CONSTRUCTION AND CONSTRUCTION MATERIALS FOR 2050 AND BEYOND

ReConstruct

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FOREWORD

Leonore Gewessler
Federal Minister for Climate Protection, Environment, Energy, Mobility, Innovation and Technology

credit: BKA/Andy Wenzel

The international project ReConstruct illustrates that future-proof innovations play an important role for the construction sector. These can be achieved primarily by taking a holistic view of all activities associated with construction.

The challenging goal of climate neutrality in Austria, to which we have committed ourselves in our government program, requires radical changes. The focus is on construction materials and their various functions along the entire value chain, as well as on evolutionary management for construction activities..

Pilot projects are already pointing the way: flexible architectural designs, energy efficiency, locally integrated energy concepts and closed-loop thinking are making energy-autonomous and CO2-neutral buildings and urban districts possible.

The perspectives outlined by ReConstruct are pointing the way forward, and my ministry and I would like to see a broad stakeholder dialog and timely implementation.

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their various functions
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for construction activiti

credit: Zug Estates

EXECUTIVE SUMMARY

Buildings and the technologies associated with them will determine which challenges to be met by the current generation and the generations to come, far **beyond 2050**. The **Construction Materials Industry** will therefore become a provider of comprehensive solutions for the construction of sustainable infrastructures.

Activities associated with buildings - from zoning of land to recycling of construction materials - will play a key role in all currently conceivable **changes** in the construction sector. This applies to buildings as well as to **infrastructure** for mobility or energy management.

credit: Block Research Group, ETH Zürich / Michael Lyrenmann

THE FOUR CORE ELEMENTS OF FUTURE-PROOF CONSTRUCTION

HOLISTIC ENGAGEMENT

Industries involved in building and construction works are expanding their activities from materials to their functionalities in their use and thus gain synergies.

ACTIVE STRATEGIES FOR RADICAL INNOVATIONS

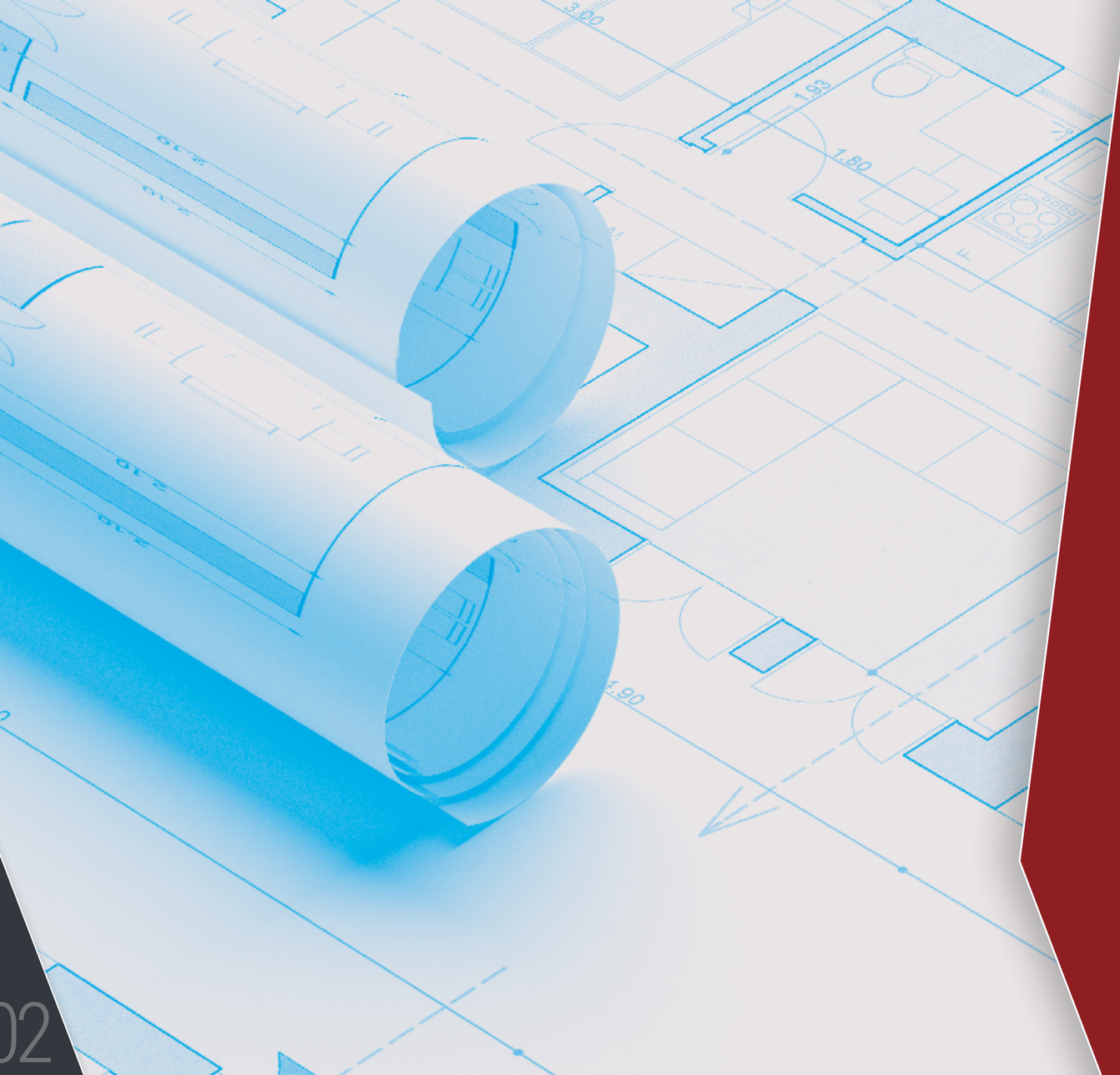
With this comprehensive perspective we are looking for potentials for radical innovations along the entire value chain that make buildings fit for the future.

