

stefano boeri

# a vertical forest un bosco verticale

instructions booklet for the prototype of a forest city  
libretto di istruzioni per il prototipo di una città foresta

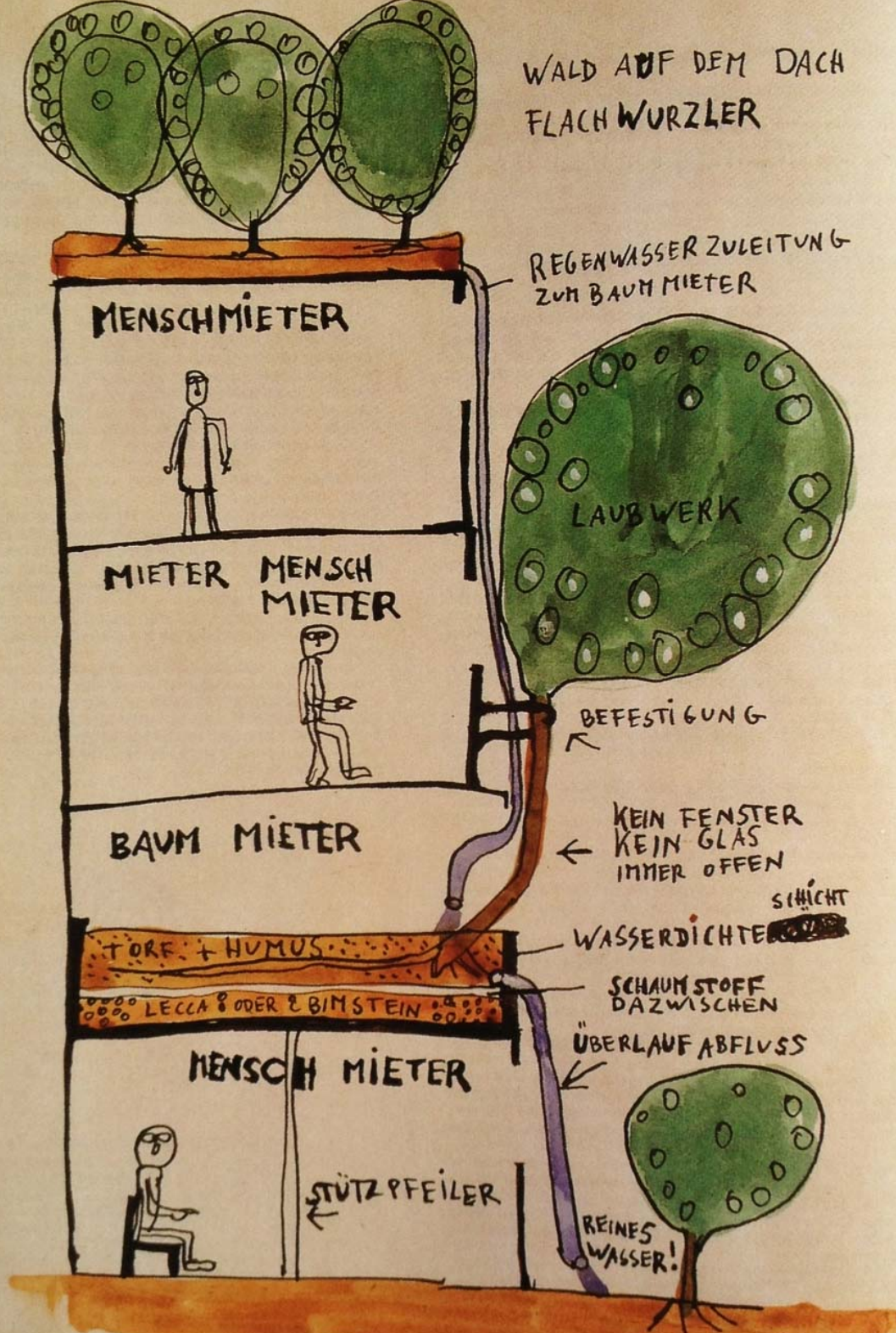
edited by guido musante and / e azzurra muzzonigro

with the contribution of / con il contributo di  
michele brunello, laura gatti e / and yibo xu



EDIZIONI CORRADI





WALD AUF DEM DACH  
FLACH WURZLER

REGENWASSER ZULEITUNG  
ZUM BAUM MIETER

MENSCH MIETER



MIETER MENSCH  
MIETER



BAUM MIETER



LAUBWERK

BEFESTIGUNG

KEIN FENSTER  
KEIN GLAS  
IMMER OFFEN

SCHICHT

WASSERDICHTER

SCHAUMSTOFF  
DAZWISCHEN

TORE + HUMUS

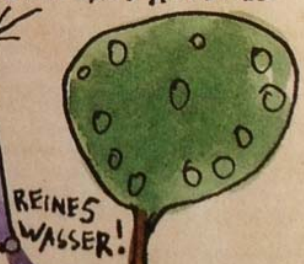
LECCA ODER BIMSTEIN

ÜBERLAUF ABFLUSS

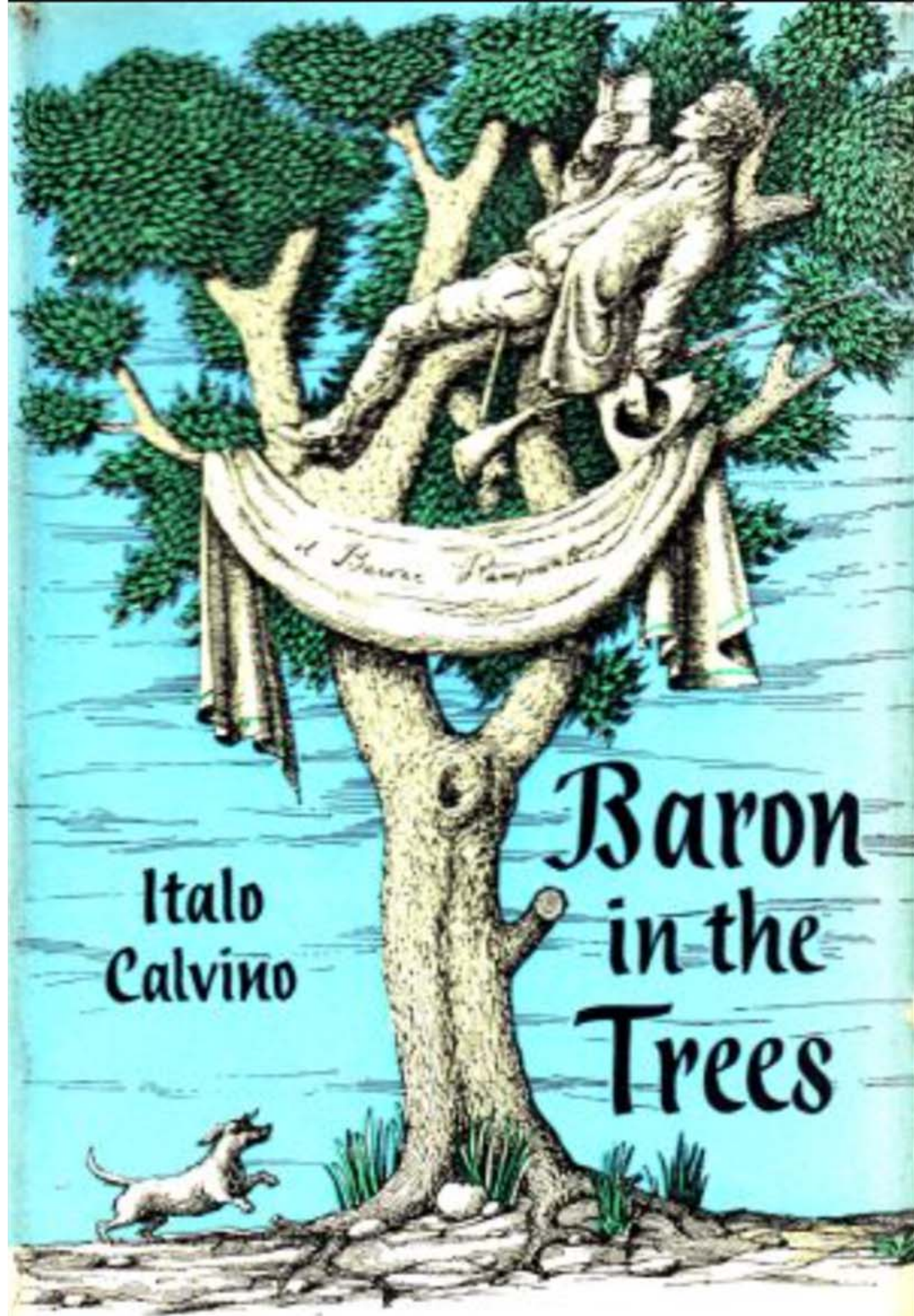
MENSCH MIETER



STÜTZPFEILER



REINES  
WASSER!

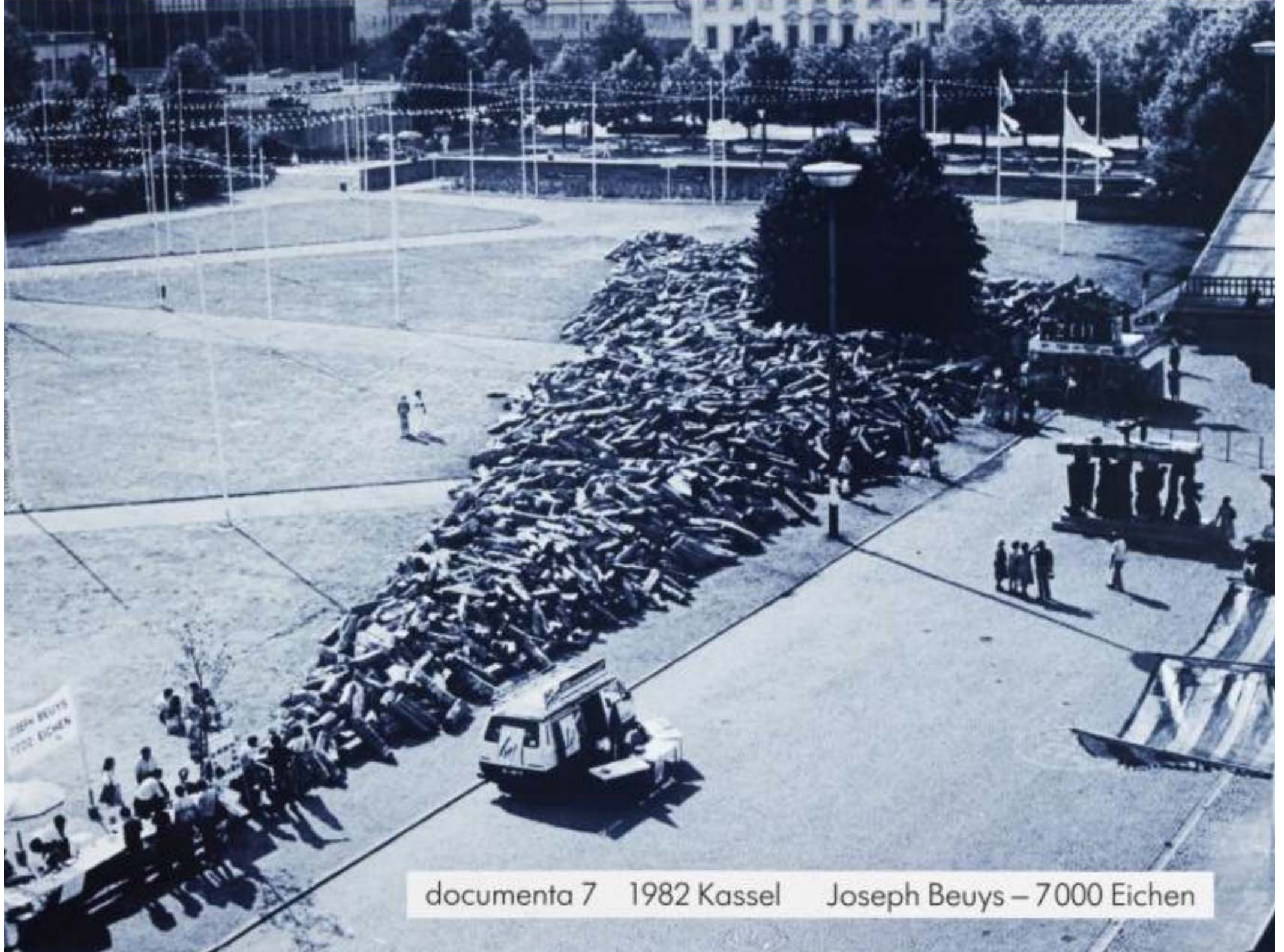


*Italo Calvino*



*Il barone rampante*

Einaudi



documenta 7 1982 Kassel Joseph Beuys – 7000 Eichen





DSR

**Bringen Sie Ihren Stein  
ins Rollen.**



**« Joseph Beuys - 7000 Eichen »**

Spendenkonto: Stadt Kassel/ Stadtparkkasse Kassel - BLZ 251 201 51 - Konto-Nr. 01 090 - Verwendungsgruppe: FW280

