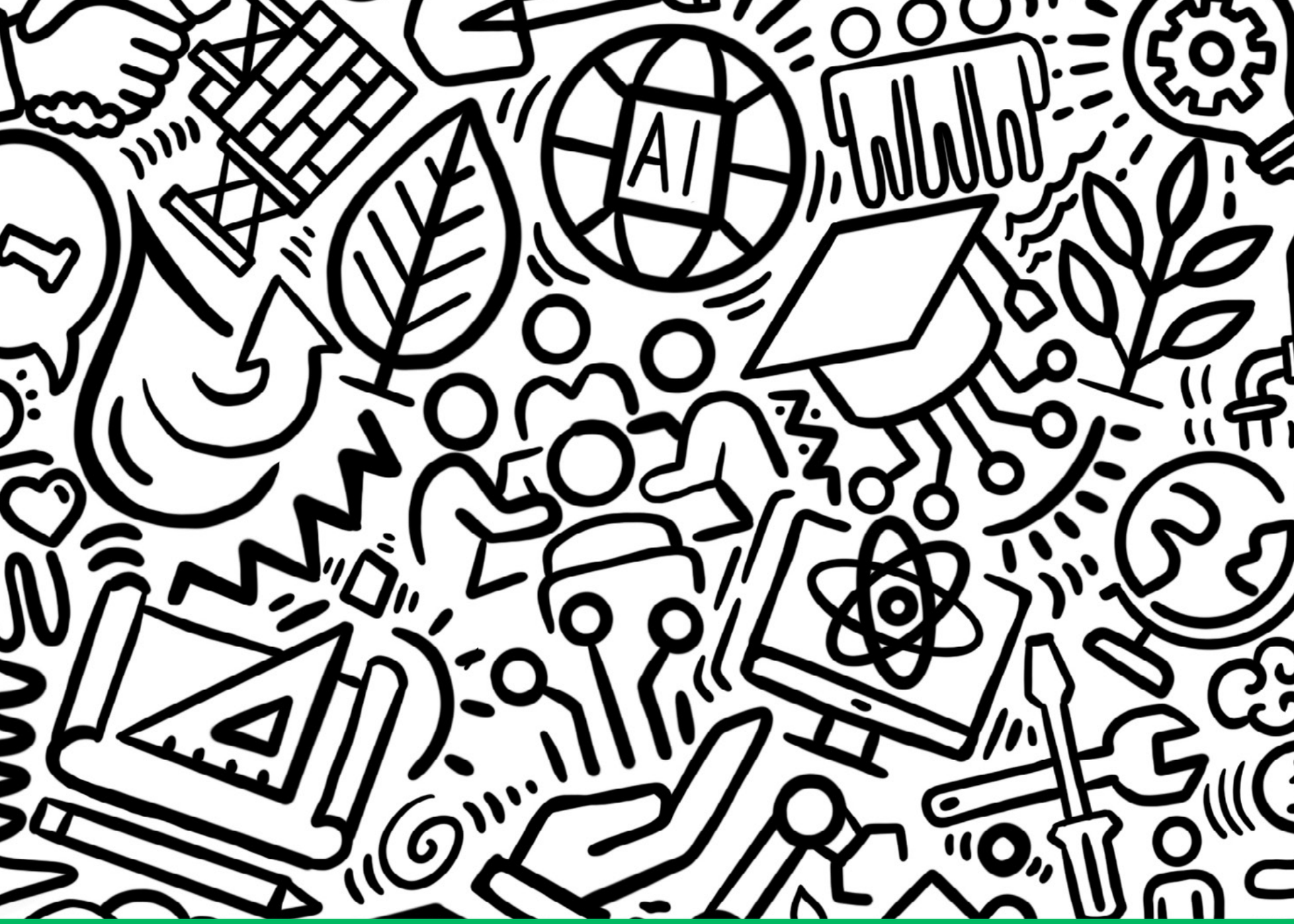


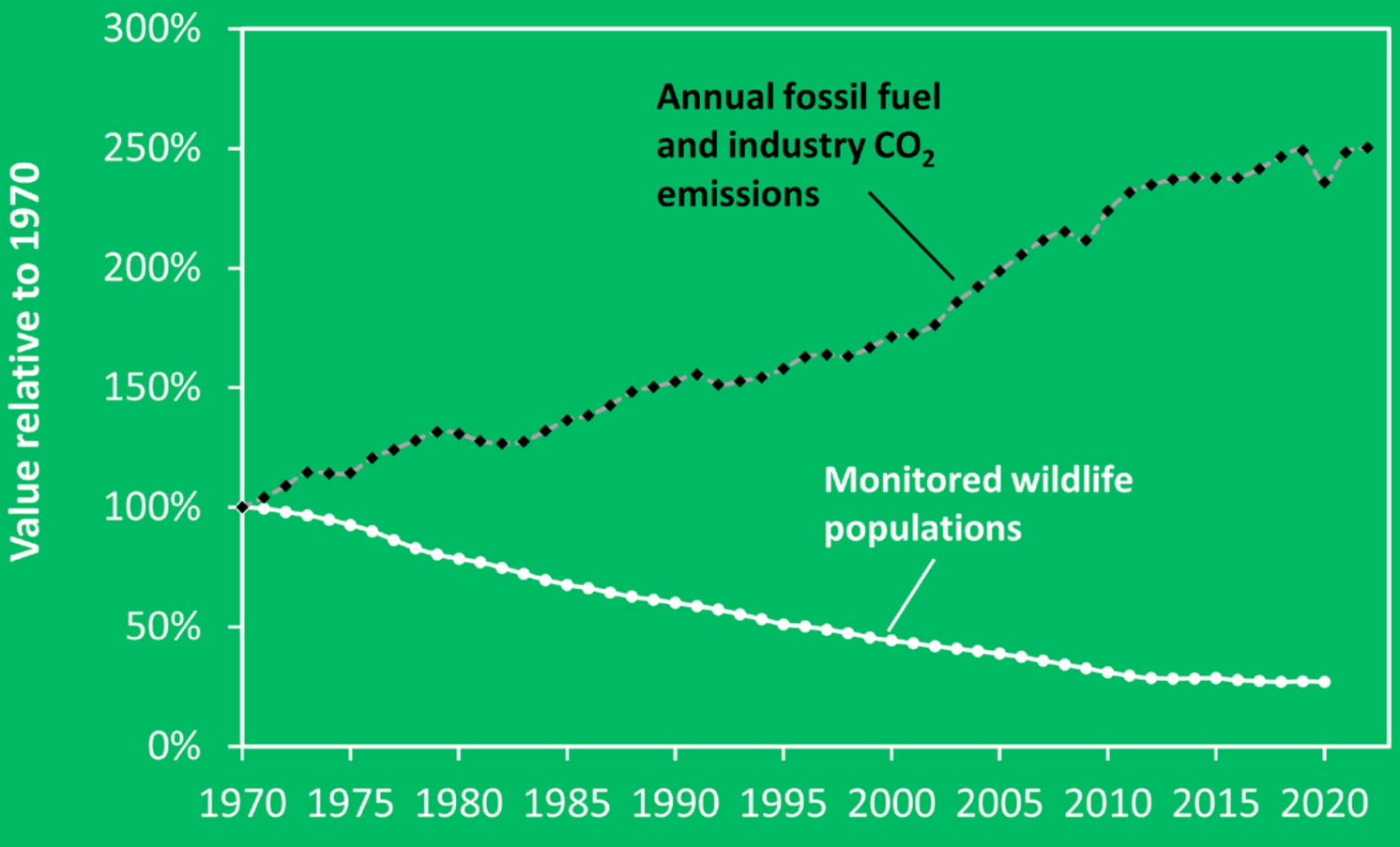
RENEW

a manifesto for regenerative design and engineering

“This manifesto sets out the Why, What and How of regenerative design and engineering. Beware! This manifesto is not perfect: no regenerative process can be. It is but a start on the path to continuous future improvement.”