FROM CONVENTIONAL TO MULTIFUNCTIONAL BUILDINGS

Future-proof buildings not only require durability, but also flexibility in use as well as locations that are coordinated with infrastructure for mobility and for an emission-free energy supply.

CONSTRUCTION WORKS AS ACTIVE COMPONENTS IN ENERGY SYSTEMS

Buildings play an active role in the energy system, for example by providing solar energy and thermal storage within massive building components.



THE KEY ROLE OF THE CONSTRUCTION PRODUCTS INDUSTRY

In order to **reduce greenhouse gas** emissions, the production processes of the **Construction Products Industry** must be further developed. **Digital technologies** are also increasingly being used in this context.

credit: Zug Estates

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THE EUROPEAN GREEN DEAL CHALLENGES THE CONSTRUCTION PRODUCTS INDUSTRY

For the Construction Products Industry, the **European Green Deal** and the associated goal of **climate neutrality** by 2050 represents an enormous challenge, because the industry is not only a consumer of fossil energy, but also generates significant greenhouse gases through thermal processes.

» This challenge can be addressed with proactive strategies. The Construction Products Industry is improving its production processes to further **reduce greenhouse gas intensity**.

» Business models are being expanded along subsequent value chains.

CONSTRUCTION PRODUCTS DETERMINE FUTURE-PROOFING

The Construction Products Industry considers itself to play a central role today and will continue to play a central role in the **provision of infrastructure** in all conceivable future economic developments.

„The products of this industry are the pioneers for **increasing** energy efficiency and associated **reduction of greenhouse gas emissions**."

With innovations emerging along the construction material value chain, the **Construction Products Industry** can become an **enabler** for economically sustainable structures.

credit: Block Research Group, ETH Zürich / Michael Lyrenmann

CASE STUDIES FOR ORIENTATION

What might buildings and construction look like in the future? What strategies are emerging to meet the challenges ahead? **Innovative pilot projects** already show how **sustainable construction** could develop. Here are some outstanding examples from Switzerland.

credit: Zug Estates

03 THE QUARTIER SUURSTOFFI

THE QUARTER SUURSTOFFI

A special example of future-proof construction can be found on the former Suurstoffi industrial site in Risch Rotkreuz, Switzerland. There, a mixed-use neighborhood was created where **living, working and leisure activities can coexist**. The key is a central location with excellent transport links, high building density and plenty of urban greenery. **Thinking in cycles** and using of resource-efficient materials and products are additional constituents of this innovative neighborhood.

In the medium term, the entire Suurstoffi is considered to be **CO_2-free** and largely **without external energy**.

