
DESIGN
Foresight
FUTURE RESILIENCE
RAMBØLL
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Prologue

One Past, Many Futures, & Multiple Presents

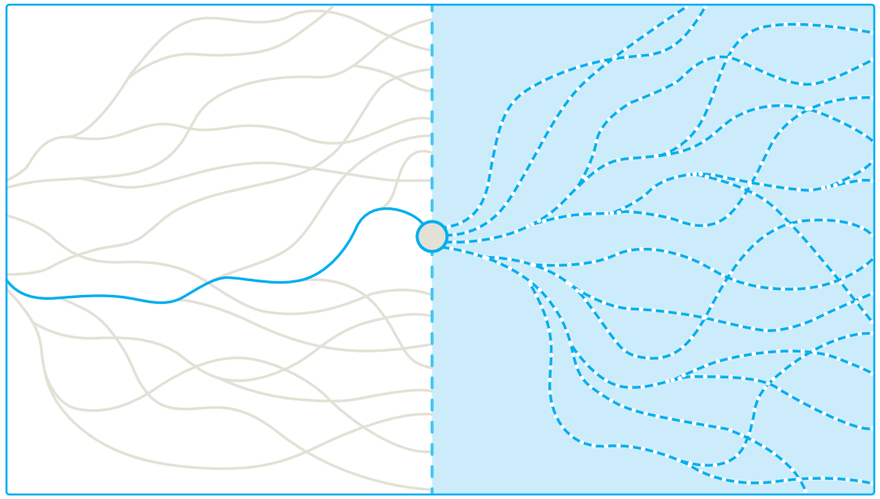
The study of the future and foresight is intertwined with the concepts of resilience and the multiplicity of states of what constitutes the "present."

While any phenomenon has a single past journey from its inception to its current state, many possible futures exist, of which only one will eventually materialize. The departure point for each of these possible futures is one of many present states.

The analogy here is that of various present states resembling a train station. On any map, a train station might appear as a single location, but within that location are multiple platforms, from which trains depart to numerous possible future destinations.

Belgium Liege Guillemins train railway station hall platform trains Santiago Calatrava

Future Scenarios



Future Scenarios
Adapted from Tim Urban

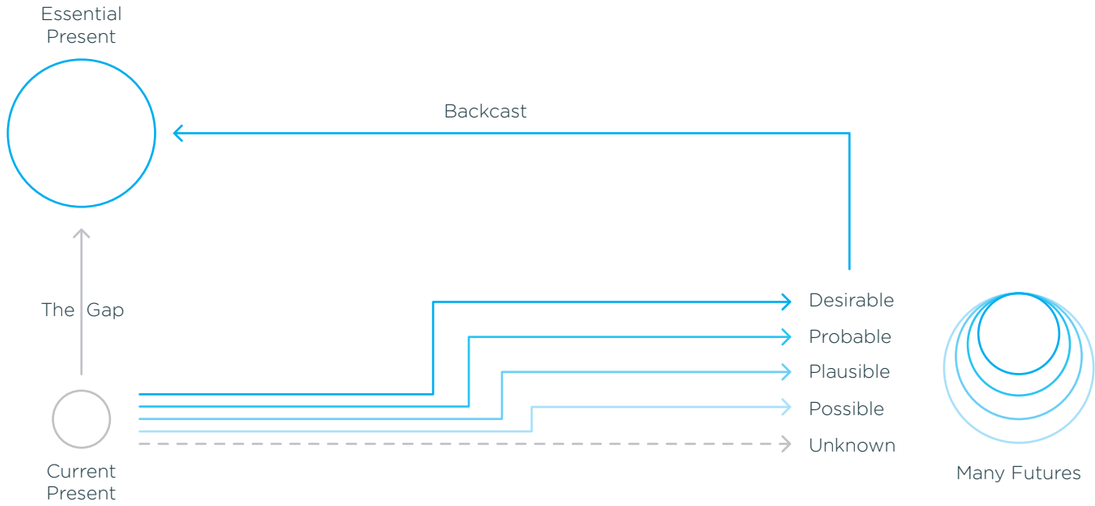
The science of foresight is not about predicting a seemingly pre-ordained future.

