

**Addressing Climate Change Effects in Cities:
Nature-Based Solutions and Green Infrastructure**

Roof Garden Projects in Seoul Metropolitan City

2021.10. 05.

Won-Ju, Kim (Research Fellow)



서울연구원
The Seoul Institute

Dept. of Safety and Environment Research

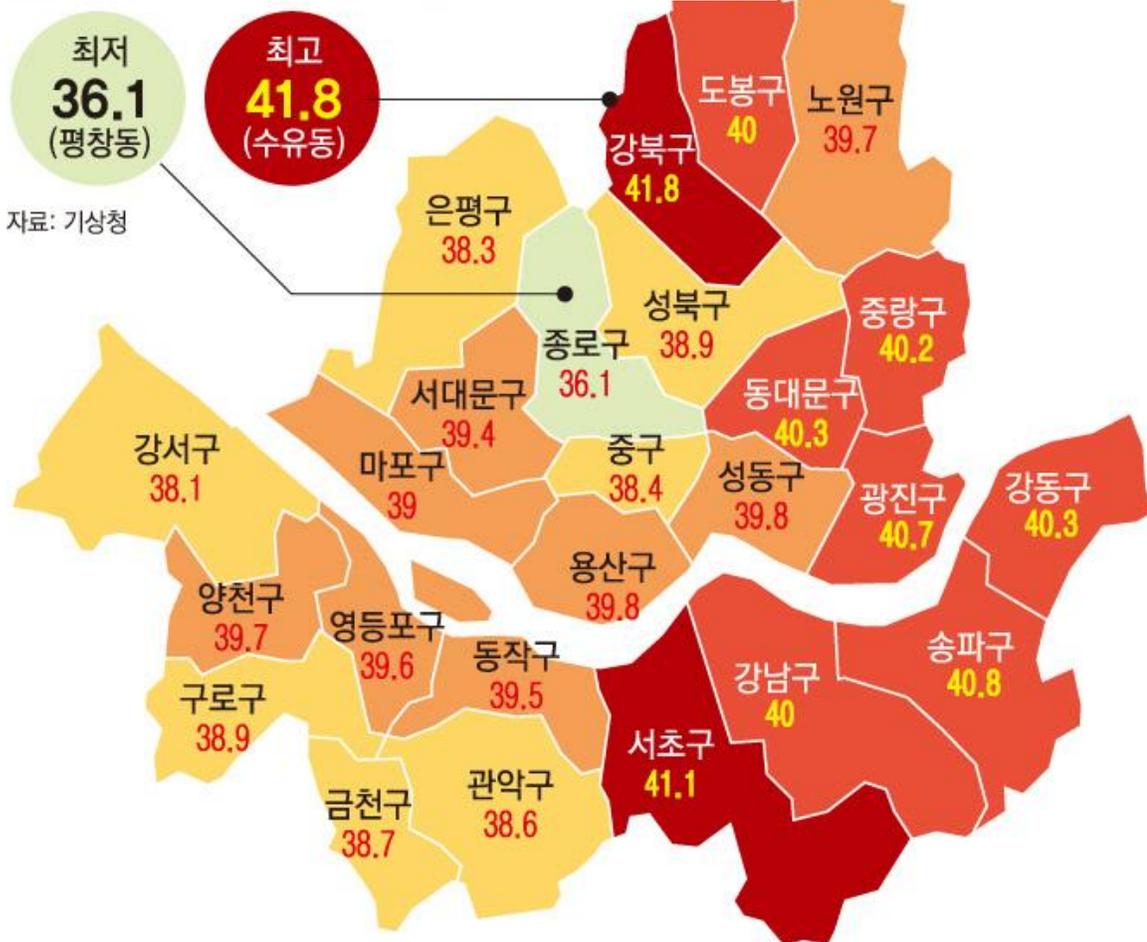
❖ Green Oasis & Cooling Space

- ▶ The need for space and shelter for healing in everyday life is increasing.
- ▶ This is all the more so because COVID-19 lasts for a long time.
- ▶ Roof garden Project : A green project to obtain ecological and landscape effects by placing soil on the roof of a building and planting plants such as trees and grass.
- ▶ It helps to reduce fine dust and alleviate the heat island phenomenon by planting trees on the roof and creating a shelter.
- ▶ It provides a pleasant rest area for residents.

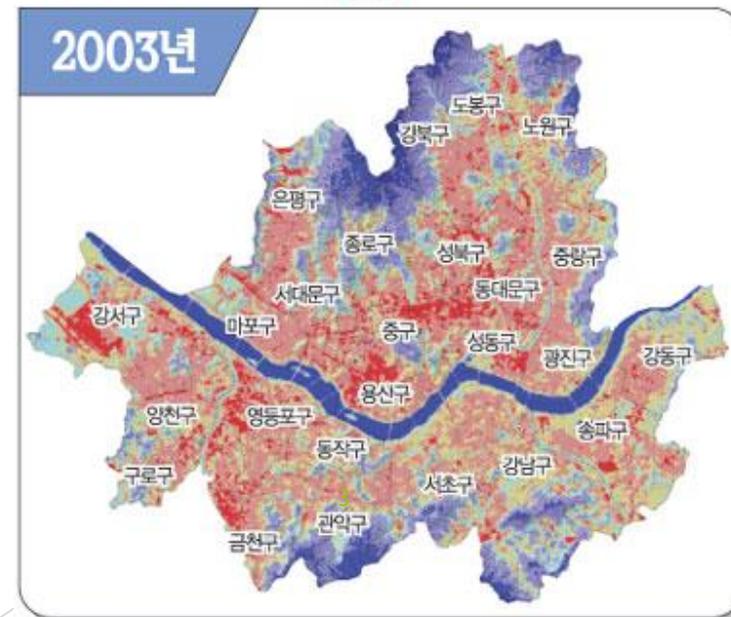
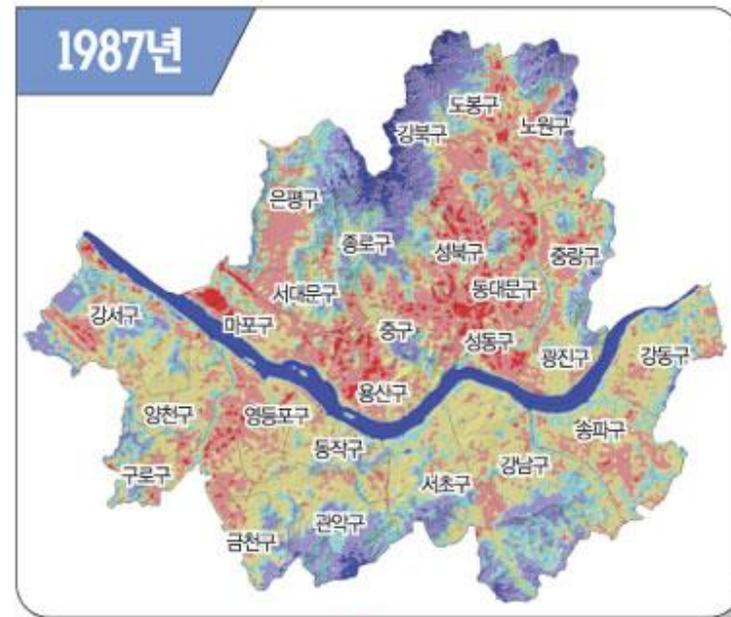
❖ heat island

- Rooftop gardens should be built first in areas where there are many heat island phenomena.