Three special features characterize the design of the energy system. Firstly, systems for solar electricity and heat are integrated into the buildings. Secondly, an **energy grid** that operates at low temperatures enables the **recycling of waste heat** in conjunction with heat pumps and heat exchangers. Thirdly, geothermal probes are used to obtain heat in winter and cooling in summer.

Further sources:
https://www.suurstoffi.ch/startPage

credit: Zooey Braun

03

THE PROJECT NEST

THE NEST PROJECT

The two Swiss research institutes Empa and Eawag operate a **modular research and innovation building** in Dübendorf near Zurich in close cooperation with partners from research, industry and the public sector. The basic structure of this **laboratory for construction technologies** consists of three open platforms, on which individual research and innovation modules are installed according to the "plug & play" principle, in order to test and further develop construction technologies.

Examples of such modules are dealing with **urban mining & recycling, building component optimization, digitization and 3D printing in construction**, solar energy and a wellness area for hotels.

Further sources:
https://www.empa.ch/web/nest

THE ENERGY HUB DEMONSTRATOR

The energy research platform ehub with itsEnergy Hub Demonstrator is dedicated to the **synergies** at all scales of **energy systems**, which derive from coupling and energy management of all components, ranging from application to supply and storage. A central aspect is the **integration of different technologies**, renewable energy sources and storage options (see graphic Page 18-19).

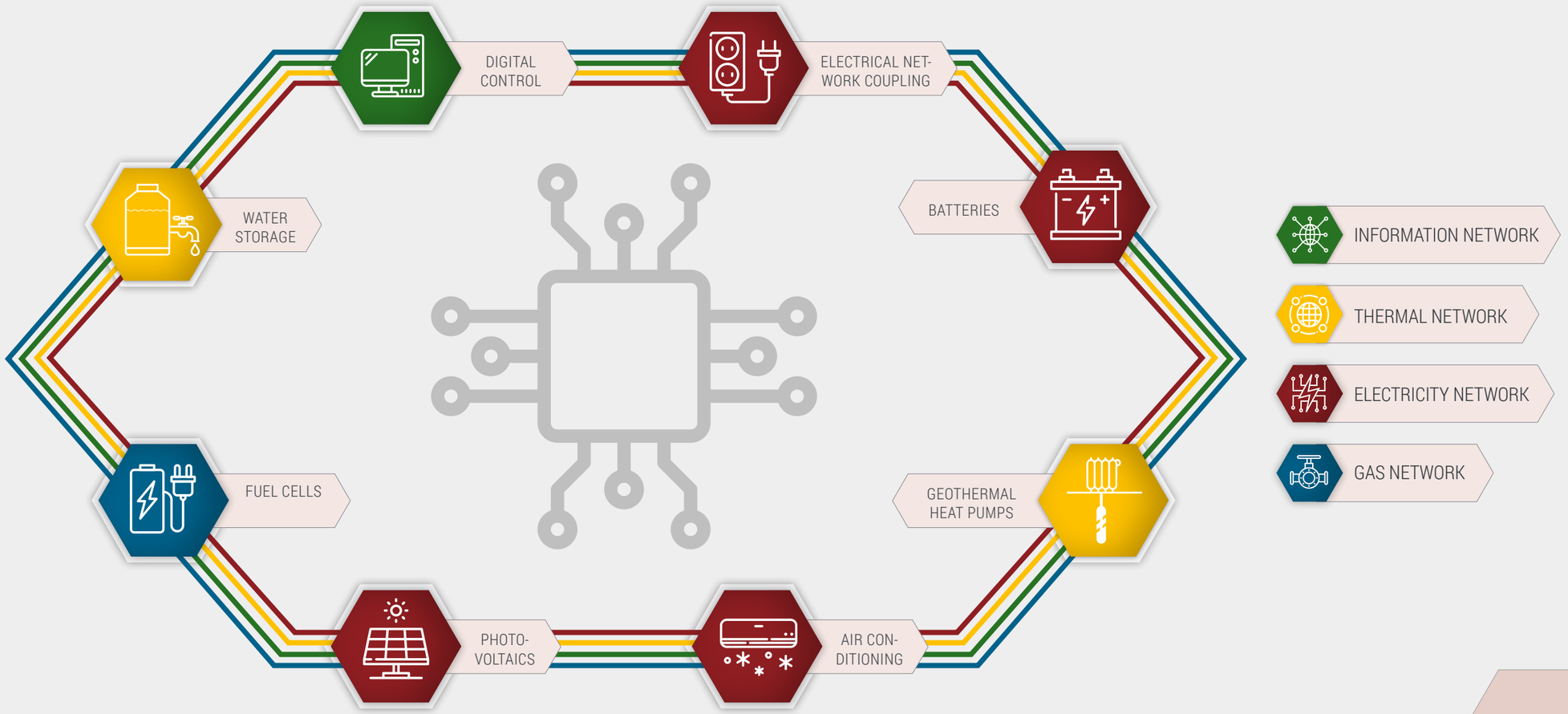
This raises the following questions: How can buildings be more energy efficient in both the use and generation of energy, and how can they be be linked to the energy demand for mobility? What are the potentials for increasing efficiency and CO2 reduction? What role will new network structures for electricity, gas and heat play?