Instead, it is based on the premise that the future, in itself, does not exist and that the future ahead is inextricably linked to the actions we take in the present.

In classic foresight, four future scenarios and definitions are studied:
- Scenarios that are possible
- Scenarios that are probable
- Scenarios that are plausible
- Scenarios that are desired

These four categories exclude future scenarios that remain unknown.

All futures, including the unknown ones, remain dynamic and ever-changing. They are agent-specific, as in what is unknown or desirable to one, may not be unknown or desirable to another, and/or in time.



Modern studies of foresight and leadership encourage the selection of a desired future, followed by backcasting from that desired future to an essential present.

Unlike the traditional forecast, which takes us from the present to a future state, backcasting takes us on a journey from a desired future back to the present time. Depending on the ambitions of the desired future, the journey back to the present rarely brings us to our current state but to a present state essential for achieving the desired future.

Therefore, the journey to the desired future begins with a shift from the current present state (where we are) to the essential present state (where we ought to be).

This shift is termed the “required disruption” in the present to enable the desired future. The more ambitious the desired future, the larger the gap between the essential and current present states, and hence, the greater the disruption required.

On Creativity, Continuity, System Improvement, and System Change

Disruption is an attribute of creativity and innovation.

a creative act is one that produces something new that did not exist before. It is by definition a non-continuous act. It does not improve on something that existed before, but creates one that did not exist.

Continuous improvement of any system or organization does not lead to a system change, nor to the change of output or income. If we improve a system, we rarely change the outcome or output. Instead we improve on the rate with which an outcome is achieved; it can be faster production, cheaper products, etc. if the intent is to change the outcome of a system to a desired one, then what is needed is a system change.

Foresight and future resilience are therefore intricately connected with studies of systems, complexity thinking, and uncertainty.

Understanding Resilience

in Designed Systems and in Nature

1. The concept of resilience

Resilience is about ensuring uninterrupted functionality, where a system can continue operating despite external shocks or internal malfunctions in some parts. This ability to adapt and continue functioning, sets resilience apart from efficiency. It is inherent in any resilient system that it can function with some non-functioning parts, which can be seen as superfluous to an otherwise efficient system.

It is said that

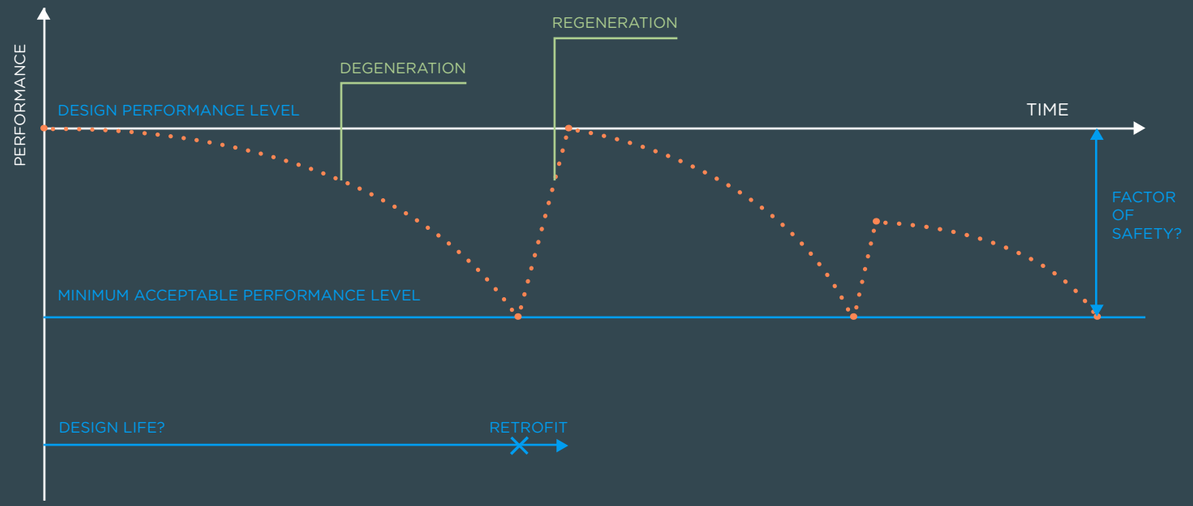
> "If a system which comprises 2 or more components that work interactively together to produce an outcome, can produce the same output with one or more components removed, then those components were never integral parts of the system!"

