ENERGY SHAPES THE CITY

HOW DO WE DESIGN CLIMATE NEUTRAL CITIES?

INTRO

SAVING

CONNECTING

RENEWING

INFO

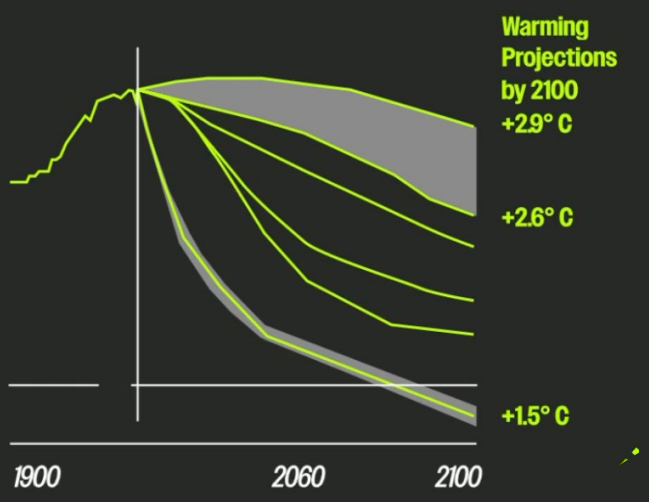
FULL VIDEO

Bauhaus Earth, Transsolar KlimaEngineering, Urban Catalyst 2024

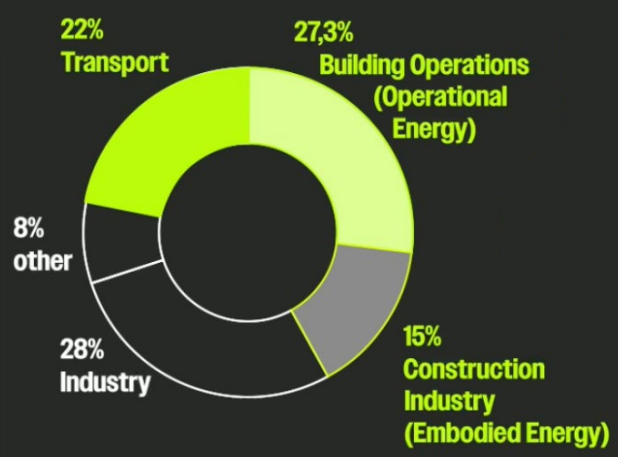
ENERGY / CO_2 / CITIES

WE ARE FACING GLOBAL CHALLENGES

The consequences of the climate crisis are becoming increasingly severe. In order to contain the consequences and meet the 1.5°C target, we must act quickly now and reduce global CO_2 emissions. Energy plays a key role in this. In Germany, for example, 84% of CO_2 emissions are energy-related.



Global Greenhouse Gas Emissions *(Gt CO eqv./ year)* and Warming Projections by 2100

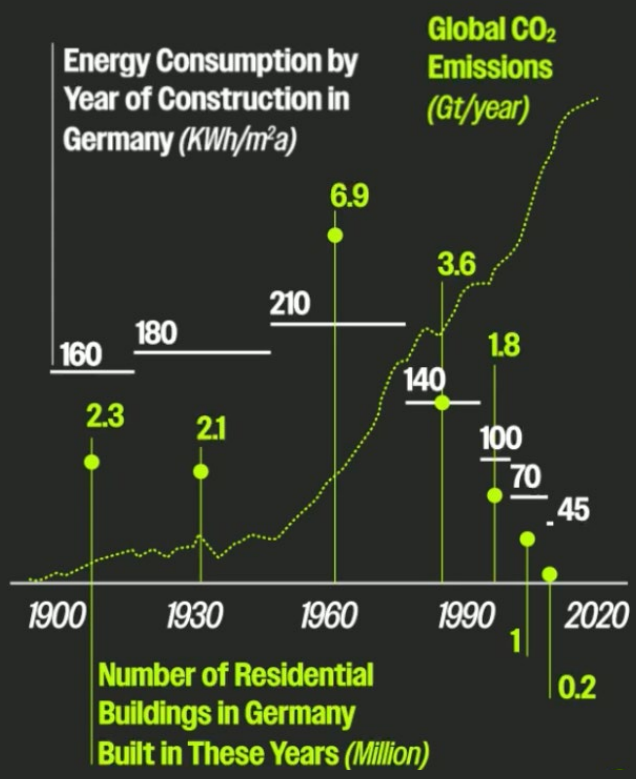


TOTAL ANNUAL GLOBAL CO_2 EMISSIONS

Energy determines where and how we live and do business. The focus on fossil fuels has shaped the form of our cities so decisively that today there are not only structural dependencies, but also a great demand for energy: cities consume 75% of global primary energy.

Our cities and regions are built in such a way that they consume a lot of energy: This is particularly evident in the areas of construction and mobility, where most urban areas follow car-centric designs and operate buildings built without energy standards.

HOW CAN WE DESIGN THE CLIMATE-NEUTRAL CITY UNDER THESE FRAMEWORK CONDITIONS?