Further sources:
https://www.empa.ch/de/web/empa/energy-hub

THE ANERGY NETWORK IN THE EN ERGY HUB

FOUR NETWORKS CONNECT ALL THE COMPONENTS OF THE ENERGY SYSTEM

Source: Empa - Materials Science and Technology



credit: Zug Estates

BETTER UNDER-STANDING OF CONSTRUCTION AND CONSTRU-CTION WORKS

A deeper understanding of construction and related technologies can be achieved with the **I-Mindset** of innovation, integration and inversion. In this way, THE Construction Products Industry is broadening its perspective to include value chains and networks.
Synergies and innovation potentials
can be identified.

credit: Zug Estates

I-MINDSET EXPANDS PERSPECTIVES

INNOVATION

It is no longer only a single construction material is being explored, but also its potential for innovation along the entire value chain for the fulfillment of a desired **functionality**, such as thermal storage.

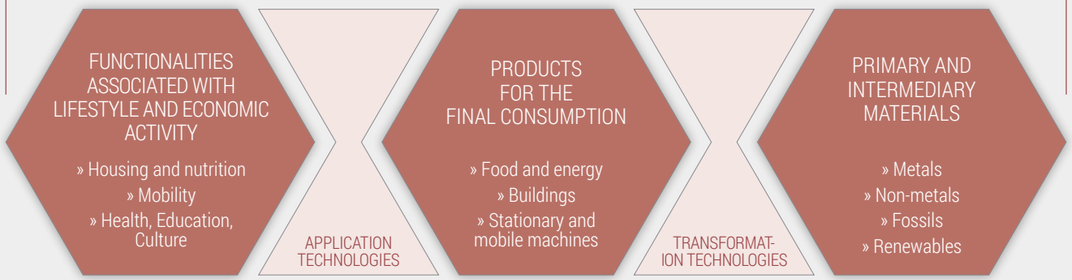
INTEGRATION

All aspects in this value chain of components and modules are being **examined for potential synergies.**

INVERSION

It is no longer the construction material, but the requirements for its functionality that are the starting point for further developments from products to business models. The companies in Construction Products Industry consider themselves more and more as **suppliers of total solutions.**

VALUE CHAIN OF FUNCTIONALITIES



The figure shows the new perspective of the I-Mindset of the entire value chain, that enables functionality. Final products, such as buildings and stationary or mobile machines, coupled with selected application technologies provide the required functionality for buildings or mobility. Transformation technologies convert primary and intermediate materials into final products.

creativ. Zug Estates

FOUR STEPS TO SUSTAINABLE BUILDING

All over the world, buildings and construction materials are undergoing **radical changes**, which are relevant for future-oriented construction. Four **evolutionary steps** can be observed.

CHANGE OF PERSPECTIVE FOR THE CONSTRUCTION PRODUCTS INDUSTRY

STEP 1

RENEWABLE REPLACE FOSSIL

OPTIMIZATION OF PROCESS ENERGY

Through increased use of renewable energy and substituted fuels the emissions from the production of construction materials are reduced.

STEP 2

THE PRODUCTION PROCESSES BECOME MORE EFFICIENT

CARBON MANAGEMENT

Improved production processes are the starting point for active carbon management. In the process not only the carbon footprint for construction materials and construction modules is assessed, but also the avoidance of greenhouse gas emissions through the building infrastructure created by the Construction Products Industry.

