
Carbon Neutral Buildings

CREATING VALUE THROUGH ARCHITECTURE



white



Creating value through architecture

For us at White Arkitekter, architecture is about creating long-term value. We work proactively to ensure that our projects have the lowest environmental impact possible.

We are all facing the same challenges of climate change and increasingly scarce resources. To lead change in our industry is a responsibility we take very seriously. With the 2030 Agenda for Sustainable Development as the starting point we are working together with others to create a sustainable future.

The construction sector accounts for a significant share of greenhouse gases. We have a joint responsibility to implement the changes needed to limit emissions as soon as possible.

'Carbon neutral' and 'net zero carbon' have become buzzwords within our industry, but what do they really mean? Below you can read about our definition of carbon neutral buildings and how we aim to get there. The more of us that are working with carbon neutral buildings the faster we will arrive at the net zero goal.

ANNA GRAAF / SUSTAINABILITY DIRECTOR AT WHITE ARKITEKTER

Outside Nyköping is Lindeborg's Eco Retreat – a hotel, conference and retreat with innovative agriculture, vegetable gardens, flower meadows, solar cells, biochar production and a biological water treatment system. At the centre of the farm is the "Ekoladan" (Swedish for "The Eco Barn") which has been rebuilt and renovated using timber from the nearby forest.

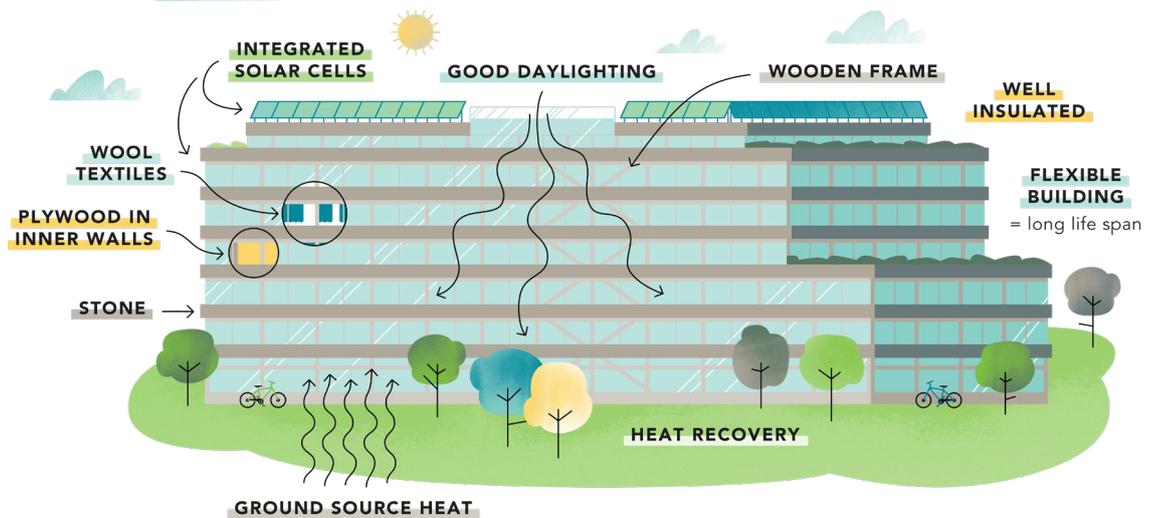


**SIX STEPS
TO MINIMISE
CLIMATE IMPACT**



1. Define a clear target.
 2. Agree a carbon budget and follow it up throughout the project.
 3. Make use of what is already there.
 4. Minimise the use of materials and energy demand.
 5. Choose materials and energy sources that have a low climate impact.
 6. Offset the remaining emissions.
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“Net Zero” as a Driving Force



The construction sector is responsible for almost 40% of greenhouse gas emissions globally. Around three-quarters of this relates to heating and operational emissions, and the remainder comes from material production and construction processes.¹

Many nations signed up to the Paris Agreement, but we must now move from words to action.

Architects work from the early design stages of a project and have a great opportunity to effect change, but stakeholders in all parts of the construction process must take responsibility and collaborate in order to speed up progress towards carbon neutral construction.

