JAJA Architects
- Danish Technological Institute
- Regnestuen
- BUILD
- Søndergaard A/S
- Enemærke & Petersen A/S
- Ungdomsbo

Countless buildings are demolished yearly. In many cases, these buildings contain materials which are still structurally sound and therefore have long lives ahead of them if reused. However, due to complex factors – socioeconomic, technical, aesthetic – buildings and building materials are often demolished and lost.

In Denmark, 1.3 million m^2 of social housing is set to be demolished by 2030, following the Government plan One Denmark without Parallel Societies – only to be substituted by 700,000 m^2 of new build housing.

In this context, direct reuse of concrete has vast environmentally beneficial potential but comes with its own intractable challenges. Prompted by the unique situation arising from the politically mandated demolition, Ressource Blokken brings together a wide array of partners, including architects, demolition contractors and housing associations. They will produce knowledge and documentation on how direct reuse of concrete can be initiated at a large scale to create sustainable buildings with a high-quality aesthetic.

Photography: Transition ApS



Renovation can be the more sustainable choice

Postcentralen on Ankersgade, Aarhus, stands as a prime example of how preserving materials and renovating an old building can be the more sustainable choice compared to a new, energy-efficient building.

Contributor
- Transition ApS

In collaboration with
- Olav de Linde

When working with sustainability in buildings, it is essential to consider the whole life of the building. This means everything from the materials used in the construction, their journey from raw materials to end-of-life and how much energy it requires to operate the building.

In the renovation of Postcentralen on Ankersgade, Olav de Linde hired Transition to show whether their decision to renovate was more sustainable than if they had decided to tear it down and build a new building. Transition made an in-depth examination of the specific case with an analysis and comparison of CO_2 emission from two building scenarios: the old renovated building and a fictive new building. Lifecycle assessments and CO_2 calculations were the backbone of the analysis that considered both embodied carbon, CO_2 emissions from building materials, and CO_2 emission from energy used to operate the buildings.

The results were clear: if the renovation of the old post terminal includes replacing old technical installations with new, energy-efficient solutions, and if the materials used for renewing the building are chosen based on low CO_2 emission, the old building will be more sustainable than a new one.



Photography: Søndergaard A/S

Why sustainable demolition is the future

Reusing and recycling demolition materials that are normally discarded is a necessity in the future if we want a sustainable building industry and a circular society.

Contributor

– Søndergaard A/S

Raw materials are getting increasingly scarce, more expensive and environmentally disturbing to extract. That is why Søndergaard wants to shift the focus when it comes to the demolition phase of a construction project. By focusing on urban mining, the old building materials can be reused, recycled or upcycled on a much larger scale than today.

As “first responders”, demolition companies must begin to separate more and demolish less. Entrepreneurs and builders also need to adapt to this new approach for a more sustainable demolition to succeed.

During a recent large-scale demolition project at Bella Center, Copenhagen, Søndergaard was able to prolong the life cycle of several valuable building materials by working closely together with other links in the building value chain. Windows were gently disassembled and reused elsewhere. 5,000 tons of construction concrete was upcycled by implementing it in the production of new concrete. Wooden beams from the roof were reused as new green sheds and mobile beer bars for Carlsberg.

Sustainable demolition is not just for show. It can play a vital role in the future of a more circular building industry – if we want it to.

Photography: : Enemærke & Petersen A/S



Extend lifecycles through innovative refurbishment

The preservation of outer walls and gables in renovation projects and internal insulation provides advantages in a circular context, as well as supporting architectural value.

Contributor

- Enemærke & Petersen A/S

In collaboration with

- Fyns Almennyttige Boligselskab (FAB)
- ERIK arkitekter
- Viggo Madsen

Deep renovations of older buildings usually include replacing the existing facade in order to add more insulation or rebuilding the facade. This approach contributes to a significant amount of material demolition and often has a negative impact on the original architectural expression of the building.

In Højstrupparken, Enemærke & Petersen developed a solution that enabled them to preserve the outer walls and materials used in the construction, removing instead parts of the inner walls and building a new internal wall with insulation for the apartments.

This solution provided a better workflow in the building process because the primary work was inside instead of outside. It also performed better when looking at CO_2 equivalent pr. m^2 compared to either the conventional gable solution with new tiles (52% more) or a new gable with reused tiles and insulation (18% more).

The chosen approach also allows more insulation to be added than conventional solutions, thereby improving comfort and reducing the use of materials. It costs less than traditional solutions, avoids risks in using reused materials and does not impact the architectural expression of the building negatively.

Circular by design – Design for Disassembly



Lene Dammand Lund
Rector, Royal Danish Academy

Design for Disassembly is pivotal and proves successful when designed for people

The need for a transition to a circular economy is indisputable, and Design for Disassembly is a crucial part of this. The success of the transition depends on whether the solutions are attractive and correspond with the values and needs of people.

It takes nature a little over a year and a half to restore what the world's population consumes of natural resources in a single year. Therefore, the transition to a circular economy is an indisputable necessity for the future.

The transition requires a daring to work innovatively and experimentally with new materials, recycle old materials, and expand our knowledge of how design can extend the life span of materials and products considerably, as in Design for Disassembly. As mentioned before in this white paper, around 80% of the environmental impacts are determined at the design stage.

These contributions must be seen from a holistic perspective, including awareness of people, their cultural habits, values and needs. This is why creative competencies such as design and architecture can contribute hugely to the current transition.

New sustainable design methodologies

Denmark stands on an internationally distinguished design tradition that is based on a deep understanding of nature and functional minimalism. This makes us fit for developing the new sustainable design methodologies.

At the Royal Danish Academy, sustainable architecture and design has been taught for decades. In 2016, the academy pushed this ambition even further when it chose to dedicate our educations to the Sustainable Development Goals. As a result, a 2017 showcase focused on the circular economy in architecture and design, with projects presented by researchers and students. Exhibited were building components in CO_2 neutral materials to be disassembled and reused, furniture textiles based on recycling, sustainable transformations of old building stock and refugee shelters constructed as wood domes to be moved and reassembled elsewhere.

Functional and attractive designs

Our level of ambition is going one way: to contribute even more extensively to solve the current challenges and do this in collaboration with other educational institutions and the business community. Our students are taught design and ethics, we focus on ecological design experiments, we research in business models and user needs, and we develop the new solutions in close connection with the people who will eventually adopt them.

Good circular design, including Design for Disassembly, is about developing technologies and products that limit material consumption, increase product lifespan and promote recycling. But good design – including circular – is also about creating functional and attractive designs that will become the people's first choice. If this proves to be successful, it will accelerate the transition to a much higher level.



Photography: Astrid Maria Rasmussen, Astrid KBH

Temporary student housing in repurposed containers

How can we create affordable student housing in urban areas? CPH Village is informed by a resource-conscious approach for making temporary housing of high quality.

