

Nature-inclusive Guiding Principles

White paper, two-year research on Nature-inclusive Area Development



Balconies for biodiversity

Balconies offer plenty of opportunities for greening, water collection, and nature education. Support initiatives from developers and residents to turn their balconies into lush green havens.



Tangible nature

Urban nature should lead to tangible experiences. Designing urban waterways as ecological corridors, for example, and linking them to housing developments. This unlocks nature services and enhances community support.



Concise system

Be specific about which nature-inclusive interventions are mandatory. A concise point system can serve as a foundation for developers, with ample space for designers to implement these requirements.



Under cover

Aim for multi-layered native greenery stacked vertically, with consecutive flowering periods. Ensure green spaces are accessible to wildlife and minimise interventions in the lower green layers.



Home, sweet home

To make a building nature-inclusive, the surroundings must also be included. Not only is a safe (nesting) space crucial, but so are food and water.



Measuring is key

The state of biodiversity should be assessed before and after nature-inclusive measures are taken.



Natural benefits

Use ecosystem services as a base for tenders and project ambitions. Monitor the effects of area developments after realisation to check service quality retention.



Building for nature

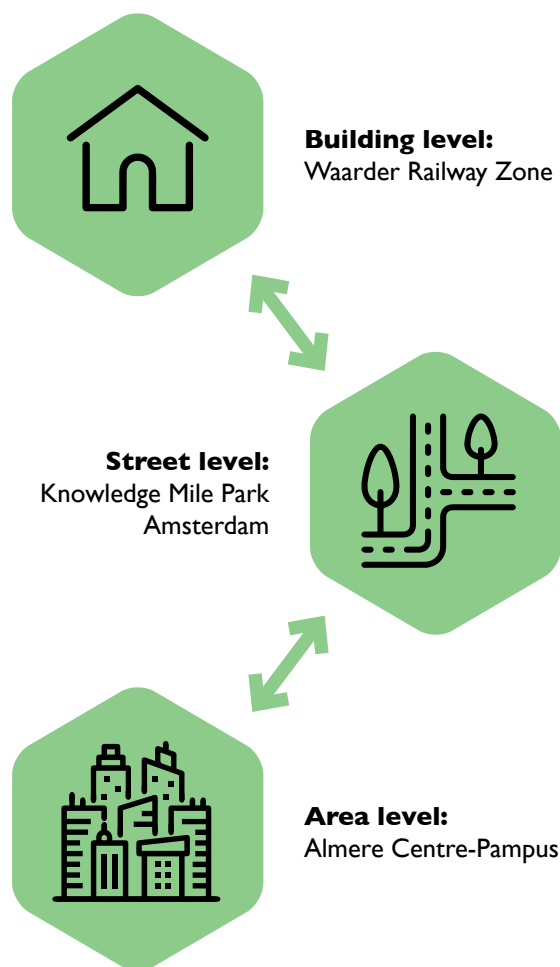
Use biobased façade materials, such as wood and biocomposite, tailored to provide shelter for insects, birds, and small rodents.



Nature-inclusive across scale levels

Urban nature enhancement is a theme that needs to be considered across different scales. From pocket parks and façade-greening to urban green infrastructure, biodiversity thrives best through connectivity.

In the SIA-project, Nature-inclusive Area Development, four universities of applied sciences - Aeres University of Applied Sciences, Avans University of Applied Sciences, Amsterdam University of Applied Sciences, and Van Hall Larenstein University of Applied Sciences- researched three levels of area development to accelerate the transition to nature-inclusive area development. The study consisted of three case studies: Waarder Railway Zone (building), Knowledge Mile Park (KMP - street - Amsterdam), and Almere Centre-Pampus (area). The case studies represent common types of urban interventions, such as small-scale new developments, public space improvement, and inner-city densification. Although each case had its own thematic focus - biobased materials (Waarder Railway Zone), natural greening (KMP), and governance (Almere) - sub-studies and collaboration between universities led to cross-pollination. The following pages present the main results and key lessons learnt.