STEP 3

SEARCH FOR SYNERGIES ALONG THE ENTIRE VALUE CHAIN

INNOVATION AND EFFICIENCY THROUGH COLLABORATION

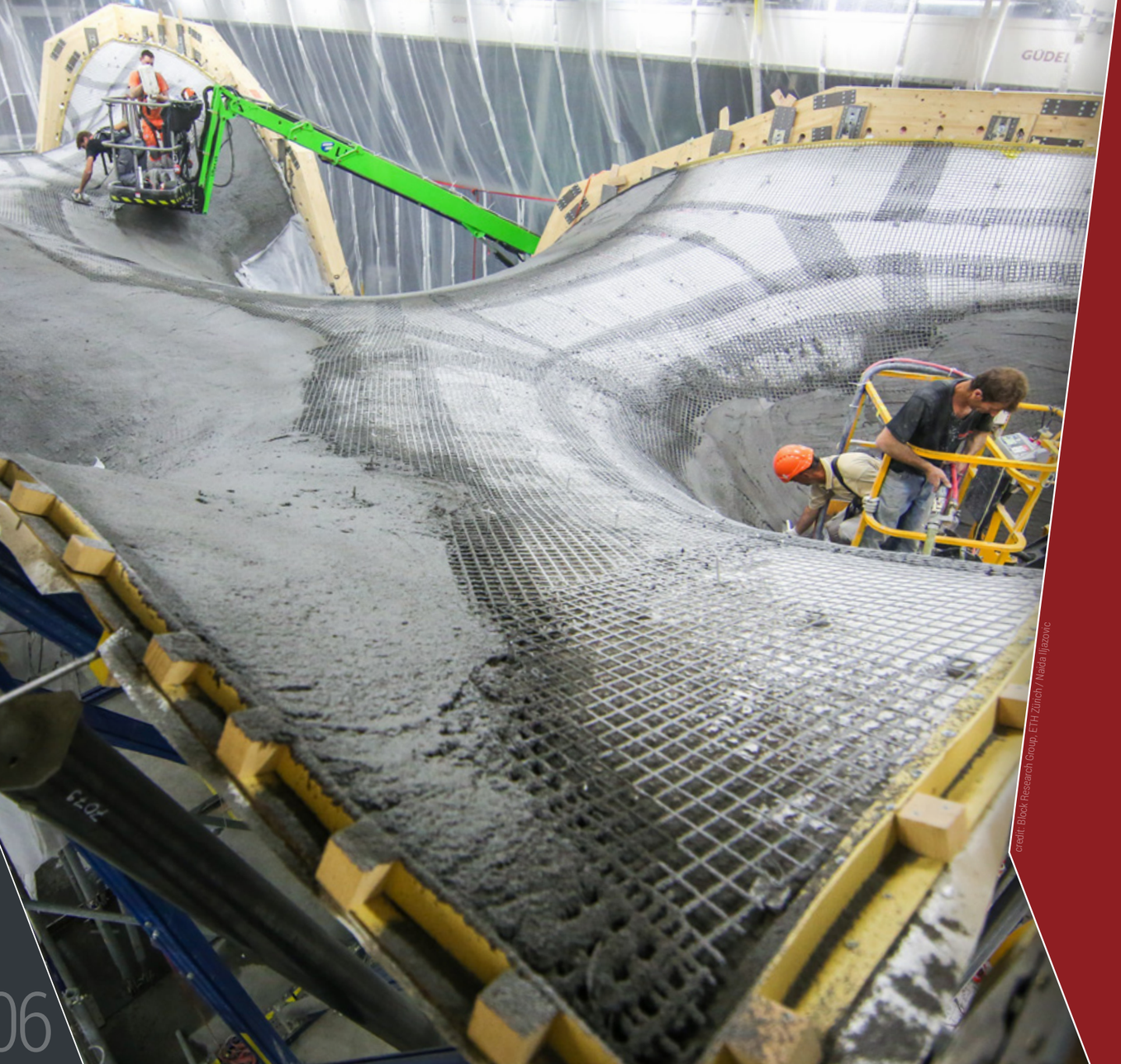
Through targeted cooperation with the network of the entire value chain innovations and synergies are generated. The precondition is an orientation towards the functionalities required by the end-costumers.