Contributor
- Arcgency

In collaboration with
- CPH Village
- Vandkunsten
- Rambøll
- Steensen Varming

The entire life cycle of a building is in focus at CPH Village. Repurposed containers are adapted into housing using the principles of Design for Disassembly that enables the buildings to be easily taken apart, moved and reassembled.

The first CPH Village developed by Arcgency is located at Refshaleøen, a former shipyard in Copenhagen. The student villages are temporary because the only vacant and affordable land in the city is located in former industrial areas and ports, which are currently zoned with restrictions on permanent development. The modular village can be relocated to a new site when the current area is ready for permanent development. This approach incites the use of quality materials as it is only the site that is temporary – the building can have a long life and all materials can be reused or recycled after its end-of-use.

Each housing unit is built into a 40 ft container. They contain a shared entrance and bathroom, plus two private rooms, each with a large window and kitchenette. The aesthetics are raw; all joints are made with visible screws and the walls are dented from the containers' previous life at sea.

Photography: KALK



Build lasting culture with lime mortar

KALK A/S is a Danish company utilizing lime and lime mortar in construction and painting materials. Since 1986, the company has been pioneering sustainable solutions in the industry.

Contributor

– KALK A/S

One of the most significant issues in construction is recyclability. Traditional cement is simply not a recyclable solution, which is a massive hindrance to true sustainability in construction. This is what the Danish company KALK A/S has been working to change for more than 30 years.

Using lime mortar instead of cement makes it possible to incorporate a whole new level of recyclable solutions into construction. Lime mortar has many sustainability advantages over traditional cement. Firstly, lime is a much more recyclable material, as it separates easily from bricks and can be repurposed and reused after decomposition. Secondly, lime emits less CO_2 as it burns at a significantly lower temperature than traditional cement.

Importantly, lime mortar remains easy to work with and is super adaptable and easily incorporated into any building – unlike traditional cement.

At KALK A/S, they are excited to be at the forefront of pioneering recyclable solutions such as lime mortar. They have the solutions to build an environmentally friendly tomorrow – quite literally.



Photography: Tom Rossau

Employing Design for Disassembly as a key principle

Tom Rossau has a long tradition of designing beautiful lamps with a strong Danish design DNA. Over the last decade, sustainability has been an important focus for the company, and one of their latest circular initiatives is implementing Design for Disassembly as a key principle.

Contributor
- Tom Rossau

In collaboration with
- In futurum
- Danish Design Centre

For more than two decades, Tom Rossau has designed and created his characteristic lamps in wood veneer. His work is driven by the intriguing relationship between geometry, materials and light, both natural and artificial.

In collaboration with In futurum and the Danish Design Centre, Tom Rossau and his company have developed three new solutions to reduce their carbon emissions through circular principles that will be implemented in the business:

- A flat-pack product that reduces packaging waste by up to 80%
- A cleaning kit to prolong the lifespan of products
- Design for Disassembly principles that make it possible to repair lamps at home, minimising the need for return transport, extending a product's lifespan and allowing the disassembled lamp a new afterlife

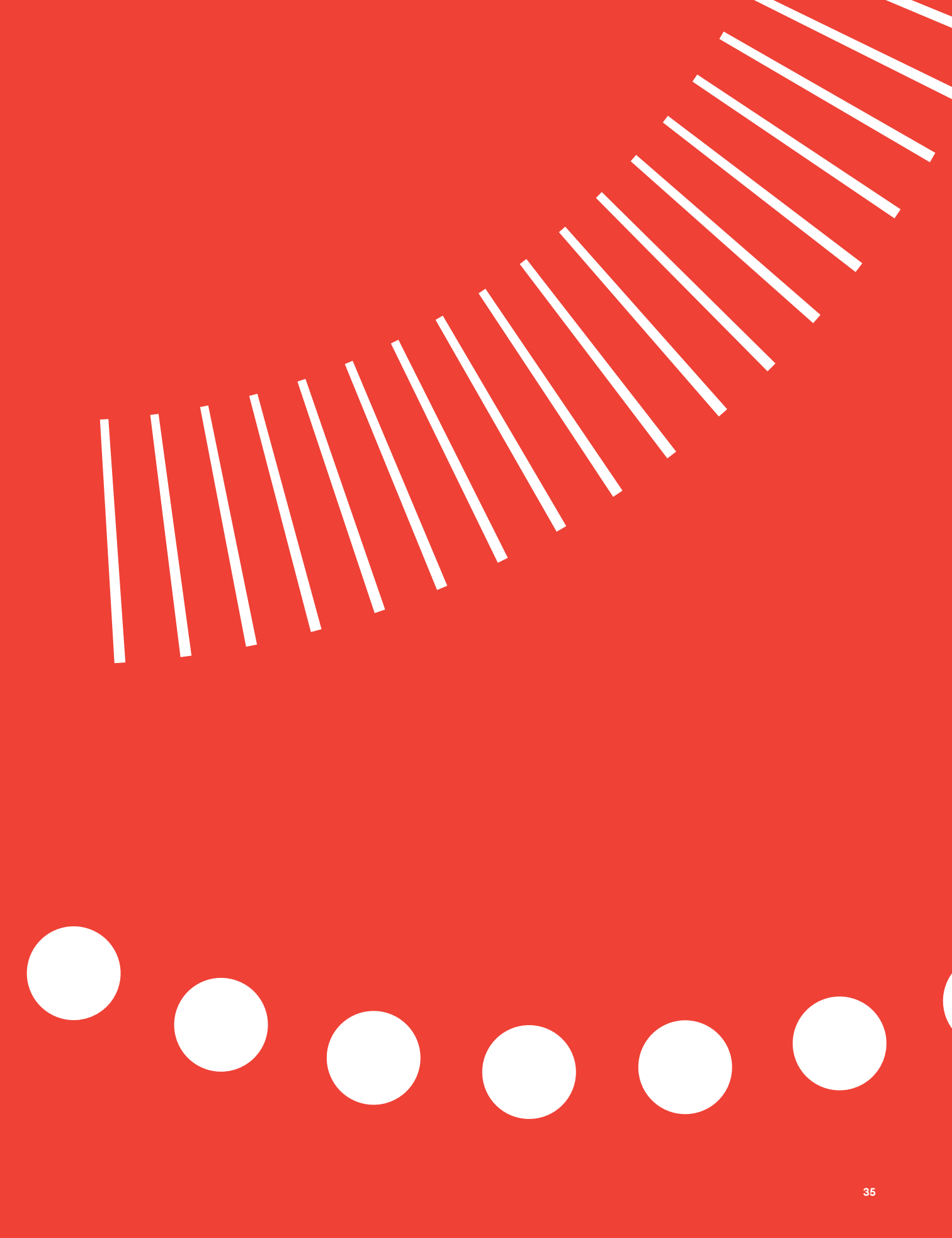
It is inevitable and crucial for all businesses and organisation to rethink their way of using materials, designing and creating products. With Design for Disassembly as a key principle in Tom Rossau's company, he hopes to leave a greener and more circular footprint and be a part of the solution – and not the problem.