Section 1 **Introduction**

The last gasp of the twentieth century was to leave human society with the entrenched idea of sustainability as a worthy goal, as exemplified by the Brundtland report of 1987. From classrooms to boardrooms, there is hardly a human who cannot now articulate the core principle of sustainability of leaving the earth for future generations no worse than we found it. What has this steady rise in sustainable, carbon and climate literacy in the ensuing four decades brought us? An equally steady, and in some ways dramatic decline in planetary health, such as growing annual CO_2 emissions and diminishing wildlife populations as shown below.



Data sources: www.ourworldindata.org

“Our problems are not isolated to carbon, but part of a larger pattern of extraction-led degradation.”

It is a paradox that our societal inability to plan and act in time in the face of mounting evidence and knowledge is in stark contrast to homo sapiens’ generational paradigm of “a long childhood”, as Jacob Bronowski, the famous twentieth century public intellectual put it. Unlike every other mammalian species, the human child takes several years to mature. While the fawn must learn to walk within minutes of birth to avoid turning into prey, the human baby typically learns to walk towards the end of its first year. The nearly two decade long familial investment into maturing a human child is devoted to increasing knowledge and honing reasoning skills that will aid the child in adulthood. We are thus the only species to have such a long childhood focused on planning for the future. It is this distinguishing mark of our species, which is ultimately responsible for our planet altering abilities, that is yet to translate to a societal level.

Hence, the crux of the regenerative paradigm is to enable our ability to plan for and support a continuously improving, prosperous life for humankind in harmony with nature.

Section 2 **The Evolution of Regenerative Design**

A Transformative Response to Historical Exploitation

The concept of regenerative design has emerged as a response to the consequences of centuries of resource exploitation and industrialisation. These actions have significantly contributed to the environmental and social crises the world faces today, from climate change to biodiversity loss and profound social inequities. Whilst advancements in science and education over the last hundred years have fostered dramatic improvements in human outcomes, such as increases in global average life expectancy, they have been largely driven by extractive non-regenerative practices.

Regenerative design, as a philosophy and practice, aims not merely to limit the damage we cause to the environment but to restore natural systems. To understand the significance and evolution of regenerative design, we must first acknowledge the historical trajectory of how humans have interacted with nature, and how these practices led to our current environmental and social challenges.

Pre-industrial Practices and Harmony with Nature

Within pre-industrial societies, some agricultural practices such as crop rotation, polyculture and intercropping promoted long-term land sustainability whilst working in balance with their environments. These practices encouraged biodiversity and maintained soil fertility by mimicking the natural cycles of ecosystems. These were disrupted with the advent of industrial agriculture, in particular the Green Revolution of the mid-20th century. While the Green Revolution was successful in increasing food production and addressing hunger in many parts of the world, it came at an environmental cost. The widespread use of chemical fertilisers, pesticides, and monoculture farming has led to soil degradation, loss of biodiversity and water pollution.

During the same period, society itself learned to work with the natural environment, identified as vernacular strategies often reliant on local, natural and renewable materials. For example, in some cultures, the vernacular strategy of the afternoon siesta created a break in work to minimise loss of productivity during the hottest parts of the day. In some tropical cultures, watering of courtyards was carefully timed to create evaporative cooling whilst also cleaning the surface of dust and debris. These are classic examples of net-positive outcomes produced in harmony with nature that were destroyed by the invention of air-conditioning: a carbon-intensive device that Lee Kuan Yew once credited for Singapore's 100-fold increase in per capita GDP between 1960 and 2011. We now know that the wasteful use of air-conditioning, which leads to overcooled indoor environments in many parts of the tropics, is eating around 1% of the entire earth's carbon budget.

The Industrial Revolution: Growth at the Expense of Nature

The Industrial Revolution, beginning in the late 18th century, marked a critical turning point in humanity's relationship with the natural world. While it has brought enormous benefits to every aspect of modern life, including your ability to read these words on paper or screen, it is based on a fundamentally extractive process. Driven by new technologies, the Industrial Revolution brought about unprecedented levels of resource extraction environmental degradation and global social inequality. Deforestation, soil degradation, atmospheric pollution, climate change and biodiversity loss arising from the industrial revolution have become entrenched processes that persist to this day.

Sustainability to Net Zero

By the mid-20th century, the environmental consequences of unchecked industrialisation and resource extraction became increasingly clear: the pollution and degradation of our natural resources to the point of irreversible damage. In response, the sustainability movement emerged, advocating for more responsible resource use and reduced ecological footprints. Early environmental activists called for limits on pollution, better management of natural resources, and protection of endangered species.

The idea of “sustainability” became central to environmental discourse, but it became largely focused on minimising harm rather than restoring damaged ecosystems. It emphasised slowing the pace of resource extraction, reducing waste, and protecting remaining ecosystems, rather than fundamentally rethinking how human systems could contribute positively to natural systems.

While Brundtland’s ‘Our Common Future’ uses the term regeneration, this is largely restricted to the idea of regeneration to sustain and conserve, rather than regeneration for systems to flourish. As the climate crisis deepened, the focus on environmental sustainability, often seen myopically in carbon terms, came at the cost of a focus on social and economic sustainability. This has led to the invention of solutions that are critical to delivering net-zero, but unintentionally resist regeneration. This includes LED lighting, consuming 90% less energy than the incandescent bulb common during Brundtland’s time, but now known to impact the natural behaviour of some bat species. Similarly, super-insulated buildings, a critical link to net-zero given that 39% of global carbon emissions come from buildings, design out the nooks and crannies necessary for migratory swift nests whose populations have fallen by 66% since 1995.

The Birth of Regenerative Design: A New paradigm

In the 1970s, John T. Lyle, an ecologist and landscape architect, introduced the term “regenerative design” as a more comprehensive and proactive approach to addressing such environmental challenges. Lyle proposed that sustainability, while necessary, was not enough. He argued that human systems should be designed to actively regenerate ecosystems rather than merely reduce harm. This represented a profound shift in thinking: from seeing humans as separate from and dominant over nature, to recognising humans as an integral part of natural systems.