CARBON NEUTRAL BUILDINGS

In order to reduce the climate impact of a project we need to define a clear target at an early stage. Already in the first sketches we should strive to reduce the climate impact, whilst planning to meet people's needs in a way that encourages a sustainable lifestyle. We should also

make the most of what is already there, for example by remodeling rather than demolishing and rebuilding.

Through wise design and material choices, we can create efficient buildings with low energy use, where the energy needed is supplied from renewable energy sources. Energy demand can be reduced by optimizing the building volume and orientation, through careful design of the building envelope and by specifying energy-efficient building services and controls.

By establishing carbon budgets, we can ensure that carbon neutrality is a guiding principle in all our projects. The goal is to have a minimum of emissions from materials and energy throughout the life-cycle of every building and to balance all emissions with climate-positive initiatives.

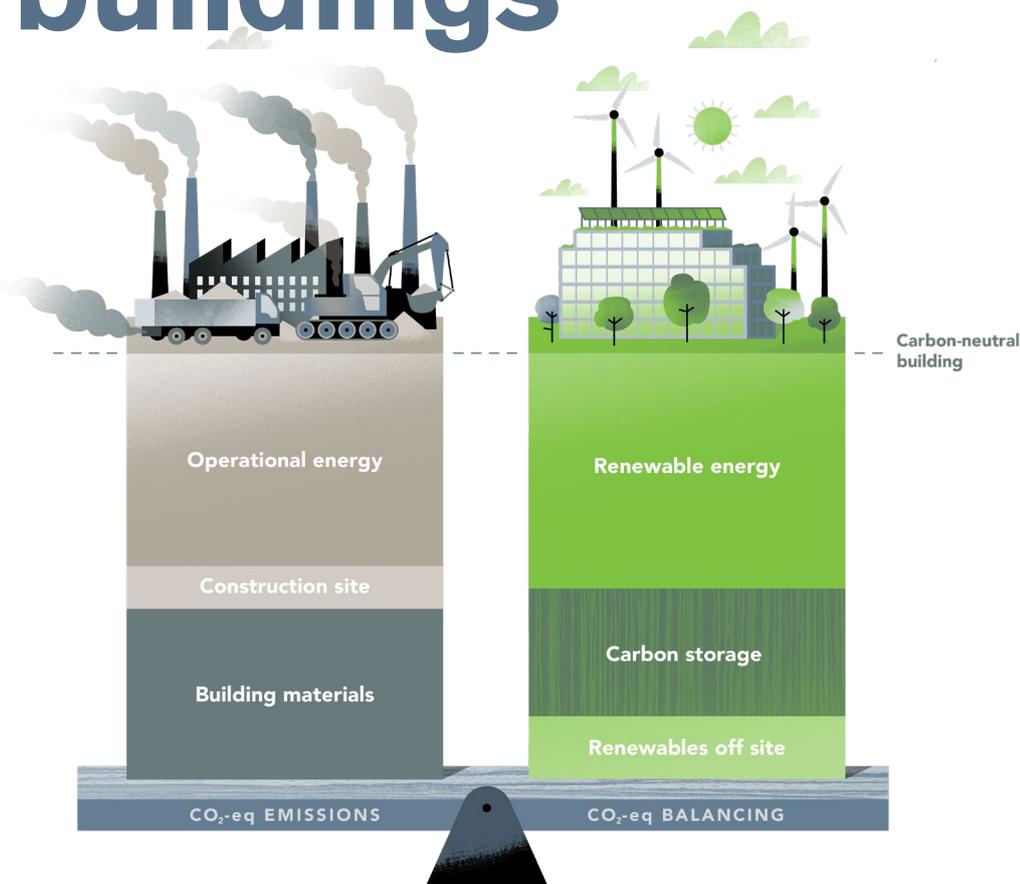
The illustration shows an example of a carbon neutral building and how, through wise design and material choices, we can create energy-efficient buildings from low carbon materials and use renewable energy sources to meet energy demands.

ILLUSTRATIONS: SOJA

1. <https://www.worldgbc.org/news-media/WorldGBC-embodied-carbon-report-published>



Balancing strategies for carbon neutral buildings



Throughout their entire life cycle, all buildings have a carbon footprint – from the manufacturing of the products and materials used until the building is repurposed or demolished.

