

# Sustainable Urban Water Management under Climate Adaptation

## Water - Food - Energy Nexus

### An urban perspective

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STATI GENERALI – ECOMONDO - November 7th 2018 RIMINI

# SUSTAINABLE CITY INDEX 2018



ARCADIS

Design & Consultancy  
for natural and  
built assets

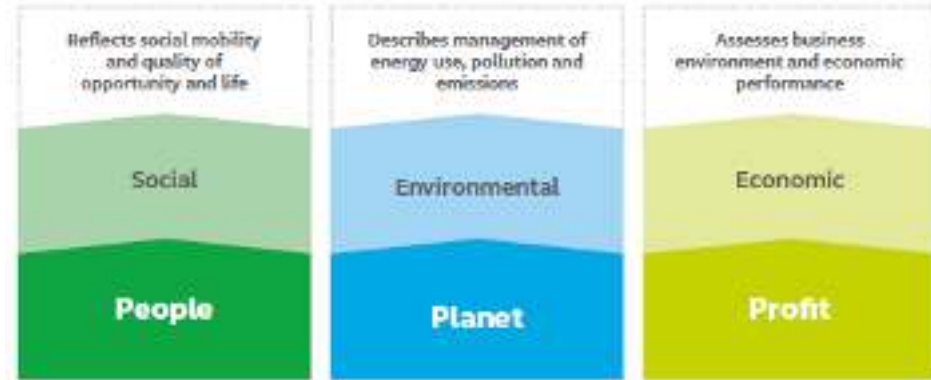
ARCADIS



**Citizen Centric Cities**  
The Sustainable Cities Index 2018

People/Planet/Profit pillars  
are aligned to UN Sustainable  
Development Goals  
(SDGs) and track  
progress against UN  
SDG commitments covering:

- ✓ Health and well-being
- ✓ Water and sanitation
- ✓ Industry, innovation and infrastructure
- ✓ Inclusive, safe, resilient and sustainable cities
- ✓ Climate change impacts
- ✓ Life on land



Using integrated  
sensors to manage city  
services

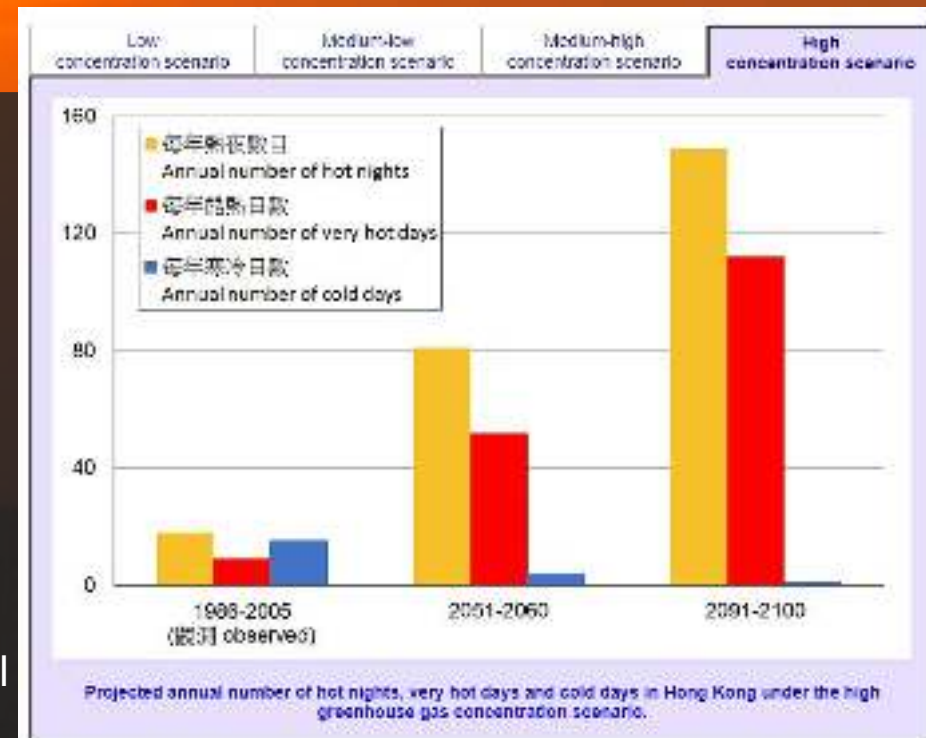
Using accessible  
infrastructure to  
enable all people to  
go about their  
daily lives.