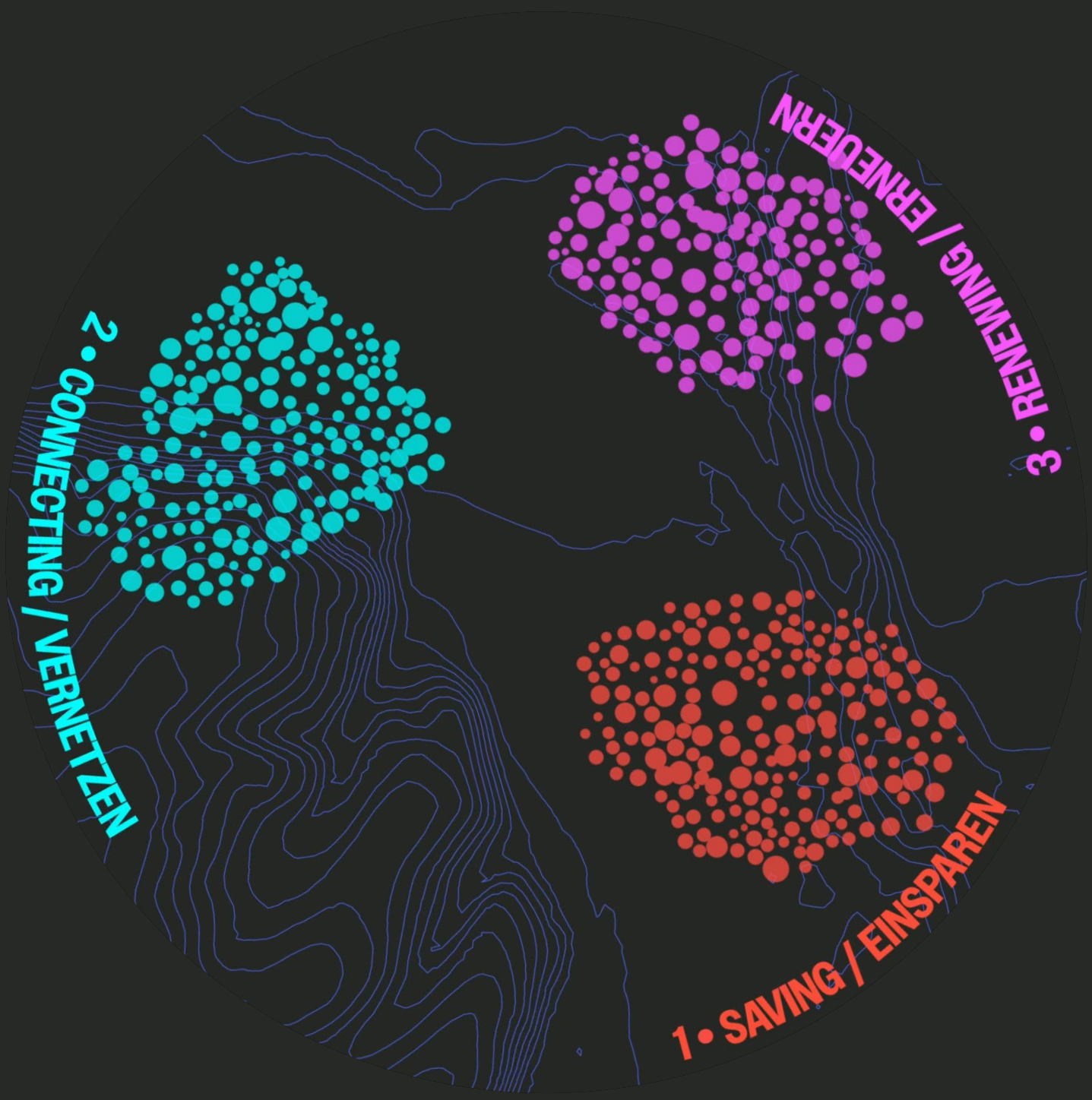


From top to bottom:
[1] UN Habitat, 2024. https://unhabitat.org/topic/urban-energy
[2] Adapted from Architecture 2030. Total Annual Global CO2 Emissions. „Why the Built Environment?“, 2023. https://www.architecture2030.org/why-the-built-environment
[3] Bundesministerium für Wirtschaft und Energie BMWi. „Sanierungsbedarf im Gebäudebestand“, 2014

3 STEPS TO THE GOAL

WE NEED A HOLISTIC APPROACH

Cities are complex and energy can be found in all aspects of life – in making coffee or taking a hot shower in the morning; in keeping the trains running or our computers working; even in the materials we use, which retain the energy used to process and transport them – and that‘s why we need to think about them holistically when aiming for climate-neutral and energy-efficient cities. For this, we propose to follow three steps: save, connect renew:

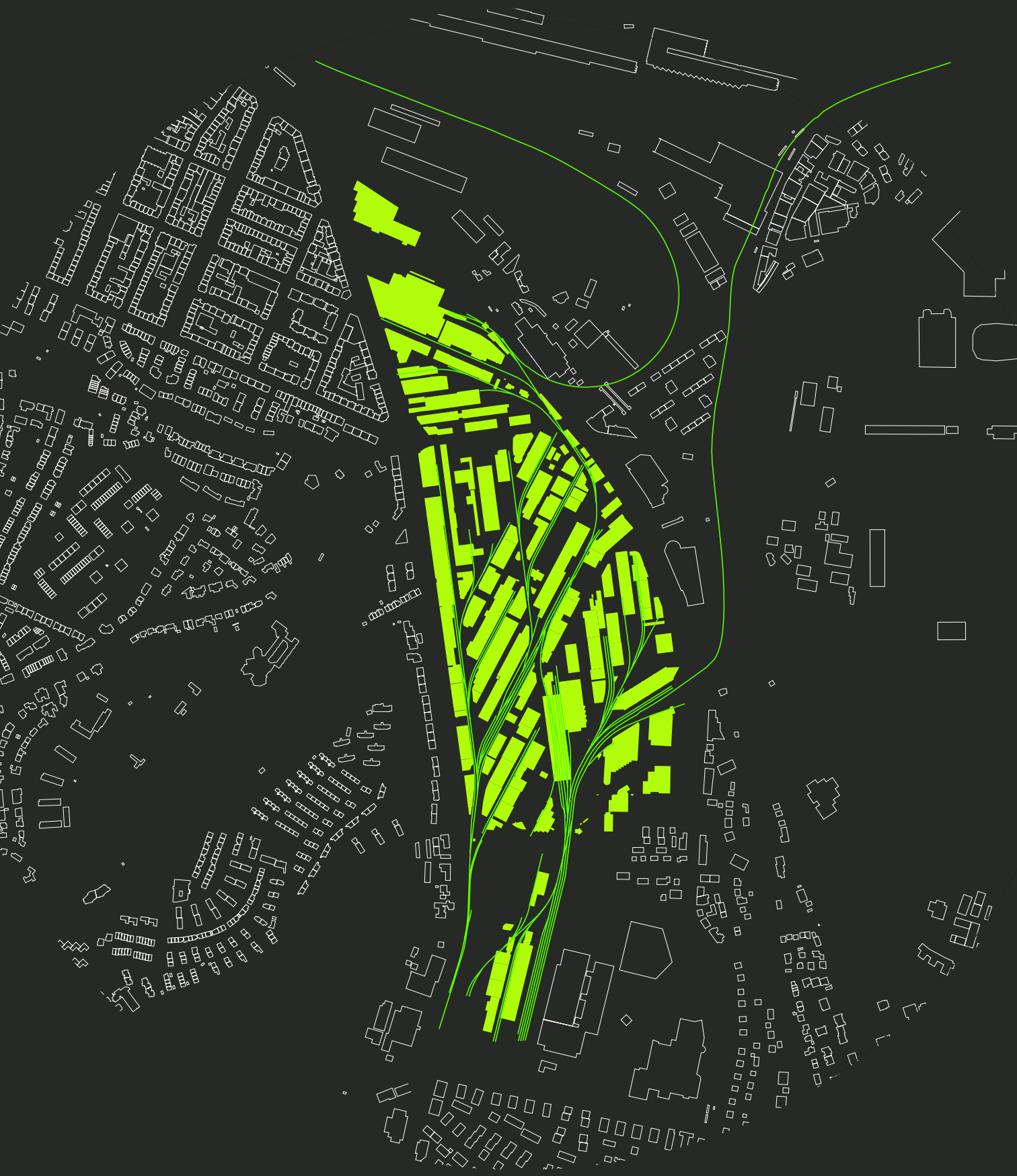


CASE STUDY DREISPITZ

HOW DOES THIS PLAY OUT IN REALITY?