Learning with the field and students



Nature-inclusive development and biobased construction are urgent and complex challenges. During the project, seven 'acceleration sessions' were held with professionals in the field. This active interaction facilitated the gathering of practical insights and sharing of developed knowledge.



Linking biobased and nature-inclusive approaches is a transdisciplinary task, also in education. In a learning environment organised as part of the project, around 25 students from biology, architecture, and urban planning collaborated to collectively build new knowledge each semester, supported by guest lectures and work sessions. Over the course of the project, over 400 students from 12 study programmes contributed to the project through modules, minors, internships, and theses.



Building level

Case: Waarder Railway Zone



Prototype of the new substations, source: ProRail

Nature-inclusive biobased substations

ProRail aims to make the substations of the Dutch railway-system nature-inclusive by installing biobased façades. The façade for the Waarder Railway Zone is made of a biocomposite and is designed to provide shelter for insects, birds, and small rodents. Research was conducted regarding the criteria a façade must meet if it is to accommodate as many species as possible. Furthermore, the correlation between nature-inclusiveness and climate resilience was examined. Within ProRail, Avans University of Applied Sciences surveyed employees on their acceptance of biobased materials and nature-inclusiveness. Findings indicate safety concerns, but there is also enthusiasm to contribute to sustainability and nature-inclusiveness by serving as 'good practices'. Finally, the aging of the applied biocomposites in outdoor conditions was investigated.

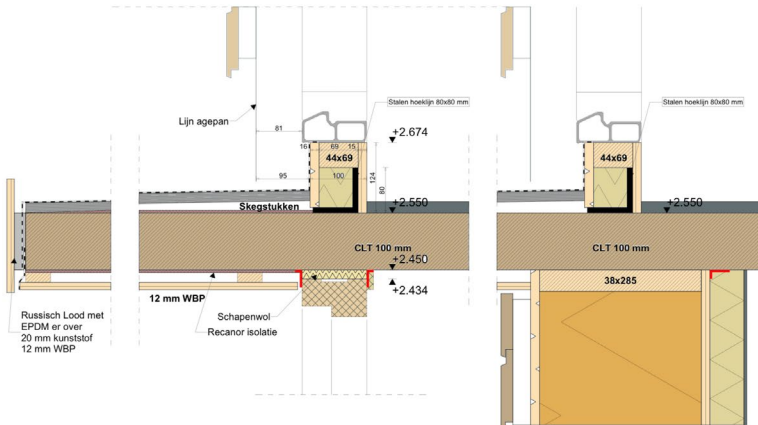
Key lessons

- To increase biodiversity on and around the building, it is important to tailor the design and placement of a façade to the surrounding ecosystem and the variety of species within it.
- Nature in urban areas can be enhanced by specifically designing the building and its surroundings to cater for target species.
- To measure the effects of a façade on nature-inclusiveness, it is important to map the biodiversity of the area and building before and after implementation.
- A notable finding was the lack of transparency from manufacturers of biobased materials regarding the composition of their materials.

Laying tracks for nature

To develop a façade that can be utilised by numerous species in the Netherlands, it is crucial to research the criteria it must meet, including orientation, entrance size and shape, and neighbouring ecosystems.

ProRail's network traverses nine different ecosystems. The façade must be designed with attention to the target species in each ecosystem. A flowchart has been devised to aid professionals in identifying the ecosystem type and its associated target species. Design criteria have also been formulated for the façades, focusing on pollinating insects and recommendations for vegetation surrounding the structures to enhance biodiversity. Utilising the flowchart increases the likelihood of promoting biodiversity on and around the buildings.



Residence Olstergaard van Dijkhuis: Detail of a balcony overhang where the wooden (CLT) floor extends from inside to outside without forming a cold bridge. Sheep's wool has been used for sealing instead of PUR.

Biobased materials

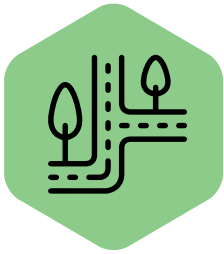
Available biobased construction materials were documented in a material list, along with their properties and potential applications. A notable finding was the lack of transparency regarding their composition. Case-study analyses reveal that biobased materials are used for their unique properties. They provide advantages over traditional construction materials and they therefore appeal to the construction industry.