In a carbon neutral building, greenhouse gas emissions are minimised at all stages, including the manufacturing processes, during construction and during use. The emissions that occur are balanced by climate-positive initiatives so that the net carbon footprint over time is zero. This can be done for example, by investing in solar cells on the roof or facades to compensate for the building's emissions.

"Wood acts as a carbon store. Built-in materials derived from wood contain an amount of carbon that relates to the uptake of carbon dioxide from growing new trees. During a building's lifespan new forests that absorb and bind carbon dioxide can be grown to replace the timber used for construction."

To the left: Sara Cultural Centre, Skellefteå, in northern Sweden. Here, the Skellefteå tradition of building in timber is combined with the latest engineering techniques, making the project an exemplar in sustainable design and construction. Due to be completed in 2020.

FROM CARBON BUDGET TO CARBON DECLARATION

Documented Climate Impact

There are several benefits of calculating the climate impact of buildings. When investing in a home for instance, a buyer should easily be able to find information about the emissions generated during the construction process. A carbon calculation is also a powerful tool for reducing the climate impact of a building throughout its lifecycle.

In January 2022 the Swedish Board of Housing, Building and Planning is intending to introduce requirements for “Carbon Declarations”. For projects in Sweden this means that the emissions that occur during the extraction and manufacturing of certain materials and products, as well as emissions during the construction of the building, must be reported. White’s extended carbon declaration however goes a step further, as we report on the emissions from energy use during the operational phase as well as the climate-balancing strategies adopted.

A carbon calculation shows a building’s climate impact and any compensatory measures proposed, in the same way that economic calculations show costs and revenues. Early in the project, we make a carbon budget indicating the amount of emissions that need to be balanced if the building is to achieve carbon neutral status. By calculating and balancing the

emissions that affect the climate, we encourage both climate smart construction and climate-positive initiatives.

Using an informed BIM model, we can control material selection and costs, which helps to ensure that the costs are managed and the building contributes to low emissions from a life cycle perspective, without exceeding the budget. Many choices of materials and products are made when they are being procured during the construction phase. This stage is critical as there can be a great difference in carbon footprint not only between different types of materials but also depending on the manufacturer.

With a carbon calculation, we can ensure that every stage of the project is taken into account, and balanced, so that the net climate impact is zero. When the project has reached practical completion and is ready to be occupied, we report the results in a “Carbon Declaration”.

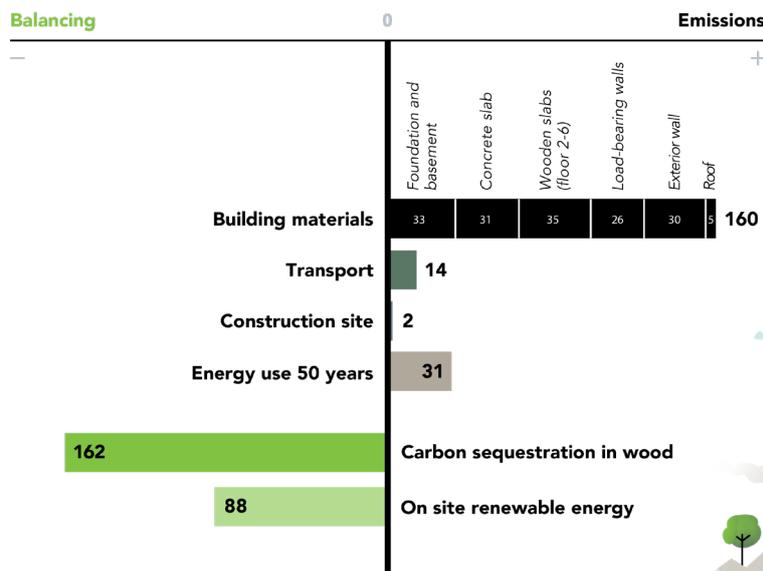
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CARBON DECLARATION

KV TRÄKONTORET

Heated floor area **12 000 m²** | Total no. of floors **6** | Area solar cells **1100 m²**



SUMMARY

Total emissions

207 kg CO₂-eq

Total balancing

-250 kg CO₂-eq

Summary climate impact

-43 kg CO₂-eq



SEVEN STEPS TO A CARBON DECLARATION

1. A carbon budget is made at an early stage, in the same way as an economic budget.
2. All greenhouse gas emissions from materials and products are converted into carbon dioxide equivalents CO₂e. We use generic data, or product specific data gathered from EPDs.
3. By incorporating climate impact data into digital models, we can keep track of material choices, quantities and cost.
4. Energy demands are minimised and the remaining energy-related emissions converted into carbon dioxide equivalents CO₂e. These emissions are compensated by climate-positive measures.
5. All steps must be balanced to stay within the carbon budget. The budget is followed up with increased detail and accuracy for each step during the design and construction processes.
6. Any variations and changes in the project must not lead to increased emissions.
7. When practical completion is reached the result is reported in a carbon declaration.