# URBAN HEAT ISLAND EFFECT

## Heat intensification from urbanization

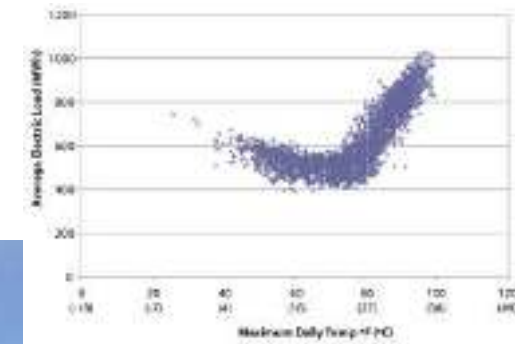
- Number of hot nights ( $\geq 28^{\circ}\text{C}$ ) increased from **10** to **41** between 2013-17
- Chinese University Research: a  $1^{\circ}\text{C}$  rise above  $29^{\circ}\text{C}$  results in a 4.1% increase in natural mortality in areas with high UHI - Mong Kok, TST, CWB
- By 2050, if global greenhouse gas emissions remain unchanged, the number of hot nights and very hot days ( $\geq 33^{\circ}\text{C}$ ) will increase to 81 and 52 per year



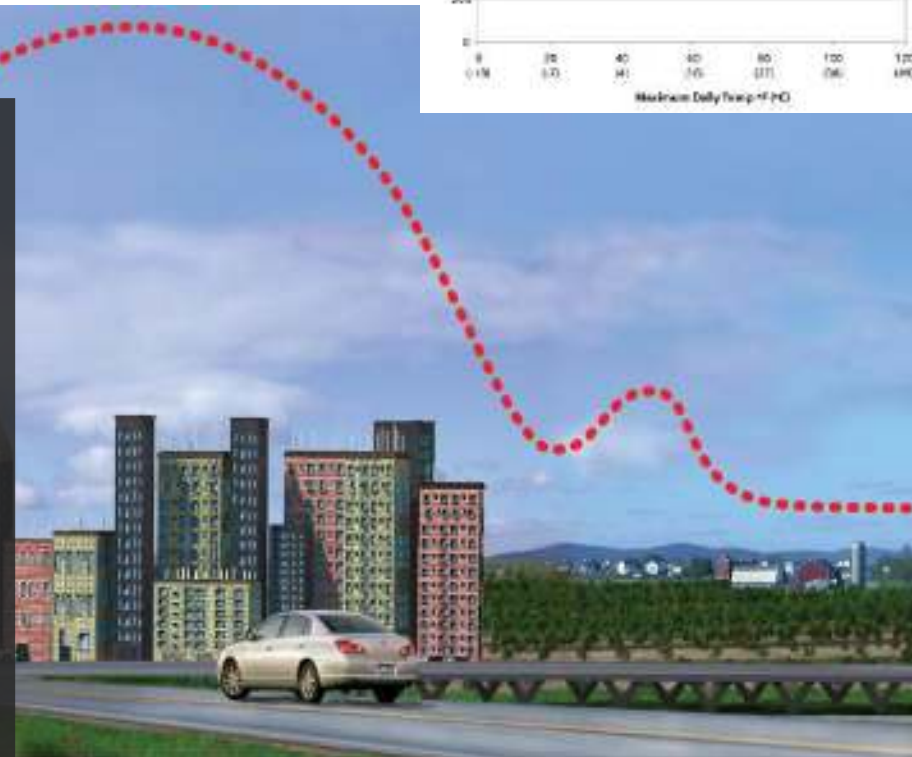


# URBAN HEAT ISLAND EFFECT

## Energy Consumption



- » Electricity demand for cooling increases 1.5–2.0% for every 0.6°C increase in temperature
- » In the U.S., electric load increases steadily once the temperatures begin to exceed about 20–25°C
- » This increase in temperatures suggest a 5-10% of rise in demand for electricity to compensate for UHI



# URBAN FARMING

- » Driven by the need for local, low carbon food
- » Innovative and sustainable
- » Urban farming start-ups are attracting substantial investment
- » Rooftop farming – Brooklyn Grange (NYC)
- » Common techniques include:
  - Hydroponic
  - Aquaponics
  - Modular