Conversely, "adaptation is admission of defeat in restoration".

Adaptation is an invitation to adopt a changed circumstance (usually undesired change, like climate change).

In Architecture, Engineering, and Construction (AEC), artificial and reductionist approaches are often applied to challenges like resilience and adaptation. These reductionist approaches tend to treat such issues individually rather than systemically. As a result, they lead to complexities and anomalies that we are then unable to effectively address.

This leads to the rather confusing description of what resilience is!



Design Life Diagram of a Structure
This diagram shows how a building's resilience decreases with age, while efficiency reflects the increasing effort and resources needed to maintain acceptable performance. They support informed decisions to retain, retrofit, or replace structures.

2. Factors influencing resilience

Factors such as redundancy, external load effects, and the rate of internal deterioration all influence the resilience of a system. Understanding these factors is crucial in designing resilient cities that can withstand unforeseen shocks and changes.

Limit state design principles, which have been progressively prevailing since the 1970s, are based on probabilistic approaches to the internal capacity of a system in time, and the likelihood of change in resistance, as well as the probability of exceedance of external forces beyond design loads.

The design life diagrams provide a good representation of resilience vs efficiency. What "Factor of Safety" do we pick to move away from efficiency towards resilience? On the spectrum from efficiency to resilience, where is the sweet spot? How much redundancy do we need to make in an efficient system in order to make it resilient?

3. Designing for resilience

Designing for resilience requires a deep knowledge of foresight and understanding of future mega-trends, both internal and external to the system.

What are the trends

- in key environmental drivers?
- In population growth?
- In seawater levels?
- In transport?
- In health?
- In geopolitical dynamics?
- In defense?
- In energy?
- In food?
- In agriculture?

And many other key drivers of a modern society...?

There are also 2 branches in studies of resilience:

1 - Designing a resilient entity (a new city, etc)

2 - Adding resilience to an existing entity (city, neighbourhood, etc) Whether building new resilient entities or retrofitting existing ones, specialized knowledge and competence are essential for creating truly resilient systems.

4. Resilience in cities

Cities, as complex systems of systems, require built-in inefficiencies to be truly resilient. These inefficiencies allow for redundancy in the system, ensuring that essential functions can still be carried out even when certain parts are non-functional. In complex systems like cities, boundaries of a resilient unit need to be understood and defined.

Can a single residence ever be resilient on its own? Or does it need to be a neighbourhood? Or a larger unit?

The smaller the unit, the more inefficiency needs to be built into the system for it to be resilient. Degrees of resilience are also key considerations. It is like the Factor of Safety (FoS). The higher the FoS, the more resilient the system.

In our cities, how likely are the probabilities of external factors such as population, natural forces, etc to exceed the limits for which our cities have been "planned" and designed for?

These are questions and concerns of resilience.

5. Resilience in nature

Unlike artificial systems, resilience in nature is built over time through evolutionary interactions.

Nature leans towards adaptation rather than resilience, with changes occurring gradually to ensure survival in changing environments.

6. Ramboll and resilience

By breaking down the concept of resilience into these key aspects, we can gain a clearer understanding of its importance and the complexities involved in designing resilient systems for the future.

Speaking about resilience as if it is an abstract monolith will not help address any of the pertinent points raised above, and will instead be a repetition of the rather unstructured information which is widely available on the net.