Unlike sustainability, which focuses on maintaining the status quo or minimising impact, regenerative design seeks to restore and enhance ecosystems, aiming to improve their capacity to thrive. This approach involves adopting a holistic systems perspective, where economic, social and environmental factors are interdependent. Regenerative design principles aim to create systems—whether water, land, machines, processes, buildings, cities or economies—that operate in harmony with natural cycles, ensuring that the materials and energy used are part of a continuous, regenerative loop.

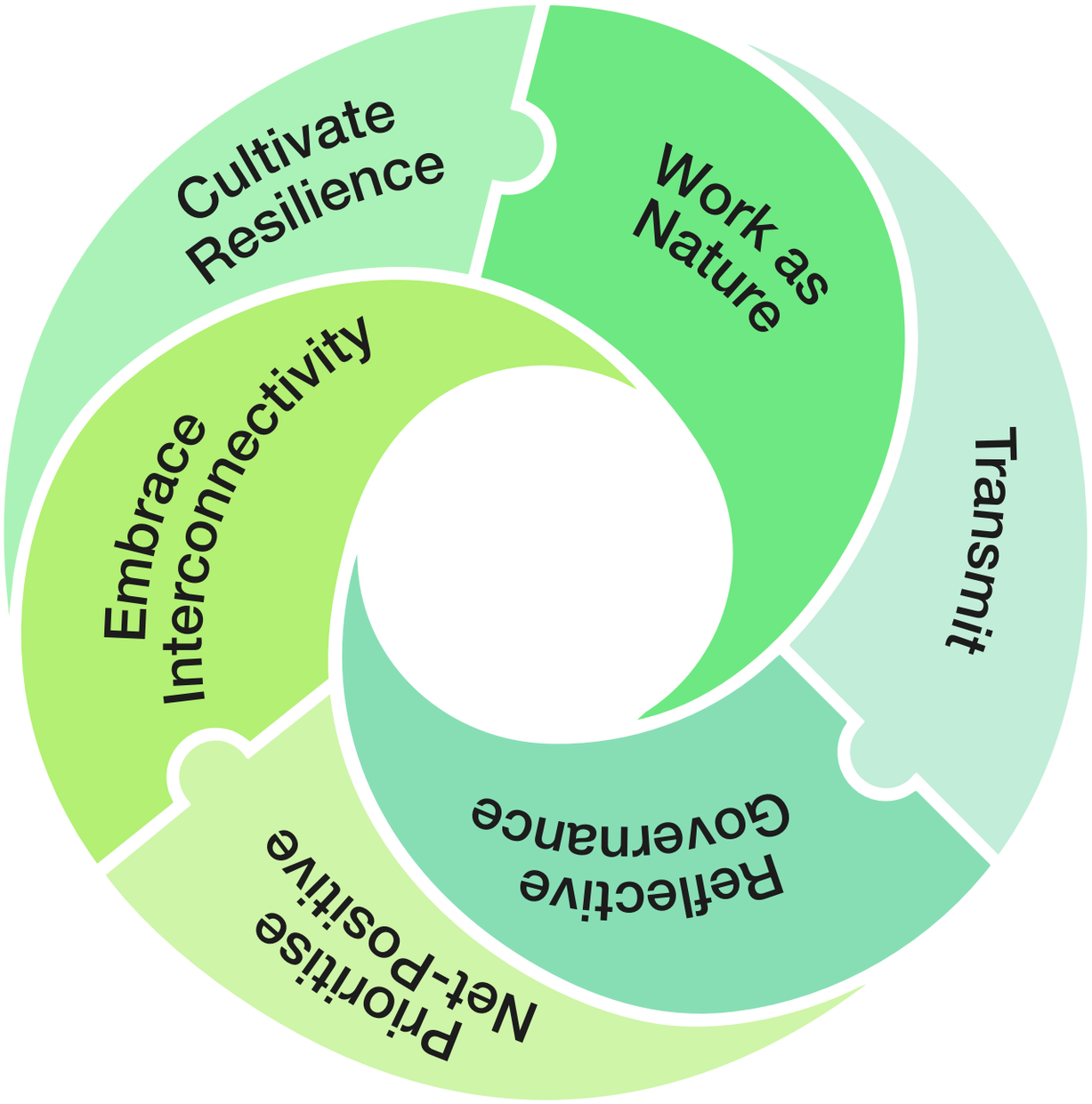
How do we go forward from here?