**Eine Idee schlägt Wurzeln.**



**« Joseph Beuys - 7000 Eichen »**



**1900**



**2007**



**2030**



**2050**



**612%**

increase in traffic accidents  
1990-2002

**628,000**

privately owned cars

**25x**

increase 1999-2005

**16.6m**

residents in Shanghai including

**3m**

unregistered internal migrants

**65m**

square metres of construction  
in 2006

**63%**

increase in tons of shipping cargo  
1999-2003

**6,340km<sup>2</sup>**

area of Shanghai

**9m**

bicycles used by residents

**121**

buildings over eight storeys in 1980

**3,529**

buildings over eight storeys in 2000

**10,045**

buildings over eight storeys in 2005

**70%**

employed by the state in 1992

**25%**

employed by the state in 2004

**63%**

of homes are owner occupied

**8x**

population increase since 1920s

**9.7%**

single households, compared to

**51%**

in Berlin

**26,000**

people/km<sup>2</sup> in the urban core,  
compared to

**4,800**

people/km<sup>2</sup> in London

**70%**

increase in average time of work  
commute 1995-2004

introduction / introduzione

**humans**

tirama, may 2014

**and trees**

stefano boeri

**alberi**

tirama, maggio 2014

**e umani**



## 1. VERTICAL FOREST

IS A PROJECT FOR METROPOLITAN REFORESTATION.

The presence of trees, bushes and green walls distributed throughout the facades of the building, contributes to the regeneration of the environment and urban biodiversity while limiting the expansion of the city. Each Vertical Forest equals, in amount of trees, a large area of level land forest.

The first example of a Vertical Forest composed of two towers of 110 and 76 meters height, will be realized in the centre of Milan, within the project Porta Nuova on the edge of the Isola neighbourhood, and will host almost 1.000 trees (measuring up to 9 meters tall), a wide range of shrubs and floral plants and 2.300 square meters of plant covered walls. In terms of amount of trees the Vertical Forest in Milan will equal a wooded surface of 9.000 square meters.



existing forest



first phase



metrobosco

## 2. VERTICAL FOREST

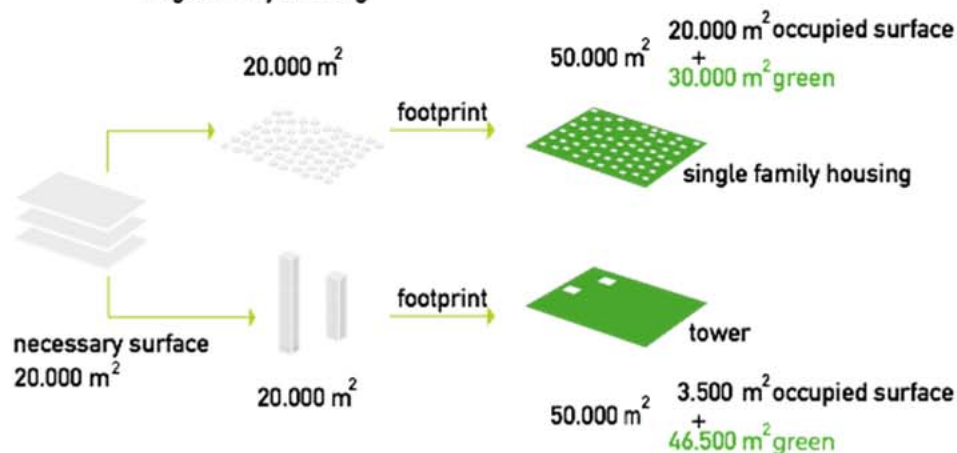
IS AN ANTI-SPRAWL DEVICE THAT CONTRIBUTES TO THE CONTROL AND REDUCTION OF URBAN EXPANSION.

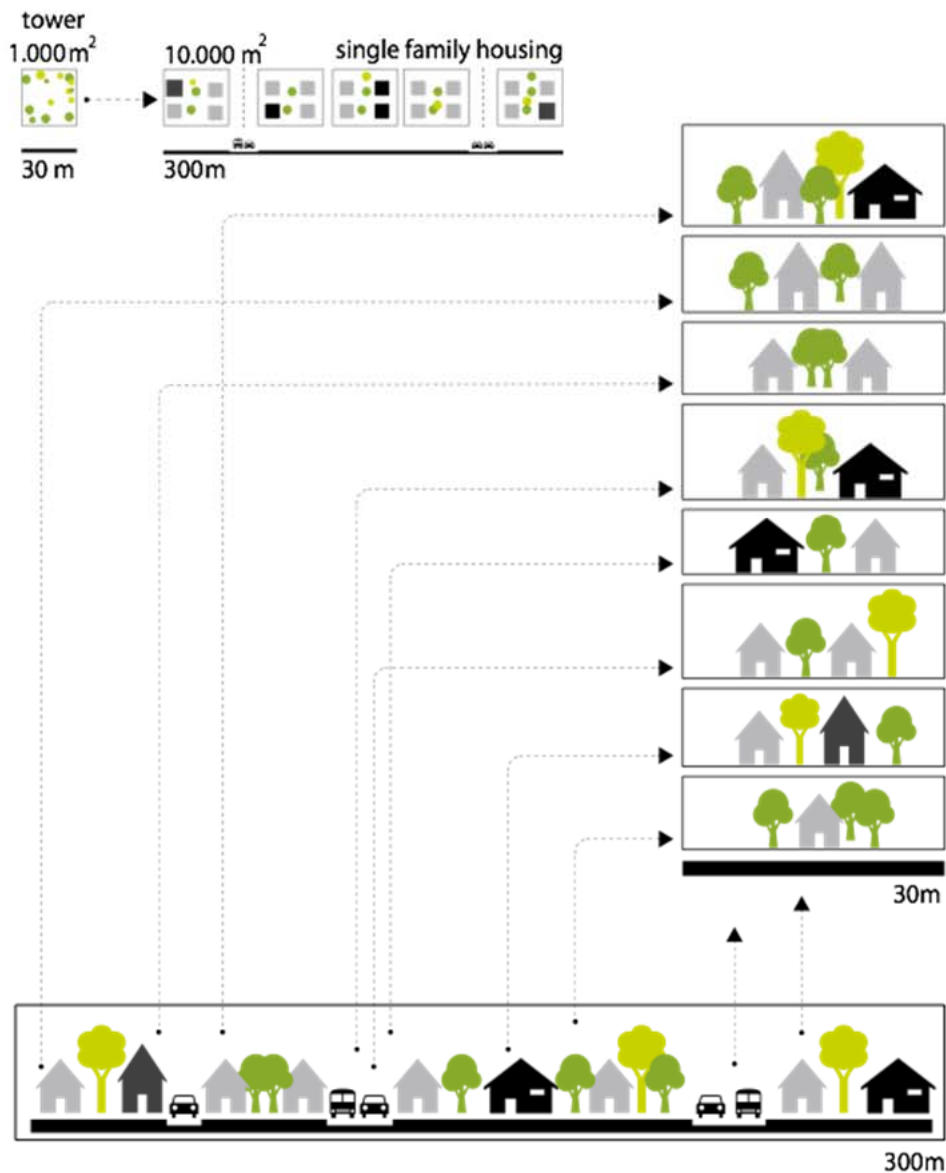
Each tower constitutes the equivalent in urban densification of an area of single family dwellings that consumes an amount of land of 15 times that which is consumed by a tall building. Through the reproduction, in vertical and within the urban tissue, conditions of lifestyle comparable (in terms of property of green or privacy) to those that make suburban life appreciated Vertical Forest contributes to reducing the consumption of the urban asset par excellence: the ground.

The first Vertical Forest (or Bosco Verticale 01) is composed of large windowed apartments surrounded by large terraces perimetered by trees that, if sparse upon the territory would consume a portion of land equal to 50.000 square meters. The stacking logic of cantilevered terraces permits the growth in specific points of trees up to 9 meters tall. The green façade compensates the transparency of the continuous windowpanes, frames the view upon the urban panorama, transforms the terrace into an extension of the apartment.



single family housing



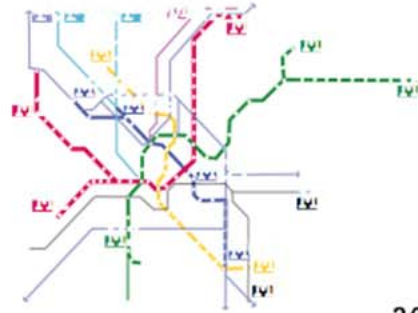


### 3. VERTICAL FOREST IS A MODEL OF URBAN DENSIFICATION.

The Vertical Forest is a model of vertical densification of green and built within the city. It is a model that operates correlated to the policies for reforestation and naturalization of the large urban and metropolitan borders. The synergy of these two devices for the environmental survival is useful to reconstruct the relation between nature and city within contemporary Europe. Vertical Forest acts by subverting the principle of enclosed green spaces (garden, parks) typical of the tissue of European cities and proposes a diffused yet adaptable system of vertical green.

The first Vertical Forest in Milan represents the terminal within the urban centre of the great external ring of parks and forests (the Metrobosco) that multiplicity.lab and the Province of Milan are realizing. The link between the Metrobosco and the Vertical Forest will be guaranteed by the green corridors (green rays project) proposed by the Municipality of Milan.





2007

## 4. VERTICAL FOREST

CAN AID IN THE REDUCTION OF URBAN TRAFFIC CONGESTION.

If realized in the proximity of public transport junctions, the towers of Vertical Forest can contribute drastically to the reduction of urban incoming and outgoing traffic, favouring the return towards the city centre of families and individuals - today commuters - that in the last decades have preferred to move their homes to periurban zones. The Vertical Forest model can be adapted to different typologies of intervention: private or public residential buildings, tertiary, representative or public buildings. It can also add value to abandoned buildings or buildings whose construction has been interrupted.

In Milan, in addition to the one within the Isola neighbourhood (next to the infrastructural junction of the Garibaldi Repubblica area), new Vertical Forest can be realized in the areas of proximity to key existing underground stations.