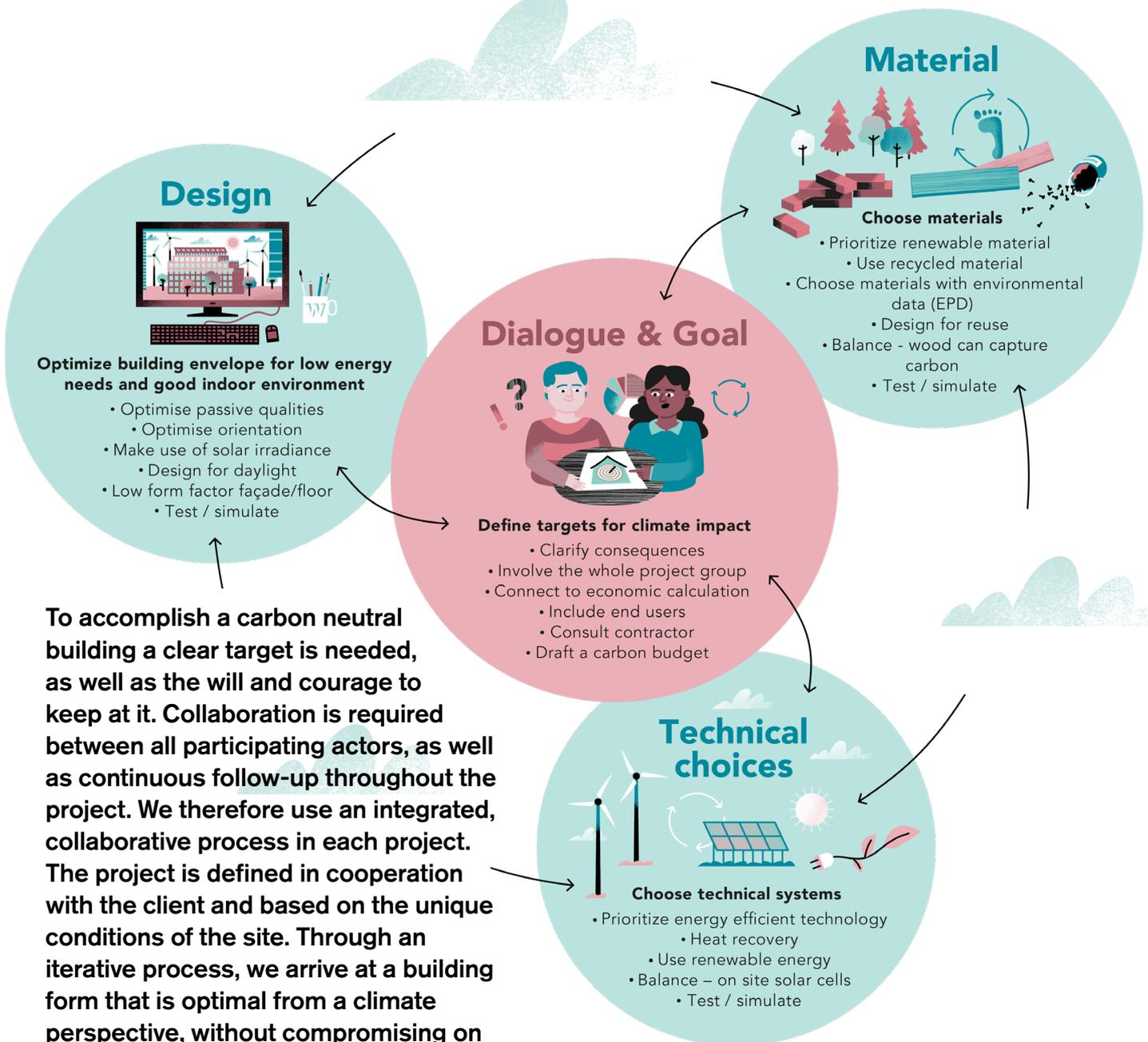


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To us, architecture is about creating long-term value. With architecture as our tool, we can contribute to a sustainable society and a living planet.