CYKELSTYRET
JORDSPEKULANTEN
CENTURION

Section 2

City(nature), resilience and biodiversity

Circular urban development
Recycling and upcycling infrastructure
Thriving multi-species cities



Circular cities and neighbourhoods



Kent Martinussen
CEO, Danish Architecture Center

Large scale circularity

What does it take to make the future circular society truly irresistible? And for whom should the future circular society be irresistible?

We have to answer this question if we believe in the vision of the irresistible circular society, because everything comes with a price – even that which is necessary. The answer is quite clear: this vision of the future society must be irresistible for the broader majority of society, which means the true constituents of society – the people, the citizens. They are the true nucleus of any change. In a world of rising individualism, it is essential to focus on what humans have in common: we are social beings. Though we all live in individual homes, we do so in societies that consist of neighbourhoods. The neighbourhood is our most basic element of social belonging, therefore our common platform for actions of change. But what can a circular neighbourhood look like and how can it be attractive or even irresistible? This chapter looks at circularity on a larger scale, with cases demonstrating how entire neighbourhoods, precincts and cities can be completely circular across buildings, mobility, resources and biodiversity.

The role of architecture in the circular transition
Architecture plays a core role in achieving sustainable development. Architecture shapes the everyday life of billions of people. Wherever you are, you find yourself surrounded by architectural design, shaped by architects, urban planners and landscaping. The cities and buildings keep you comfortable, healthy and safe, providing a basic belonging for all individuals. But the same cities and buildings have a huge environmental impact and constitute a large proportion of the world's resource use.

Individuals and businesses are rapidly developing new materials, finding better ways to recycle and upcycle building materials, and saving energy and resources when renovating or building new houses.

But imagine if that could be done on a much larger scale. What if entire precincts could be transformed? Or entire towns and cities could be made circular? Not just in terms of building materials, but also in terms of water treatment, resources and biodiversity. Imagine adding the human factor onto that – thinking about human wellbeing, inclusiveness and creating neighbourhoods that are safe frames for a good life.

Demonstrating circular solutions
The good news is that it is all possible and the cases in this chapter show that it is happening right now. Knudrisrækkerne is a small precinct where materials from existing buildings are recycled into new ones. The result will be 89 new apartments in a five-storey wooden structure, among the features in a platinum DGNB-certified inner city precinct.

These ambitions are taken to even higher levels in Nye, a completely new town for 15-20,000 people outside of Aarhus. Here, surface water is collected and covers about 40% of local water use, for instance, for toilets and laundry. Former agricultural land is laid out for biodiversity, recreational use and water catchment. Moreover, the housing itself is structured with a careful mix of ownership and rental housing, limited private land but lots of communal spaces and ploys to nudge people to interact and grow a feeling of care and responsibility for one another. You can visit Knudrisrækkerne and Nye for yourself.

The last case in this chapter has a different character. The REFLOW methodology for urban circularity is a model that is essentially an answer to this question: "I want my city to become circular. What should I do?" The model is a result of a large international project which sets out to describe an approach and a process to guide you and your neighbours.



Photography: Sweco Architects

Sustainable urban housing with responsibility

Boligkontoret Århus has transformed a negative environmentally impacted area into Knudrisrækkerne – a responsible and sustainable urban housing construction with a minimal climate footprint using wood, upcycling and DGNB certification.

Contributor
- Boligkontoret Århus

In collaboration with
- NIRAS
- Q-Construction
- Sweco Architects
- MOE
- VEGA Landskab
- Lendager

In Aarhus C, Boligkontoret Århus is responsible for constructing 89 sustainable urban homes in the city centre with a five-storey CLT hybrid wooden building with a DGNB gold certification.

Using the existing building on the site, the organisation responsibly recycles and upcycles the building materials that have the most significant CO_2 footprint: aluminium ceilings reused for facades, windows upcycled for facade sections and outdoor lighting fixtures upcycled for new lighting.

The 26 new housing variants from 35-110 m^2 in one or two floors with either garden, balcony or French balcony cater to different target groups and thus ensure a varied composition of residents. The future residents will have free access to a café and common facilities facing Knudrisgade, a shared roof terrace and a green city courtyard. Furthermore, the residents will have the opportunity to book shared electric cars.

Lastly, 100% of all the residents' electricity will be supplied from fossil-free Danish wind turbines.

Photography: AART architects



Community through architecture

The name of the city says it all – “Nye” is the Danish word for “new”. A new city built from scratch with one overall mission: to design a beautiful and sustainable city with a strong social purpose.

Contributor
- AART architects

In collaboration with
- Tækker Group
- Tækker Rådgivende Ingeniører
- JCN Bolig

When dealing with circularity within the built environment, AART always focuses on how the architecture will create as much value as possible for both users and society. In the emerging city, Nye, one aim has been social value for the residents in the form of community. Therefore, AART has contributed 30 innovative wooden terraced houses that nudge residents towards a new way of living, one based on sharing, co-creating and socializing.

In the post-occupancy evaluation, residents in Nye report that the built environment through architectural instruments actively support interaction between residents, which contributes to a strong and shared sense of community. They report that they see more people; have more social engagements; help each other; interact across generations; talk when they meet; participate in common dining and activities; borrow things from each other; watch each other’s pets, plants and children; and keep an eye on each other.

When benchmarked against a national survey (Kantor Gallup 2019), the residents in Nye perform better in terms of both community and quality of life. 66% of residents report that they “socialize a lot with their neighbours and have a good neighbourhood-feeling” compared to the national average of 26%.



Photography: Copenhagen Business School

Methodology for urban circularity

REFLOW unites 28 European multi-disciplinary partners to co-create circular and regenerative cities, bridging the gap between private and public institutions, academia and the maker movement.