● : BOSCO VERTICALE 01



2010



01 02 03 04 05

● :+ BOSCHI VERTICALI



2014

bovisa 06

maciachini 02  
moscova 03  
garibaldi 01  
p.ta volta 07  
piola 04  
pagano 05

lodi 08

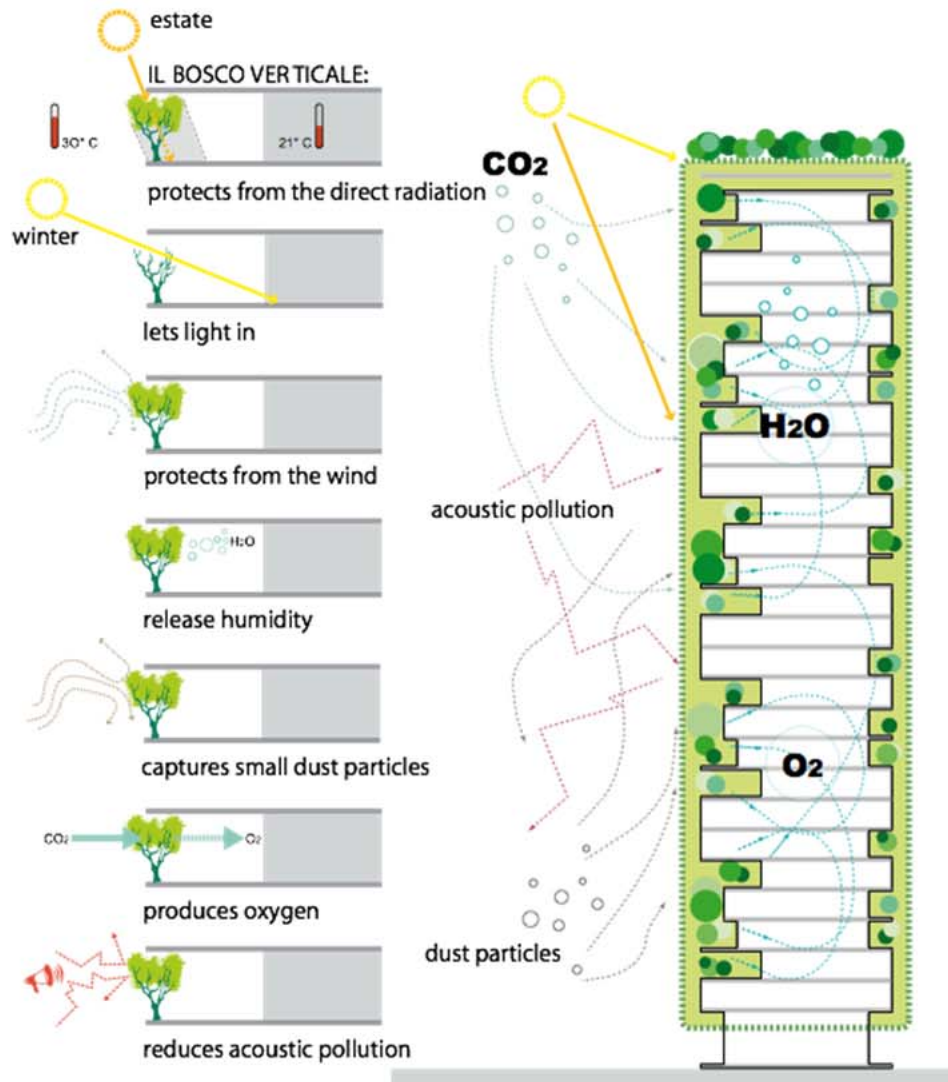
2020



01 02 03 04 05 06 07 08

● :++ BOSCHI VERTICALI



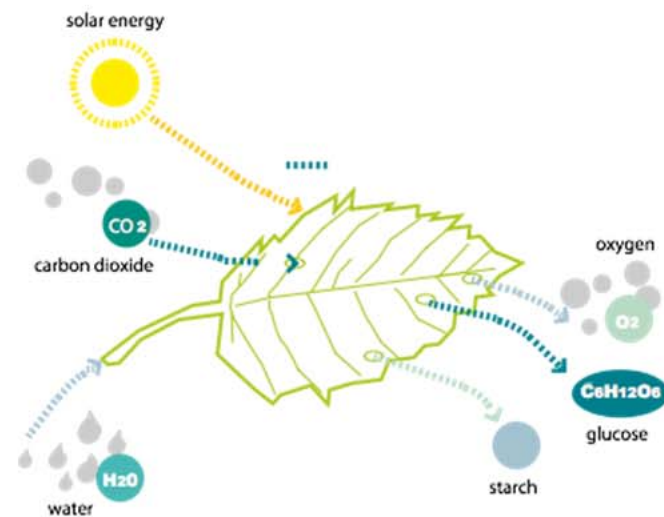


## 5. VERTICAL FOREST

GENERATES A MICROCLIMATE AND FILTERS SMALL DUST PARTICLES.

Vertical Forest aids in the creation of a microclimate and to filter small particles of dust from the urban environment. The diversity of plants and their individual characteristics produce humidity, absorb carbon dioxide and dust particles, produce oxygen and protect from solar irradiation and acoustic pollution increasing the level of comfort.

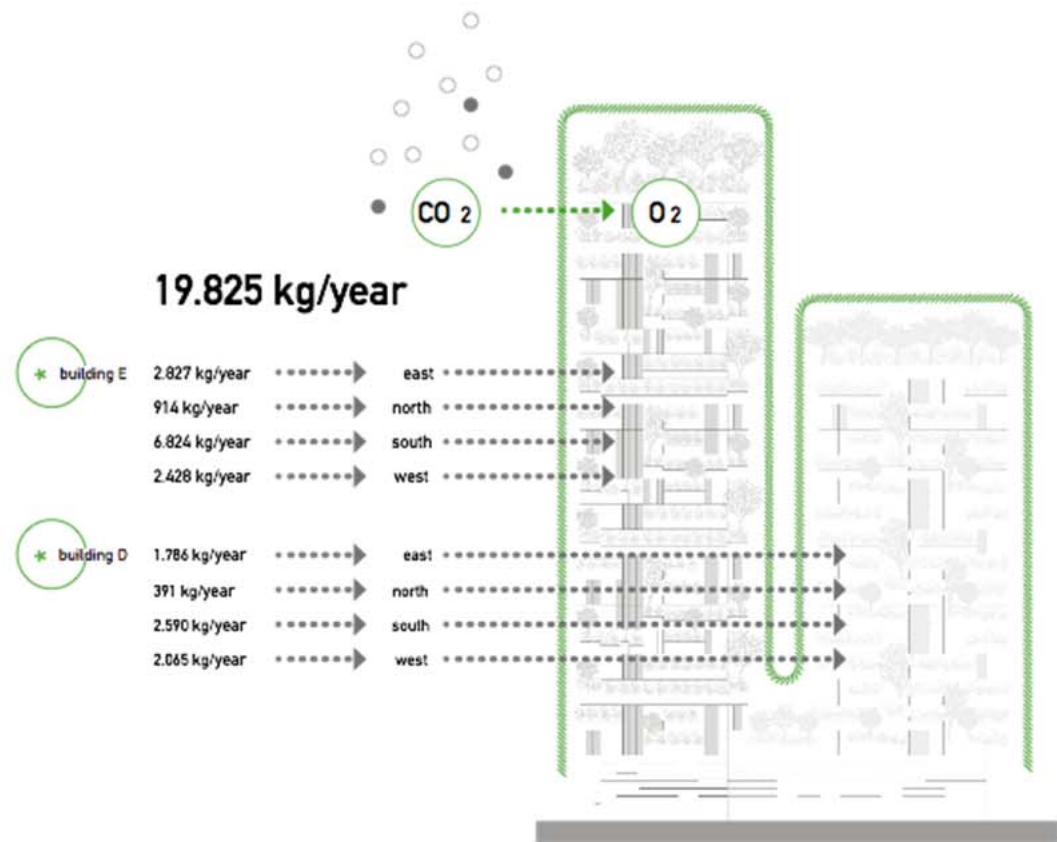
The Vertical Forest 01 foresees on each floor the perimetral construction of a sequence of planters of different sizes to contain soil and plants. Given the high artificiality of the system the management and maintenance of the green facade and its fittings will be centrally conducted and controlled.



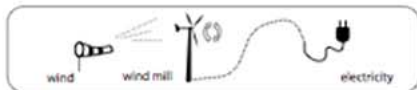




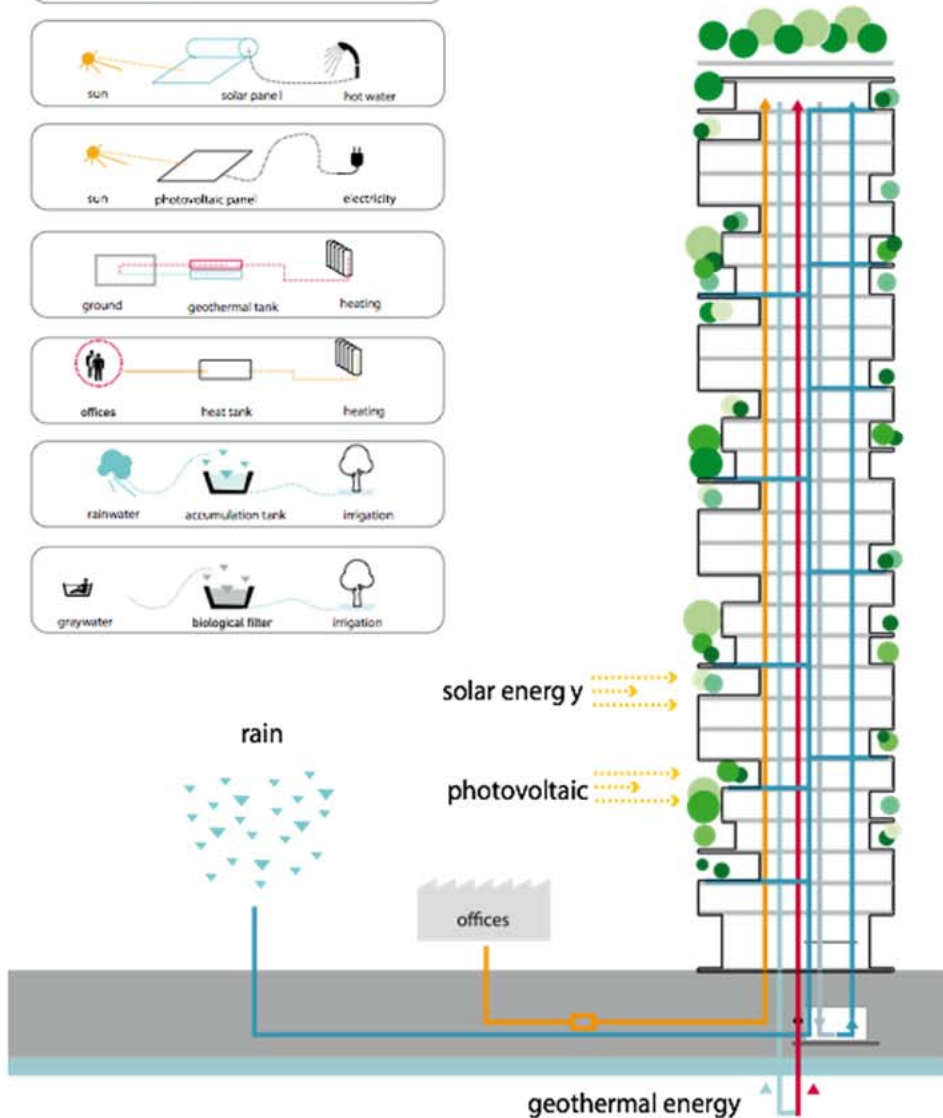
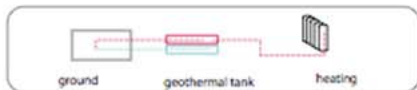
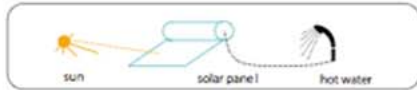
THE BARRIER OF PLANTS REDUCES THE QUANTITY OF POLLUTANTS PRESENT IN THE AIR



DURING THE DAY PLANTS ABSORB SIGNIFICANT AMOUNTS OF CO<sub>2</sub> TURNING INTO O<sub>2</sub>



aeolic energy

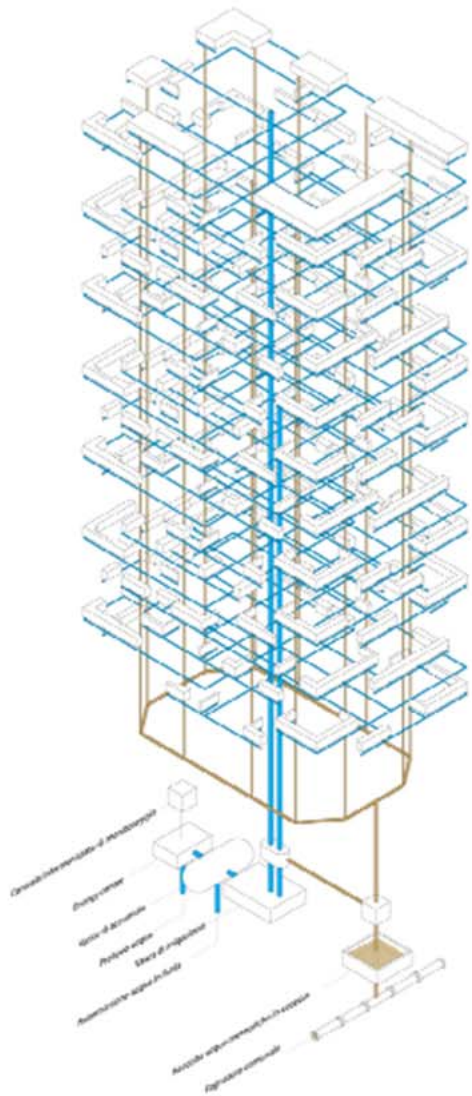


## 6. VERTICAL FOREST

IS A SYSTEM THAT OPTIMIZES, RECUPERATES AND PRODUCES ENERGY.