The highest temperature in Seoul (August 1)

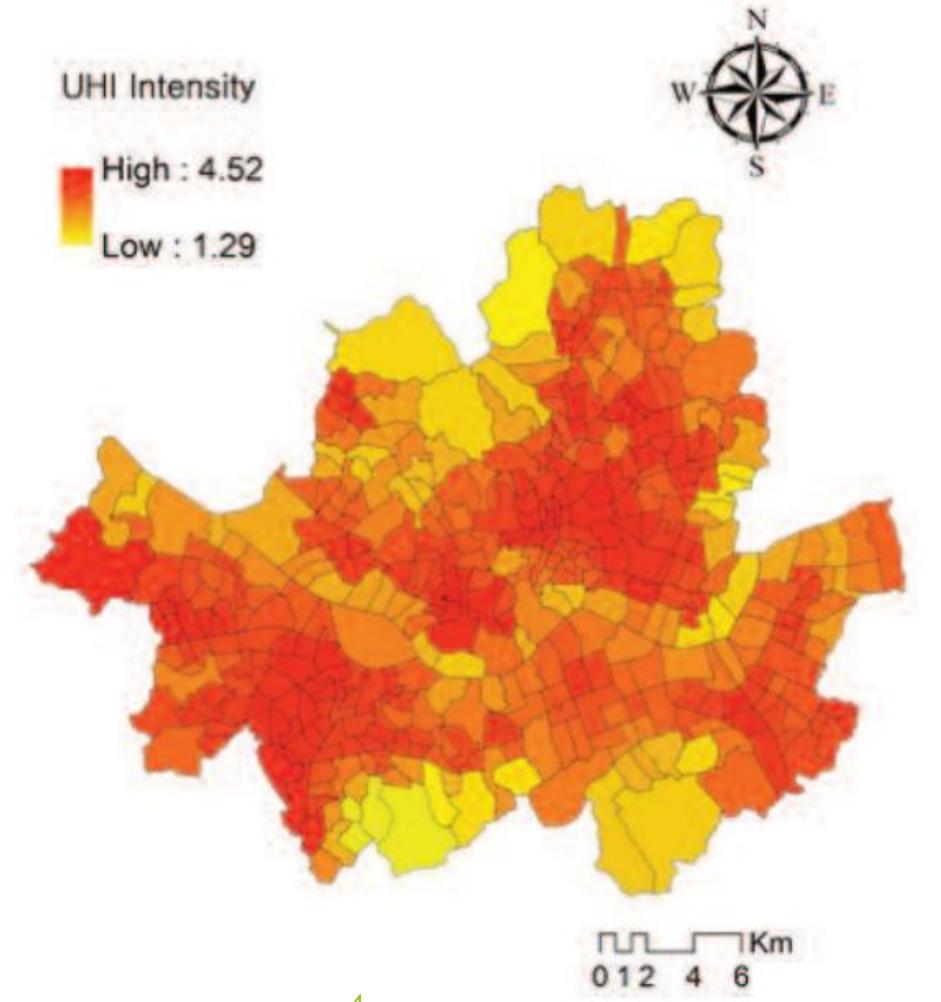


Heat Islands in Seoul



UHI Intensity

- ▶ UHI Intensity : The difference in average temperature between urban and suburban areas.
- ▶ The temperature difference between Seoul and Yangpyeong increased by about 0.56°C from 1970 to 2000.
- ▶ In terms of UHI Intensity, the difference is larger at the administrative dong level.



Source :

“Analysis of the Effect of Heat Island on the Administrative District Unit in Seoul Using LANDSAT Image”

Korean Journal of Remote Sensing, Vol.33, No.5-3, 2017, pp.821~83

■ UHI Intensity of Administrative dong

❖ Green Oasis & Cooling Space

- A building with a rooftop garden has an average temperature of 3.1°C lower than other buildings.
- It alleviates the urban heat island phenomenon.
- The cooling and heating energy of buildings is reduced by an average of 12-15%.
- If the temperature is above 35°C, energy is saved up to 17%.
- If you garden an area of 100m² and a depth of 10cm, you can store about 200 liters of rainwater.
- 14% of insects and birds increased by more than five species than before.

❖ The ground law about Roofgarden

- ▶ 「 The Seoul Metropolitan Government Ordinance on Urban Greening 」
(Subsidy for urban green projects)
- ▶ Plans to promote the rooftop greening project in 2021
- ▶ Approval for change of target site for rooftop greening construction project in 2021



- Trees and grass are planted in the rooftop garden.

❖ Performance (2002~2020)

- ▶ In terms of the size of the football field, 44.6 rooftop gardens were created. (7,140m²)
- ▶ Roof of 764 buildings
- ▶ Details of the project: structural safety diagnosis service, waterproof, installation of rest facilities, planting trees, etc.

➤ Before and after the rooftop garden at Gangnam-gu Health Center.

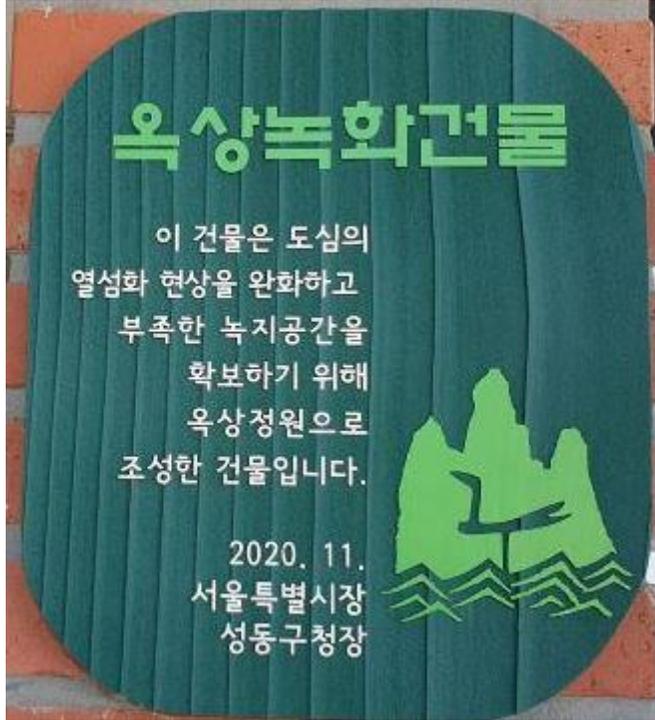


➤ Before and after the rooftop garden of Gangnam-gu Internet broadcasting station.



(Photo = Provided by Seoul.)

➤ Site : The 2nd Seoul Creative Arts Education Center in Seongdong-gu, Seoul.



There are 570 kinds of trees and 1,498 kinds of grass flowers.

The view from the rooftop garden

➤ Site : rooftop garden of Seoul Station.



Source : <https://opengov.seoul.go.kr/mediahub/22543769>

❖ Garden City Seoul, 1000 Green Roof Projects

- ▶ By revising the ordinance, the Seoul Metropolitan Government is providing support by raising the subsidy from 50% to 70%
- ▶ For all buildings of public institutions and private buildings.
- ▶ 2021 :
 - ▶ 23 buildings, including the Supreme Court building in Seocho-gu, will promote the creation of rooftop parks.
 - ▶ Area : 9,150m²

❖ Discussion



- Jungnang-gu Office opened the rooftop garden to residents.