Contributor

- Copenhagen Business School

In collaboration with

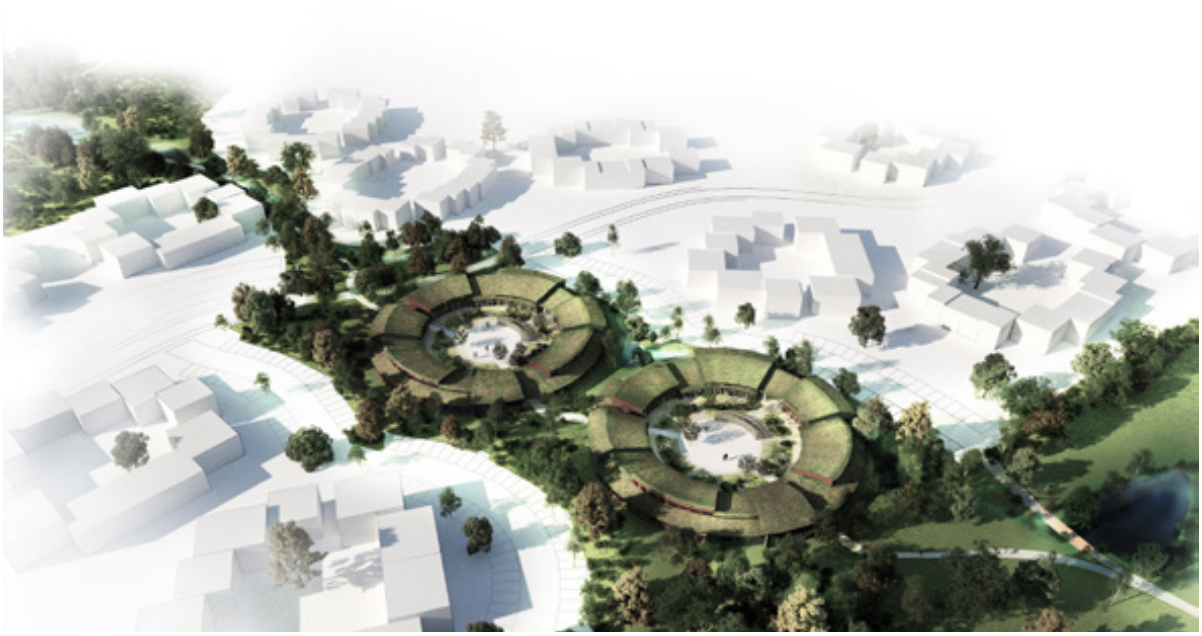
- REFLOW Consortium

REFLOW is an EU Horizon 2020 project coordinated by Copenhagen Business School. The project is guided by the REFLOW vision of a circular and regenerative city, represented as an urban system with social and business practices which place equal attention to social, environmental and economic impact. Here:

- Technology is open source and represents a central enabler of positive social and environmental change
- The urban system ensures and supports the resilience of social and ecological systems
- Governance is collaborative and inclusive
- Knowledge is shared, and stakeholders are active and involved

The project employs a multi-stakeholder approach from public institutions, private companies, fab labs and academia to reach this vision. This unique combination of competencies allows for innovative solutions for the most pressing challenges in cities, illustrated by the highly technical material flow analysis as the basis for the specific pilot solutions, bridging academia and fab labs. At the end of the project, all methods, tools and best practices will be available for other cities to take up the torch and start the transition to circularity.

Photography: Peter Kjær Architects



Wooden framework for flexible living

What will future homes look like? We do not have the answer to that question, but a solution could be to create robust wooden structures that allow life within that framework to be ever-changing.

Contributor

- Peter Kjær Architects

In collaboration with

- fsb
- STED
- Ekolab
- Regnestuen

In close collaboration with their client, the social housing organization fsb, Peter Kjær Architects have developed a proposal for 40 social housing units and communal facilities in a green neighbourhood close to Copenhagen.

The framework for the project is a simple and robust wooden structure that can last for centuries, while the life within it can be dynamic. As opposed to typical concrete element developments, the floor plans are not fixed by the structure for the entire lifespan of the building, but can be changed when the needs of the inhabitants change.

The repetition of the fixed structure and the flexible elements sustain a circular way of thinking among the future tenants; if a wall is removed from one unit, the materials could be reused in another. The ability to change your home according to your needs and the wide range of unit types will hopefully keep residents in the neighbourhood, supporting a social life around the communal garden.

Circular building is not just a question of designing structures that can be taken apart and reused at the end of their lifecycle. Circular thinking can also change the way we live here and now.

Stations for recycling



Lisbet Wolters
City Architect, Vejle Municipality

Handling of waste as a valuable resource

Municipalities can accelerate recycling among citizens and businesses with a strategic approach to local resource centres and circular urban development.

Waste was once something thrown away – in nature, rubbish bins or landfills. Today, this use-and-dispose mentality has been behind. Increasingly, waste is seen as a resource that can and should be used again and again, as we cannot continue to obtain new resources from nature. Sustainability and the idea of circular resources have become more common over the last few years. An increasing proportion of consumers want to be more sustainable. By changing consumption patterns and minimising food waste, they have a much greater focus on recycling, reducing and sorting their rubbish. The business community is also ready for a change. Increasingly, they want to lead and develop sustainable products and business models. Large Danish companies, across industries, work according to a sustainable strategy with circular design principles, and their suppliers are pressured to integrate sustainability into their product development.

The future belongs to the visionary, sustainable companies and public actors that take part in this transition.

The future handling of waste

In Vejle Municipality, a journey has been embarked upon with the citizens and local companies to secure resources for our shared future. With the development of a new resource centre opening in 2022, further unfolded in this chapter, a big step is taken towards the future handling of waste as a valuable resource that can be sent back into a production cycle. The centre will be an innovative example of sustainable construction with a sustainable function. It will allow citizens and companies to reuse resources and provide a valuable platform for knowledge sharing about circularity.

In 2015, Vejle became a part of the global urban network 100 Resilient Cities, established by the Rockefeller Foundation. Following this, a resilience strategy was formulated that would strengthen the sustainable development within the municipality. The strategy puts extra focus on the cross-pressure of climatic, economic and social challenges. These challenges require us to collaborate and co-create to find the necessary solutions – both now and in the future.

Inspiration for citizens and local businesses

In becoming more resilient, we collaborate across municipalities, businesses and civil society to build the ability to turn new challenges into opportunities through renewal, innovation and value-creating prevention. In continuation of the resilience strategy, the city council adopted Vejle Municipality's first Climate Plan in December 2020, following the Paris agreement's goal of a net zero discharge by 2050. The resource centre in Vejle is a beacon for resilience and an essential piece in the climate plan implementation. With its construction and core purpose, the resource centre will inspire citizens and companies to accelerate recycling resources. The centre is an excellent example of how a strategic approach to circular urban development can also contribute to more climate-friendly behaviour, sustainable growth and a basis for greener business development.



Photography: Vejle Municipality

Circular resource centre turns waste into resources

The new Resource Center Vejle will be built using circular materials and function as a place for knowledge, teaching and meeting, where waste is treated as a resource.