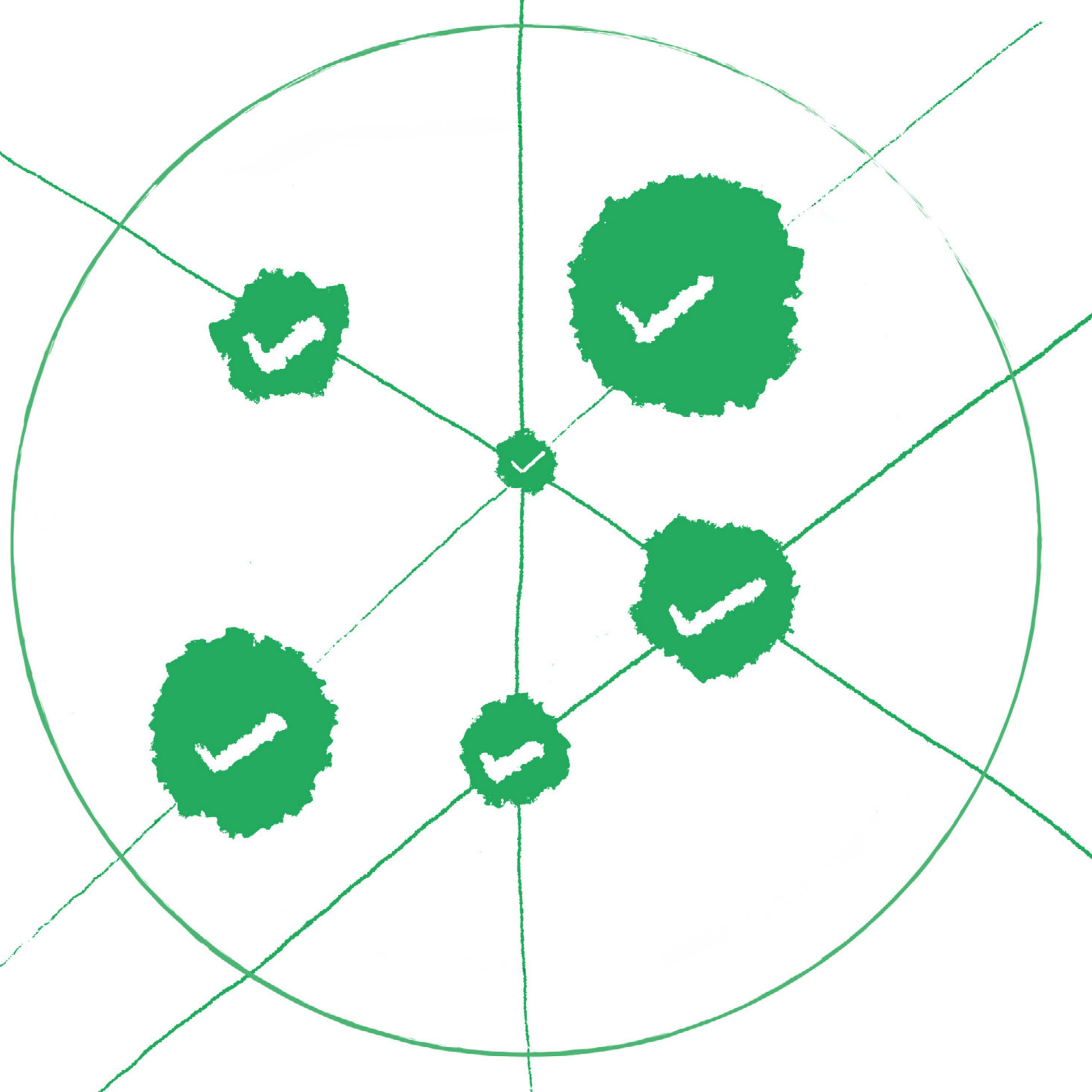
Section 3 **A Path To RENEW**

The journey towards a regenerative future is undoubtedly challenging, but it also holds immense potential. Regenerative design and engineering envisions a world where human activities restore and enhance natural systems, creating resilient, equitable communities that can thrive in balance with nature and each other whilst continuously improving standards of living, as embodied by the following definition.

"Regenerative design and engineering creates self-evolving net-positive solutions that renew our unity with nature."

To work with this definition will likely require transdisciplinary approaches, with diverse expertise from the sciences, engineering, humanities, local communities and industry to co-create solutions that endure. The following RENEW principles set out a fundamental shift in the engineering community's mindset to one that values regenerative thinking as a core identity.