The Dreispitz district project in Basel shows how this practice plays in real life. This district, which developed in the 20th century as a commercial area, is located 15 minutes by train from Basel city center.

Today, the Christoph Merian Foundation is the owner of the area and wants to develop the district in a sustainable way. The goal is to transform it into a mixed urban neighborhood where people work, live and learn.



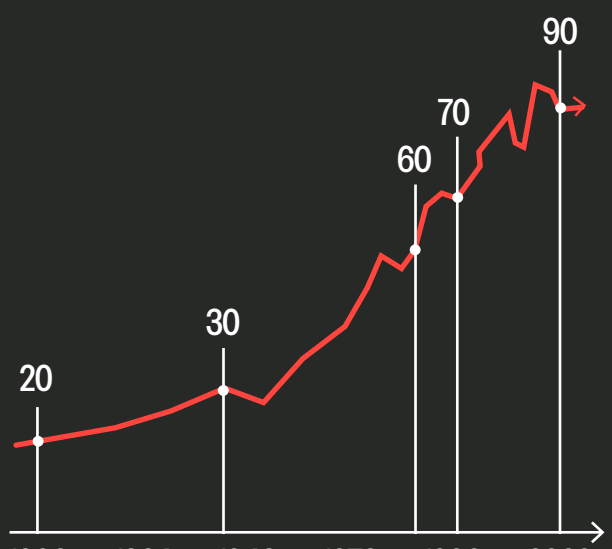
[4] Christoph Merian Stiftung, 2024. https://www.dreispitz.ch / Herzog de Meuron: „Plan Guide“, 2022

DENSIFICATION

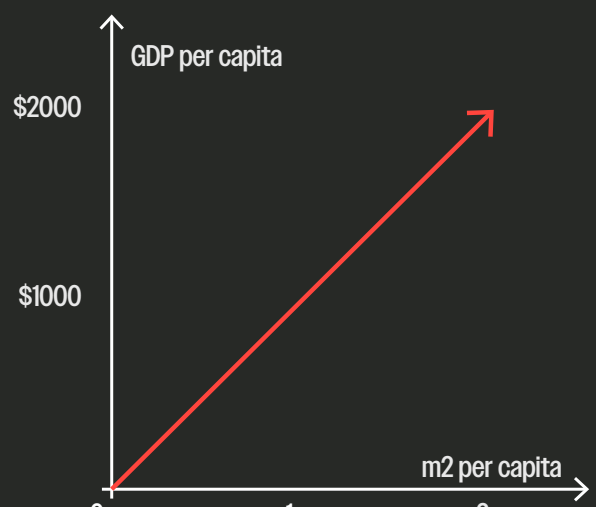
STEP 1 – SAVING

The more space we use, the more energy we need to heat rooms, to lay infrastructure or to produce building materials. The current global trend is towards more and more living space per person, driven in part by increasing prosperity. We need to reverse this trend by moving closer together and using less space – sharing saves space and energy!

In urban development, this also means densification: We are not building on clear fields, but on existing structures.

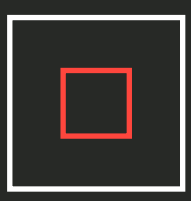


LIVING SPACE PER PERSON BY YEAR IN THE USA



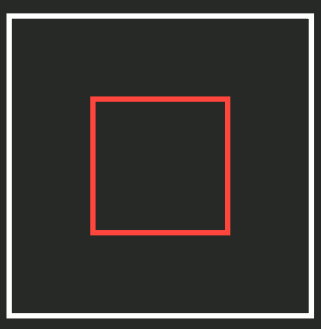
THERE IS A DIRECT LINEAR RELATIONSHIP BETWEEN PER CAPITA INCOME AND PER CAPITA LIVING SPACE