- ✓ There is a need for cooperation and coordination between related departments on the creation of a method suitable for the target site.
- ✓ Monitoring after construction is required.



- Box garden for urban agriculture.



- Solar energy facilities.

Thanks a lot.

The Nature-based climate adaptation programme for the urban areas of Penang island

thinkCITY
REJUVENATING THE CITY TOGETHER

GOALS

To use nature-based solutions to reduce climate change impacts in Penang, reducing threats to human life, infrastructure and property

SCIENCE-DRIVEN :

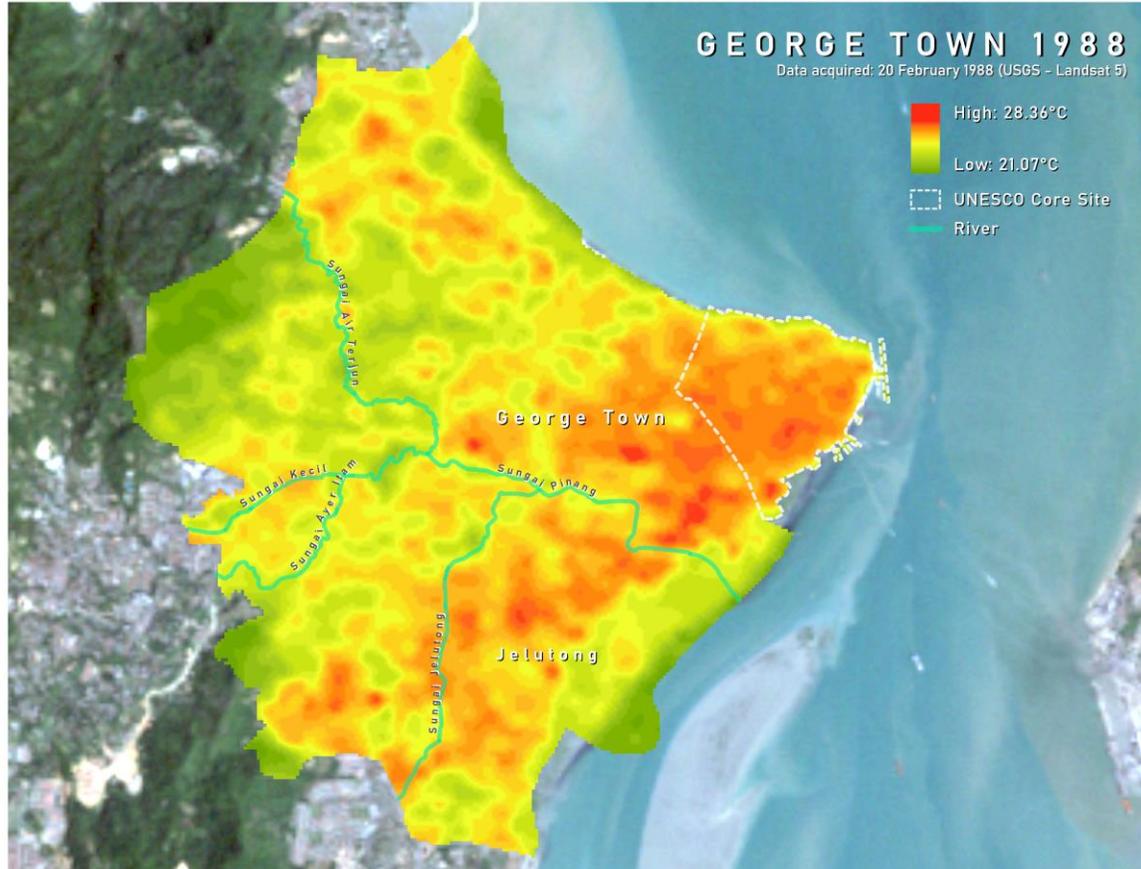
- Design
- Results/ Impact Assessment

GEORGE TOWN

Increase of temperature in the last 32 years
(verified by remote sensing data on surface temperatures - Landsat 8)