Contributor

- Vejle Municipality

In collaboration with

- HM Entreprenør A/S
- Raunstrup Byggeri A/S
- Ravn Arkitektur A/S
- LOOP Architects A/S
- EKOLAB A/S
- Hundsbæk og Henriksen A/S
- Schønherr

The new Resource Center Vejle works ambitiously with the circular economy, waste management, recycling, upcycling, DGNB Gold standards and sustainability management. The centre consists of 17,000 m² production halls, administration and crew buildings, and several smaller exhibition and maker spaces. The ambition is to create a well-functioning resource centre as well as a place where it is possible to teach, investigate and demonstrate various options for treating waste as a resource.

Information boards, screens and creative lighting convey the values and essential work of the resource centre. Visitors are introduced to Vejle Municipality's ambitious climate and environmental initiatives, resilience and the Sustainable Development Goals. The centre allows visitors to follow the materials' path from the trailer to the dump and further down the production halls.

The centre will be Denmark's first recycling site without containers to avoid goods breaking when they are handed in. It will be an inspiring place with clear signals about the possibilities for a sustainable future and resilient urban development – both in the concrete construction with many recycled materials and in its entire purpose of motivating citizens and companies to recycle resources.

Photography: Næste



Next generations' sheds from recirculated waste

The demand for unheated storage and shelter space is increasing. So is the need for every building owner to take immediate action on the climate agenda.

Contributor

- Næste

In collaboration with

- Enemærke & Petersen A/S
- G. Tscherning
- Fremtidens Fundament
- Fischer Lighting
- Art-Tek Structural Engineers
- Danish Technological Institute
- City of Copenhagen and Municipality of Frederiksberg
- Lejerbo
- Realdania
- Danish Design Centre

Næste offers a low-risk, high-quality, full-service circular shed solution, with a prefabricated building system of waste materials that offers the market's best performance in relation to lifecycle assessment and lifecycle costing.

The system has the potential to keep up to 50,000 tonnes of wood waste at the highest value rather than incinerating it. This could save up to 40,000 tonnes of CO_2 equivalents yearly in Denmark if all secondary buildings are built out of waste materials rather than the virgin steel solution common today.

With a strong, sensual tactility and clear inspiration from the history of the local building culture, the design reminds its users to take care of our common resources and local habitats. The sheds are used as learning spaces at schools in Copenhagen and as spaces for social activities in affordable housing areas.

With an established value chain ecosystem of industrial partners from selective demolition, prefabrication and end product installation, Næste has already proved a successful and viable circular business case for all partners and customers.



Photography: Vandkunsten Architects

Reduce, reuse, recycle, rebeauty

Local resource stations in Roskilde, Denmark, are designed to promote everyday reuse through creative play, with building components from the site of a former factory.

Contributor

– Vandkunsten Architects

In the innovative urban development Musicon, the resource stations by Vandkunsten Architects are primarily built using locally sourced building materials from the former concrete element factory on the site. First, the reusable materials from the factory building were mapped prior to demolition. Then, the materials were kept on-site. Finally, old roof components, gates, sliding doors, cable trays and vinyl flooring bridge the new neighbourhoods with their industrial past while enhancing the local identity. In this way, the city itself is a material bank for regenerative urban development.

"Rebeauty" is a concept to promote the new aesthetic potentials of a climate-friendly design. In Musicon, secondary structures become frontrunners as a testbed for implementing direct reuse and Design for Disassembly, because any risk is worth dealing with. As the resource stations are central to the everyday practice of reuse, they will serve as daily inspiration for a circular transition.

Without rebeauty – no circularity!



Urban nature and biodiversity



Lotte Nystrup Lund
Futurista® and Industrial PhD,
Royal Danish Academy,
Board member of Design Denmark

Now is the time for radically new ways of approaching cities, landscape design and nature

As biodiversity declines and ecosystems collapse, design for nature is becoming crucial. Cities striving for positive interaction with the ecosystems to which they belong are heading towards a regenerative future where humans and other living organisms thrive.

For centuries, humans have explored and developed the Earth. We have been fascinated by nature as the adventurous wilderness and as a landscape to shape and enjoy. One might say that nature most often has been perceived as an object of design. Today, people are increasingly aware that the Earth is not just a skin, suitable for human-centred design, but a living organism, interacting with us in complex and fragile ways that cannot be controlled or predicted. This realisation bringing us to the fact that humanking lives inside a closed cosmos, with nowhere else to go, calls for new approaches to cities, landscape design and nature.

Multi-species cities

Danish designers, architects and planners are recognized for their ability to create great cities. Denmark is known for its safe, beautiful and healthy cities, characterized by lush parks, fresh air and friendly infrastructure providing urban flows for everyone. In Copenhagen, residents can jump in the harbour to take a swim, while Biohuts nearby function as hotels and nurseries for fish. These green and blue cityscapes have been realized through visionary thinking, creative professionalism and design for social and environmental sustainability, empowered by a willingness to work across disciplines. This has also led to a range of Danish climate innovations targeting the built environment. One example is the Climate Tile for sidewalks and urban spaces, collecting rainwater and directing it to plants for nutrition while creating educational adventures for citizens. We have now reached a point where the ability to transform our (urban)future through interdisciplinarity and unleashed imagination is essential. Cities of tomorrow are designed not just for humans but for a diversity of species.

New aesthetics

The UN has proclaimed that transforming humankind's relationship with nature is the key to a sustainable future. Planning for resilient and biodiverse urban spaces is an opportunity to design for synergy: to strengthen relations between human and nature; to create multi-species habitats, which might act as stepping stones for the spread of species; to establish measures targeting the microclimate, e.g. collection of rainwater or carbon uptake by plants. Urban nature can raise the well-being and eco-literacy of citizens, increasing our ability to understand the natural systems on which all living organisms depend. In Denmark, there is a strong tradition of involving citizens in urban development. Engaging co-creation is highly needed in the design of a multi-species city, as it calls for a radically new view on (urban)nature, rethinking both the aesthetics and functionalities of nature in and beyond urban areas.



Photography: Habitats ApS

Multi-species society over time

Habitats works in various ways with the transformation to a multi-species society. Their approach to urban development that encourages biodiversity is detailed in two cases.

Contributor
- Habitats ApS

In collaboration with
- Better Energy
- Pelican Self Storage

In an area in front of a Pelican storage centre in Copenhagen, Habitats were asked to design a “wild urban garden”, which is a paradox in itself: gardens are typically tame and the opposite of wild nature. To overcome this, they created a place that looks wild yet designed and welcomes visitors to socialise, interact with nature and forage the edible plants.

In the solar panel park in Blangslev, they collaborated with Better Energy about incorporating as much biodiversity as possible in a 75 HA infrastructure site. Not an easy task in a landscape farmed for centuries. They took departure in the few remaining areas of nature and enhanced them, making adjustments to the soil and forest to create the best possible conditions for a wide variety of life to strive.