LESS-WEALTHY COUNTRIES



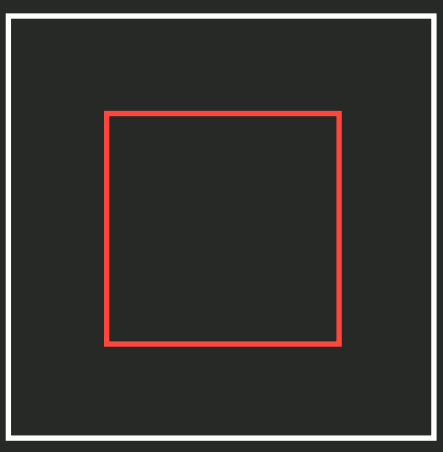
20-40 m^2 / 3-3.5 inhab.
ca. 5-10 m^2

GLOBAL AVERAGE



70 m^2 / 3-3.5 inhab.
ca. 20 m^2

WEALTHY COUNTRIES



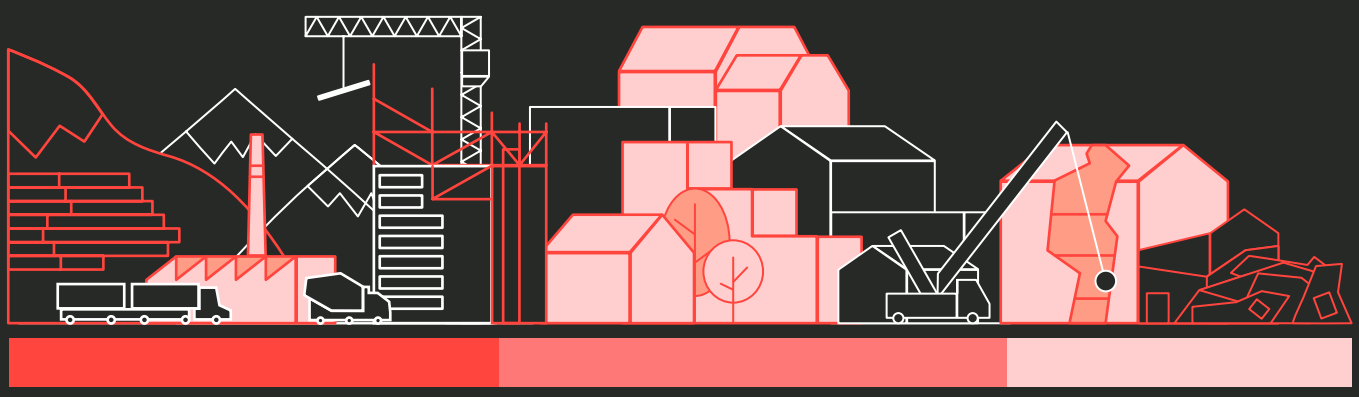
130-200 m^2 / 2-2.5 inhab.
ca. 60-80 m^2 per person

[5] West, Rob. "Average home sizes: living space per person?" Thunder Said Energy. Accessed February 20th, 2024. https://thundersaidenergy.com/downloads/average-home-sizes/.

USE THE EXISTING

STEP 1 – SAVING

Embodied energy is the total amount of energy required to produce, transport, install, and dispose of building materials and building anew consumes a great amount of it. However, by repurposing existing buildings and using renewable raw materials, we can save energy – and therefore, CO_2!



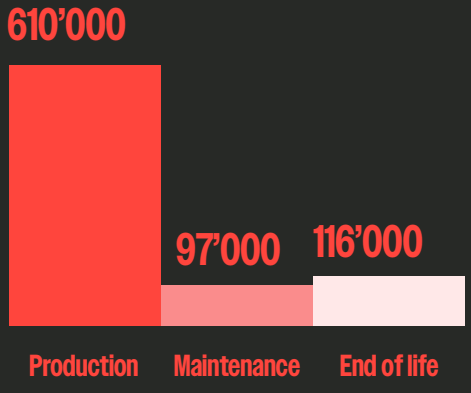
PRODUCTION MAINTANANCE END OF LIFE

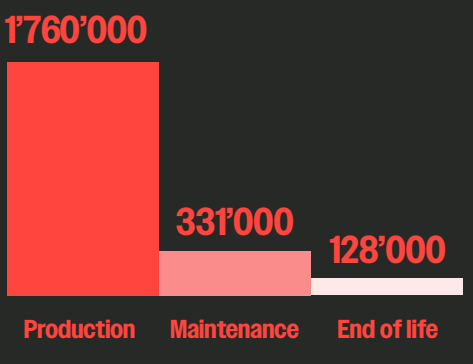
Greenhouse Gas Emission
GWP t CO_2eqv.

Embodied Energy
MWh

SCENARIO 1 NEW BUILD

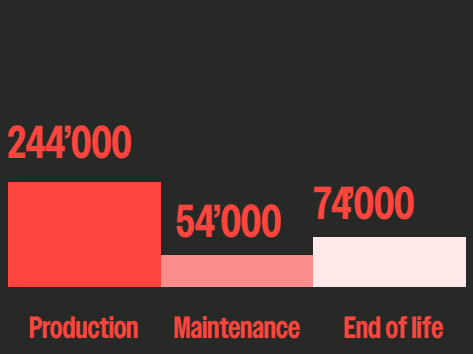
Demolition and new construction with conventional materials

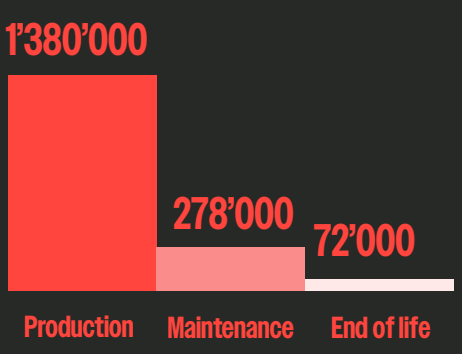




SCENARIO 2 RENOVATION

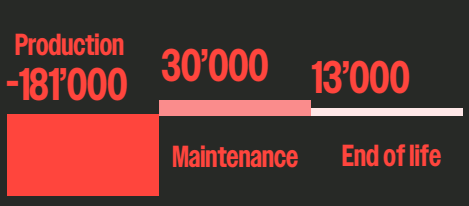
Refurbishment of existing buildings, densification with conventional materials