STEP 4

MATERIALS PLAY A LEADING ROLE IN THE CIRCULAR ECONOMY

FUNCTIONALITY AND CYCLE-ORIENTED VALUE CREATION

Innovation potential increases with integrated value chains. Functionality-based technological and organizational innovations and new business models reduce material consumption and prepare the transition to a circular economy.



credit: Block Research Group, ETH Zürich / Nataša Ilijazovic

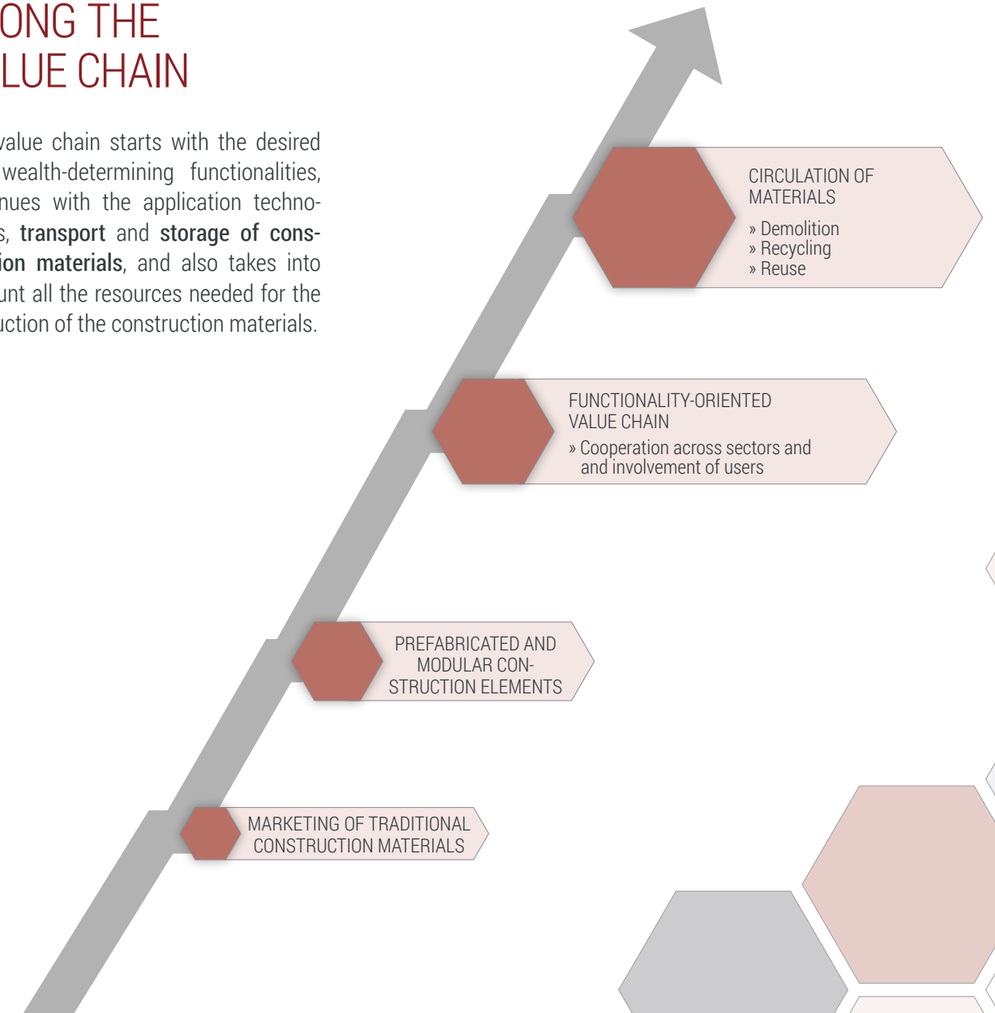
TRANSFORMA-TION OF THE CONSTRUCTION PRODUCTS INDUSTRY

The goal of climate neutrality, which has gained political consensus, means a major challenge for the construction product industry in particular. New active roles are the storage of thermal energy and the avoidance of greenhouse gas emissions. These functions also generate an added value creation.