Both projects are newly established and over time a combination of natural dynamics and human interaction will shape the places and their biodiversity. This underlines an approach to design for a multispecies society where design is only the first part of a project: the social and natural aspects are the second.

Photography: SLA/Philip Handforth



Strengthening biodiversity and local microclimate

Al Fay Park in Abu Dhabi is a paradigm shift in how to design and implement nature-based solutions and biodiversity in the dense megacities of the Middle East.

Contributor

– SLA

Al Fay Park is designed by the Danish nature-based design studio, SLA, and is the Middle East's first urban biodiversity park. The 27,5000 m^2 park is the first of its kind to focus on strengthening the region's biodiversity, while using the new planting and wildlife to enhance the local microclimate as well as the public social realm.

Al Fay Park is specifically designed to provide both biological, environmental and social benefits to the city. The special planting and soil design radically reduces the park's irrigation by 40% compared to conventional parks. The native vegetation is designed to attract bees, pollinators, birds and animals, providing a lively atmosphere and a guarantee of birdsong – all while providing a lush and green frame for revitalised public life.

The nature-based microclimate design reduces the park's temperature, air pollution, sand infiltration and traffic noise, providing the best possible social ecosystem for play, sports and leisure, and making Al Fay Park both socially and climatically "the coolest place in town."



Photography: : Jonas Lysholdt Ejderskov

Reusing oyster shells to secure higher biodiversity

With fish nurseries made out of leftover oyster shells, By & Havn is improving the biodiversity of the harbours of Copenhagen.

Contributor

- By & Havn

In collaboration with

- WWF
- COVED
- Ecocean

The harbour environments of Copenhagen are among the best in the world. To help secure this, By & Havn has partnered with the World Wide Fund for Nature (WWF) to install 50 Biohuts. These work as fish nurseries, homes, pantries and shelter for the fry of more than 25 species, so that they can hide from larger predators in the most vulnerable part of their lifecycle.

The installation of Biohuts is part of a perennial agreement between By & Havn and WWF to improve fish habitats and increase biodiversity. By enhancing fish stocks and creating a better harbour environment, the Biohuts provide an immediate effect in terms of increased biodiversity and, over time, more fish, which also benefit the many anglers utilising the harbour's 42-kilometre long quayside.

The project is a great example of how investing in nature benefits the fish population and biodiversity through a circular initiative. The Biohuts consists of a steel cage filled with leftover oyster shells gathered from oyster farms in Marseille, France. With the Biohut project, the shells are collected, disinfected and reused for new a purpose instead of being thrown out.



Section 3

Social values and communities

Cooperative ownership
Strong civic society
Circular mindsets of the future

Designing for behavioural change



By Julie Hjort
Programme Director of Circular and Sustainable Transformation, Danish Design Centre

Changing human behaviour means challenging existing behaviour

"We need to change our lifestyle faster than our climate is changing," says Brett Jenks, CEO of Rare.

Circular economy implies not just a significant shift in how products are produced but a radically different relationship between products and people – how products are used, owned, lent, taken care of and reused. The 21st-century consumer will have to partake in completely new consumer models, accept different product aesthetics and materials and get into new habits of reusing, repairing and meticulously sorting their trash.

Managing the shift towards circular consumer behaviour will be key to the success of the circular transition. It will help stimulate the demand for sustainable products and be instrumental in normalising a circular society for both the private, public and civic sectors.

There are several strong efforts among government and industry already in place to accelerate the techno-economic side of the circular race, such as regulating for increased reuse of materials or support programmes that aid businesses in their circular business development. Yet, undertaking the job of changing consumer behaviour at scale is harder to grasp. Traditional approaches, such as information campaigns to shift behaviours through education and public information, are insufficient. People rarely change behaviour because they are told to do so.

Changing human behaviour means challenging existing behaviour deeply embedded in people's everyday lives, their individual values, and how they perceive prestige and social status.

Designing for behavioural change

It is a major design challenge to change consumption patterns, stop the massive overconsumption of products and insert a new responsibility towards a product and its whole lifecycle.

How does a reused product appeal positively to the emotions of the consumer? How is the consumer socially rewarded for lending, sharing or repairing a product? And how can we redesign everyday life, so that the circular choice is easier, more intuitive – or even irresistible?

Design offers concrete tools such as field research, personas, prototyping, scenario building and co-design, which allows us to understand and deeply engage both the explicit and unspoken needs of people. Building on these, triggers and design incentives that can spur new sustainable practices and norms can be identified. Many of the most successful new circular products and services we see arise today, and that you can learn from over the following pages, have managed the job of interacting with and touching people in new ways.

While every individual can have their personal reasons to give their contribution to a sustainable and circular society, managing behavioural change should never be solely an individual responsibility. Changing behaviour remains a hard challenge, but through the collective effort of ambitious companies, organisations, public bodies and civic society, individual change can be turned into collective action.



Photography: Dansk Retursystem

Circular economy for beverages packaging

Through high return rates, an innovative supply chain and closed-loop recycling of beverage packaging, the Danish deposit system contributes to a circular economy and a lower impact on the environment and climate.

Contributor

– Dansk Retursystem

Imagine a world where none of the extracted natural resources are lost but instead are circulated over and over again, benefitting not only the climate and the environment but also the social economy. Dansk Retursystem works hard to support the transition to a circular economy through closed-loop recycling of beverage packaging.

So far, they have managed to ensure one of the highest return rates in the world. 92% of all deposit marked beverage packaging sold on the Danish market are returned by the consumers. 90% of the collected bottles and cans are recycled in a closed-loop to new bottles and cans. Furthermore, the packaging fees paid by the breweries and importers have been lowered by 58% over the last four years; for some specific packaging, there is no fee.

Circular economy is Dansk Retursystem's core business. In the near future, the aim is to obtain a circular economy for 99% of all beverage packaging – environmentally (bottle-to-bottle and can-to-can) and economically (no fees).

It will require ongoing stakeholder involvement in the innovation of an even more efficient and user-friendly deposit system with the highest environmental performance.

Photography: Too Good To Go



The #1 anti-food waste app

As a social impact company, Too Good To Go is fighting food waste through public affairs, working with businesses and a mobile app. They are present in 15 European countries and across the U.S. and Canada.

Contributor
- Too Good To Go

In collaboration with
- Planetly
- MyClimate

Too Good To Go creates value through its B2C marketplace for surplus food. Here, businesses are connected with citizens who are able to buy this food and collect it at the end of the day. These users pay a small amount for a "magic bag" of food, worth three times the amount they pay.

The "magic bag" concept is significant because it addresses the reality of food waste in retail and food service – it is unpredictable and the businesses do not know exactly which items will be left. To address this challenge, each store has the flexibility to add whichever items are in surplus that day. This is food which businesses would have had to throw away despite being completely edible, so the small amount of money made on it goes straight to the bottom line.