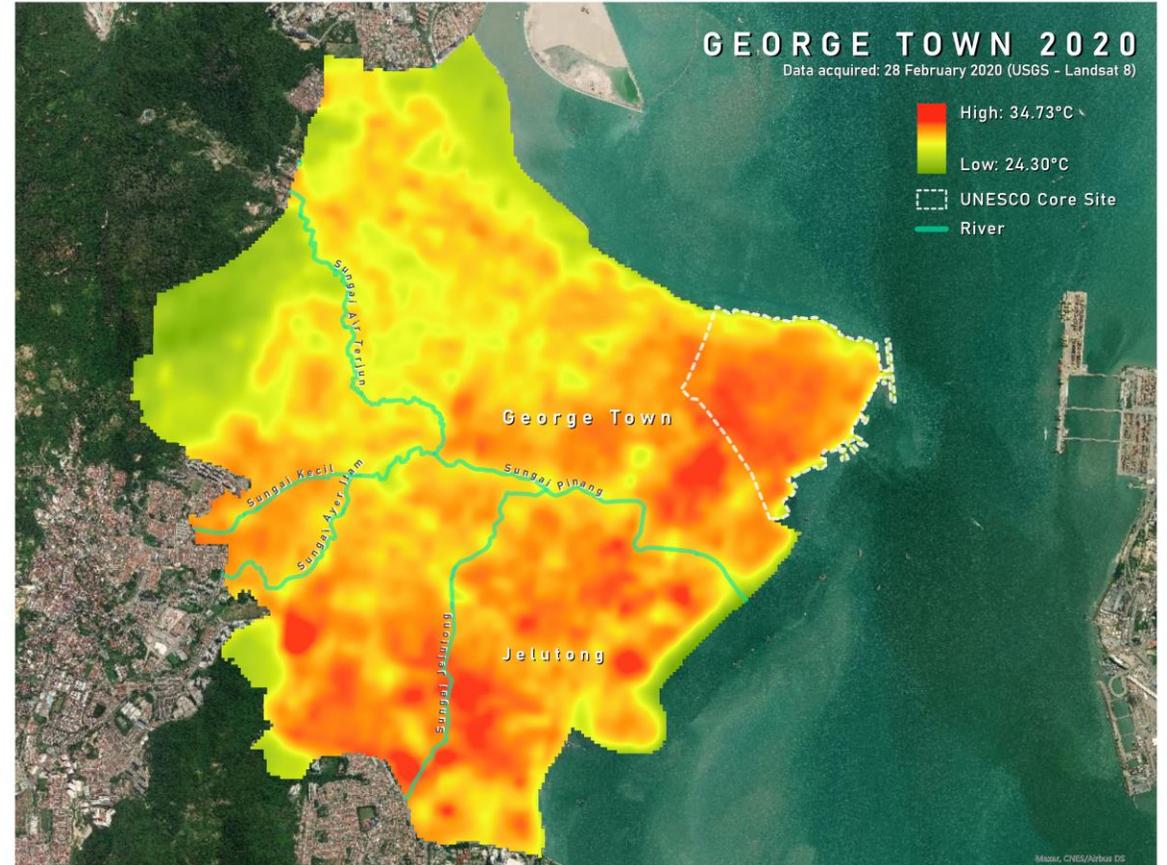
↑↑ Max. 8.7°C
↑↑ Min. 2.4°C

1988



Max. 28.5 °C
Min. 21.2 °C

2019

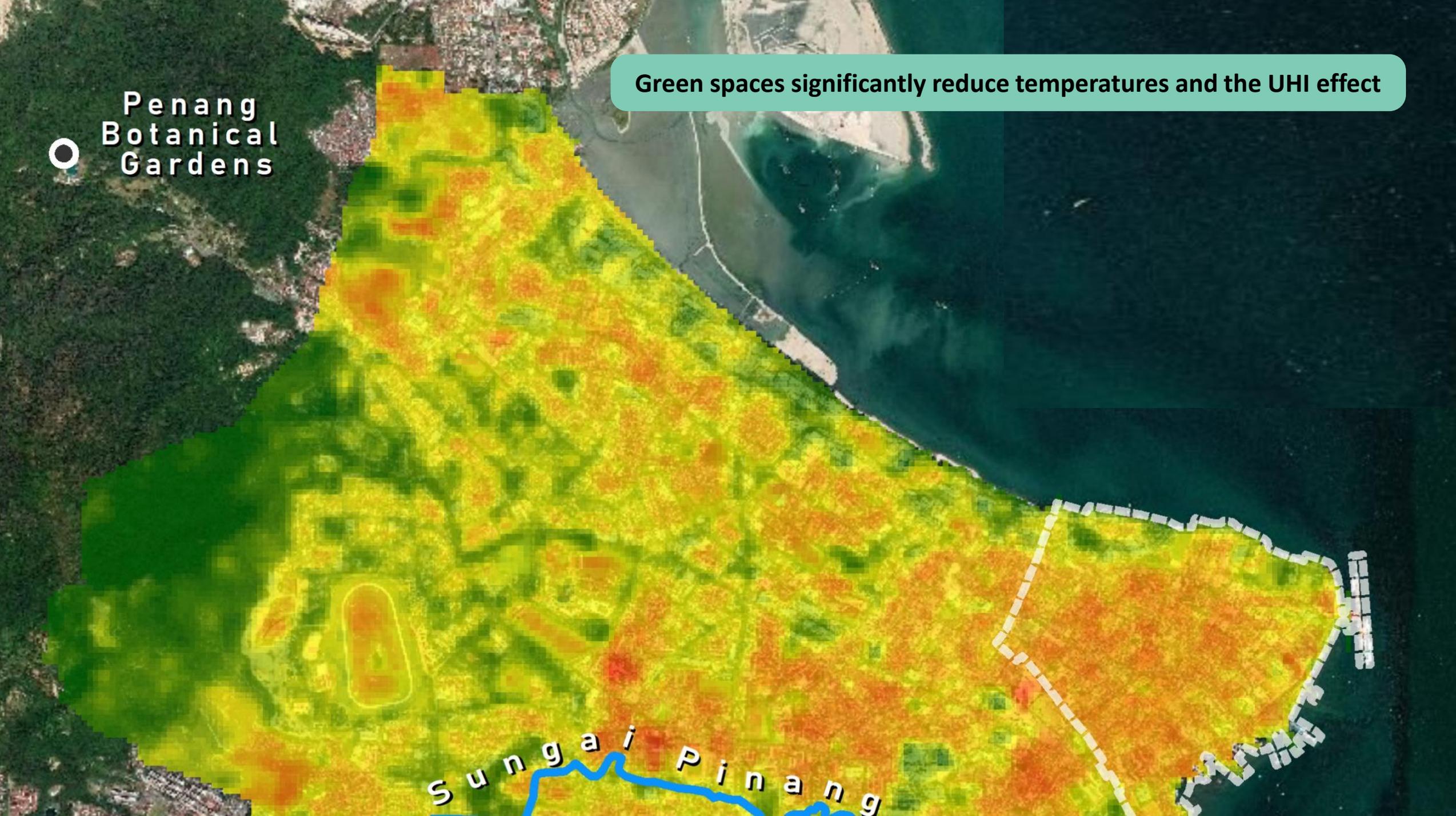


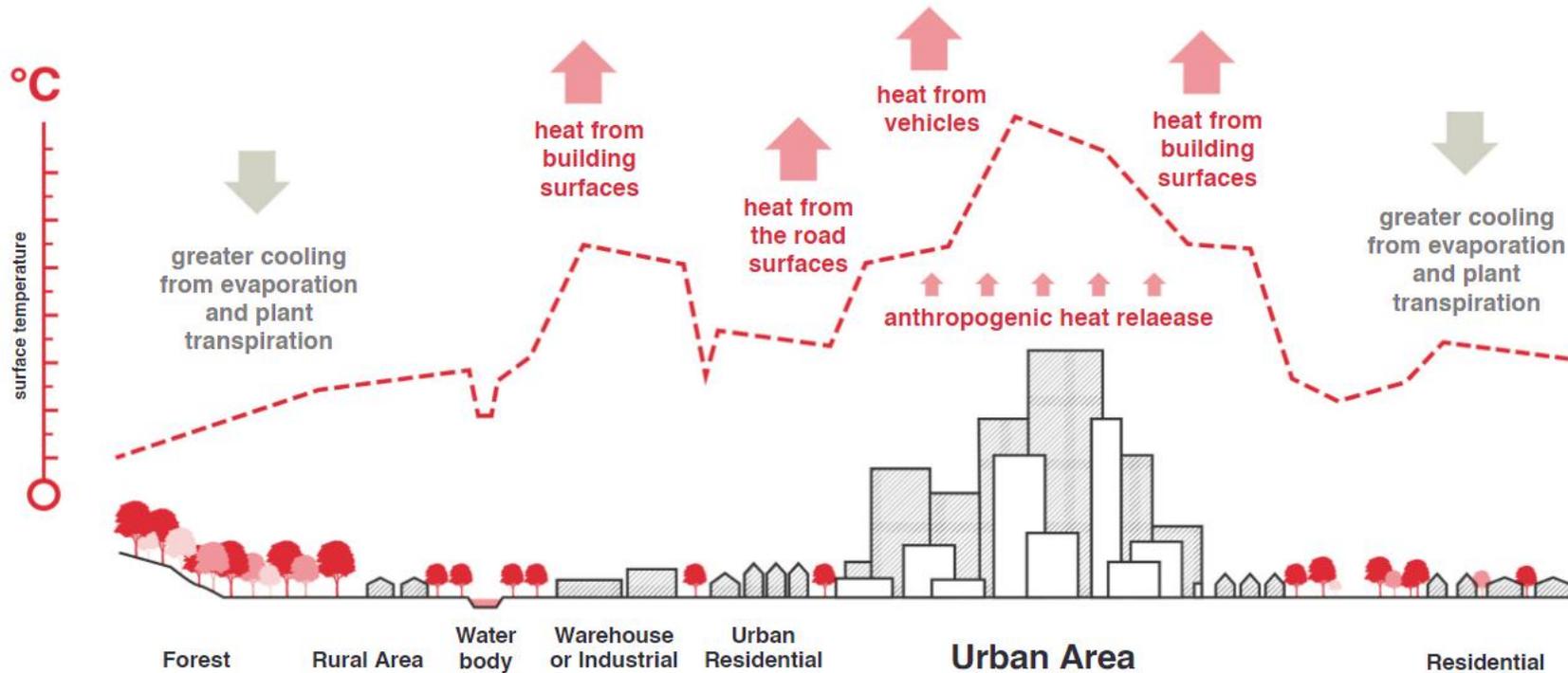
Max. 37.2 °C
Min. 23.6 °C

Green spaces significantly reduce temperatures and the UHI effect

○ Penang Botanical Gardens

Sungai Pinang





Due to the increased **heat capacity** of cities, the imperviousness of urban surfaces inhibiting evaporative cooling and anthropogenic heat sources. Night time temperature differences can be up to 10°C.