Ramboll's definition and understanding of resilience must differentiate us from those who are guided by generic documents and storylines on the topic. Or we stand not to offer any differentiation in the marketplace.

Understanding Foresight and Future Scenarios

Consider scenarios as stories or future worlds that unfold hypotheses, expectations, and assumptions, offering insight into the positive and negative consequences of ongoing trends and drivers. They lay the foundation for discussions about preferred and undesired futures, using narratives to make strategic decisions today with foresight.

Scenarios serve various purposes, including outlining the range of uncertainty, presenting a wide range of possibilities, encouraging exploration of risks and opportunities, and testing the effectiveness of potential strategies across different future situations.

Elements of each scenario could also coexist, encouraging us to consider the possibilities of scenarios' characteristics overlapping in different ways.

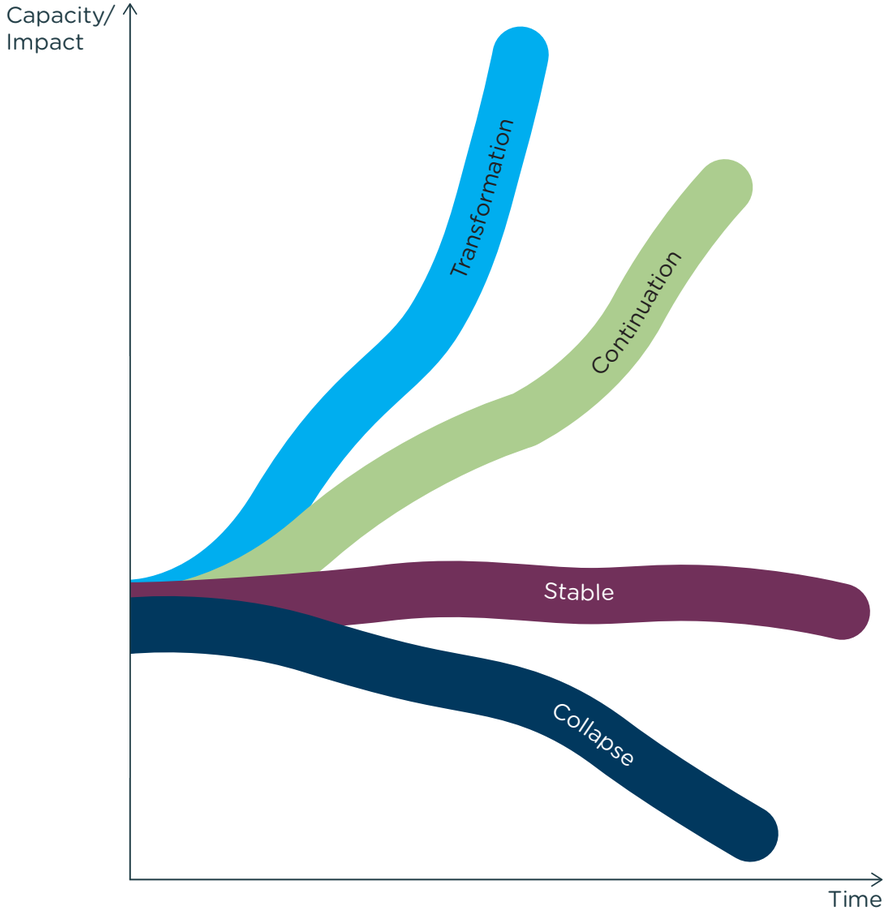
Importantly, there is no single most likely scenario, as each generic form carries equal probabilities in the long run. Therefore, each scenario demands equal consideration in shaping the industry's future.

As we examine each of Dator's four futures in turn, we must also consider how the driving forces identified in our Futures Triangle exercise—the weights of the past, the pushes of the present, the pulls of the future—interact as a specific scenario unfolds.

The four Dator futures, growth-based alternative scenarios (GBAS)
We now embark on an unknown and as-yet non-existent future, and discuss the 4 circularity scenarios of **Collapse, Continued Growth, Stable, Transformation** that can unfold in the next decade.