# SUSTAINABILITY MATRIX

## Singapore

### » Energy

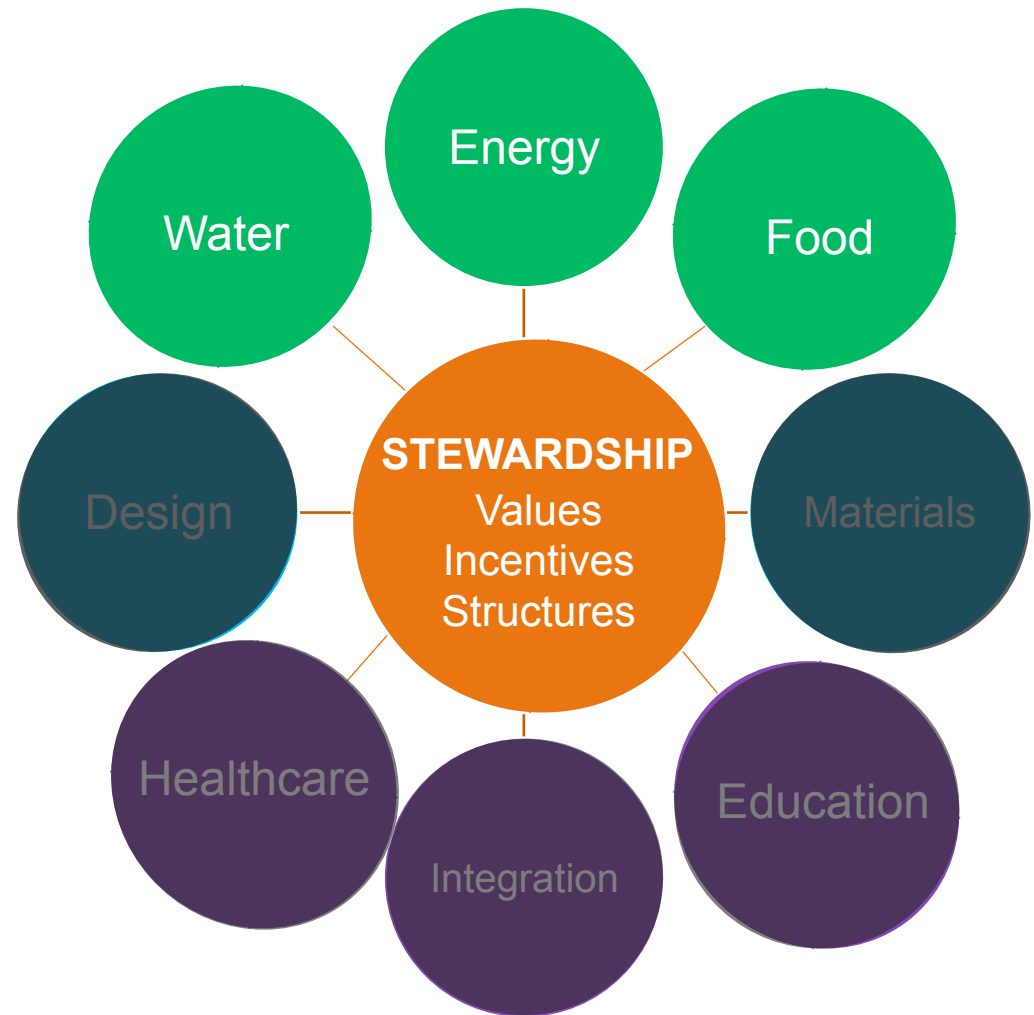
- Present itself as an attractive platform for energy professionals and leading energy firms

### » Food

- High Density Precision Farming – grow more in less space
- Drive to produce 60%-70% of food domestically
- Repurpose carparks and other suitable sites