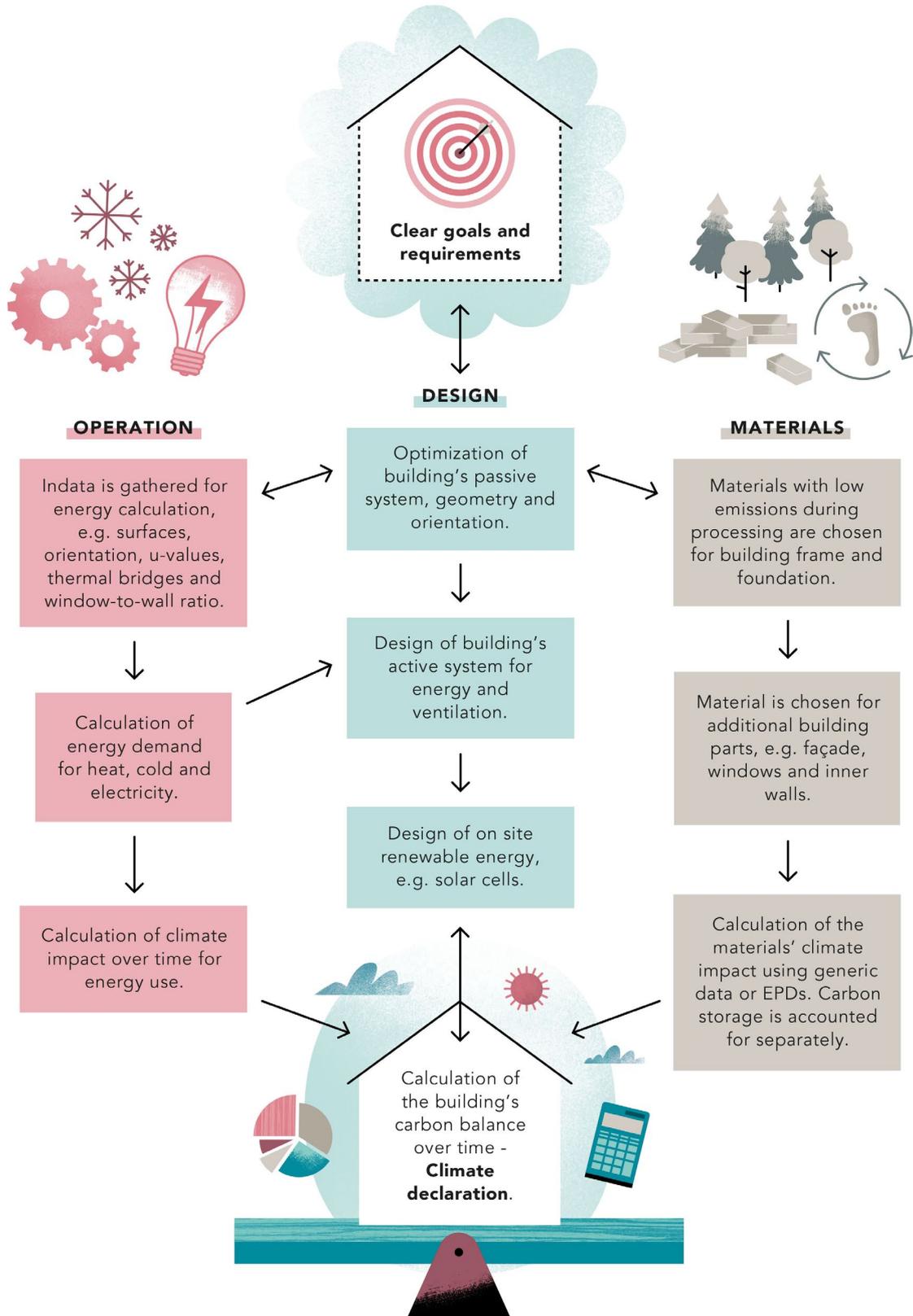
CARBON NEUTRALITY AND COLLABORATION

An Integrated Process



To accomplish a carbon neutral building a clear target is needed, as well as the will and courage to keep at it. Collaboration is required between all participating actors, as well as continuous follow-up throughout the project. We therefore use an integrated, collaborative process in each project. The project is defined in cooperation with the client and based on the unique conditions of the site. Through an iterative process, we arrive at a building form that is optimal from a climate perspective, without compromising on basic requirements such as robustness, beauty and function.