"Any foresight that connects future scenarios to the current present, without identifying a required present, is flawed."

Future Scenarios



1. The Continuation Scenario

A Vision of Sustained Growth

In this scenario, the prevailing perspective is the expectation of a sustained expansion. The overarching goal is to foster a robust economy, focusing on perpetuating economic growth and adaptability indefinitely. This outlook is the most ubiquitous among the four alternatives, as most projections about the future are grounded in the concept of continued economic growth.

In this scenario, the global built environment experiences marginal growth driven by economic wealth and technological advancements. Nations commit more to net-zero objectives, fostering decarbonisation and embracing some of the available circular economy-focused tools. Resilient infrastructure and sustainable construction practices have not yet become the norm. Despite financial barriers and social and cultural resistance, collaborative efforts generate a nominal balance between economic growth and environmental responsibility.

A new era begins, characterised by worldwide economic prosperity and sustained growth harnessed by technological innovation.

Governments commit to ambitious targets, fostering a collective push towards a greener future by reducing carbon emissions. Regulations promote circular economy-focused practices, encouraging innovative approaches to resource management. Resilient infrastructure showcases societal adaptability amidst changing climates.

Sustainable construction practices prioritise disassembly and material efficiency, responding to resource scarcity and pricing pressures. Advanced building materials contribute to a healthier planet. Policy enhancements support positive momentum, creating a foundation for sustainable development.

Despite progress, challenges persist. Financial barriers impede circular practice adoption, and a lack of industry vision slows cohesive progress. Cultural barriers and resistance to change require collaborative efforts.

The circular economy struggles to integrate fully into valuation assessments, hindering novel material adoption. Complexity, unclear incentives, and limited customer demand create uncertainty in navigating sustainable options.

The global built environment stands at a crossroads in this marginal growth scenario. Triumphs and trials mark the journey toward sustained growth, balancing economic prosperity with environmental responsibility.

Collaborative efforts, innovative solutions, and a commitment to sustainability are essential components of this scenario in ensuring a future where positive elements continue shaping a world of growth and environmental stewardship.

2. The Transformation Scenario

A Vision of Radical Innovation

This scenario centres on the profound and influential impact of advanced technologies, envisioning a paradigm shift driven by robotics, artificial intelligence, and nanotechnology. The future anticipates and embraces a comprehensive transformation of all life from its existing state into a new post-human form.

“The more ambitious the target, the larger the gap between the current and the essential presents.”

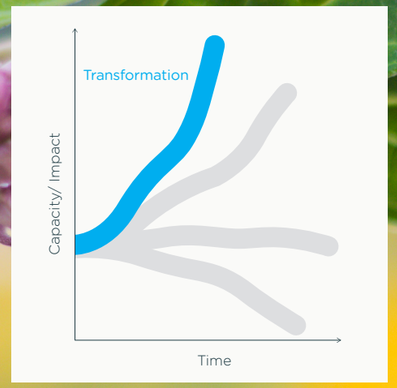
In a world shaped by a radical phenomenon, this scenario unfolds as a transformative departure from the present, marked by innovative solutions and leapfrogging technologies. The journey is not without challenges, as initial resistance to change and other collateral effects become obstacles to a new era. In this plausible scenario, a profound transformation towards a sustainable and regenerative future converges at a unique intersection, where advanced technologies play a pivotal role in driving innovation and reshaping existence. Circular economy principles guide the decarbonisation and transition to a low-carbon future, complemented by cutting-edge technologies like AI, nanotechnology, and robotics. These technologies optimise resource use, enhance energy efficiency, and facilitate regenerative design implementation. Digital twins and passports intricately connect with technological advancements, providing a real-time understanding of environmental impact and informing decision-makers.

A tax shift incentivises responsible practices with advanced data-centric approaches. Blockchain ensures transparency and traceability, while smart contracts dynamically adjust incentives based on sustainability metrics. This synergistic policy-technology approach creates an active and adaptive regulatory framework.