The frequency of extreme weather events is affected by UHI, as the amount of **heat wave days** is **increasing twice as fast in cities than in the rural surroundings**.
(Lauwaet, 2016)

Urban areas are typically between 2°C and 8°C above surrounding natural and rural areas

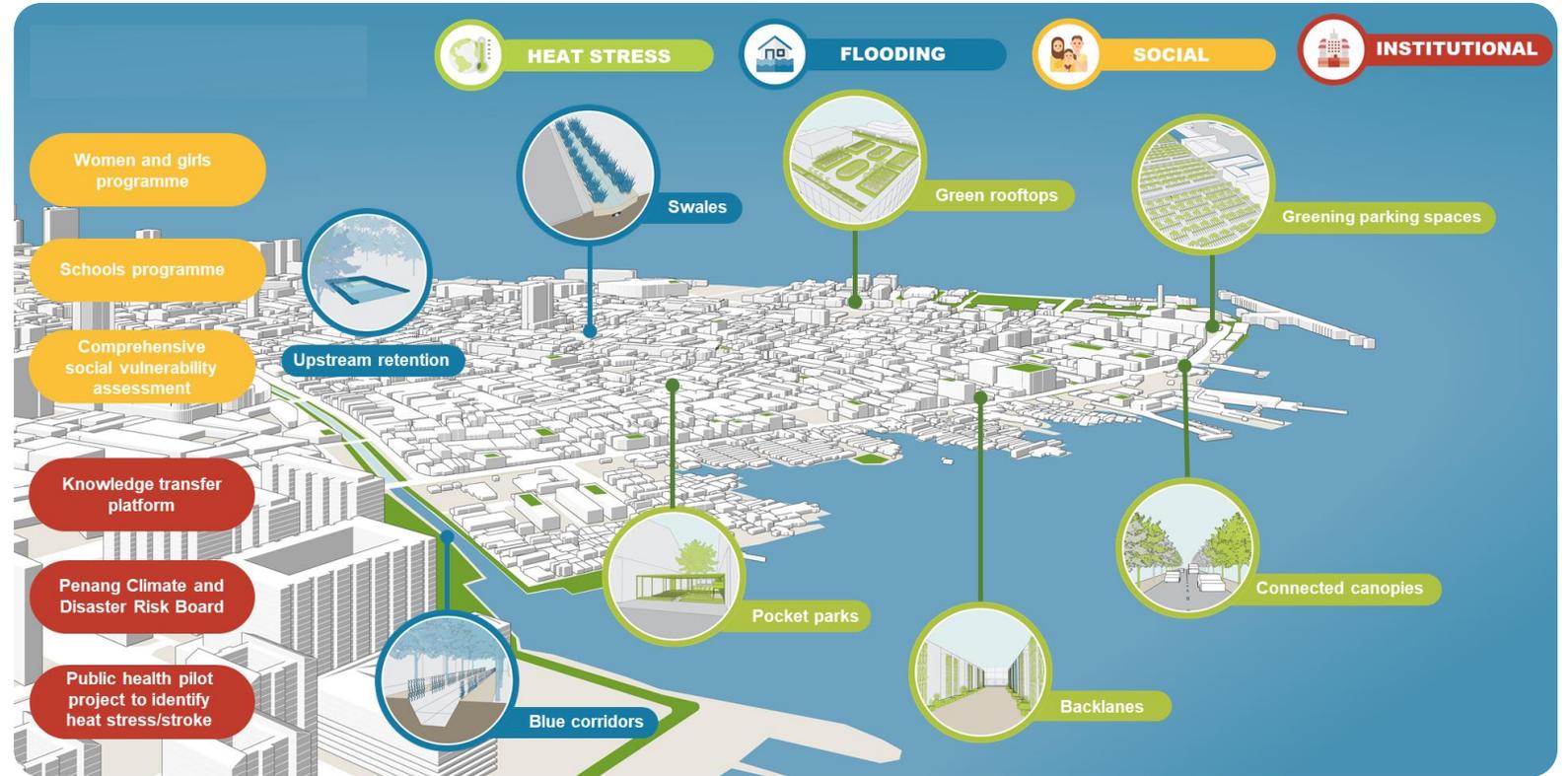
Climate Adaptation Programme Components

Nature-based Climate Adaptation Programme for the Urban Areas of Penang Island

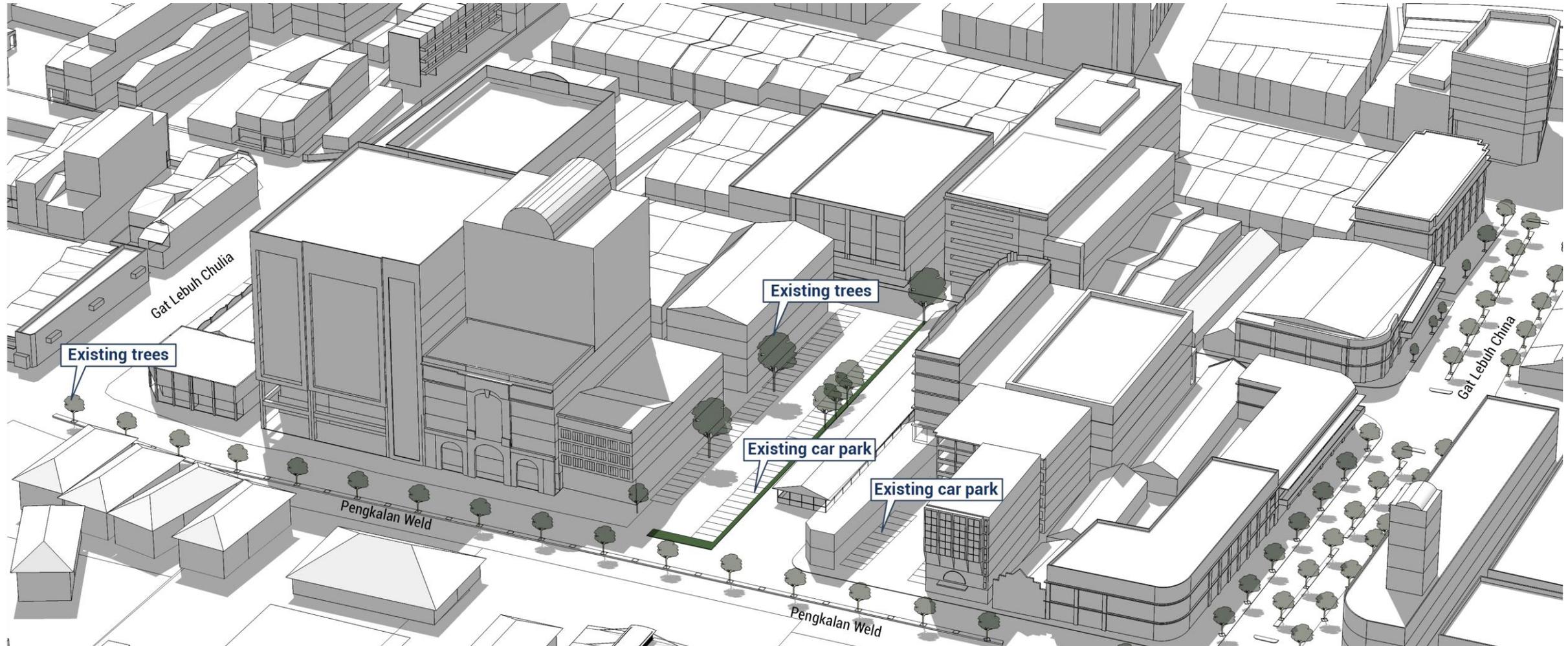
Enhance Urban Resilience and Reduce Vulnerability

of human and ecosystem health to climate change impacts by implementing **nature-based solutions** and prioritising resilience of natural infrastructures