Each Vertical Forest can be designed to host rooftop wind power mills, rooftop and facade photovoltaic panels for the production of electric energy and solar panels for the production of thermal energy. Plant irrigation can take place to a great extent through the filtering and purification of grey waters produced by the building. Above all, the screen produced by the plants located along the perimeter of each floor favours a significant reduction of energetic consumption produced by artificial air conditioning of spaces.

In Milano, the first Vertical Forest also represents an alternative to the great residential towers built with continuous glass facades that are constrained to enormous energetic efforts (even when using alternative energy sources) to compensate the enormous accumulation of heat in the summer and the scarce protection from the cold during the winter season.



**WATER SYSTEM**



**VEGETATION**



**VERTICAL FOREST**



MAINTENANCE DIAGRAM



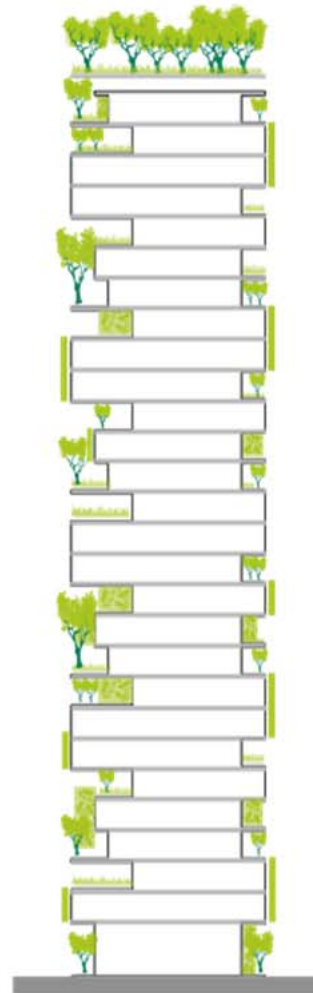
Vertical green: creates a network the plants of different levels increasing vertical ecological functionality.



horizontal green: diversification and flowering



vertical green = forest effect, shading.











## 7. VERTICAL FOREST









IS A SYSTEM THAT INCREASES BIODIVERSITY.

Vertical Forest favours the formation of a rich and varied urban para-ecosystem, where different types of plants (trees, bushes, hanging gardens, vertical green structures that connect the different nuclei of trees) form an vertical system that creates an environment that could be potentially colonized by a fauna of different species of birds (rock thrush, kestrels, goldfinches or doves), but also insects (such as beetles, dragonflies, small spiders, ladybugs or butterflies if there are hedges or flowered corners). The repetition of several systems of Vertical Forest within the city can contribute to the creation of a diffused environmental network of ecological corridors that graft the city's main urban parks, consolidate the green of avenues and gardens and connect spaces that host the spontaneous growth of vegetation.

## west facade

Quercus ilex		<22m	●	●	●	●
Koelreuteria paniculata		<15m	●		●	●
Pyrus pyraister		<15m	●		○	●
Arbutus unedo		<9m	●	●	○	●
Amelanchier lamarckii		<3m	●	●	○	●
Crataegus monogyna		<3m	●		○	●
Hypericum calycinum		<0,3m	●		●	●
Rynchospermum jasminoides		<4m	●	●	○	●
			autumn	winter	spring	summer

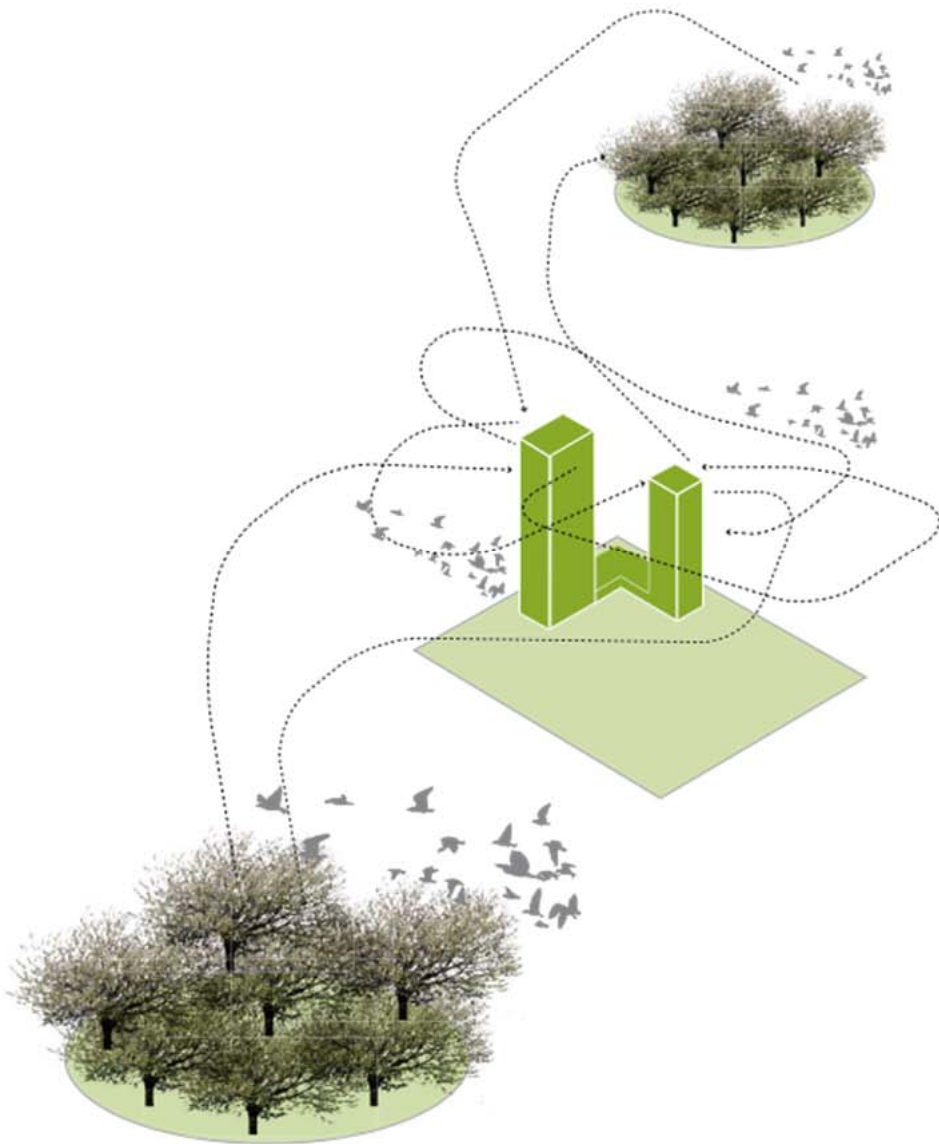
## south facade

Quercus ilex		<22m	●	●	●	●
Quercus pubescens		<20m	●		●	●
Flaxinus ornus		<18m	●		○	●
Arbutus unedo		<9m	●	●	○	●
Cytisus scoparium		<2m	●	●	●	●
Ceanothus spp		<3m	●	●	●	●
Cratostigma plumbaginoides		<0,3m	●		●	●
Jasminum primulinum		<4m	●	●	●	●
			autumn	winter	spring	summer

## 8. VERTICAL FOREST IS A CHANGING LANDMARK.

The towers of Vertical Forest not only offer their inhabitants an extraordinary perspective from within the apartment. Cyclically changing their skin according to the diversity of the plants and their disposition with respect to the sun's axis, the Vertical Forest also offers a changing landscape to city dwellers.

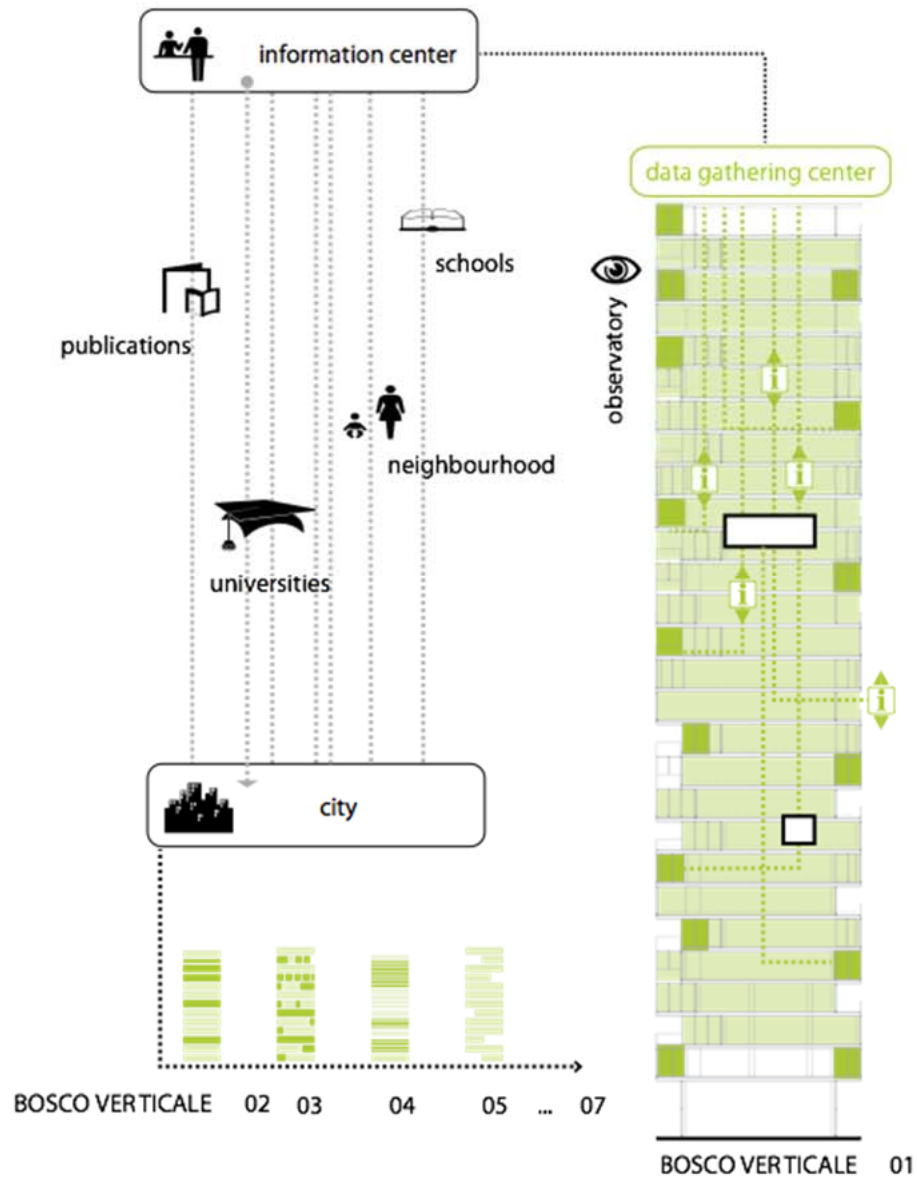
The first Vertical Forest in Milan will be realized by assembling circa 60 species of plants distributed on the different facades of each tower.