Climate measures

Nature-inclusive construction helps reduce the urban heat-island effect and improve air quality. The research also indicates that adding trees and permeable paving, combined with shrubbery and more organic material in the soil, are the most effective measures for climate-proofing urban substations and their surroundings.

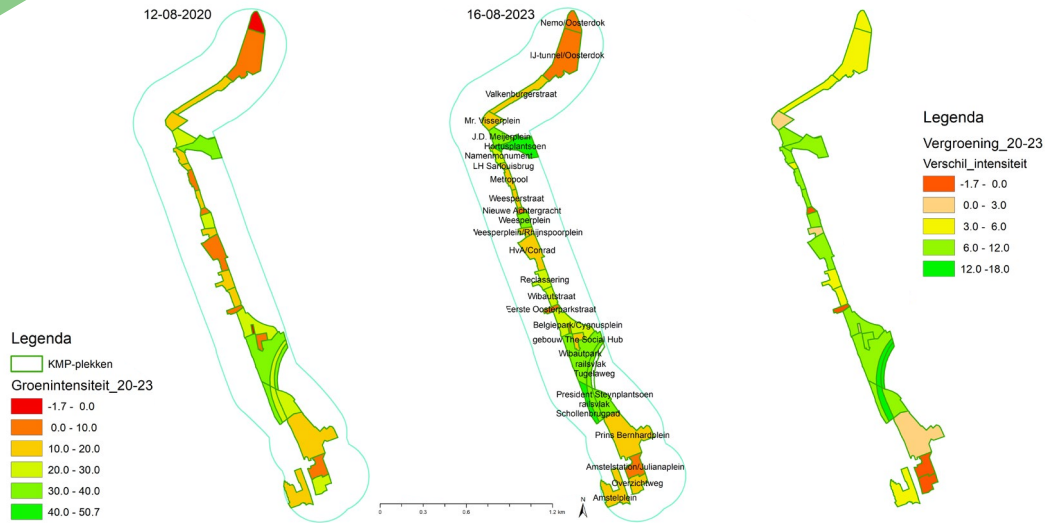
Picture	Scientific name	Common name	Minimal hole diameter [mm]	Suggested entrance location	Orientation	Expected life stage during construction usage	Purpose of construction usage
	<i>Apis mellifera</i>	European honeybee	20	Middle and higher part of the construction	East or eastern south	All	Laying eggs, nesting, resting, food storage
	<i>Bombus hypnorum</i>	Bumble bee	22	Lower to the middle part of the construction	All beside north	All	Laying eggs, nesting, resting, food storage
	<i>Xylocopa violacea</i>	Violet carpenter bee	25	Plinth to the lower part of the construction.	East or eastern south	All	Laying eggs, nesting, resting, food storage
	<i>Osmia leaiana</i>	Orange-vented mason bee	10	All	All beside north	All	Laying eggs, nesting, resting, food storage
	<i>Bombus cullumanus</i>	Cullum's bumble bee	21	Plinth to middle part	East or eastern south	All	Laying eggs, nesting, resting, food storage
	<i>Platycheirus scutatus</i>	-	10	All	All beside north	Adult	Resting, nesting
	<i>Episyrphus balteatus</i>	Marmalade hoverfly	12	All	All beside north	Adult	Resting, nesting
	<i>Chrysotoxum cautum</i>	Large wasp hoverfly	13	All	East or eastern south	Adult	Resting, nesting
	<i>Volucella zonaria</i>	Hornet mimic hoverfly	22	All	All beside north	All	Laying eggs, nesting, resting, food storage
	<i>Sphaerophoria scripta</i>	The long hoverfly	11	All	East or eastern south	Adult	Resting, nesting
	<i>Aglais io</i>	European peacock	n/a	Middle and higher part of construction	East or eastern south	Adult	Rest
	<i>Aphantopus hyperantus</i>	Ringlet	n/a	Middle and higher part of construction	All beside north	Adult	Rest

Interactions among insect pollinators in the context of a nature-inclusive and biobased building façade for ProRail, source: Zaklin Tomaszewska, Avans University of Applied Sciences



Street level

Case: Knowledge Mile Park Amsterdam



Green intensity (2020 and 2023) was derived for each Knowledge Mile Park location from NIR images via NDVI calculation. The difference indicates the amount of greening.