Components include social resilience, public health and institutional capacity



In formulating the concept and strategies, different types of green elements will be implemented



Penang Won The Climathon Global Cities Award 2020

(shortlisted with Miami, Khartoum, Salvador and Dublin)

The Penang programme was endorsed by the Adaptation Fund in October 2020 for funding of US\$10,000,000



January 2020



A view of one of the decorated balconies located at Lebuh Pantai in George Town February 3, 2020. — Picture by Sayuti Zainudin

The **Climathon Global Cities Award 2020** prize money is sponsoring the **Climate Resilient Street Tree Species Study for Malaysia**

The development and publishing of research for climate-resilient tree species includes:

- **Main climate-related challenges for urban trees**
- **Selection criteria and methodology**
- **Full list of species**

A compact, pedestrian scale city until recent growth and latest urban developments.

3 Km.



- *Administrative Capital of the Basque Country*
- *255,042 inhabitants*
- *276.81 km.*
- *46 homes/ha.*
- *101.51 inhabitant/ha. (residential areas)*

European Green Capital 2012:

The acknowledgment of a lifetime of...

- *Political consensus*
- *Technical support*
- *Citizen engagement*

A journey of more than 30 years... and still going on...



جائزة دبي الدولية لأفضل الممارسات
Dubai International Award
For Best Practices

Main challenges faced by Vitoria Gasteiz

01 Improve air quality

02 Reduce the urban heat island effect

03 Increase the carbon sink effect

04 Prevent flooding and recharge groundwater reserves

05 Increase biodiversity

06 Improve the quality of the landscape

07 Spaces for leisure, sport

08 Encourage contact with nature

09 Encourage social gathering

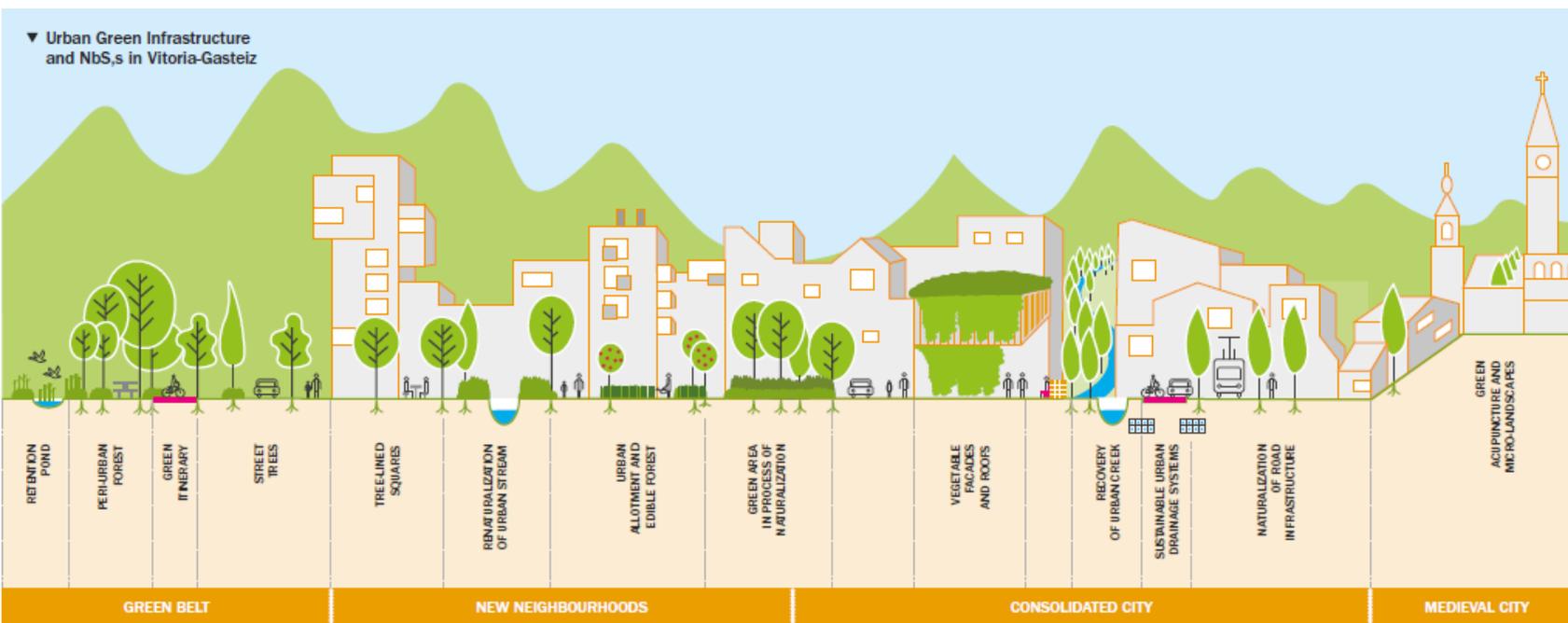


▼ Vitoria-Gasteiz Urban Green Infrastructure System



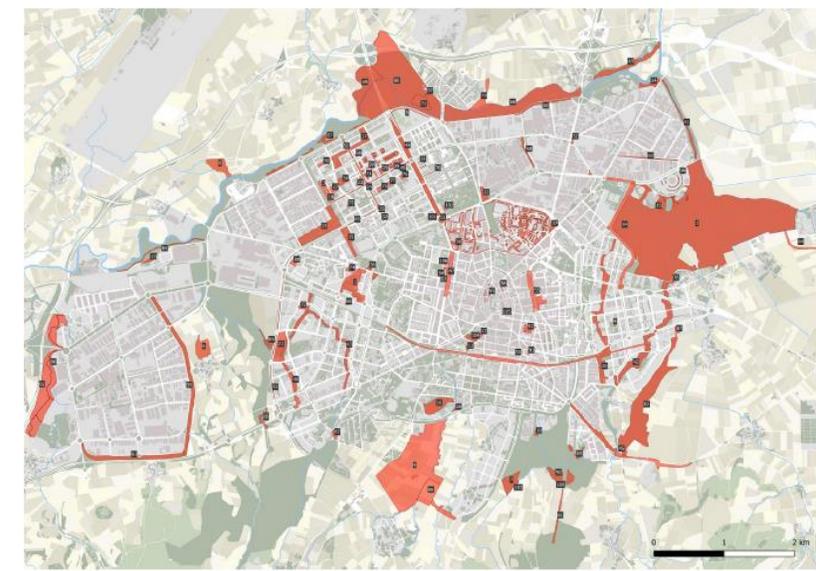
www.vitoria-gasteiz.org/greeninfrastructure