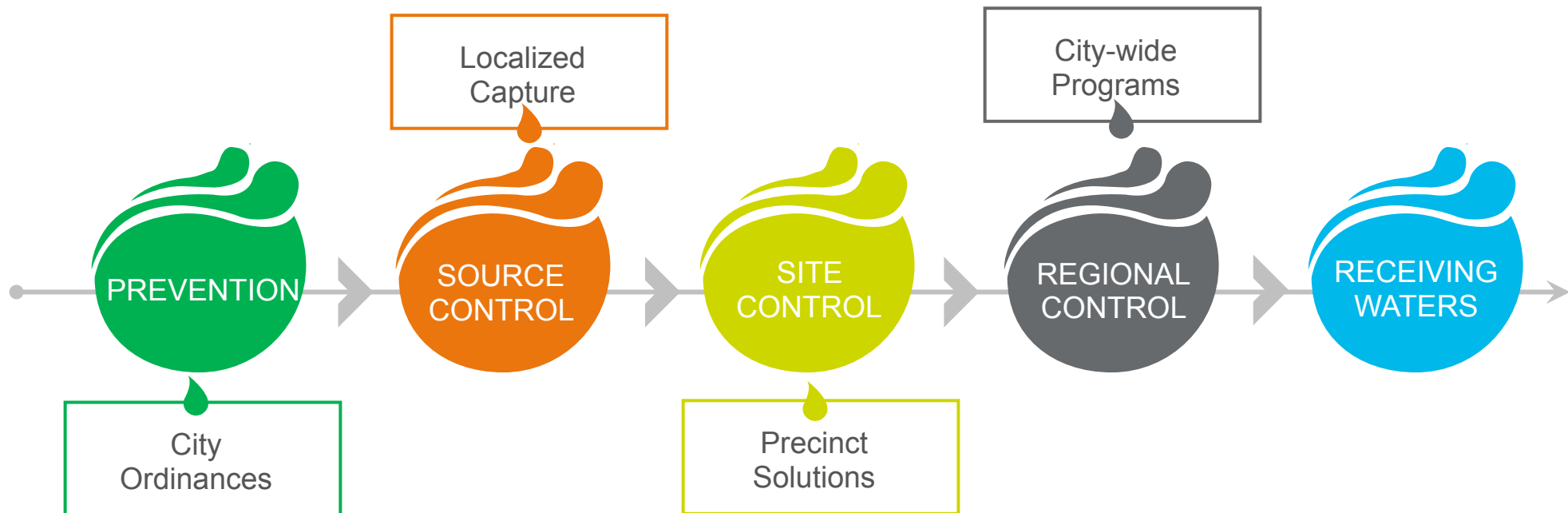
### » Water

- Recycle every drop of used water to create new water



# SUSTAINABLE URBAN DRAINAGE SOLUTIONS

The nexus of water with the urban environment







## SINGAPORE

### » Penjuru Road Urban Farming

- A PPP framework – between HSL and Urban Farming Partners –in an urban farm development
- Potential capacity of 1,000+ tons of produce
- Sustainable and innovative farm design
- Circular processes, LED-lighting, fertigation and climate control





## ROTTERDAM, NETHERLANDS

### » Schouwburgplein (Theatre Square)

- Part of the 7 Square Endeavour ambition to improve sustainability of the city area
- Aim is to make the area 40% climate neutral by 2020; 100% climate neutral by 2030
- Broad collaboration and participation between the private and public sectors





## DELFT, NETHERLANDS

### » Delft University of Technology Library

- Replaced original leaking single ply roofing
- Use of green roof, high-performance facades and subterranean water storage for heating and cooling
- Green roof converted into a sledding hill in the winter for recreational purpose







## CHICAGO, ILLINOIS

- » A Stormwater City Ordinance
  - Requires rain detainment on-site and limited release rate for large buildings
- » City Green Permit Benefit Tier Program
  - Green roofs, rainwater harvesting systems and more are rewarded with expedited permitting process & multi-faceted benefits
- » Green roofs in Chicago have a current capacity of 70 million gallons/year and growing





## DRIEBERGEN- ZEIST, NETHERLANDS

- » **Triodos Bank** – the leading expert in sustainable banking for over 30 years
- Creating a sustainable office complex that revitalizes the landscape and reflects the bank's corporate social identity
  - Integration of building and landscape architecture, combining function, nature and culture





# EINDHOVEN, NETHERLANDS

## » District-E Mixed-use:

- Three towers, 500 dwellings, exhibition hall, offices, retail, hotel, business centers
- Underground buffer system connected with local water system
- Building form uses air flows and water for cooling and a pleasant public space