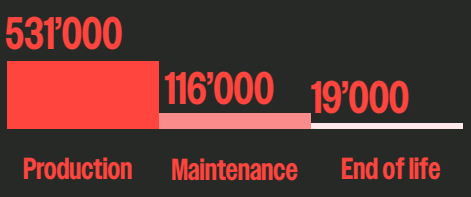




SCENARIO 3 ECO-RENOVATION

Refurbishment of existing buildings, densification with renewable materials



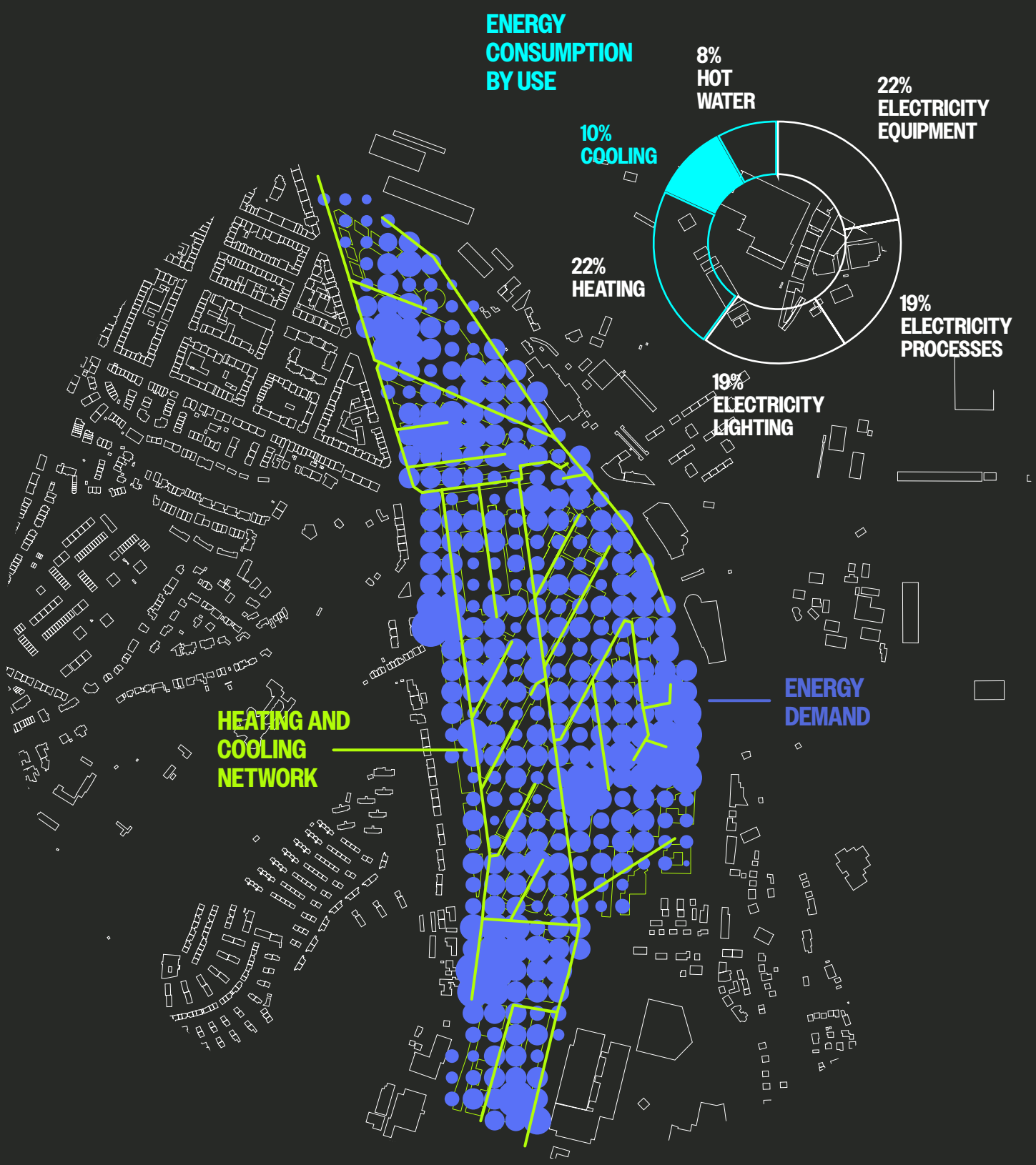


[6] Own calculations

ENERGY NETWORKS

STEP 2 – CONNECTING

Buildings require different types of operating energy such as electricity for lighting and electrical appliances; thermal energy for heating, to heat water and for cooling. Energy requirements vary depending on the use and the time of year and day and it can be used most efficiently in an interlinked system: laboratories/data centers can produce enough waste heat to keep neighbouring households warm.

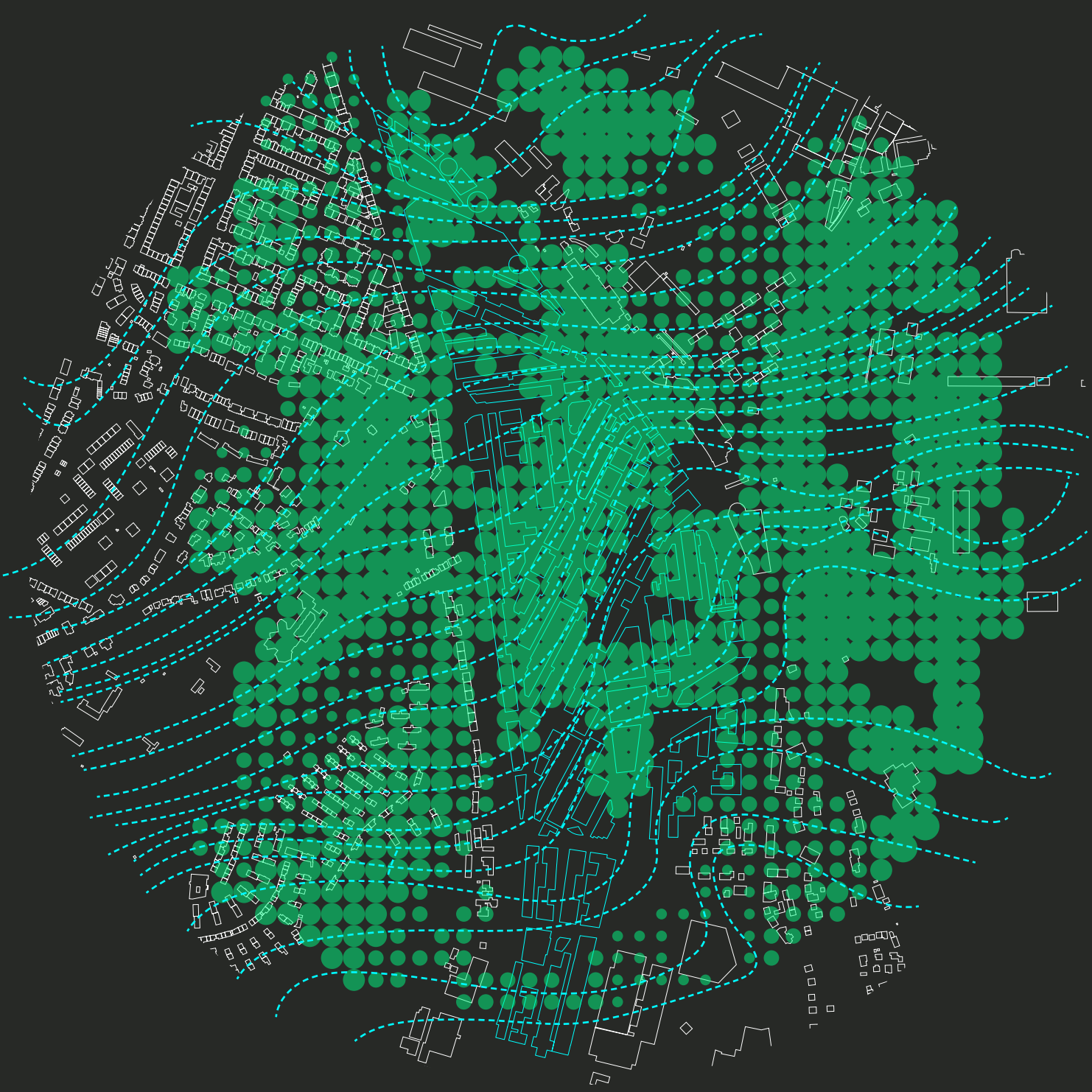


[7] Own calculations

OPEN SPACES

STEP 2 – CONNECTING

As the summers get increasingly hotter, cooling becomes paramount. An abundance of greenery in the city can reduce the perceived temperature on hot summer days by up to 10ºC. Maintaining/Creating a network of green spaces and wind permeability is important to reduce cooling energy requirements while ensuring pleasant public spaces and thriving biodiversity