Resilient infrastructure, crucial for sustainability, incorporates advanced materials and nanotech construction techniques. Buildings designed for disassembly also possess self-repairing capabilities, reducing the need for constant construction and deconstruction.

Cultural barriers transform into catalysts for innovation through immersive technologies and augmented reality. Communities actively shape their sustainable futures through virtual collaboration, overcoming resistance to change with vivid illustrations of transformative benefits. In this visionary world, human ingenuity, combined with advanced technologies, overcomes change trials, resulting in a sustainable and regenerative future. It embraces a new post-human existence, blurring boundaries between nature and technology, opening unprecedented possibilities for life’s evolution.

In this scenario, we must remain vigilant, conducting thorough assessments of the potential impacts of advanced technologies and carefully considering their ethical implications. In the face of current uncertainty and risks, we must recognise that artificial intelligence deployment could significantly affect society, the environment, and economies, positively and negatively.



3. The Stable Scenario

A Vision for Sustained Balance

This scenario often emerges when individuals perceive continued economic growth as undesirable or unsustainable. Some believe that the relentless pursuit of economic growth threatens our world and that preserving or restoring the earth's elements holds greater significance for humanity than the continual acquisition of new virgin materials and the specific type of labour and time investment required for their production. This perspective acknowledges that we inhabit a finite planet with depleting resources and a rapidly expanding population. Despite technological advancements, the stable scenario argues that continued growth is reaching its limits.

This scenario proposes reorientating our economy and society toward fundamental universal values in response to these challenges. The aim is to find a deeper purpose beyond the relentless pursuit of wealth and consumerism, emphasising the need for a "stable" existence.

This scenario unfolds as a beacon of hope for a future where systematic practices guide balance in a world where the built environment embraces stability, prioritising sustainability and harmony. Positive elements flourish as resource efficiency becomes the cornerstone of development, fostering resilient communities that thrive harmoniously with their surroundings. Challenges arise in the form of initial implementation costs, testing the determination of societies committed to sustainable practices.

The Circular Economy takes centre stage, propelling a transformative shift towards a cleaner, more inclusive, and sustainable future. Societies defeat the weight of historical linear practices and limited risk awareness, and embrace innovative solutions to surpass financial barriers and foster circularity and resilience.
The built environment becomes a sustainability model, seamlessly integrating circular economy principles into valuation assessments. Collaborative efforts overcome the absence of market volume for novel circular materials, creating economies of scale for sustainable alternatives. Clear roadmaps replace past complexities and disincentives, driving a harmonious future.

Growing awareness transforms limited customer demand, which is evident in circular construction practices and material efficiency. Advanced building technologies, supported by policy advancements, become the construction bedrock. Virtualisation through digital twins and material passports revolutionises the industry, ensuring transparency, traceability, and reusability of buildings, components, materials, and products.

The present push for sustainability aligns with the pull of the future, where regulations and resilient infrastructure support sustainable development. Enhanced policies lay the groundwork for a legacy of environmental responsibility.

In this scenario, the built environment exemplifies disciplined sustainability and a conscientious community. Navigating initial challenges, the promise of harmonious coexistence inspires a global commitment to a future where discipline and circular economy go hand in hand.

4. The Collapse Scenario

A Potential Future of Decline

This scenario envisions a significant deterioration in societal, economic, and organisational structures. Amidst this collapse, there are winners and losers, as specific individuals or groups may thrive during the turmoil while others may face challenges. Historically, discussions around collapse scenarios have been avoided, with groups of individuals reluctant to entertain the possibility, while other groups adopt this as a more realistic and even official outlook for the future.

This scenario sees a significant breakdown for the built environment due to exceeding its system limits. Positive elements include a potential re-evaluation of unsustainable practices. However, negative consequences like economic downturns and social unrest need consideration.