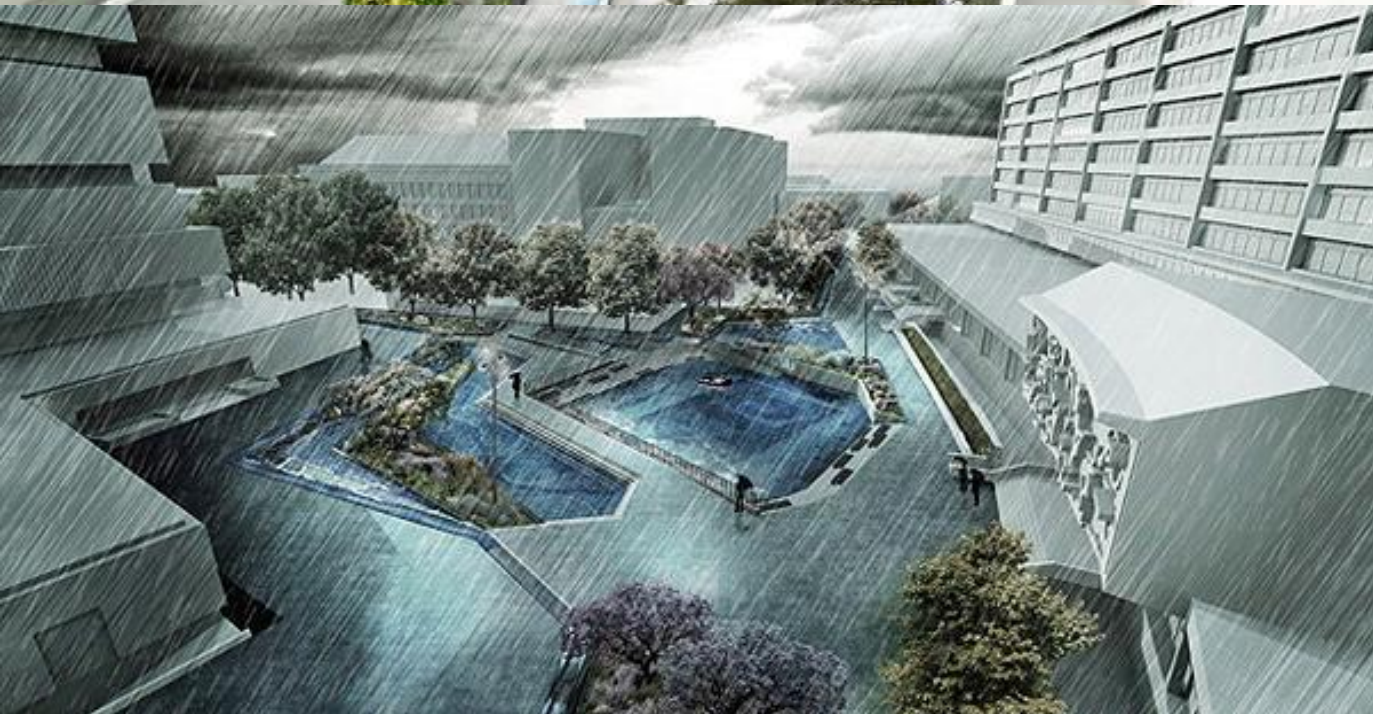




## ROTTERDAM, NETHERLANDS

### » Benthemplein Water Square

- World's first Innovative Public Water Plaza
- Meeting place and recreation area
- Converts to reservoir during heavy storms
- Inspired residents in the surrounding districts to implement
  - Green roofs
  - Rain gardens
  - Urban farming







## AMSTERDAM, NETHERLANDS

### » ING Bank Campus Gardens

- Transforming an office complex into a multipurpose one with residential apartments
- Sustainable water collection: rooftop gardens, atria, and public greenery
- Use of different planting styles to create a balanced ecological system





## AMSTERDAM A10

### » Integrated Urban Water System with Highway

- 32km long ring road motorway around the city of Amsterdam.
- Sensitive, green hydraulic design for highway drainage
- Reduces highway flooding, urban inundation and surface water pollution from highway capacity doubling





# SAN FRANCISCO, CALIFORNIA

## » Stormwater Ordinance

- Requires use of green infrastructure for stormwater management

## » Seawall Resiliency Project

- Protection of San Francisco Waterfront by fortifying century-old sea wall

## » Mission Creek

- Seven full plans to build resiliency and increase public amenities in this low-lying bay front area







## WASHINGTON, DC

### » Green Infrastructure Plan

- Unique and integrated technologies to maximize runoff capture and improve urban streetscape
- Integrates economic development, connectivity and environmental improvement

### » Climate Mitigation

- Solutions proposed to update National Mall
- Blue Current DC: “protect, collect, direct and connect”