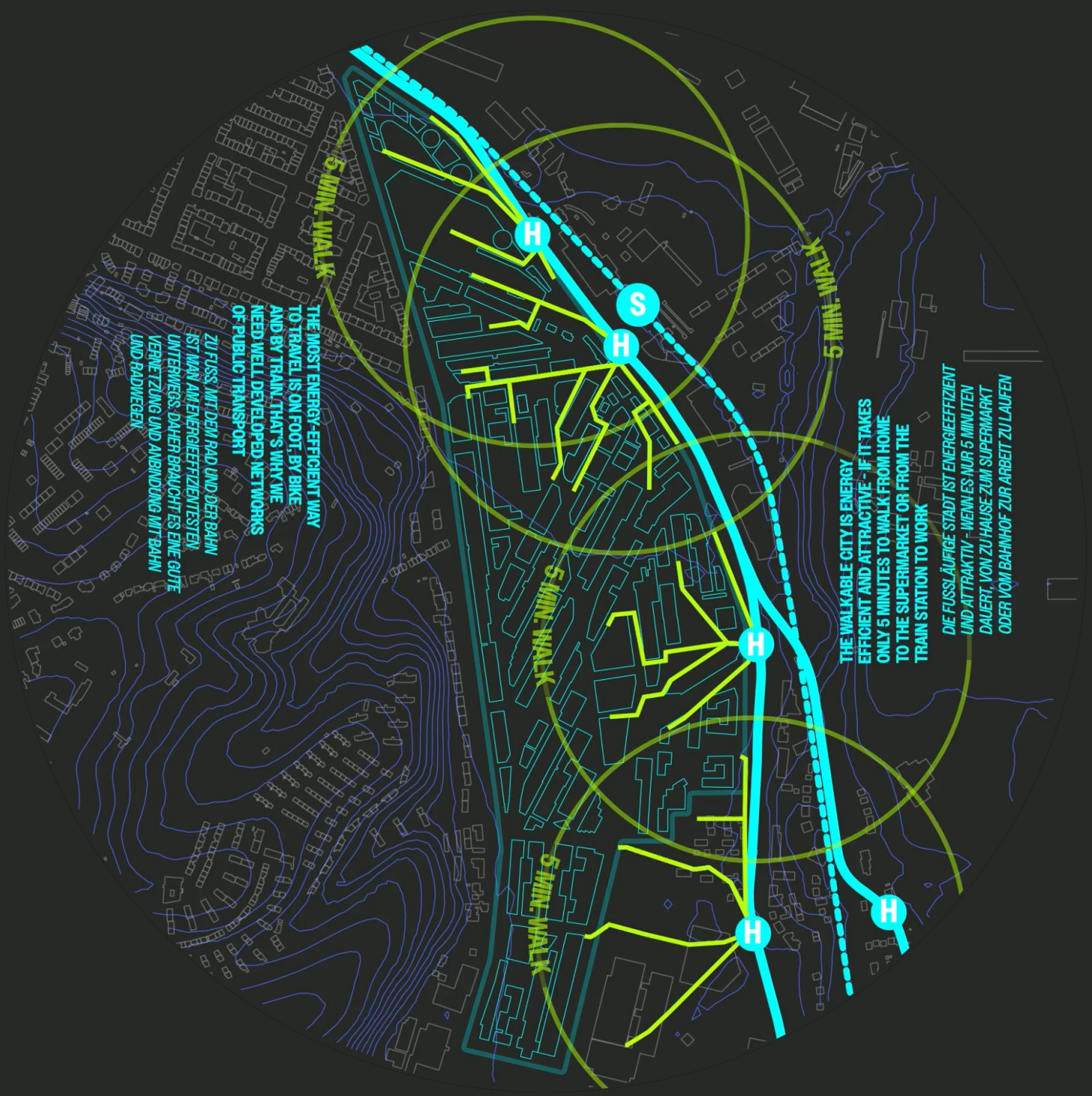
[8] Herzog de Meuron: „Plan Guide Dreispitz“, 2022

SHORT DISTANCES

STEP 2 – CONNECTING

The most energy-efficient ways to travel are by walking, cycling and taking the train. Therefore, good networking connections between rail and cycle paths are needed.

City dwellers prefer low-energy transportation options that are within a five-minute walking distance from their home, workplace, school, or supermarket.