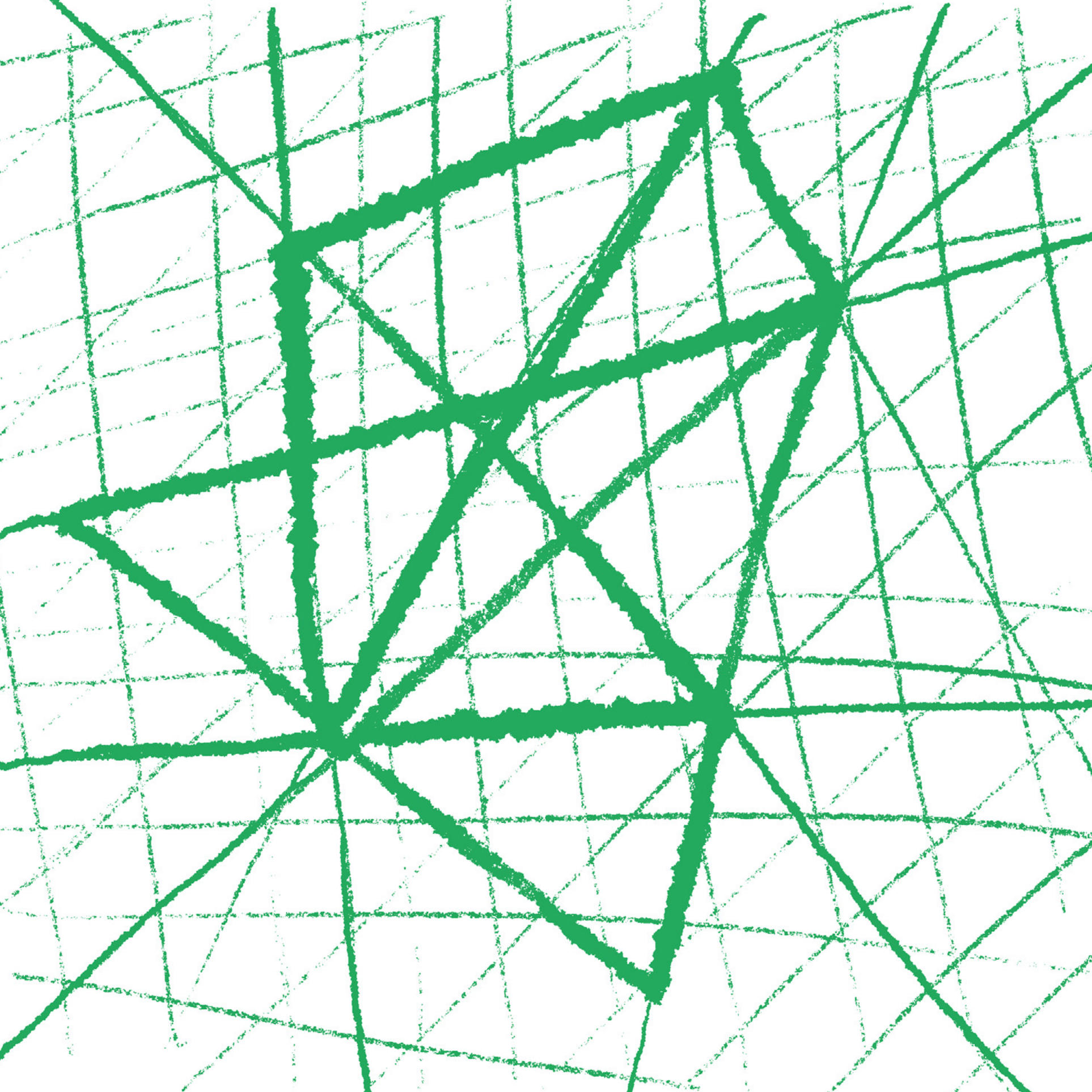


RENEW Principles

P1

Reflective Governance

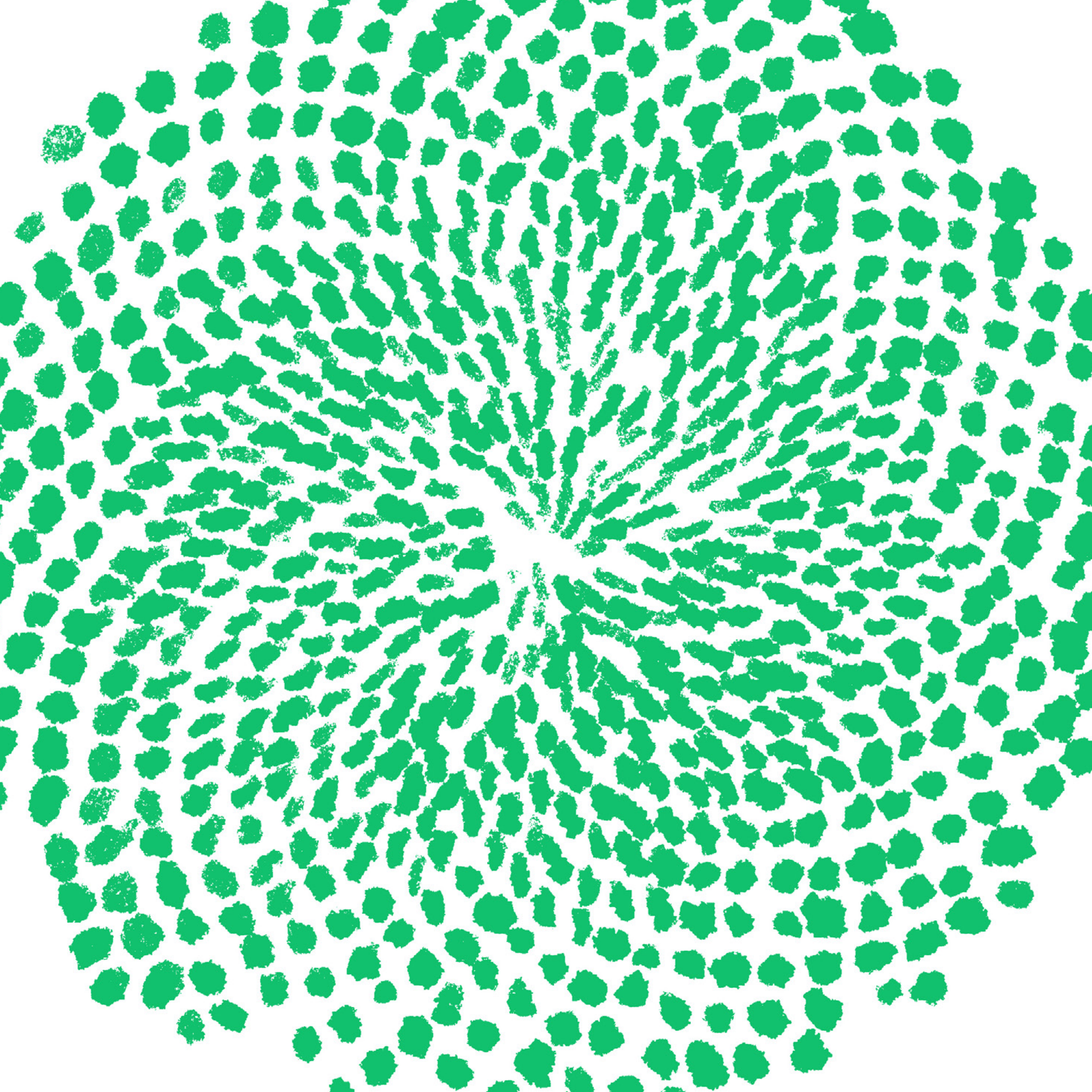
Establish continuously evolving metrics and monitoring practices to track progress and impact.



P2

Embrace Interconnectivity

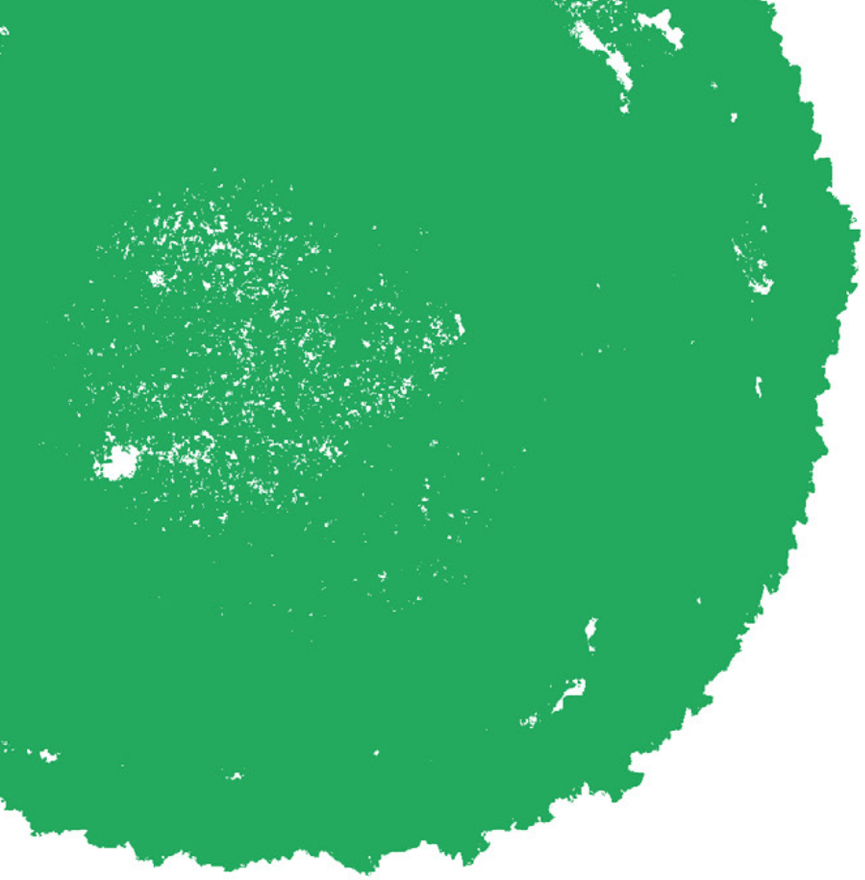
Recognise that the world is intricate and interdependent. Take a holistic view accounting for the dynamic relationships between ecosystems and communities.

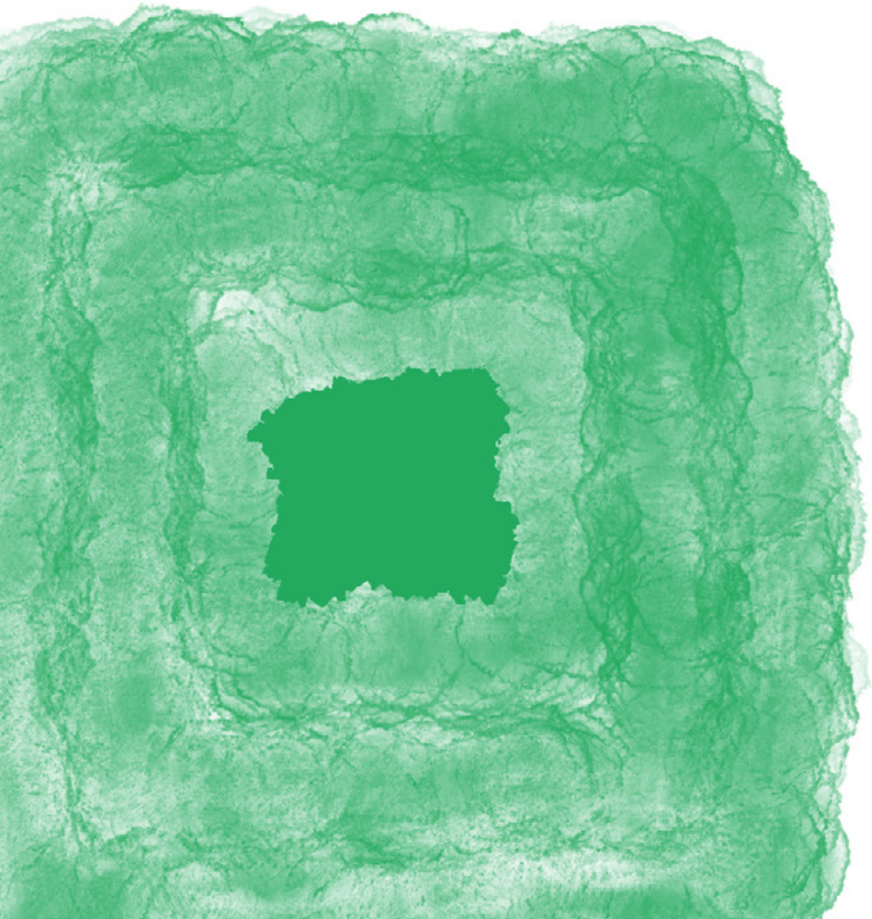


P3

Work as Nature

Work harmoniously with and as nature. Design systems that work as part of species and ecosystem patterns, processes, and cycles.