OUR METHOD



CARBON NEUTRAL BUILDINGS

White Arkitekter's definition

In a carbon neutral building emissions resulting from the materials, construction and energy use in the building are balanced with renewable energy and carbon storage. Here, we specify what is included in the calculations according to the model that we propose.

CLIMATE DEBT

The climate impact of the building is calculated from a life-cycle perspective with a calculation period of 50 years. Greenhouse gas emissions resulting from the production of materials, transport, construction processes and operational energy use, including end-user related energy (A1–A3, A4–A5, B6 according to SS-EN 15978) should be taken into account.

Material: Greenhouse gas emissions from the manufacture of the materials and products necessary for the construction and maintenance of all heated floor space and the plant rooms that serve the building with heat, cooling and/or electricity. Building components covered are as follows: building envelope, load-bearing structural components and

non-loadbearing interior walls. Life-cycle data from materials, products and building components are retrieved from open access databases with generic data, or from product-specific Environmental Product Declarations (EPD's).

Construction: Greenhouse gas emissions linked to energy use on the construction site and transportation of products and materials.

Operation: Greenhouse gas emissions that are linked to the building's total operational energy demand shall be worked out for the calculating period. Total energy demand should include both building-related "regulated energy" and end-user related "unregulated energy" use within the property boundary.



Magazine X in Uppsala, at 13,500 sqm, will be Sweden's largest office building in timber. The goal is to come near to zero climate impact, in terms of energy, materials and construction. Given the depth of the building extra focus is placed on daylight. The facade consists of both glass and slate (which have a low carbon footprint) with photovoltaic (PV) cells on both facade and roof. Due to be completed in 2022.



BALANCING THE CLIMATE DEBT

The calculated climate impact from materials, construction and operation must be balanced by new renewable energy sources, or by carbon capture. The effect of these carbon reduction methods must be calculated and reported separately.

Renewable energy within the property boundary:

Applicable for all buildings of 1 or 2 storeys. The building must achieve a net surplus of energy through renewable energy production within the property boundary, e.g. solar cells, that on an annual basis produce more than the total annual energy demand (both regulated and unregulated energy). The surplus is valued as a displacement of fossil energy. For buildings over 2 storeys, at least 10 percent of the regulated energy must be balanced within the property.

Renewable energy outside the property boundary:

Applicable for all buildings of more than 2 storeys. New renewable energy sources shall be added to the energy system. Long-term ownership of renewable energy production must be linked to the construction project, wholly-owned or via shared ownership, e.g. via investment in wind turbines or investment funds for renewable energy. Energy production from these shall be verified and documented annually.

Storage of biogenic carbon in wood:

Carbon is stored in timber and cellulose-based building materials. Growing forests captures a corresponding volume of carbon dioxide as long as the extraction of timber is at a lower rate than its regrowth. Lifecycle data for valuation of this carbon storage is retrieved from generic data, or product-specific EPD's. The effect of carbon capture in timber is reported separately.

The Climate Innovation District in Leeds is the UK's largest timber frame housing development. Here, residents will be able to live with a minimum negative climate impact. The houses are built to Passivhaus standards, with MVHR systems, green roofs, rainwater collection and solar cells. "Each wooden house generates 88 tons fewer CO2 emissions compared to a similar one in concrete", according to the client, CITU. Due to be completed in 2022.

White Arkitekter is an interdisciplinary practice for architecture, urban design, landscape architecture and interior design. Embedded in our work is a commitment to sustainability in all its forms, underpinned by practice-based research. As a collective of 800 employees organised in networks across 13 offices in Sweden, Denmark, Norway and the United Kingdom, we work with clients, communities and consultants to create inclusive, resilient architecture that inspires sustainable ways of life.



MAGASIN X, UPPSALA. ILLUSTRATION: WHITE VIEW

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