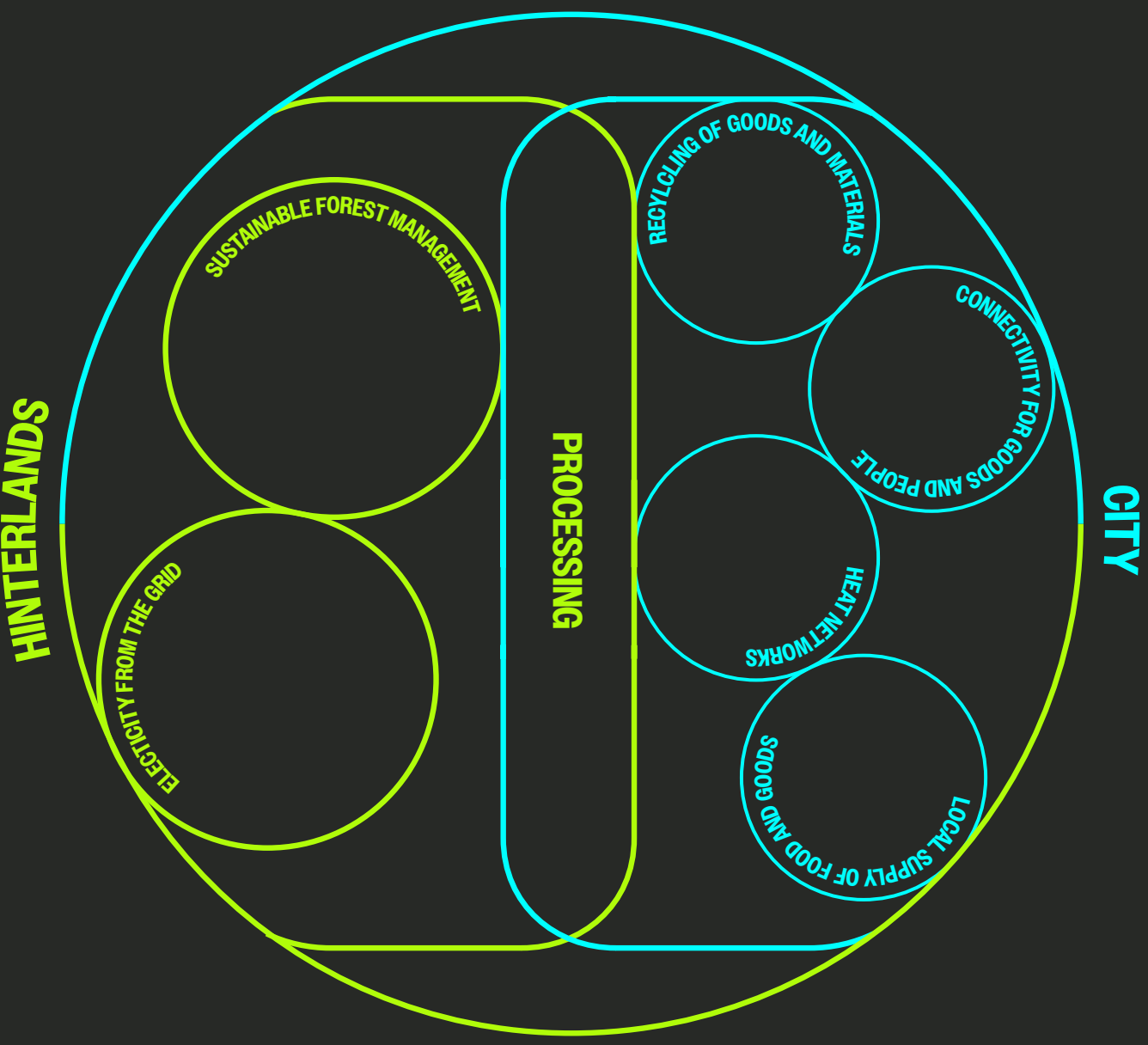


[9] Rapp AG. Plan Guide Mobilitätskonzept, 2022

CONNECTING TO HINTERLAND

STEP 2 – CONNECTING

The energy connection should also be considered beyond the city‘s districts. On the one hand, they cannot generate enough climate-neutral electricity or grow sufficient natural resources on their own. On the other hand, we, of course, enjoy traveling.



[10] Adapted from Bauhaus Earth, Towards a Regenerative City, 2022

RENEWABLE CITY

STEP 3 – RENEW

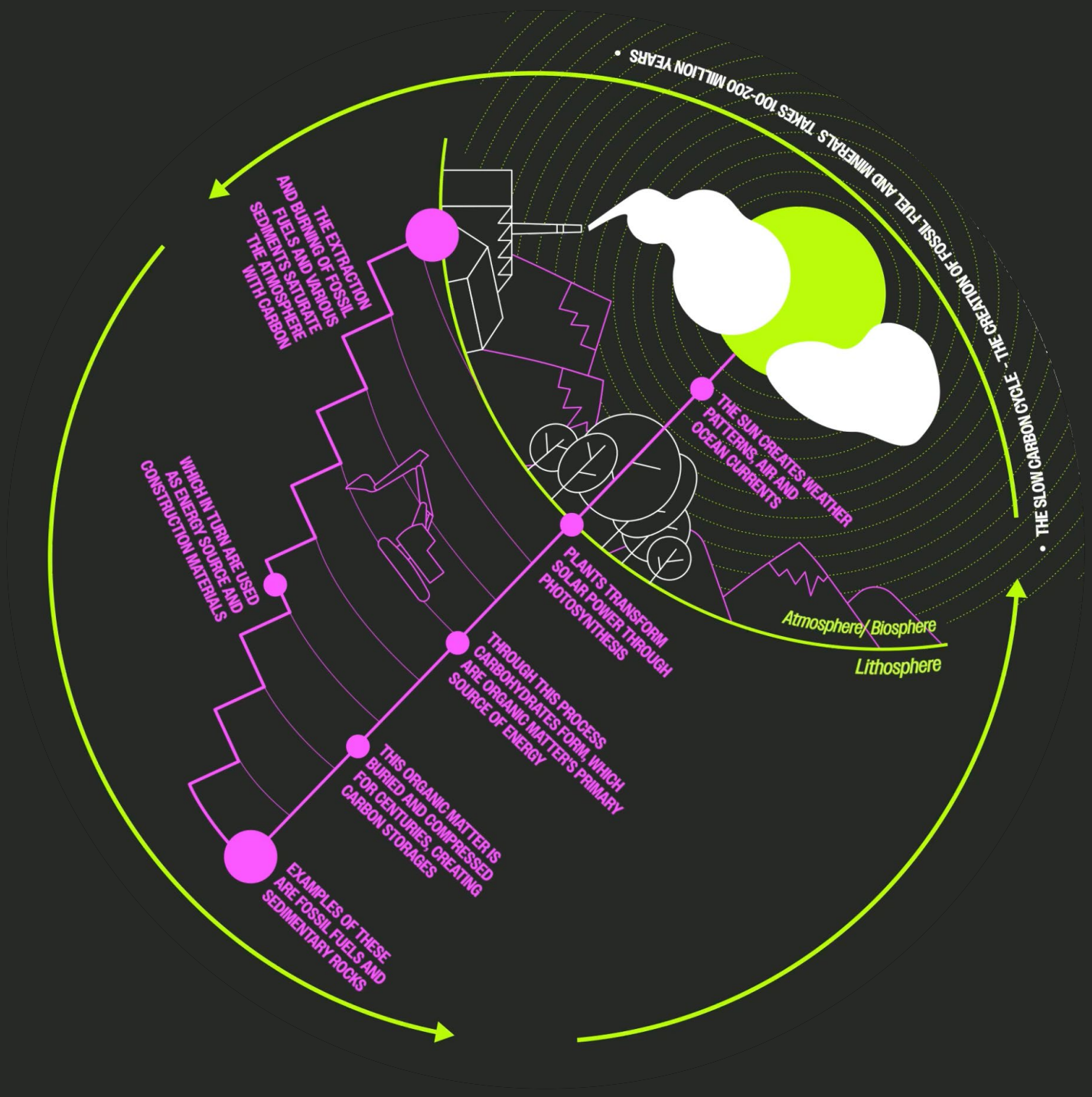
To maintain our standard of living, we will always require more energy and resources, even if we use them optimally. Therefore, we must produce them sustainably and think in cycles.