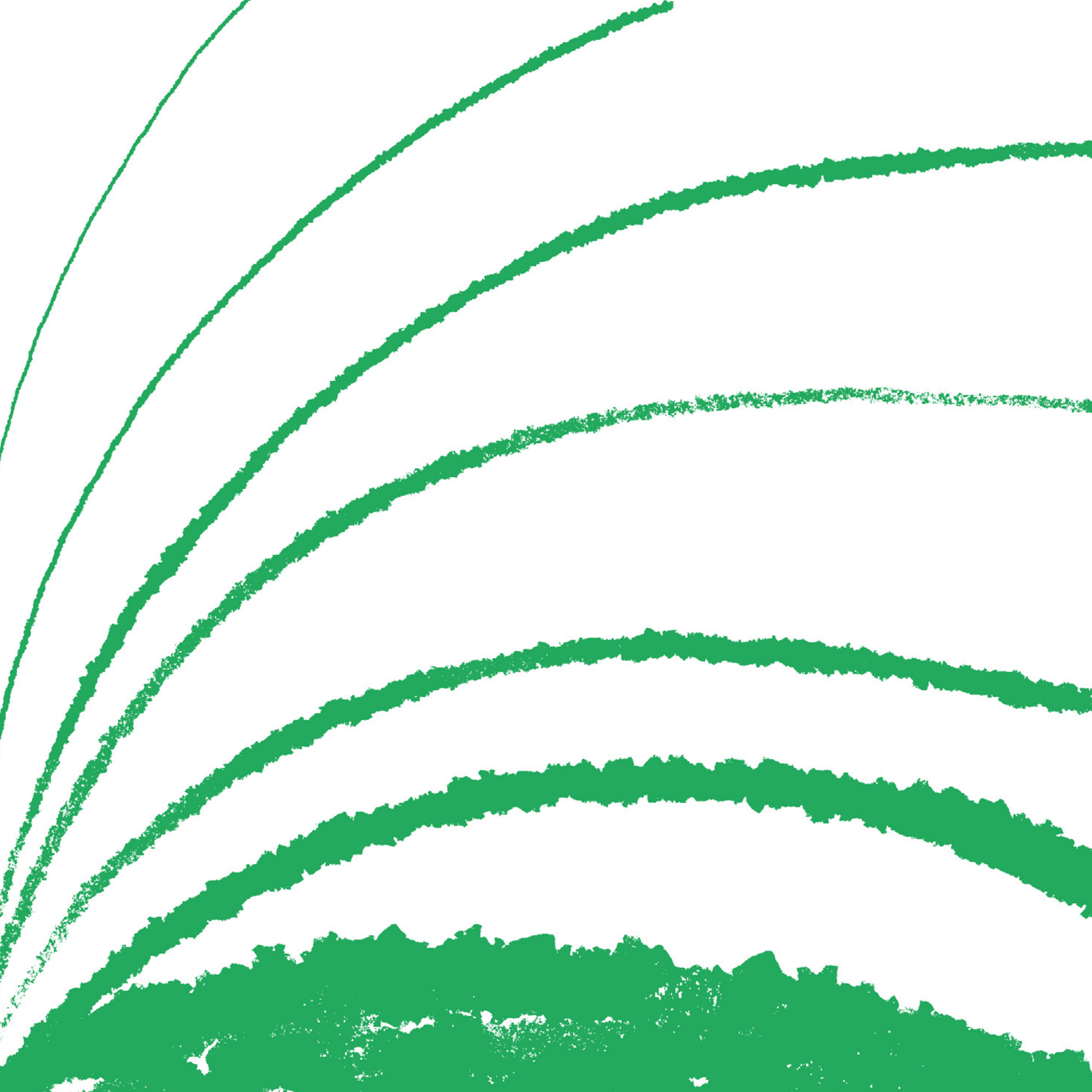




P4

Prioritise Net Positive

Prioritise regeneration, replenishment and restoration, recovering and reusing waste to create net-positive solutions and an abundance of resources. The aim should be to repair, sustain and enrich the planet, rather than deplete its precious resources.



P5

Cultivate Resilience

Systems should be designed with a capacity to adapt, diversify and self-renew even in the face of uncertainty, change and disturbances.

P6
Transmit

Document, curate and publicise to help proliferate best practice through active discourse on a global scale.

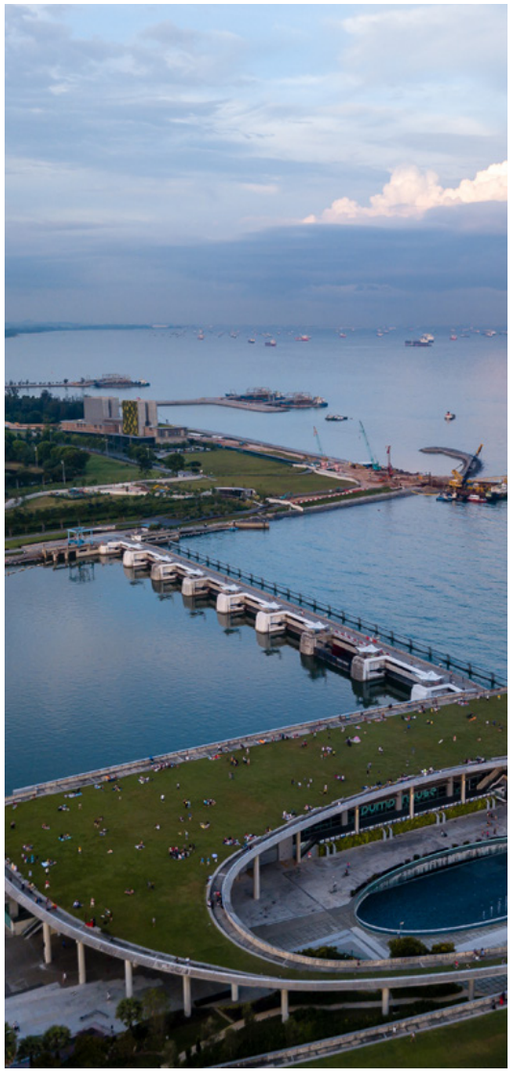
"The MAGMA framework is designed to help implement the RENEW principles and foster a community that values regenerative thinking as a core identity."