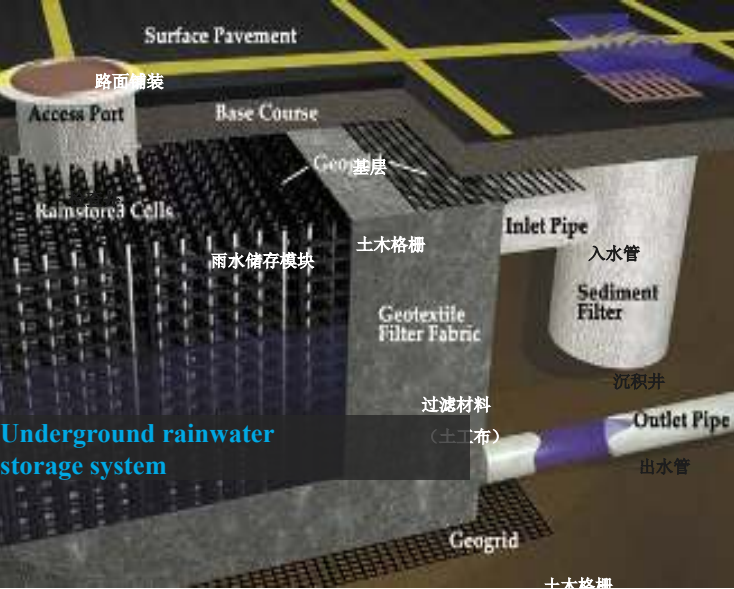


## WUHAN, CHINA

### Sponge City

- » Wuhan is one of sixteen pilot cities, starting with vulnerable pilot precincts
- » Innovative pilot solutions to create green public spaces to absorb stormwater, making the city more permeable, cooler and resilient





## WUHAN, CHINA

### Sponge Cities

- » Implementation of practical and aesthetic green measures
- » Application of innovative construction materials to absorb urban run-off and excess water





## SINGAPORE

### » Gardens by the Bay

- 101 hectares water front urban park
- Over 162,900 plants of more than 200 species are planted on the Supertrees (25-50 metres tall)
- Some Supertrees are embedded with photovoltaic cells to harvest solar energy, others act as air exhausts for localized cooling





## KL, MALAYSIA

### » Le Nouvel Residential Complex

- Dual-tower development in CBD facing Petronas Towers
- Use of vertical gardens and green walls to cool down buildings, reduce urban heat island effect, improving air quality
- 243 different species of lianas to cover the 200-metre high towers
- Water is collected from the rooftop and recycled, creating a mini eco-system







## SYDNEY, AUSTRALIA

### » Central Park, Sydney

- An 8-hectare urban village in downtown Sydney
- Accommodates 5,000 residents and 15,000+ worker and visitors daily
- Multiple water resources: rain water, storm water, ground water, drinking water
- All water related infrastructure are operated and maintained within the complex





## UTRECHT, NETHERLANDS

### » Wonderwoods mix-use complex

- Two towers development near Utrecht Central Station
- Vegetation provides natural shades, reducing heat and energy use
- Glass surfaces to optimize daylight – areas that require less sunlight are placed in the complex's middle





## PHILADELPHIA, PENNSYLVANIA

- » **Green City, Clean Waters Plan**
  - 25 year, \$2.4 billion plan
  - Alternative to increasing underground “grey” capacity
  - In the first five years, diverted 1.5 billion gallons of runoff
  - Will reduce the stormwater pollution entering city waterways by a stunning 85%
  - 840 greened urban acres including urban farms to improve city landscape and address urban heat island effect





## NEW YORK CITY

### » Green Infrastructure Program

- \$1.5 billion investment in public green by 2030
- Green roofs on city-owned properties and community bioswales
- Grants for private green infrastructure implementation
- Neighborhood demonstrations and initiatives for overall adaptive management





## MELBORNE, AUSTRALIA

### » Urban Forest Strategy

- Urban heating and climate change intensify the need for an urban forest
- Strategic planting of trees can reduce temperatures by 2-3 °C
- Captures stormwater runoff
- Contributes to mental and health benefits

PIONEERED BY THE  
ROCKEFELLER FOUNDATION

**100**

**RESILIENT CITIES**





# CONCLUDING THOUGHTS

- » Urban water is an asset that can be managed to mitigate Urban Heat Island Effect, improve city resiliency and promote urban farming
- » Cities shifting from gray to green infrastructure solutions
- » Cities are taking the lead — implementing ordinances and developments at a local, precinct and city-wide scale to address climate change and improve city livability











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