More than 80.5m magic bags have now been saved from landfills, equal to 201.25m tonnes of CO_2e.

Food waste is responsible for 10% of global GHGs. Reducing it is the single most impactful thing we can do to reduce global emissions.

In addition, Too Good To Go leads projects with businesses and public affairs to change date labelling and food waste legislation.



Photography: Almenr

Eat together to act together

By reinventing Baugruppen in a digital age, the Almenr platform enables cooperative commitment to sustainable behaviour in shared housing communities.

Contributor

- Almenr

In collaboration with

- LOOP architects
- Spacon & X and members of the baugruppe
- Enemærke & Petersen A/S

Every year, millions make a new year resolution to get in better shape, only to lose motivation after a few days. To keep the promise: get a buddy, join a community – do it together!

That is why co-living encourages sustainable behaviour. Research into ecovillages points to substantial environmental benefits: as much as 35% less water usage, 40% less CO_2 footprint, 80% less private car miles and 60% less food waste. By building and living together, intentions are turned into action.

Almenr's project Fridlev, presently under construction outside Copenhagen, is a great example. When the Fridlev baugruppe's 43 families move in, they have already been engaged in 14 teams for more than a year. During the design and building process, the social bonds encourage a highly responsible culture with shared cooking, cars, tools, gardens, a commitment to a circular lifestyle, greener architecture and much greener operations.

Almenr's co-living platform with 14,000 members disrupts the individual consumer approach to real estate and empowers the co-creators in its place. Almenr is based on how commons have secured sustainable behaviour throughout history – and leverages the strong Scandinavian tradition of cooperative decision making and ownership.


Too Good To Go

Product as a service



Tim C. McAloone
Professor,
Department of Mechanical Engineering
Technical University of Denmark - DTU



Daniela C. A. Pigosso
Associate Professor,
Department of Mechanical Engineering
Technical University of Denmark - DTU

Decoupling value creation from resource consumption

More than ever before, companies are transitioning from pure products to Product as a Service, a promising business approach to provide enhanced value to customers by switching focus from selling products to solving needs.

What?
Product as a Service takes all sorts of shapes and forms – from additional services added to extend a product's lifetime (e.g. maintenance and repair services) to sharing systems for urban mobility (e.g. car and bike sharing) and pay-per-result solutions (e.g. outdoor Furniture as a Service that adapts to the city's needs).

Why?
In addition to enabling enhanced competitiveness and value creation, Product as a Service solutions also change the system's incentives towards the development of more sustainable solutions.

When properly designed, Product as a Service breaks the link between production volume and profit, changing the motivation towards providing more durable, efficient and long-lasting products within a circular economy context.

How?
The development of Product as a Service solutions often comprises the holistic consideration of four main elements: the product, the service, the infrastructure and the ecosystem.

Start by understanding the needs to be fulfilled by the Product as a Service solution. Looking into the existing solutions out there often helps to find the sweet spot.

Develop new value propositions and test them out with potential customers in quick iterative cycles.

When there is a good opportunity, continue by analysing what products could help fulfil the identified needs and investigate how to keep the products in the loop for as long as possible.

The next step is to identify key potential partners that can help in getting the Product as a Service idea into the real world. Remember that you do not need to do it all by yourself.

Finally, ensure that the proper infrastructure to deliver your solution is in place to avoid any unpleasant surprises along the way.

What now?
If your company has not yet started considering Product as a Service solutions, there is still time. Lots of knowledge is already readily available – dig down and start your journey. It is easier than it looks and often more rewarding than it seems. You just need to make it right.



Photography: Continued Fashion

Circular retail platform for systemic change

Continued is a digital retail platform that offers a full-service resale solution that allows fashion brands to facilitate take-backs, renting and reselling products.

Contributor

– Continued Fashion

Continued offers an all-in-one resale solution that enables fashion brands to integrate circular retail models like rental or peer-to-peer resale. Their full-service solution is a white-label digital platform that is easily integrated into a brand's existing sales channel and skinned according to its visual guidelines. The platform is a turn-key ecosystem that monitors the afterlife of customer and product behaviour and helps the brand to understand how to stay relevant on the journey – and monetize on all activities.

Continued's mission is to create a new consumption model in the fashion industry that:

- reduces resource consumption
- matches consumer behaviour
- demonstrates that sustainability is good business
- extends product life and thus minimizes vulnerability to global events like COVID-19

Recirculating clothes is the most efficient way of reducing the fashion industry's footprint. Continued has helped many international brands implement circular retail in their core business.

Photography: Skagerak



Seeking the sustainable path

Skagerak has a sustainable ambition deeply rooted in the Scandinavian heritage. Its rental and resale concepts keep the brand's pre-loved furniture in circulation and lives up to its promise to create quality designs that last a lifetime.

Contributor

– Skagerak

Skagerak believes it is time to stop linear thinking and start putting things into circulation. To design items that can be repaired, reused, decomposed and regenerated. Therefore, the company has launched two new sustainable concepts that make it easier for customers to make the right decisions: Reclassic and RENT.

Reclassic is an online platform with pre-loved Skagerak indoor and outdoor wooden furniture that Skagerak wants to give a new chapter in an ongoing story. They want their furniture to stand the test of time, patinated with age. If the owner's needs change, it can be passed on to someone else. With Reclassic, the company buys back Skagerak designs, which they then carefully restore and resell online.

RENT is Skagerak's rental service that makes it easy to furnish your outdoor space while at the same time acting responsibly. With these two initiatives, the company honours valuable materials, keeps them in circulation and lives up to their promise to create furniture that lasts a lifetime.



Photography: : Fischer Lighting

Sustainable lighting

Fischer Lighting is a 100% Danish family business with a circular business model. They recycle existing light fixtures and turn waste into new, beautiful and sustainable LED solutions.

Contributor
- Fischer Lighting

In collaboration with
- Schmidt Hammer Lassen Architects
- 3XN/GXN
- Realdania

Fischer Lighting has recently launched the world's first light fixture catalogue, focused on reclaimed lighting for the professional market. It is a showdown for the linear economy that honours Danish design heritage and proves that great design solutions can be sustainable and cost-competitive. The catalogue focuses on high-quality vintage fittings, which are themselves design classics. Fischer Lighting rejuvenates these fittings with patented LED systems that are modular and updatable.

By reusing light fixtures, Fischer Lighting can conserve a number of valuable resources and save a significant amount of CO^2. The approach improves waste reduction in construction and the mitigation of overconsumption. The circular lighting approach rescues existing light fixtures from demolition sites and reinvests them with replaceable components, assuring a capacity for repeated upcycling and reuse.

Fischer Lighting can further install the latest health-promoting LED technology, which creates a healthier and more productive work environment. They work with leading architects in upgrading the technology and design to produce a whole new aesthetic expression.