Nature-inclusive traffic artery

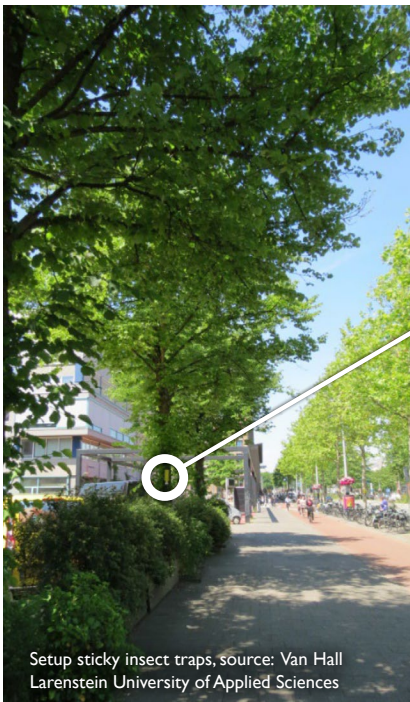
The Knowledge Mile Park in Amsterdam is a greening and sustainability programme. It is an initiative of the municipality of Amsterdam and the Knowledge Mile Business Investment Zone (KM BIZ). In this programme, vegetation is added to Amsterdam's busiest traffic artery through small-scale plant beds, green verges, trees, façade gardens, green façades, and roofs, etc. The project owes its name to the educational institutions located along the traffic artery. Van Hall Larenstein University of Applied Sciences conducted research on the effects of these greening measures on the surrounding ecology (including on insects, birds, and bats), and on human behaviour and perception (including health, social cohesion, and nature engagement). Additional research was conducted on maintenance and participation by residents, businesses, and other stakeholders. The overarching research question was: how can a traffic artery become a shared habitat for plants, animals, and people?

Key lessons

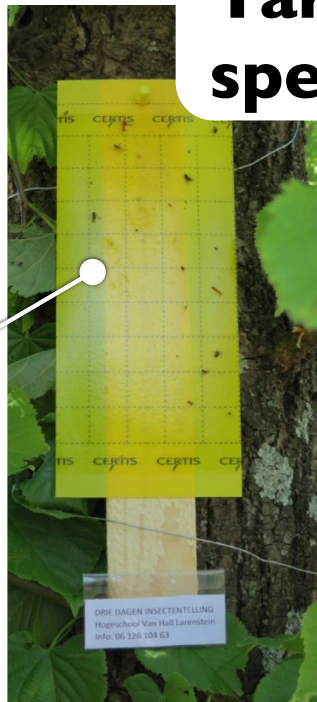
- Consider the needs of the target species and remove constraints on food, safety, movement and reproduction. This will greatly increase the return on investment in greenery.
- Strengthen the connection between public and private green spaces.
- Align bottom-up approaches with existing collectives where organisational strength is already present.
- Incorporate maintenance from the outset, involving residents in the process.
- The research results support expanding the green areas into a green corridor through the city.
- Longitudinal research could provide insights into the long-term effects of greening initiatives.

Target species require specific greenery

The research question was: What effect does the greening of the KMP have on the presence of sparrows and bats (some of Amsterdam's target species)? In places with more greenery and/or water, the researchers found more insects. The combination of bushes (for safety and procreation), rough areas/grasses, and insects (food), creates areas with high densities of sparrows. Bats also require frequently recurring linear green or blue elements (movement).