## 9. VERTICAL FOREST

IS AN URBAN SENSOR FOR SPONTANEOUS VEGETABLE AND ANIMAL RE-COLONIZATION.

Vertical Forest can become an urban sensor for the spontaneous vegetable and animal re-colonization of the city, mainly due to the wind transported seeds and the movement of flying insects. On the rooftops of the Vertical Forest free plans for the colonization of nomad species can be created. A diffused system of the Vertical Forest could also favour the monitoring of this evolution; a bridging between the peaks of tall buildings and skyscrapers.



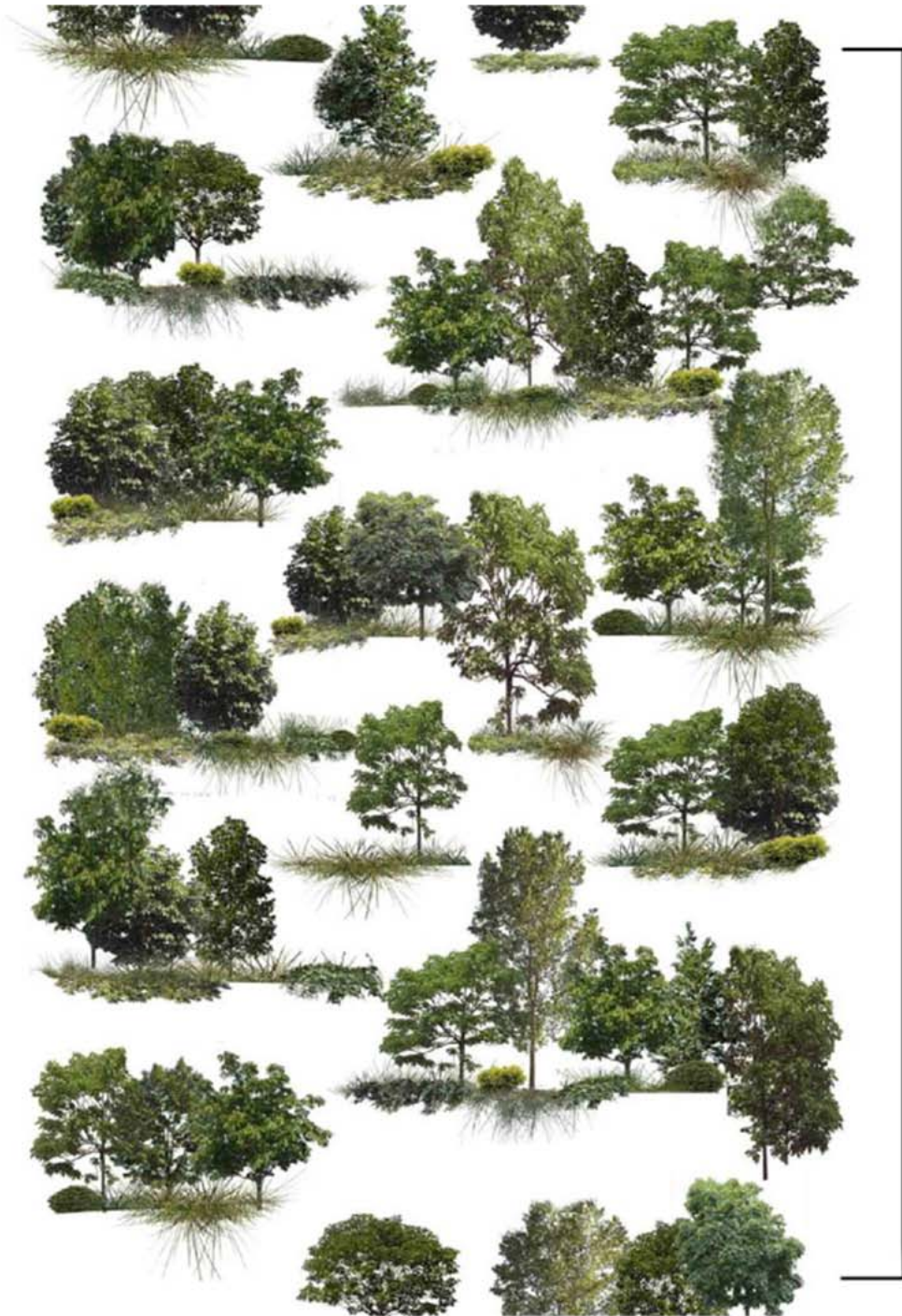
## 10. VERTICAL FOREST

IS A SYSTEM THAT INCREASES URBAN ECOLOGICAL CULTURE.

The service "cell" in charge of guaranteeing the functionality and maintenance in time of the vertical green can become a reference point of information of these urban para-ecosystems both for neighbouring schools and for the city. Each "vertical green maintenance cell" may in fact be used for the gathering and spreading of information useful for evaluating its ecological functioning (conducting census of species or colonization fluctuations etc.): a hand-down and dispersed "know-how" that grows and evolves together with the Vertical Forest.

The first Vertical Forest of Milan foresees a centralized maintenance agency, with an office counter open to the public, located at the ground floor of the two towers.





## MORE THAN 700 TREES:

480 BIG AND MEDIUM SIZE TREES,  
250 SMALL SIZE TREES,  
11.000 GROUND COVER PLANTS,  
5.000 SHRUBS.

Quercus ilex  
Koelreuteria paniculata  
Pyrus pyraeaster  
Arbutus unedo  
Amelanchier lamarckii  
Crataegus monogyna  
Hypericum calycinum  
Ryncospermum jasminoides  
Quercus ilex  
Quercus pubescens  
Flaxinus ornus  
Arbutus unedo  
Cytisus scoparium  
Ceanothus spp  
Cratostigma plumbaginoides  
Jasminum primulinum