credit: Zug Estates

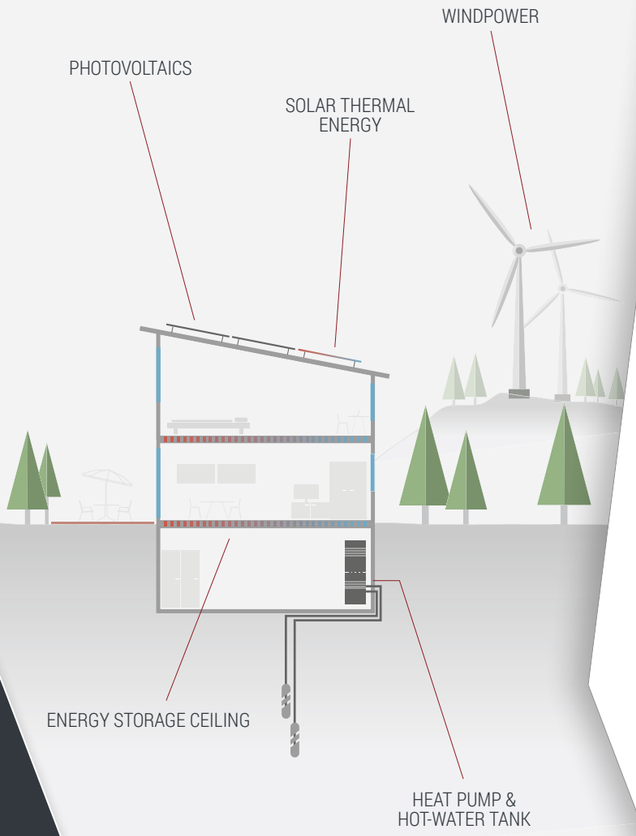
CHANGE ALONG THE VALUE CHAIN

The value chain starts with the desired and wealth-determining functionalities, continues with the application technologies, **transport** and **storage of construction materials**, and also takes into account all the resources needed for the production of the construction materials.



THERMAL BUILDING COMPONENT ACTIVATION AS ENERGY STORAGE

Source: Austrian Cement Industry Association



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BUILDINGS AS ACTIVE COMPONENTS IN THE ENERGY SYSTEM

Massive components of the building structure serve as an energy storage. This thermal activation of building components offers excellent possibilities for the storage of volatile electrical energy from the sun and wind. Surplus electricity is converted into heat and cooling and stored in the components.

The thermal storage capacity of the components enables emission savings during the use of the buildings, which are made visible by system-oriented (eco-)balancing.

ACTIVE STRATEGIES FOR RADICAL INNOVATIONS

The Construction Products Industry is beginning to realize the potentials of comprehensive innovations. The technologies for infrastructure to be built, for transport, and for the use of resources, become part of new business models.

FROM CONVENTIONAL TO MULTI-FUNCTIONAL BUILDINGS

The new requirements for buildings also broaden the perspectives of the industries responsible for construction materials and construction.

THE NEW REQUIREMENTS ARE:

» **FUNCTIONALITY:** Buildings should be able to flexibly adapt to changing functionalities, such as residential buildings which can simultaneously be used for other/office purposes.

» **LOCATION:** For a chosen location, the consequences due to the mobility infrastructure should be assessed.

» **THERMAL QUALITY:** The consequences of the thermalquality of buildings on the occupancy costs are to be considered.

» **THERMAL BUILDING COMPONENT ACTIVATION:** Massive building components that act as thermal storage units give buildings an active role in the energy system.

» **INFRASTRUCTURE FOR ENERGY:** Bi-directional grids for electricity - but also for heating and cooling - via energy networks, connected with heat pumps and geothermal energy, are becoming the standard for energy infrastructure.

ReConstruct

Within the framework of the cooperative research project “ReConstruct”, an international consortium is analyzing the perspectives for the further development of the Construction Products Industry in the context of radical innovations.

www.rethinkconstruction.net

FURTHER INFORMATION

The project ReConstruct
http://www.rethinkconstruction.net/

Empa Material Sciences and Technology
www.empa.ch

World Economic Forum
https://www.weforum.org/

Future of Construction
https://futureofconstruction.org/

Rocky Mountain Institute
https://rmi.org/

European Commission
https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

IMPRINT

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