Setup sticky insect traps, source: Van Hall Larenstein University of Applied Sciences



DRIE DAGEN INSECTENTELLING
Hogeschool Van Hall Larenstein
Info: 06-326-30464

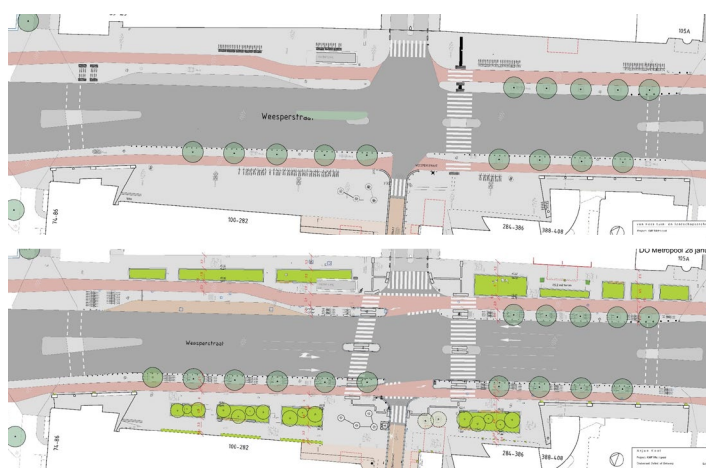
Behaviour and perception

An online questionnaire was sent to residents living near or within the KMP in the autumn of 2022 and 2023 to investigate users' behaviour and perceptions. Most residents found greenery in their street important, and they predominantly rated the green KMP locations positively. Awareness of the KMP increased from 2022 to 2023. The green areas were, however, seldom used for recreational purposes, except for walking. Traffic-related factors (noise, air pollution, lack of safety) limited appreciation and use.



Organisation, management, and participation

How should we best organise KMP's greening operation? What lessons can we learn about green management, and what role can residents play in this? Interviews with stakeholders revealed that organisation and collaboration are key. Additionally, students came up with innovations such as information boards and an app to increase support for greening and residents' participation.



KMP section-designs, for both sections: Original situation at the top and the new situation at the bottom, source: designer Arjan Kool, municipality of Amsterdam



Area level

Case: Almere Centre-Pampus



Contours of the Oostkavels in Almere Stad, source: Google Maps

Nature-inclusive Oostkavels

The Oostkavels are a series of parking lots along the city canal of Almere that are destined to become a vibrant new part of the city centre with approximately 2200 new dwellings. The municipality sets high ambitions in the Centre Development Agreement (*Centrumontwikkelakkoord*) concerning housing, nature, and climate. In practical terms, this translates to the question of how densification through housing construction can create a nature-inclusive city centre for increased thermal comfort and experiential value. To address this question, Almere's ecological network was mapped at the city level and then further detailed with fieldwork at the local level. Surveys, case studies and policy analyses of national, international, and green-area factors were also used to identify bottlenecks in, and opportunities for, nature-inclusive governance. Subsequently, both tracks were incorporated into tools through interviews and working sessions.

Key lessons

- Use nature as a base for area development and make it experiential, for instance through local rewilding or visible water systems. This renders ecosystem services tangible and increases an understanding of dynamics in nature and societal support.
- Use the migratory behaviour of target species and native biotopes as the design starting point for robust ecological networks.
- Involve management and ecology professionals early in urban development processes to gain insight into values, requirements, management and monitoring costs.
- Encourage citizen engagement in nature management to enhance social cohesion and nature connections, as well as reduce maintenance costs. Educational activities can ensure long-term continuity.

Fine-grained ecological network

The green-blue network of Almere was mapped through a combination of NDVI and NDFF data, and eco-connections outlined in the municipality's Ecological Vision 2020 (*Visie Ecologie 2020*). To verify the ecological value of this network, vegetation and insect inventories were conducted in Almere Stad. Results show that Almere has a well-established green-blue network at the urban level, but it remains highly fragmented at the neighbourhood level and in the city centre in particular. Nature often lives in the margins here, which is unfavourable for both biodiversity and humans.

Additional research into the migratory behaviour of target species as well as deploying compact point systems in tendering processes can enhance and preserve ecological quality in area development. Opportunities for synergy exist along the current cycling and walking routes, as well as the water systems.