MAGMA: A framework for change

		RENEW Principles					
		P1	P2	P3	P4	P5	P6
Mindset	Appoint a RENEW champion with the mandate to ensure that the community does not slip back into old ways of thinking.	●					●
Assess	Conduct thorough assessments of existing systems to identify depletion points and element interconnectivity. Identify ecosystem tipping points to leverage systemic rebalancing. Understanding the impact on ecosystems and opportunities for regeneration and co-creation with nature.			●	●		
Goals	List out the regenerative goals for each project. This would normally include objectives for moving beyond damage limitation and identifying opportunities for broader ecological, social, and community benefits.	●	●	●	●	●	●
Metrics	Adopt metrics for each goal. Possible metrics might include ecological health, community well-being, cultural enrichment, and long-term sustainability and economic performance.	●					●
Activate	Activate engagement with a diversity of stakeholders, including interdisciplinary experts, community representatives, and impacted individuals. Promote co-creation, creativity and innovation through diverse perspectives.		●		●	●	

A RENEW Imaginarium

Here, we present three possible imaginaries of the RENEW principles in practice. They are imaginaries as they do not represent formal examples of the RENEW principles in action and, indeed, none address all RENEW principles. Instead, each imaginary is based on one or more real examples which illustrate the challenges and potential solutions within a problem space. The idea behind presenting these here is to provide some concrete examples from our own experience, which capture the nascent ideas that have propelled us to this point.



Imaginary 1: **RENEW water security**

Water is the most important substance for humans and ecosystems. It is vital for our health and well-being. Without clean water we would not be able to grow food and manufacture the products we need to support our daily lives. The economy thus 'floats' on water. Ecosystems and biodiversity would vanish without clean water. Water can be an enemy for humans and nature through catastrophic flooding and droughts, unfortunately increasing in intensity and frequency caused by climate change. But it is not just impact on and of nature, but our own extractive practices and dam building that are creating a resource crunch where one need not exist, raising the prospect of water wars. In fact, the way we currently use freshwater exceeds planetary boundaries in terms of volume and water quality.

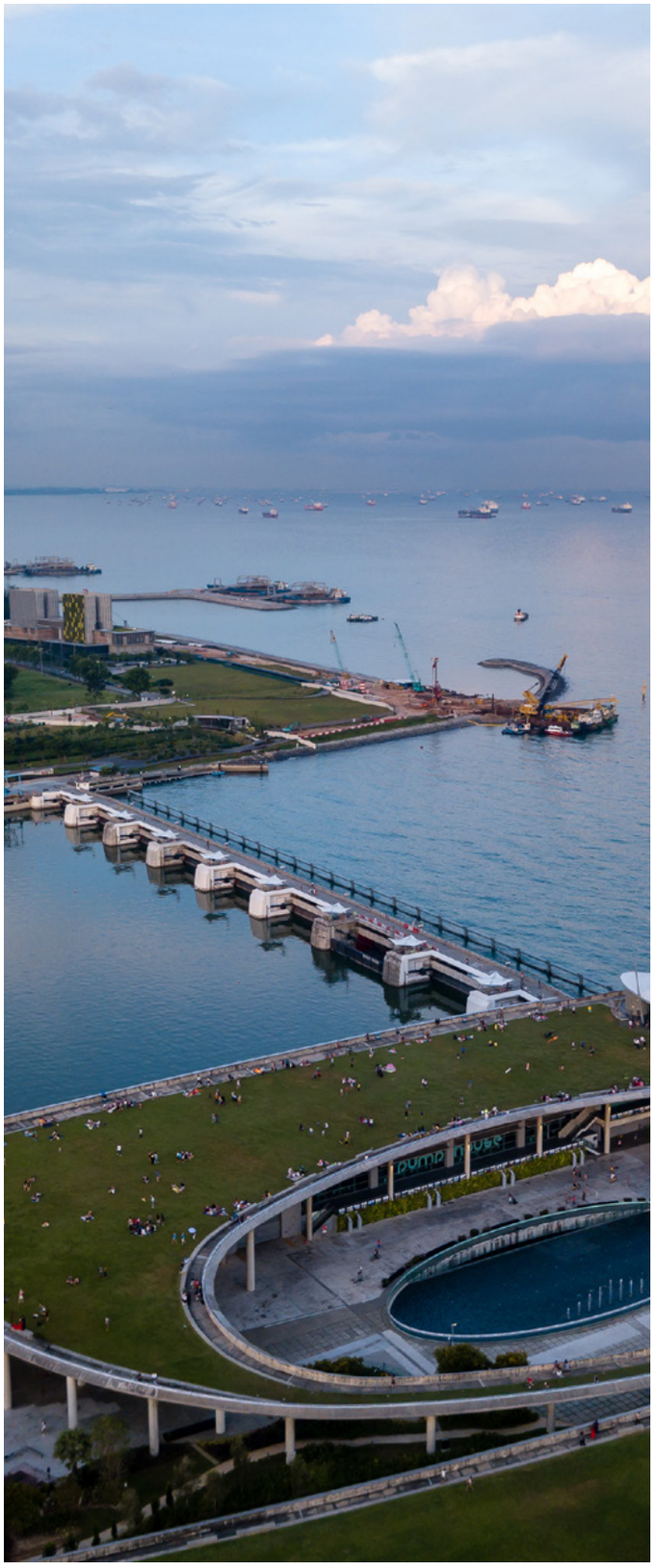
Hence, to keep and improve the availability of water for health, ecosystems, food production and economic use, and to protect life, nature and property against water-related disasters, we need to work towards Water Security.

Water Security is "*The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development; for ensuring protection against water-borne pollution and water-related disasters; and for preserving ecosystems in a climate of peace and political stability*". (UN-Water, 2013)

To address the issue of water security, we need to recognise the different scales, diversity and interconnectedness of the problem **(P2 Embrace Interconnectivity)**. It starts at people's homes: do they have access to safe and wholesome drinking water and managed sanitation? The scale goes up via catchment areas, influencing ecosystems, agriculture and cities, towards transnational and global scale.

To achieve water security on a local regional scale it is important to integrate water in our cities and the way we are living **(P2 Embrace Interconnectivity)**. Developing natural environments in our cities that can store water or can help to alleviate too much water in the case of storms will be key. Nature and ecosystems in these areas will have the function to protect the stored water resources from pollution **(P4 Prioritise Net Positive)**. By developing these systems on a local/regional level we can create resilience **(P5 Cultivate Resilience)**. Singapore is a good example where this harmony with nature is restored and the water cycle is closed. Since the early 2000s, Singapore became fully self-sustaining in water and disconnected their water import from Malaysia. Singapore lacks groundwater and natural freshwater bodies, but they created the Marina storage reservoir as a key source for water. The reservoir collects wastewater. Reclaimed water is used (NEWater) for industry, which is 40% of the nation's water demand **(P4 Prioritise Net Positive)**.