**480** people





**780** trees

**18000** bushes



**1600** birds & butterflies



**480** people



PER 1 HUMAN



>20 BIRDS & BUTTERFLIES



2 TREES



8 SHRUBS



40 BUSHES







facciata ventilata con rivestimento in lastre di fibrocemento

facciata ventilata con rivestimento in lastre di vetro

serramento in alluminio montato a filo esterno

rivestimento del parapetto in vetro serigrafato

rivestimento del parapetto in lastre di fibrocemento

rivestimento fascia marcapiano in vetro serigrafato









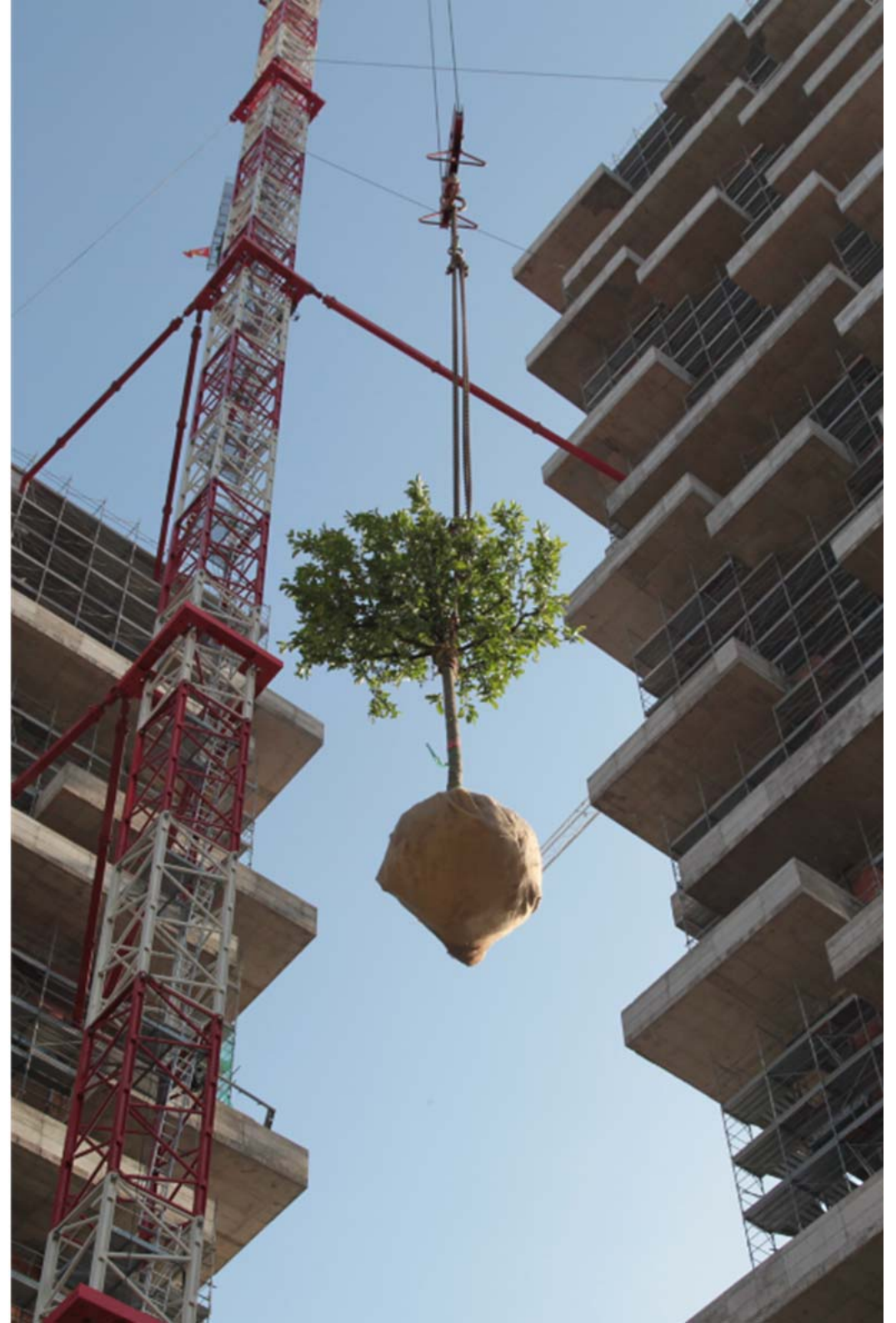










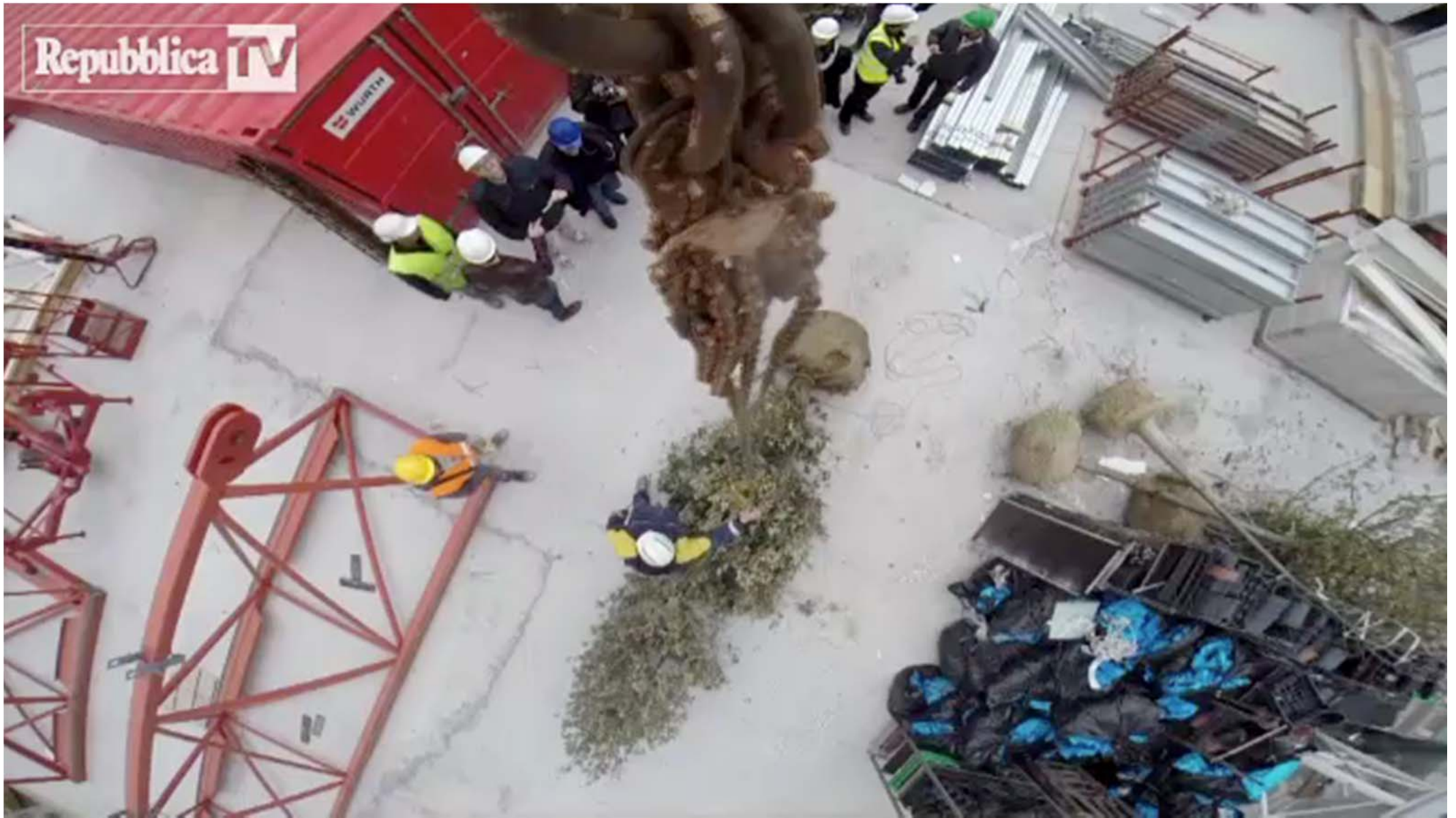
















































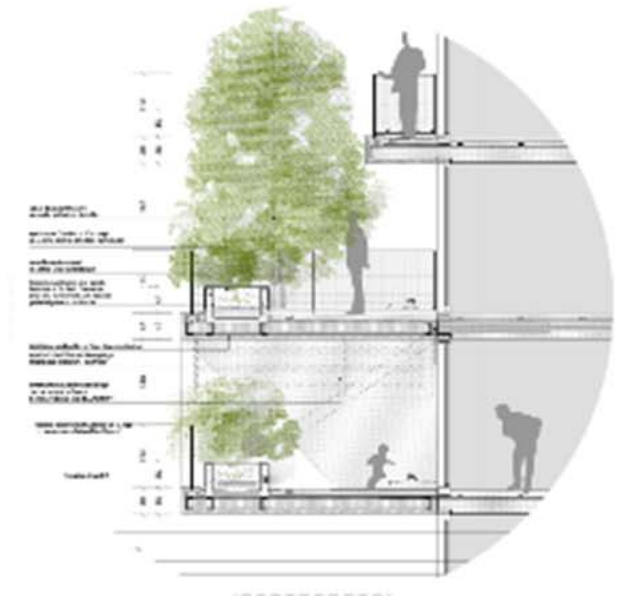




Prototype in Milan, Italy



Prototype in Laussane, Switzerland

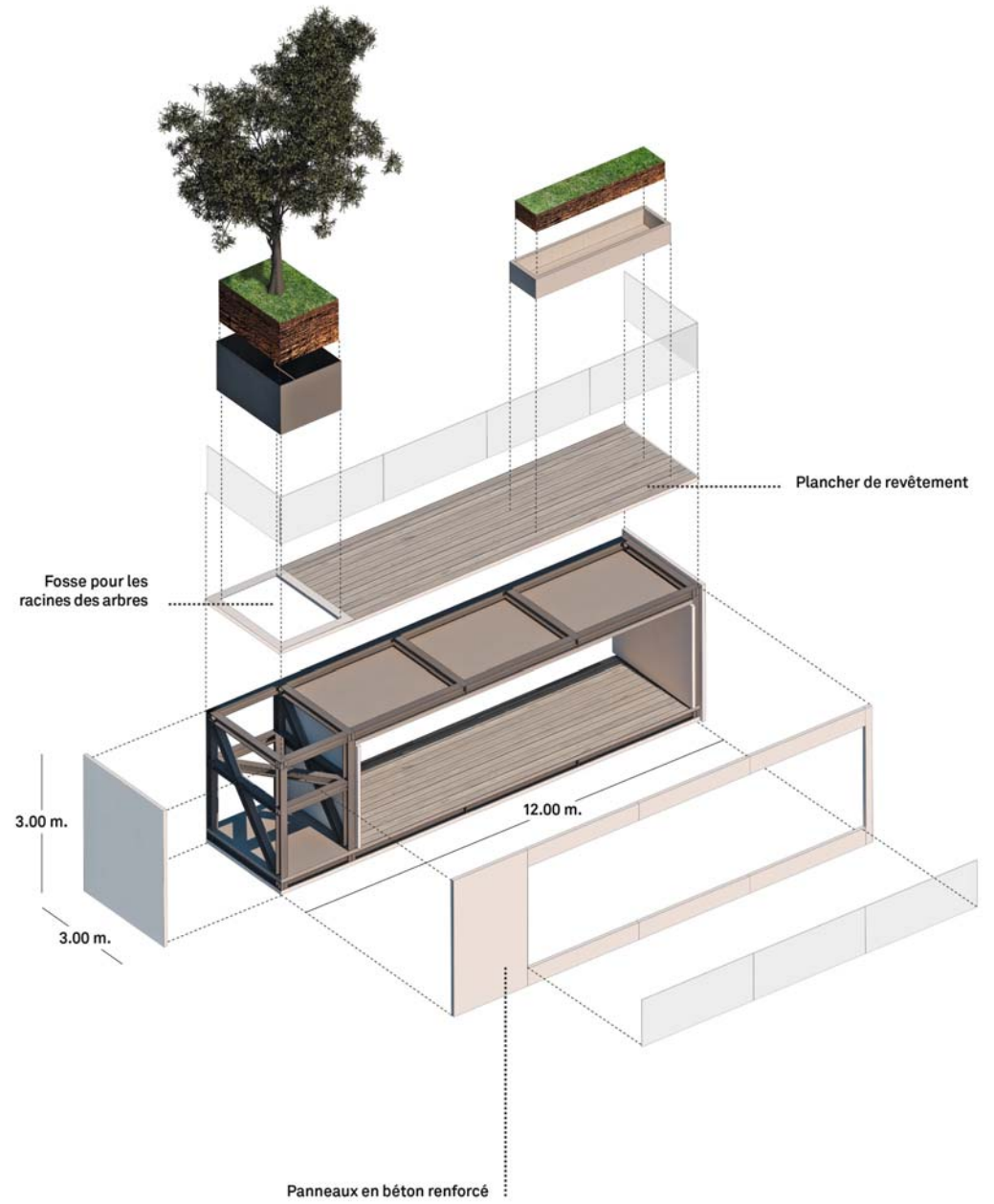












EXEMPLE POUR LOGGIA



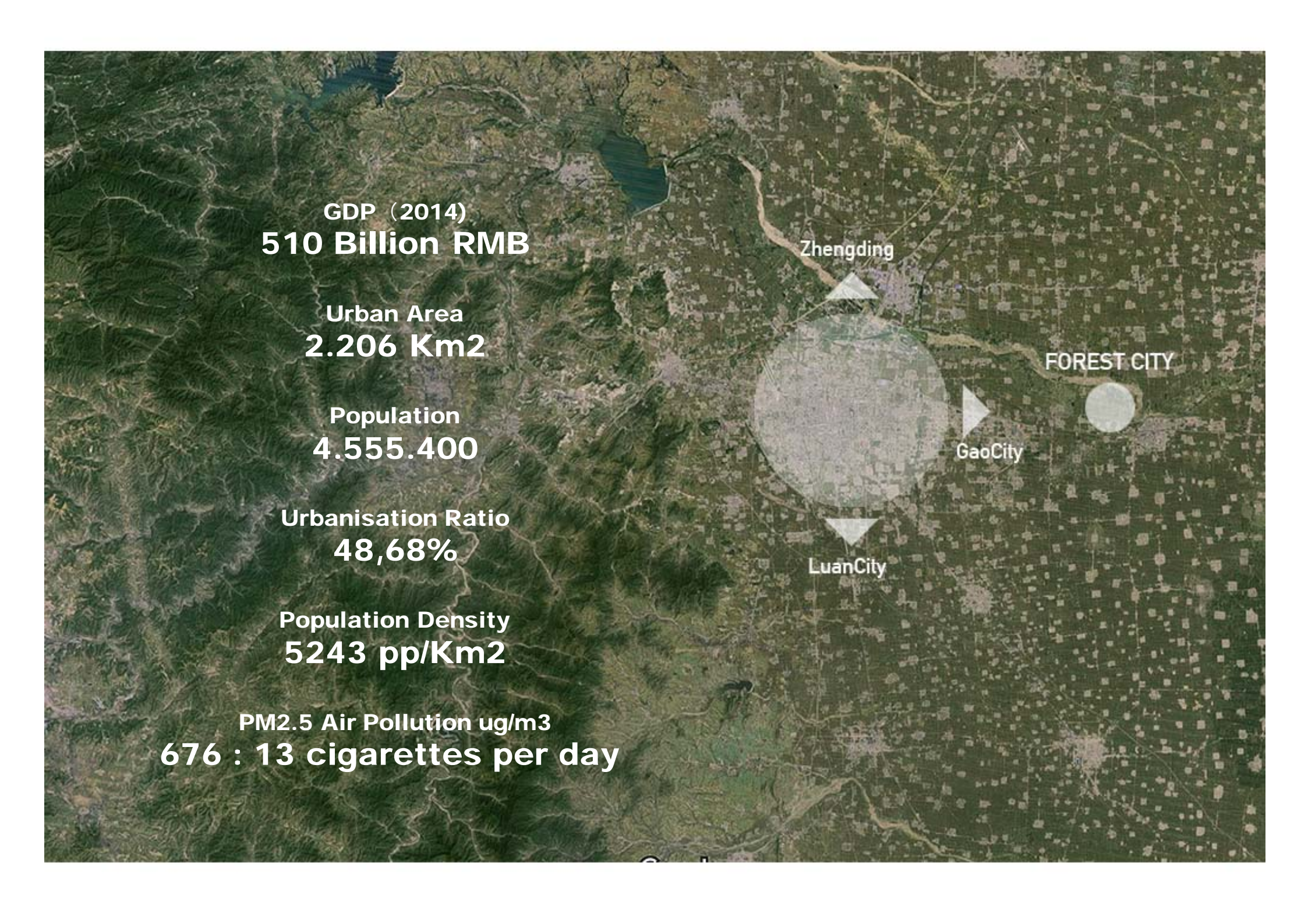
China National Metropolis:  
Jing-Jin-Ji

Beijing-Tianjin-Hebei

215.870 km<sup>2</sup>

109.564.000



A satellite map of a region, likely in China, showing a river and several cities. The cities are labeled: Zhengding, LuanCity, GaoCity, and FOREST CITY. The map shows a mix of urban areas, green fields, and a river. The text on the left provides statistics for the region.