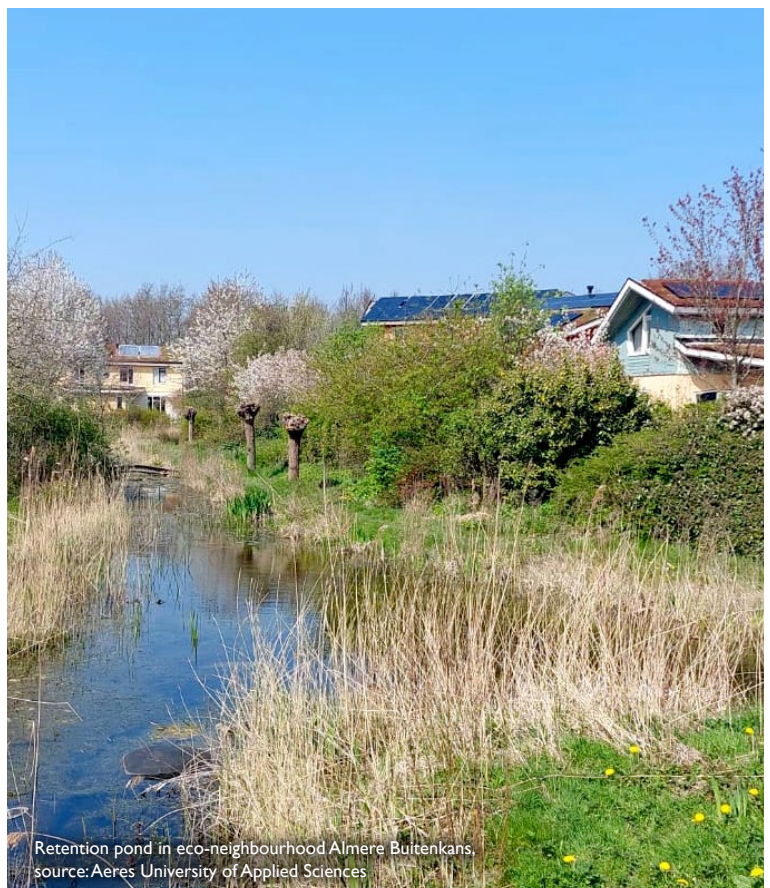


Aerial photo of Almere showing surveying methods: insects, vegetation, water and social, source: Google Earth and Aeres University of Applied Sciences

Fieldwork, source: Aeres University of Applied Sciences

Nature as a base

For nature-inclusive area development to be effective, nature must not be quantified as mere leftover space: its contributions to a healthy living environment, nature perception and climate must be incorporated from the outset. Using the green-blue networks as a base and making nature experiential through the water system makes ecosystem services tangible and enhances public support for nature-inclusiveness. This can be reinforced through citizen engagement in local nature management, which can also reduce overall management costs and enhance social cohesion. Continuity of local knowledge, even if residents move, can be ensured through activities such as neighbourhood safaris or other educational initiatives.



Retention pond in eco-neighbourhood Almere Buitenkans, source: Aeres University of Applied Sciences

Nature-inclusive & Biobased

Cross-connections



Nature-inclusive and biobased construction are often seen as separate ambitions, but in this project, they are combined. The outcomes of the research show that there are numerous synergy benefits to integrating them holistically. For a nature-inclusive city more biomass – trees, green façades, and so on – is needed to reduce the urban heat-island effect. Biobased materials can mitigate climate change by storing and reducing CO₂ emissions. Furthermore, integrating the two construction tracks enhances both physical and mental health, and urban biodiversity.