In terms of energy, all surfaces in the city can generate electricity through photovoltaics, and geothermal energy can provide climate-neutral heating and cooling throughout the year. In the built environment, we must preserve as many buildings as possible and use renewable raw materials where necessary.

LESS FOSSIL

STEP 3 – RENEW

On Earth, we get our energy from the sun, either directly or indirectly. Plants transform solar energy into sugars through chemical processes. Animals that later eat these plants absorb all the nutrients. Over millions of years, the remains of this organic matter are buried and compressed in the lithosphere, where fossil fuels and sedimentary rocks are formed. The current extraction and burning of fossil fuels and sedimentary rocks used in building materials such as concrete releases carbon dioxide, contributing to the climate crisis.



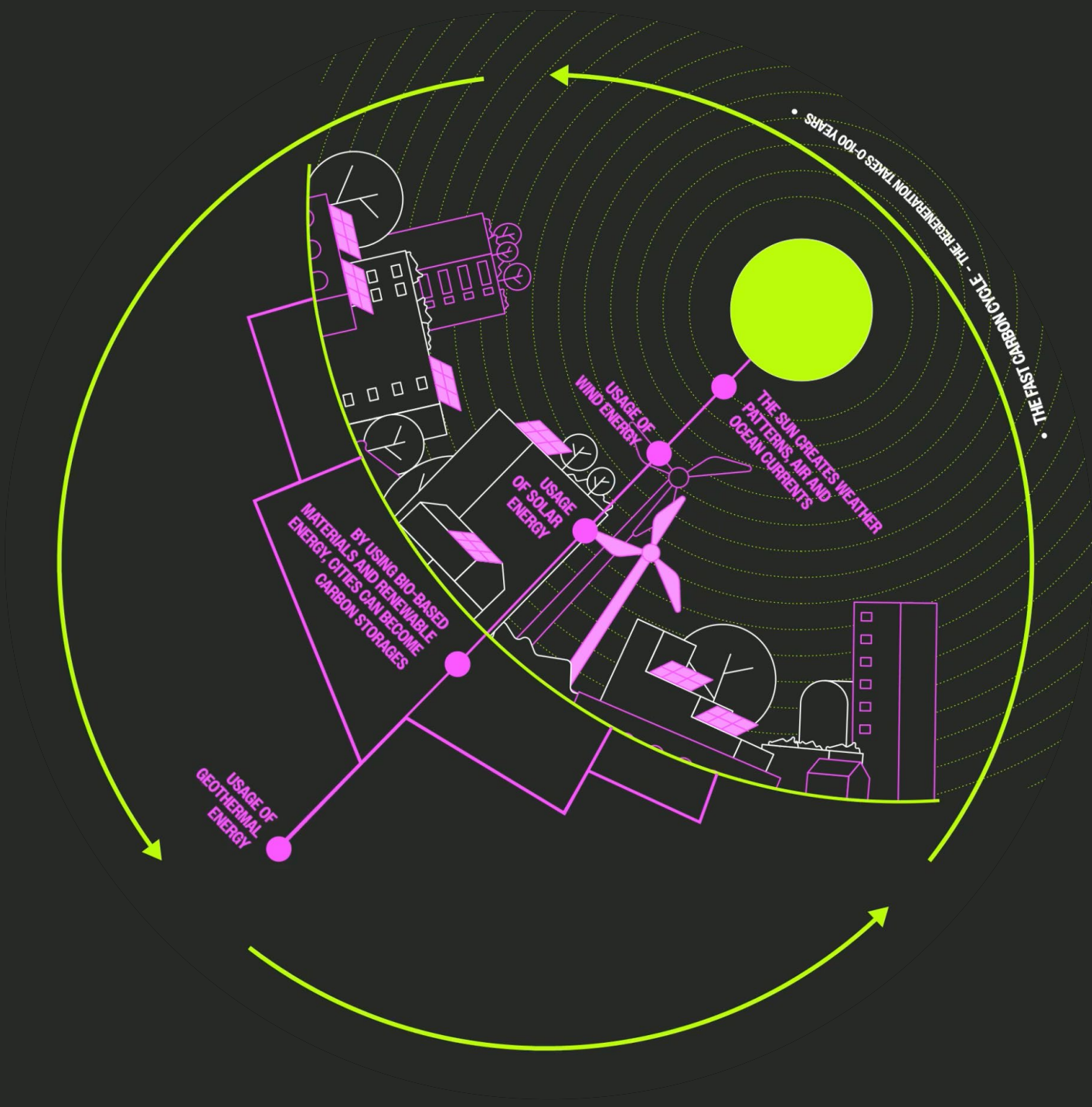
[11] Adaptation from Bauhaus Earth, Solar Energy and the Carbon Cycle, 2024.
Analysis and aggregation by Bauhaus Earth using data sources from Earth Observatory, NASA and Scientific American.

MORE RENEWABLE

STEP 3 – RENEW

We therefore need to think about tapping into the shorter energy cycles: we can use solar energy directly with solar panels or from the wind with wind turbines. Depending on the location, we can also use geothermal energy.

In combination with uncontaminated earth- and bio-based materials, the climate-positive transformation of the city can be a reality.



INFO

TEAM & EXHIBITION

A project by

BAUHAUS EARTH

TRANSSOLAR

URBAN CATALYST

Exhibition
Transform! Design and the Future of Energy
23.03.2024 – 01.09.2024

VITRA DESIGN MUSEUM

Concept und Content Johanna Amtmann, Eva-Maria Friedel, Rosa Hanhausen, Philipp Misselwitz, Luca Mule, Yuliya Navatskaya, Matthias Schuler, Christine von Raven, Christoph Walther

Design & Animation Luca Mule

Model Exhibition cncberlin.de