The future of the circular society



Christian Bason
CEO, Danish Design Centre

If you can imagine it, you can design it
We have to create a radically different future.

Imagine it is the year 2050 and you live in a world that has realised a circular society. We now understand that everything – living and non-living – is connected.

We own nothing. We rent, share and barter the things we need with others in our immediate environment. It is unthinkable for you to throw anything away. There is no trash. None.

Nature is the ultimate stakeholder. We all recognise the intelligence and integrity of Nature (yes, we spell it with capital "N"). We listen to Nature. Fossil fuels are illegal. Cars have vanished from cities. For long rides, they use electric caravans powered by renewable energy.

The marginalised voices and communities are now heard. Life is simple. Your city inspires you to live in balance with art, music, nature, dialogue, pauses, space to breathe.

If you can imagine it, you can design it
This story of a circular society may sound utopian, perhaps even naive. Maybe it sounds like a dream. But it is a fundamental truth in our world that the future must be imagined before it can be created. That is the power of design. Or, more precisely, that is the power of speculative design that thrives on imagination and aims to open up new perspectives on the wicked problems of our time.

Geologists have confirmed that we are now living in the Anthropocene – the Age of Man. It is a geological epoch defined by human-influenced climate change and our significant impact on the planet's geology and ecosystems. It is a recognition that we have designed our planet to the extent that it is no longer, geologically speaking, natural. It is man-made.

As a result, Earth's resources are running out. Our industrial system is reaching its physical limits. The linear economy has wrought environmental havoc. To stop it, every aspect of our lives must be thought of different, from the food we eat, to the clothes we wear, to the products we use. These requirements are getting more urgent.

We may not arrive in a world as described above in 2050. Some may not even find that desirable. But it is high time we start the conversation about what world we would like to live in – not only for our own sake but for the sake of generations to come. We should have started earlier but it is not too late. We just have to get going NOW.

At the Danish Design Centre, design and designers hold the key to igniting the imagination humanity needs to embrace a very different and more balanced future. To do so, we have to collaborate and use design as the catalyst for innovating circular solutions. So if you are a business, a researcher, a consumer or a policy maker – reach out. The transition to the irresistible circular society will only be achieved by collaboration. Join us!



Photography: BLOXHUB

Co-creating a circular campus in New York

Danish companies are joining forces with Barnard College to fulfil a bold vision of creating the first fully circular university campus in the United States.

Contributor
- BLOXHUB

In collaboration with
- Superpool
- SAMS Norway
- CWare
- ORCA - Circular landscape architecture
- Scaledenmark
- Madaster
- Jesper Kusk Architects
- Danish Cleantech Hub New York

College campuses function like small cities, with thousands of students staying, moving, consuming resources and producing waste in communities with enormous purchasing power. In the U.S., higher education expenditure would be the 21st largest economy in the world if it was a country. This makes campuses an ideal testbed for developing a model for a truly circular society for coming generations.

Barnard College, part of Columbia University in New York, has an ambitious vision of circularity and have partnered with BLOXHUB to identify a design approach to solve the systemic challenges to becoming a fully circular college campus. A series of interdisciplinary ideation workshops were facilitated by BLOXHUB, with members from the BLOXHUB community and Barnard staff and key stakeholders. The result is a co-created set of guiding principles and next steps for each of the three areas: reuse and sustainable purchasing, green spaces, and design and construction – to serve as a best practice model for campuses in the United States and beyond.

Photography: Danish Design Centre



Scenario kit

Living Futures is one part an evocative listening experience and one part a toolkit. It provides a thrilling yet safe space to understand, discuss and shape the future together.

Contributor

- Danish Design Centre

In collaboration with

- Danish Industry Foundation
- The IT and Development Agency of the Danish Ministry of Taxation

What does the future of the circular society look like? What would – or should – it be like to live in a truly circular economy?

Living Futures: Scenario Kit is a design tool for understanding, discussing and shaping the future. It consists of four alternative versions of the year 2050, explored through narrated stories from future citizens, themed analyses, other media files and a set of design tools that put the scenarios to work.

The kit can be used to future proof business models, develop new strategies, and understand and discuss important trends and developments in the present. The kit is flexible and can be useful in situations where you are looking to:

- Identify new opportunities: discovering and mapping new ways forward; developing new concepts and ideas for strategies, products, or services
- Wind tunnel ideas: testing hypotheses about the future like strategies or business models
- Discuss the future: kickstarting fruitful discussions in a team or with diverse groups of stakeholders

Let us explore a circular society.



Photography: BLOXHUB

New European Bauhaus

A broad circle of stakeholders in the built environment have joined forces to develop, qualify and concretise a comprehensive Danish-led bid for a New European Bauhaus.

Contributor
- BLOXHUB

In collaboration with
- Confederation of Danish Industry
- BLOXHUB
- Danish Design Centre
- Molio
- Danish Architecture Center
- Creative Denmark
- CHART
- The Danish Association of Architects
- Royal Danish Academy
- Realdania
- Danish Association of Architectural Firms

In January 2021, the Confederation of Danish Industry and BLOX initiated a feasibility study to reach out to the Danish ecosystem and create an overall narrative. In the first phase, they engaged 150 people and 75 companies through a one-to-one dialogue and two joint workshops. They created an overall mission that reads: "Designing the irresistible circular society."

The second phase has included further involvement of interdisciplinary stakeholders across two high-level roundtables, three project workshops, an international co-design workshop and a youth involvement event. So far, more than 300 people across Europe have been involved in the Danish-led bid.

Through this unique and inclusive bottom-up approach, the partners wish to initiate a behavioural change. A change they believe is durable because they have, throughout the process, engaged with people across different ages, professions, industries, and country borders. This democratic and non-elitist approach helps secure that the change initiated does in fact reflect the wishes of the European population.







What if we designed an irresistible circular society where circularity is a clear-cut choice – both in business models and for end consumers? As a collaboration between BLOXHUB, Danish Architecture Center, Danish Design Centre and Creative Denmark, this white paper features state-of-the-art cases about circular solutions fuelled by creativity.

"Designing the irresistible society" is intended to enrich and inspire your next project with creative solutions for design, buildings, production methods and circular business models. We hope to leave you inspired!

About Creative Denmark

Creative Denmark is a not-for-profit, public-private partnership that creates awareness about Danish creative strongholds internationally. We foster relations between international stakeholders and Danish solutions, products, and competencies across the creative industries.

For more information visit
creativedenmark.com

Founding partners

Ministry of Industry, Business and Financial Affairs

Ministry of Foreign Affairs of Denmark

Kulturministeriet
Ministry of Culture Denmark

DI
Confederation of Danish Industry

Dansk Erhverv
Danish Chamber of Commerce

Realdania