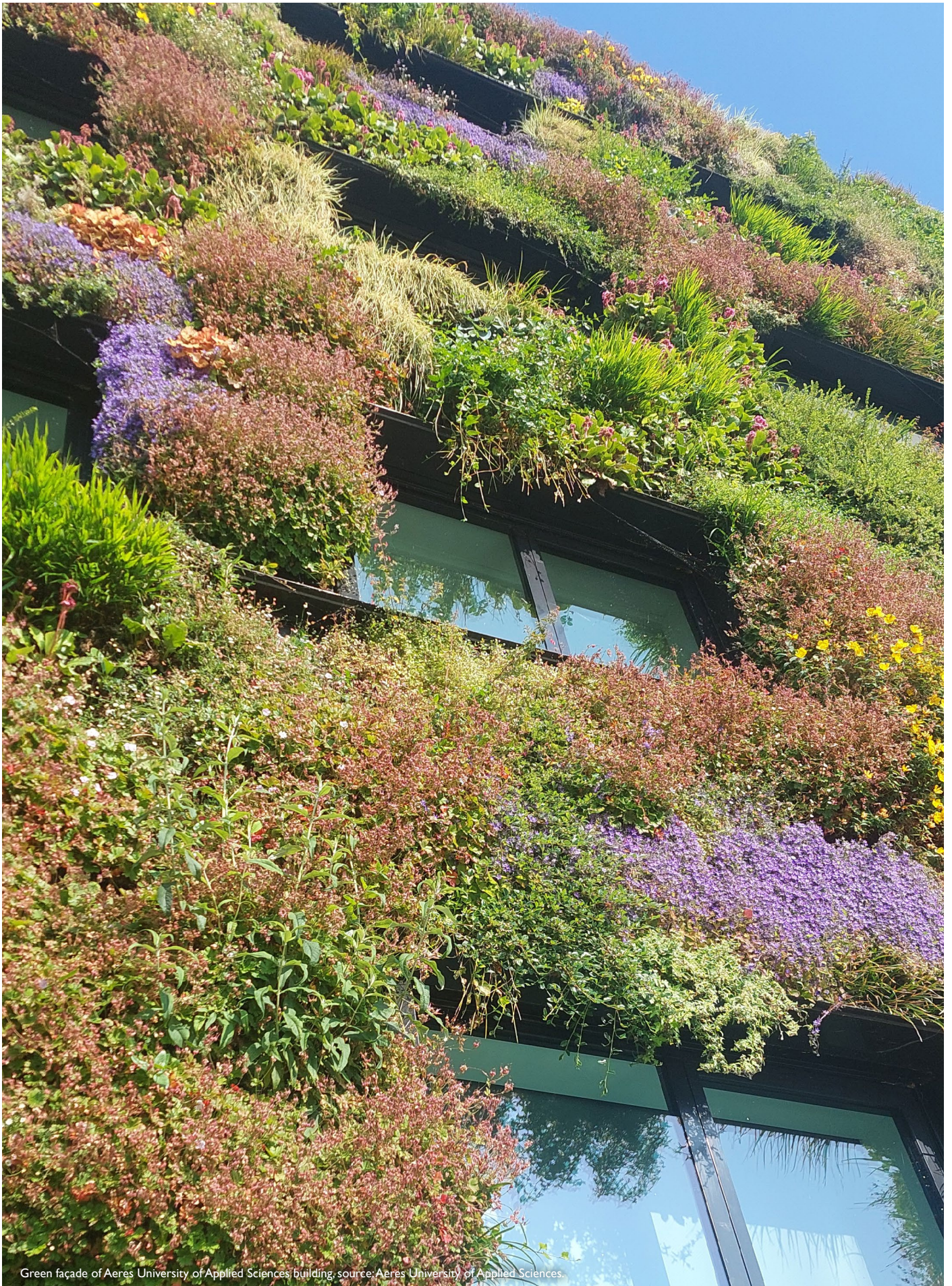
Nature-inclusive without borders

Cross-connections

The benefits of nature-inclusive development are boundless, but there still are significant spatial and governance constraints. In inner-city housing development, space is a scarce resource. Greening and opening up building blocks to strengthen the connection between nature on plots and the urban green infrastructure can help alleviate key constraints of nature-inclusive approaches.

In governance, there is evidence that nature-inclusive area development is constrained by compartmentalisation and fragmentation between policy domains and layers of governments. At the same time, the research demonstrates that there is ample opportunity at various scale levels for biobased construction and nature development.





Green façade of Aeres University of Applied Sciences building. source: Aeres University of Applied Sciences.