GDP (2014)  
510 Billion RMB

Urban Area  
2.206 Km<sup>2</sup>

Population  
4.555.400

Urbanisation Ratio  
48,68%

Population Density  
5243 pp/Km<sup>2</sup>

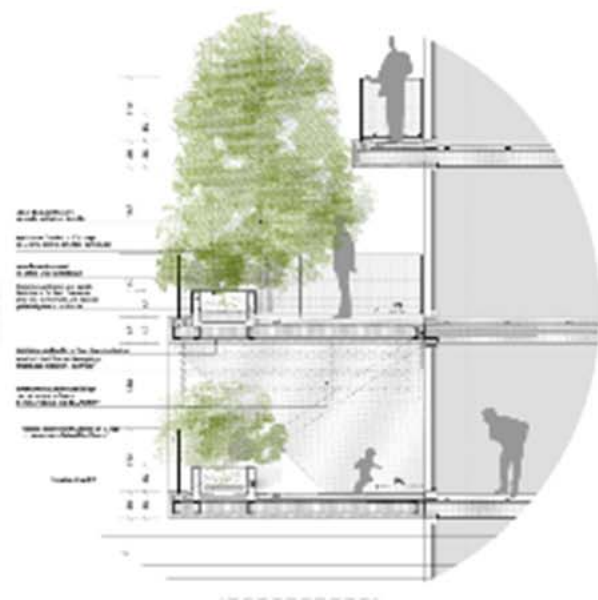
PM2.5 Air Pollution ug/m<sup>3</sup>  
676 : 13 cigarettes per day

Zhengding

FOREST CITY

GaoCity

LuanCity





China National Metropolis:  
Jing-Jin-Ji

Beijing-Tianjin-Hebei

215.870 km<sup>2</sup>

109.564.000



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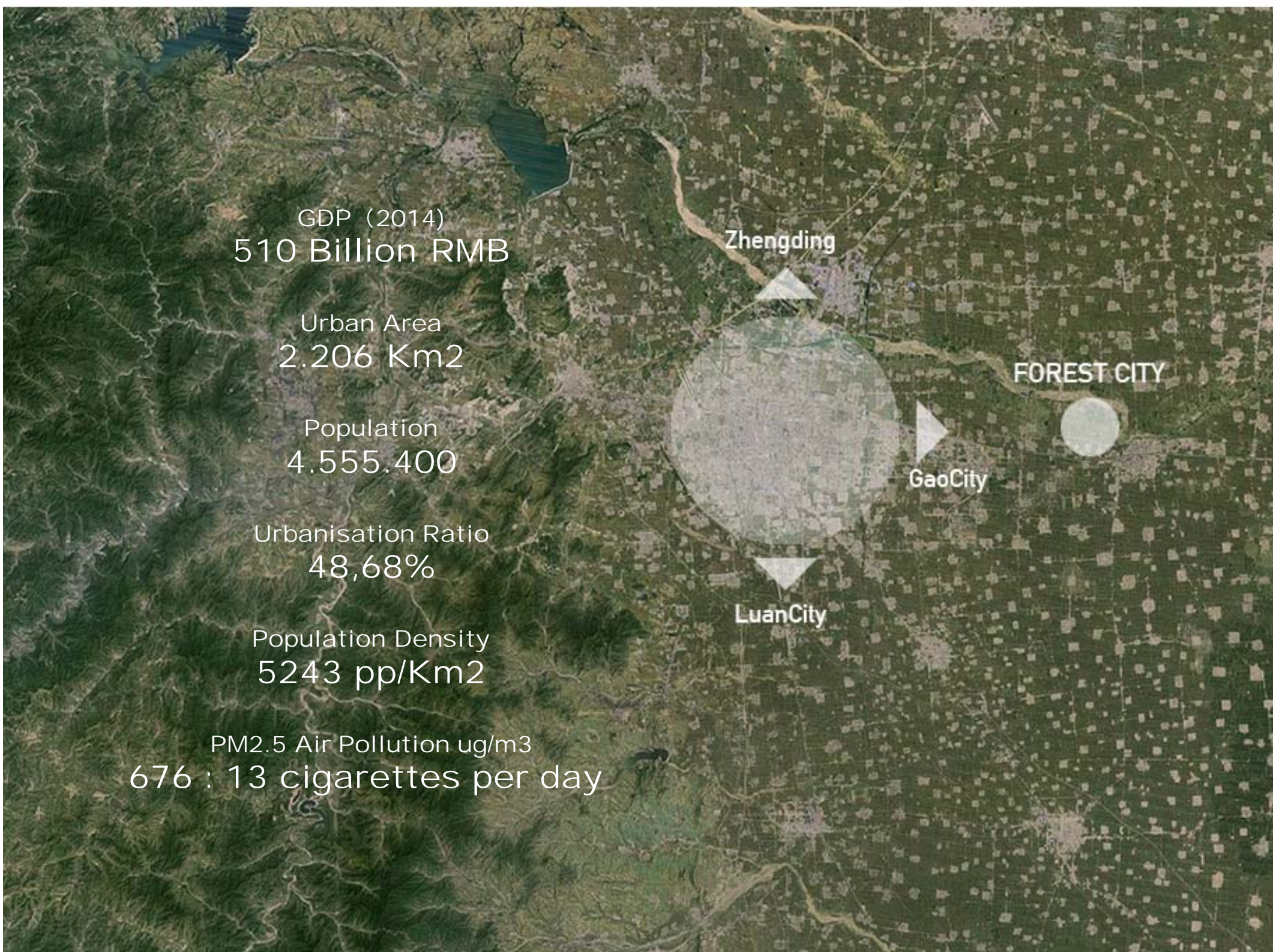
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Zhengding