NEW DESIGNS (NBSs) FOR NEW FUNCTIONS



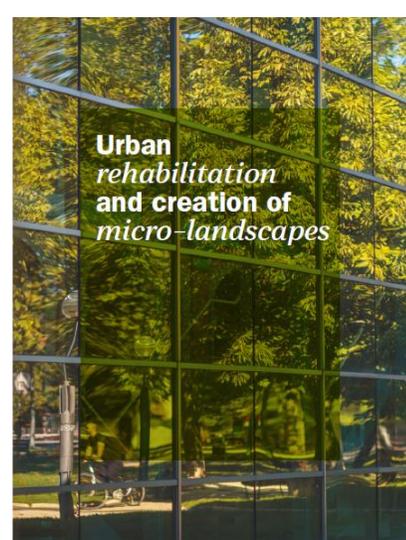
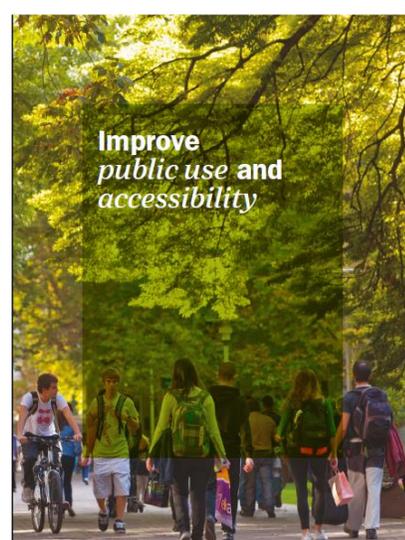
<p>INCREASE IN BIODIVERSITY</p> <ul style="list-style-type: none"> Creation of habitats and wildlife refuges Naturalized management of green areas Urban forests Flower meadows Urban pedestrian walkways with trees 	<p>INCREASE IN ECOLOGICAL CONNECTIVITY</p> <ul style="list-style-type: none"> Renaturalization of altered urban streams Naturalization of road infrastructure (medium sized streets, railways...) Ecological and landscape improvement of industrial edges 	<p>IMPROVE WATER MANAGEMENT</p> <ul style="list-style-type: none"> Retention ponds, flood plains and river diversion channels Recovery of urban creeks Installation of Sustainable Urban Drainage systems (permeable pavements/ rain gardens/purification systems) 	<p>URBAN AGROECOLOGICAL AND SOIL IMPROVEMENT</p> <ul style="list-style-type: none"> Urban allotments Edible forests Agro-ecological parks Soil Restoration 	<p>IMPROVE PUBLIC USE AND ACCESSIBILITY</p> <ul style="list-style-type: none"> Green walks and itineraries Naturalized playgrounds Tree-lined squares 	<p>URBAN REHABILITATION AND CREATION OF MICRO-LANDSCAPES</p> <ul style="list-style-type: none"> Vegetable facades and roofs Interventions following a "green acupuncture" approach
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SHARED CONSTRUCTION OF GREEN INFRASTRUCTURE



<https://www.vitoria-gasteiz.org/docs/wb021/contenidosEstaticos/adjuntos/es/28/11/92811.pdf>

Overview of solutions in Vitoria-Gasteiz



NEXT STEPS

challenges for improvement through IURC

- **UGI STRATEGY:** BASE LINE data accuracy , monitoring NBSs effectiveness, ... etc.
- **CITIZENS EMPOWERMENT:** Shared construction of Green Infrastructure....etc.
- **DESIGN,IMPLEMENTATION AND MANAGEMENT:** New opportunity spaces (school playgrounds) and new forms of construction works,etc.
- **AWARENESS:** Visualitation of ecosystem services.

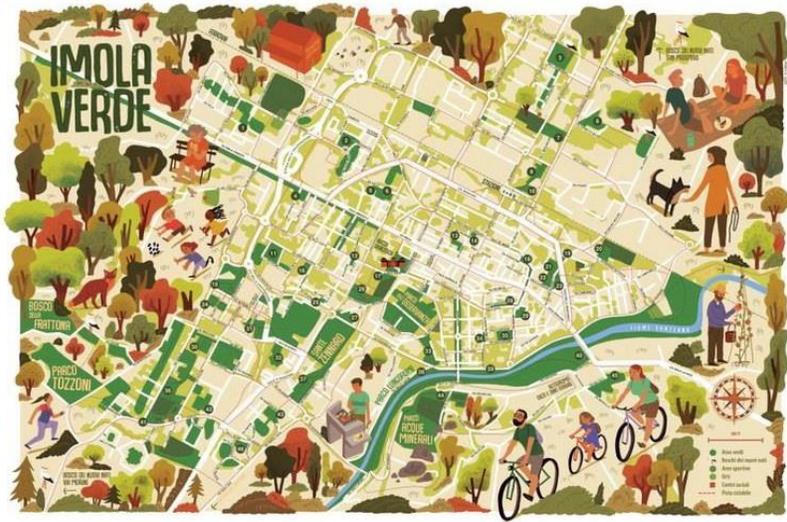


Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy



NCI is a **public body** that represents the **10 municipalities** of the eastern area of the metropolitan area of **Bologna** with **133,562** inhabitants (Bologna Metro: 1 mio.).

- NCI is **characterized** by important industries and a thriving agricultural sector. There is a very rich historical, artistic and monumental heritage. There are **universities** and research centers.
- **Sustainability** is a priority for the development of this territory. There are parks, natural areas and tourist attraction routes, which are particularly important for the development of sustainable tourism.
- **Areas of interest for international cooperation:**
 - Nature Based Solutions ecological transition & green deal (+ tourism/culture)
 - Smart & sustainable city with technology & culture aspects acting as pillars of the cities of the future



Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy

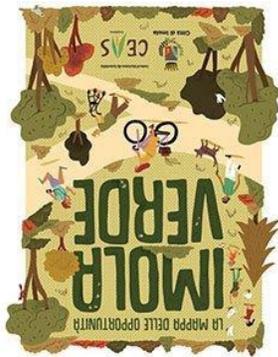


Urban Heat Islands. Challenges and Solutions.

To bring the life into the city. The network of urban parks

'Imola Verde' is the map that tells the richness and diversity of the city's green spaces, from large historical parks to small gardens, from the riverside park to the peri-urban woods, and then again the sports areas, vegetable gardens, social centers and cycle paths, highlighting how this whole ecosystem is available on foot or by bike.

The map contains 46 spaces that have been identified and included as they are green areas owned by the municipality, always usable and to be experienced at any time. This network of green oases will help make the city more livable and mitigate the heat in the central areas and in the historic center.