Colophon

March 28, 2024

University project teams:

Aeres University of Applied Sciences Almere

Guido Hilgeman, Evelien Konings, Patrick Limpens
Gideon Spanjar and Esmond Wesselink

Avans University of Applied Sciences

Arjen Boon, Fran Ortega Exposito, Susanne Heldens,
Neha John, Shannon Peuling, Ilse Rovers and Annine Rozema

Amsterdam University of Applied Sciences

Elsbeth van Battum, Federica Cefis Colombo, Joris van
Dijk, Sara Duisters, Sam Edens, Dante Föllmi, Tom Fontani,
Fleur de Greeuw, Jeroen Kluck, Lidewij Lenders, Ed Melet,
Rachel Reynolds, Sába Schramkó, Gideon Spanjar and Frank
Suurenbroek

Van Hall Larenstein

University of Applied Sciences

Ronald Boertje, Saskia Heins,
Derk Jan Stobbelaar and Bert van de Wiel

Design and editing:

Patrick Limpens and Gideon Spanjar

The icons used in this publication are from Flaticon.com.

Contact:

Project lead Gideon Spanjar:
g.spanjar@aeres.nl

CoE Green Project page

<https://coegroen.nl/>

Curious to find out more?

The QR-code to the right will take you
to more information on the various
sub-studies.



Project team

The two-year research project Nature-Inclusive Area Development was initiated through the Centre of Expertise Green (CoE) and was a collaboration between Aeres University of Applied Sciences Almere (chair of Innovation & Urban Green Space, also lead partner), Avans University of Applied Sciences (chair of Biobased Construction), Amsterdam University of Applied Sciences (chair of Spatial Urban Transformation, research group Circular Construction & chair Water in and around the City), Van Hall Larenstein University of Applied Sciences, and the CoE Biobased Economy and the CoE City Net Zero.

The project started in April 2022 and concluded in March 2024.

Funding

This publication and the associated research project 'Natuurinclusieve Gebiedsontwikkeling' (in English: Nature-inclusive Area Development) were jointly funded by the programme *Praktijkkennis voor Voedsel en Groen* (in English: Practical Knowledge for Food and Green) of the Taskforce for Applied Research SIA, a division of the Dutch Research Council (NWO), together with the Ministry of Agriculture, Nature, and Food Quality.



Acknowledgements

We are deeply grateful to the Taskforce for Applied Research SIA and the Ministry of Agriculture, Nature, and Food Quality for entrusting us with the opportunity to carry out this research project. Our gratitude also extends to our case study partners: ProRail, Studio Marco Vermeulen, the municipality of Almere, the province of Flevoland, Amsterdam Green Campus, BIZ Knowledge Mile, and the municipality of Amsterdam for their outstanding collaboration at case level.

We are indebted to the many practising professionals from our consortium: AM Real Estate, Practice & Innovation Center Circular Economy (PRICE), Foundation Stone Break, MNNR Architects, Yuverta, Eigen Haard, Spoorbeeld, ABN-AMRO, and Floriade EXPO 2022 for applying their practical knowledge to support the research and assisting in disseminating the results. Also, thanks to the sounding board for reflecting on the research findings.

The final words of gratitude go to the many dedicated students from various study programmes and universities. Without all of you, this project and publication would not have been possible. Thank you!

Universities of Applied Sciences



Partners



Sounding board





Nature-inclusive Area Development

In the SIA-project, Nature-inclusive Area Development, four universities of applied sciences - Aeres University of Applied Sciences, Avans University of Applied Sciences, Amsterdam University of Applied Sciences, and Van Hall Larenstein University of Applied Sciences - collaborated with a broad range of professionals working in the public and private sectors to research how the transition to nature-inclusive area development could be accelerated.

The project was divided into four work packages: (1) the use of biobased building materials, (2) measuring the value of natural greening, (3) mapping governance barriers, and the fourth (4) that integrally compiled the knowledge into deliverables. The research encompassed three case studies representing the three scale levels of area development: Waarder Railway Zone (building), Amsterdam Knowledge Mile Park (street), and Almere Centre-Pampus (area).