FOREST CITY

GaoCity

LuanCity









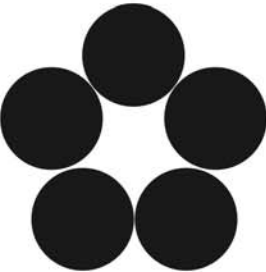
NEW FOREST CITY STANDARD



BOSCO VERTICALE



780 TREES



1 FLOWER



100 BOSCO VERTICALE AND OTHER GREEN BUILDINGS



78000 TREES

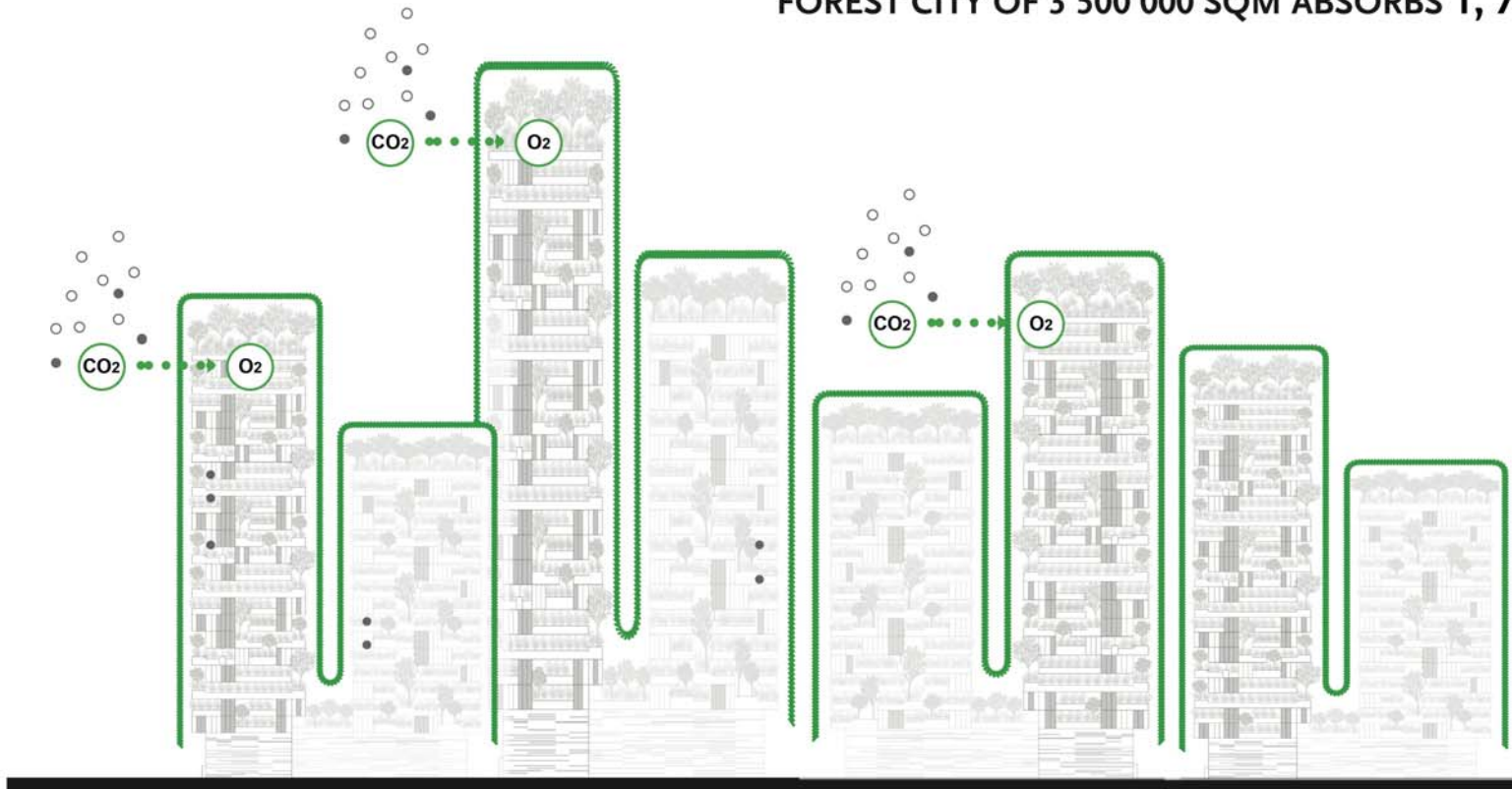
= 200 HA OF FOREST

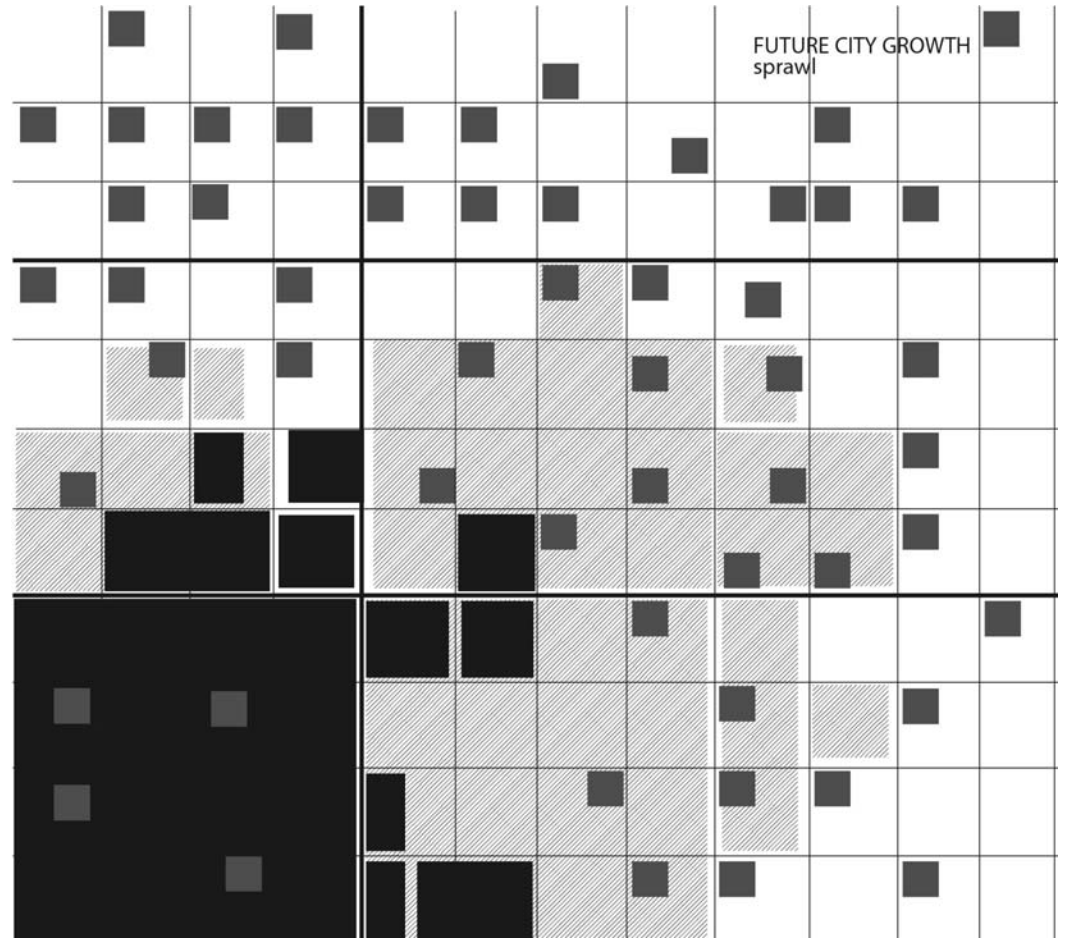
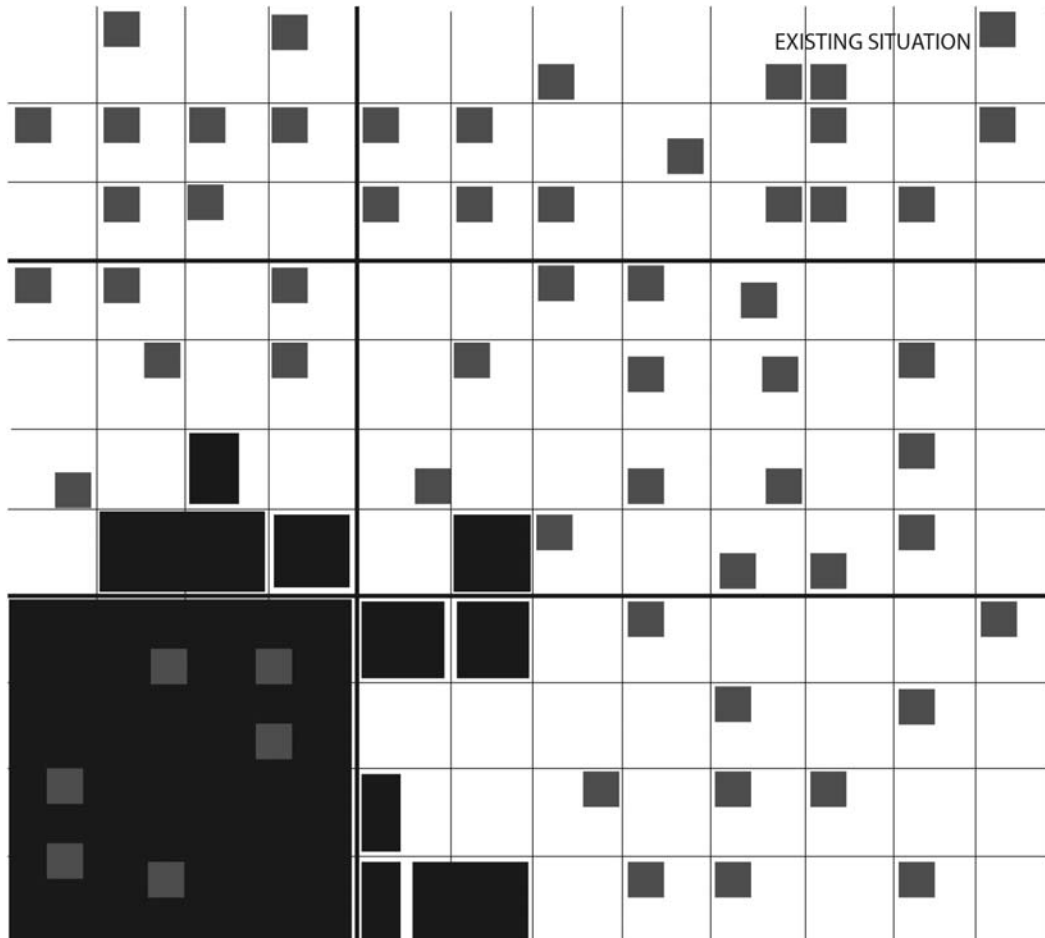


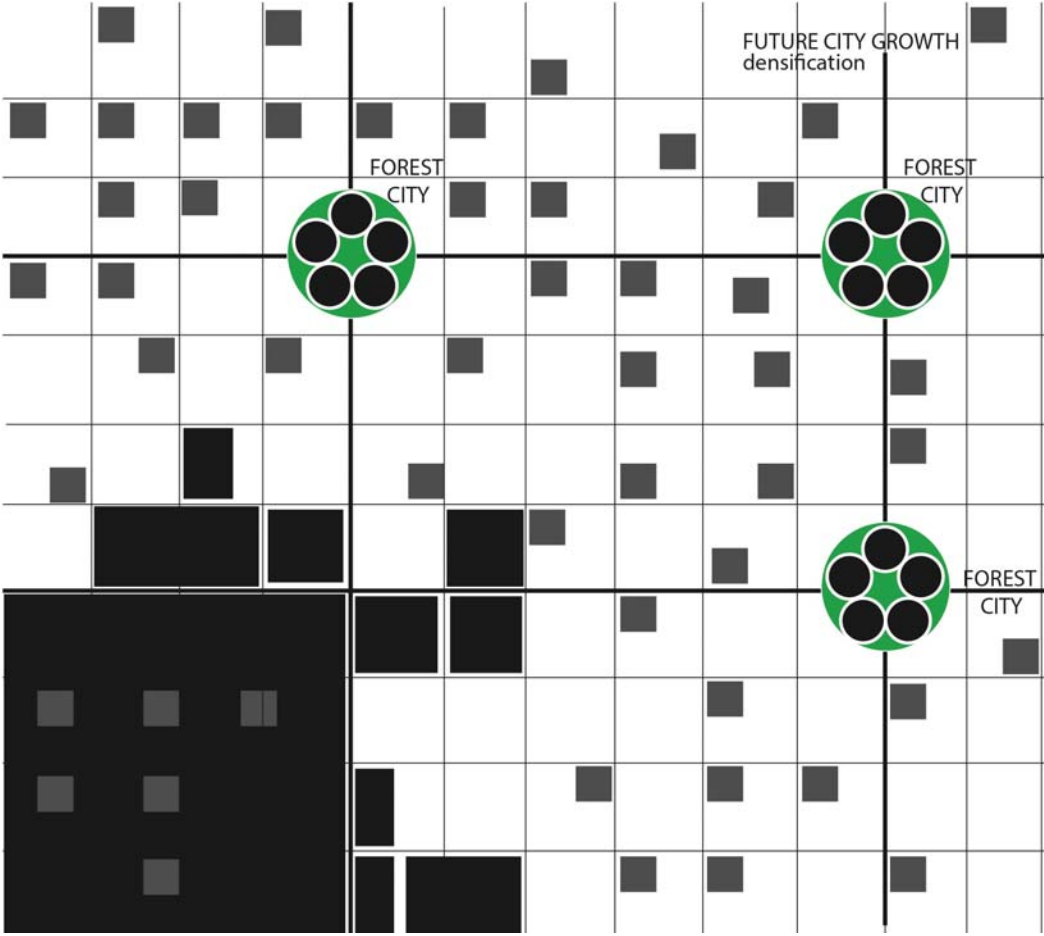
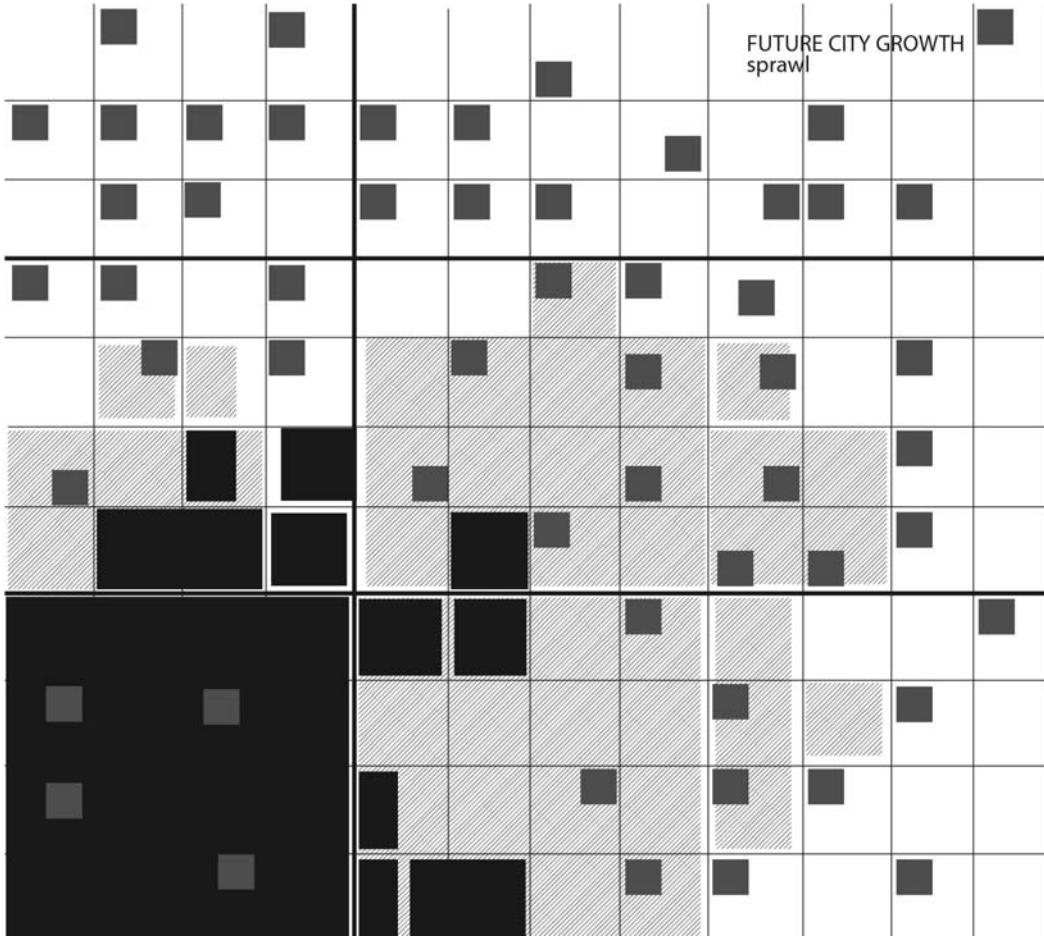
= 21kg/ year

1 TREE

**CO<sub>2</sub> ABSORPTION OF VERTICAL FOREST IS 0,4 kg/SQM**  
**CO<sub>2</sub> ABSORPTION OF FOREST CITY IS 0,4 kg/SQM**  
**FOREST CITY OF 3 500 000 SQM ABSORBS 1, 750 000 KG/YEAR**







FUTURE CITY GROWTH  
densification

1 FOREST CITY PRESERVES 2500 HA OF AGRICULTURAL LAND

5 KM

5 KM