Achieving Water Security requires a net-positive regenerative approach, seeking solutions for water use and management that enable and support a continuously improving and prosperous life for humankind in harmony with nature.



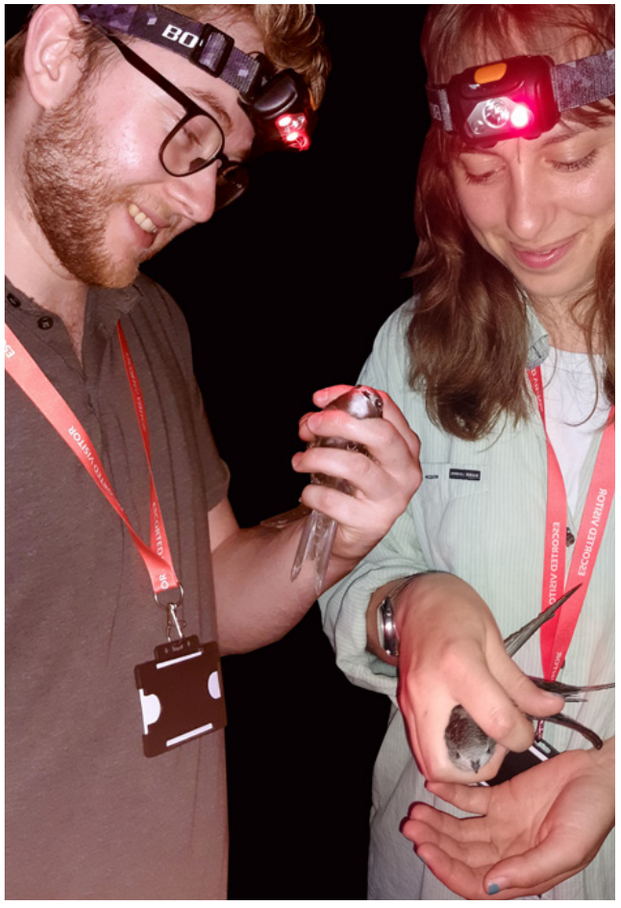
Imaginary 2: **RENEW buildings and cities**

Thinking of buildings, neighbourhoods and cities as a system of overlapping networks immediately suggests they are ripe for a RENEW approach. The Zero Emission Neighbourhoods (ZEN) living labs in Norway, for example, while primarily focusing on eliminating emissions, began with innovation hubs to co-create what ZEN actually means. They thus implicitly recognised the inter-connectivity between multiple stakeholders from users, researchers, building professionals, property developers, municipalities, energy companies and building owners **(P2 Embrace Interconnectivity)**. Their focus on emissions, however, means there was no explicit imperative to work as nature, missing a major RENEW principle.

"Declines in monitored wildlife populations function as an early warning indicator of the potential loss of ecosystem function and resilience." (WWF living planet report, 2024)

For example, at building scale, gains in carbon and energy come through super-insulated, lightweight and airtight construction, all needed to carefully manage the heat, moisture and air-mass exchange between inside and outside. Unfortunately, a surprising and unintended side effect of such a design philosophy, is the loss of nooks and crannies in buildings which are used by several fauna for nesting or roosting. These include bats, birds such as swifts, and hymenoptera such as bees, hornets and wasps. Each species provides critical ecosystem services such as pollination, managing crop-damaging insects and nutrient transport. Swifts, in particular are vulnerable as they fly from Africa to the same mate and nesting site in England each year. The removal or unavailability of suitable nesting sites is implicated in dramatic falls in swift populations, the species being red-listed and classified as endangered in the UK. Similar trends have been observed for other species too. It is hence clear that it would be ideal if the success of a low carbon / energy strategy promotes, rather than resists, an increase in biodiverse outcomes – i.e. one that is regenerative. Emerging work at the University of Bath supports the idea that the solution may need to be integrated into the building fabric, as opposed to external solutions such as 'swift boxes' for longevity, maintenance, temperature regulation and aesthetic reasons.

In other words, by working with nature and prioritising a net-positive outcome for swifts, it is possible to not only meet our climate goals but also replenish ecosystems **(P3 Work as Nature**). While further work needs to be done to develop ideal solutions, particularly for retrofitting buildings, the first step for cultivating resilience is already in place through the creation of carefully researched examples of heatwaves for now and the future at the unprecedented hyper-local spatial resolutions of 5 km for the UK and 25 km for India **(P5 Cultivate Resilience)**. These allow designers to consider how the entire system, from swift enclosures, building, neighbourhoods and entire cities can adapt and self-renew over the long-term, well into the 2080s. The data, accompanied by considerable guidance on building design in the form of videos, manuals and examples have been transmitted to a range of stakeholders through hands-on training and are available in a free repository **(P6 Transmit**).



Imaginary 3: **RENEW humanitarian engineering**

A person is forcibly displaced from their home every two seconds. Over time, conflicts are expected to be exacerbated by climate change, especially over land and water resources, and likely to increase forced displacement. In many cases, the same hotspots may be repeatedly activated, whilst new ones open up.

"We are facing the biggest refugee and displacement crisis of our time. Above all, this is not just a crisis of numbers; it is also a crisis of solidarity." (Ban Ki Moon, UN Secretary General, April 2016).

Humanitarian efforts, and the design and engineering contribution to them, therefore need to recognise that solutions need to cultivate resilience through being able to adapt, diversity and self-renew **(P5 Cultivate Resilience)**. This is much harder than in traditional settings as there are socio-political dimensions that will determine success **(P2 Embrace Interconnectivity)**. For example, green areas attached to refugee shelters are seen as a sign of permanency by host populations, and therefore unpopular. To address this, solutions need to embrace interconnectivity and use transdisciplinary approaches.

A nascent version of such an approach is in the Healthy Housing for the Displaced project at The University of Bath which pioneered the idea of a Shelter Assessment Matrix (SAM) that allows humanitarian efforts to appropriately identify and weight priorities for 34 distinct but overlapping issues ranging from cultural aspects of privacy to technical aspects of ventilation and thermal resistance. SAM, in turn, is supported by detailed guidance for each of the issues such as ShelTherm a point-and-click shelter thermal design assistant. Hence, by undertaking a SAM approach, the chances for developing resilience and net-positive outcomes are greatly enhanced **(P4 Prioritise Net Positive)**. Both SAM and ShelTherm have been actively promoted in the aid sector through active transmission of knowledge and training, with the tools themselves being free-to-access on a dedicated platform **(P6 Transmit)**.

"To embrace the principles of regenerative design and engineering we need new ideas and new science to help set the foundations of a net-positive world."

This manifesto was co-created by

RENEW

CENTRE FOR REGENERATIVE DESIGN AND ENGINEERING FOR A NET POSITIVE WORLD

UNIVERSITY OF BATH

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RENEW Manifesto

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