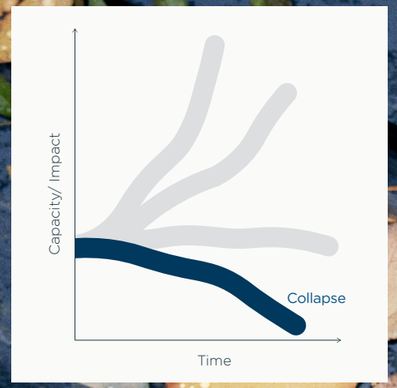
Despite once-promising sustainability efforts, the journey worsens as the built environment exceeds its limits, turning cities into grounds for social and economic challenges.

Financial barriers, lack of industry vision, and market complexities exacerbate the situation. The circular economy remains absent from valuation assessments, allowing linear practices to persist, hindered by cultural barriers and a lack of collaboration.

In the face of crisis, the absence of market volume for circular materials becomes a weakness, contributing to complacency in waste management. Complex incentives and limited awareness make it challenging for the built environment to correct course. Historical practices, lack of understanding, and limited customer demand deepen the dilemma, affecting the value chain and pushing society toward a catastrophic breakdown.

Despite a forced awareness of resource scarecity, a consumption-driven society pulls the built environment closer to the edge.

In this scenario, former growth catalysts lead to downfall, overshadowing potential re-evaluation. A radical mindset shift, comprehensive policy reforms, and united efforts are imperative to navigate away from collapse and forge a sustainable future.



Bridging the Gap

One of the central aims of these four narratives is to remind us that time is of the essence—we cannot afford to be complacent.

As a society, we stand on the brink of transformative change, and these scenarios vividly highlight the urgency and necessity of immediate, strategic—sometimes even disruptive—interventions.

City governments, developers, manufacturers, designers, architects, and engineers must recognize the importance of aligning their actions with the futures we both envision and desire.

As we contemplate the future of the built environment, we must ask ourselves:

- How does an acknowledgment of uncertainty reshape our approach to this conversation?
- Are the expected driving forces likely to emerge in time and in the manner we anticipate?
- What triggers these forces?
- And how might the actors within the built environment respond, should they materialize?

The circular economy presents itself as the most fitting paradigm to accelerate our transition toward a sustainable future.

Circular business models, construction methods, and design practices must be woven into the very fabric of the built environment.

Yet significant barriers persist, hindering our ability to adopt these principles at the pace and scale required to bring about the future we seek.

Amid rapid technological advancement—especially within the Transformation Scenario—the message is clear:

We must embrace the potential of technology and leverage it to reshape the industry, making circularity and innovation mutually reinforcing.

Finally, collaboration emerges as a vital theme, underscoring the necessity of coordinated, collective action.

"The most unknown in foresight is not the desired future, but the required present"

Epilogue

The scenarios method is a crucial strategic compass that guides us through potential trajectories. These scenarios depict societal paths, offering valuable insights into the challenges and opportunities that shape our collective journey. Understanding the driving forces within each scenario empowers us with foresight to customize strategies, policies, and collaborative efforts, enabling us to better prepare for the future.

In a world that emphasizes resilience, sustainable innovation, and a circular economy, the scenarios method becomes an essential tool for forging a path towards a built environment that not only anticipates and withstands challenges but also thrives amidst them.

By standing at the crossroads of imagined futures, the importance of taking proactive measures, collective commitment, and disciplined dedication to shaping a sustainable world becomes clear.

Ramboll is a global engineering, architecture and consultancy company founded in Denmark in 1945. Across the world, our 18,000 experts create sustainable solutions.

We combine local experience with a global knowledge base to create sustainable cities and societies, driving positive change for our clients, stakeholders and society. We enable our stakeholders to realise their goals and navigate the transition to a more sustainable future.

Bright ideas. Sustainable change.

DESIGN is a periodical publication by the Design Excellence Board (DEB) within the Buildings Market in Ramboll.

The publication promotes and articulates latest ideas on matters relating to design, technology, environment and ethos within the design industry and the built environment at large. It aims to address key issues facing contemporary design professionals, including our evolving relationship with the natural environment; as well as pressing political and social agendas for the built environment.

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