UNA MAPPA CHE RACCONTA LA RICCHEZZA E LA DIVERSITÀ DEGLI SPAZI VERDI DELLA NOSTRA CITTÀ: DEI GRANDI PARCHI STORICI, AI PICCOLI GIARDINI, AI PARCHI LUNGOFiume, AI BOSCHI DEI NUOVI NATI METTENDO IN LUCE COME TUTTO QUESTO ECOSISTEMA SIA A PORTATA DI PIEDI E BICI

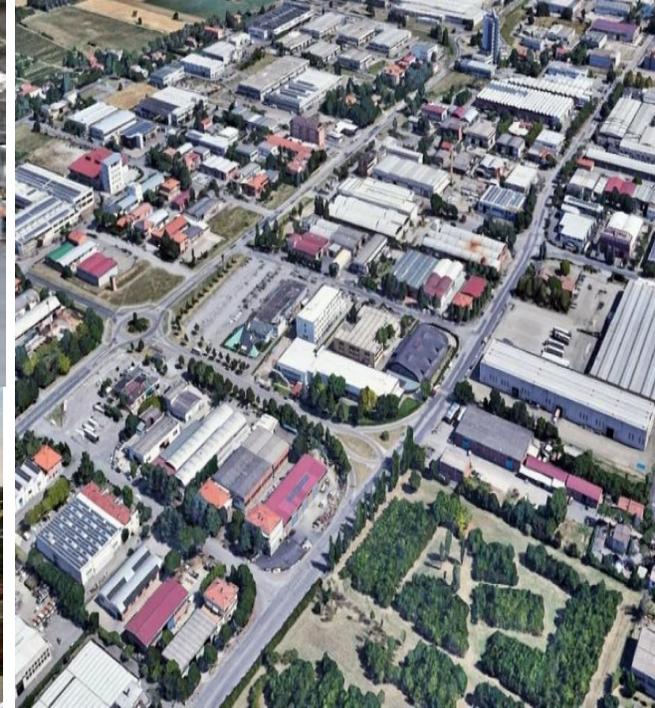
APPENDIMI VOGLIAMO CHE TUTTI I CITTADINI POSSANO Riscoprire il verde della nostra città. Per questo abbiamo creato questa mappa della città verde.

Tutti a cura di: Elena Toschi, Carla Nanni e Silvia Reggiani
 Grafica e illustrazioni: Monica Gori
 Redazione: CEAS Imola e Comune di Imola
 Foto: a stampare settembre 2021 da Blue Lemon Communication - Roma

Abbiamo utilizzato carte e icone grafiche affinché questa mappa possa essere non solo bella ma anche sostenibile. Riciclata nella carta e legata a quaderno.

MAPPA IMOLA VERDE





Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy



Urban Heat Islands. Challenges and Solutions.

Reforestation of industrial area. Eco industrial parks

- The aim of the project is to promote environmental quality even in industrial areas by transforming the industrial areas into eco industrial parks.
- The inclusion of greenery and the design of spaces with high urban quality serve to improve the quality of life and the use of these important parts of the city, making them lively and pleasant areas.
- In perspective, it will be possible to experiment projects of industrial symbiosis and circular economy within production and service chains.



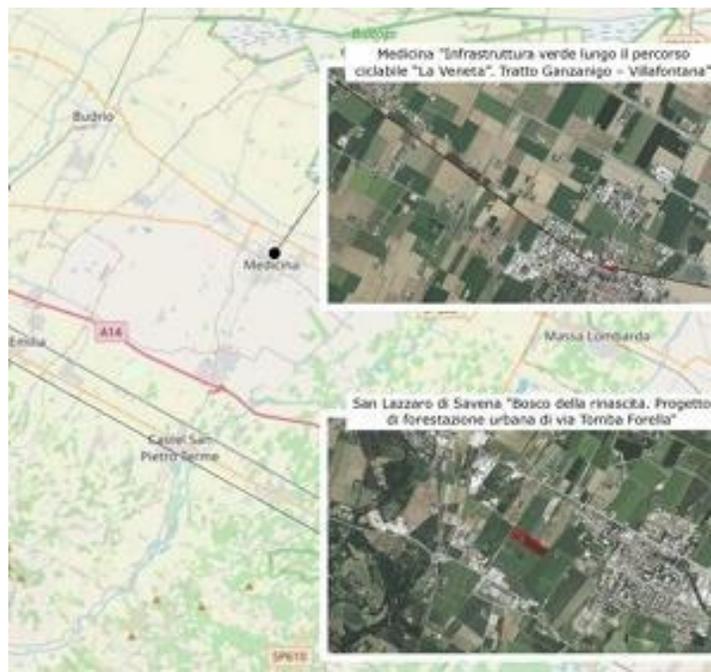


Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy

Urban Heat Islands. Challenges and Solutions.

Urban reforestation projects in NCI

- A forest at the Imola racetrack realized through the participation in the public notice of the Ministry of the Environment.
- Six hectares of trees for a more livable city. Green infrastructure in the municipality of Medicina thanks to the planting of new trees along the route of the Venetian cycle path for a total of 47,000 square meters of greenery and reforestation of a former parking lot with 517 trees.





Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy



Urban Regeneration projects in NCI

Regeneration project of the external spaces of the elementary and middle schools of Fontanelice and regeneration of the external spaces of the nursery school. Participatory planning, Outdoor education.

Roots for the future. Project of the Emilia-Romagna Region for the planting of 4.5 million trees from 2021 to 2025. Reforestation of an uncultivated area in Mordano with the planting of 2000 plants among trees and shrubs. Public-private collaboration.





Life4Oak
Forests

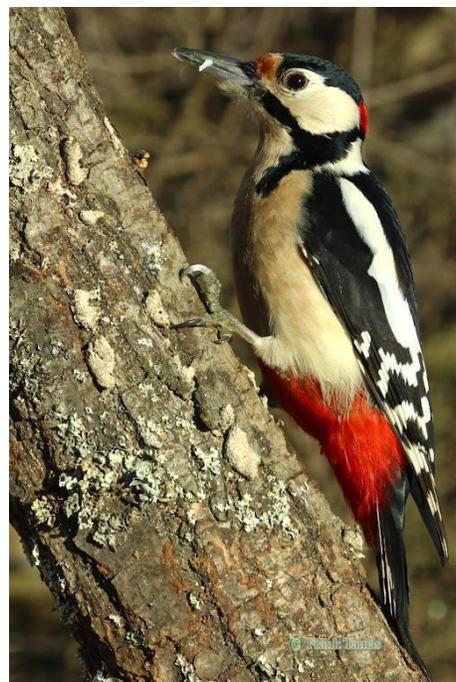


Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy



Urban Heat Islands. Challenges and Solutions. Territorial interventions.

- Parco Vena del Gesso (Unesco Cultural Heritage Candidate) EU Project Life for Oaks
- Conservation management tools for increasing structural and compositional biodiversity in Natura2000 oak forests.
- The biodiversity of oak forests is declining as a result of intensive human use. With the nature conservation interventions of the LIFE4OAK FORESTS project, our goal is to reverse this process. The project aims to promote the regeneration of the forests and to restore the diversity of forest structure, native tree species composition and micro habitats. As a results, the protected forest mammals, birds, insects, plants and fungi will be preserved and their populations will increase. The project is co-financed by the European Union's LIFE program.



Nuovo Circondario Imolese (NCI), Metropolitan City of Bologna, Italy

Urban Heat Islands. Challenges and Solutions. The garden of cultural heritage.

- A innovative idea of connection between culture and nature.
- The idea of the garden would like to be an exercise to create a relations between the towns of the Circondario Imolese in Bologna, and the traditional Chinese gardens.
- Cities are landscapes alive organisms, and like all the other organisms, they survive enhancing dynamic ecological processes that involve human activities and cultural perspectives for a new holistic vision of nature.
- For these reasons, The Garden of Nuovo Circondario Imolese is a metaphorical experiment to understand how Green healthy cities can shape landscapes to attract, surprise, and catch the future human and natural generations.

