Health Benefits: Mitigating Air Pollution and Improving Urban Microclimate

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Workshop 'The Health and Social Benefits of Nature and Biodiversity Protection'

27 January 2016, Brussels

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Session Questions

- What are the **health and social benefits** from protected areas and wider green infrastructure in terms of **air pollution** and **heat stress**?
- Are there any good **examples** of these benefits (and their values) **across Europe**?
- Who has driven this practice? What **tools** and **measures** have enabled progress?
- To what extent are the experiences **replicable** and **transferable** across issues and across Europe?

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Analysing Nature Based Solutions

1. **What is the problem?** Key drivers and variables
2. **Health burden?** Including social and economic impacts
3. **What contribution can nature make?** What does the science say?
4. **Natura 2000?** Do protected areas play a role?
5. **Green Infrastructure?** Any green innovations?
6. **Governance?** How can we capitalise on benefits?

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1. What is the Problem?

Air Pollution

- Urban air quality persistantly poor across Europe – mostly linked to transport
- 2011-2013: 75% of urban populations in EU-28 exposed to harmful levels of PM, O_3, BaP (WHO 2015)

Heat Stress

- Temperatures already higher in urban spaces due to UHI (up to +12°C)
- Climate projections: ~75% of EU urban populations exposed to increased heat stress (EEA 2012)

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2. Health Burden

Air Pollution

- Risks linked to cardiovascular and respiratory disease
- Poor air quality linked to 400,000 deaths in EU-28 in 2012 (EEA 2015)
- Largest environmental health risk in Europe
- Annual economic burden >EUR 1 billion (WHO Europe)

Heat Stress

- Forecasts: increased heat related mortality across EU (EEA 2012)
- 2003 heatwave: 70,000 deaths
- Heat induced output losses up to 0.5% of GDP by 2100 (Hubler 2007, Lancet Commission 2015)

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3. What contribution can nature make? – Air quality

A number of nature based solutions to air quality. Many of them are overlooked in existing debates, which focus on 1.

1. **Providing barriers or sinks for pollutants**: most research has been done on this pathway, mixed evidence, complex variables (e.g. street canyons), uncertainty. Could be valuable in highly polluted streets, increasingly applied in cities

2. **Providing clean air oases**: (large) green spaces lack pollutant sources and have markedly cleaner air than other urban spaces

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3. What contribution can nature make? – Air quality

3. **Interaction with climate**: cooling effect of vegetation and water promotes clear air exchange through urban spaces

4. **Facilitating behavioural change**: green infrastructure can reduce pollutants at source by facilitating lifestyle change – e.g. promoting cycling

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3. What contribution can nature make? - Heat

Green and blue spaces contribute to cooling by providing shade and through evapotranspiration. Offer an invalubale tool in climate change mitigation. Multiple variables determine benefits:

1. **Configuration**: tree-lined streets, green walls, green roofs, and protected areas all offer different forms of cooling

2. **Type**: certain species provide more shade than others, key differences between grassland and forests

3. **Size and density**: large trees offer more shade than small ones, but take a longer time to mature

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3. What contribution can nature make? - Heat

4. **Health of vegetation**: maintenance of green infrastructure ensures continuous contributions to cooling

5. **Temporal & seasonable variations**: differences between deciduous or coniferous vegetation

6. **Air exchange**: green corridors can encourage air exchange through built up areas

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4. Protected Areas

Large protected areas are oases of clean and cool air, offering essential relief to millions of urban dwellers on a daily basis

Example: **Vitoria-Gasteiz and Salburua Wetlands (Spain):** 5 degree UHI and high vulnerability to heat waves; 250,000 citizens never more than 300 meters from green and blue infrastructure, including protected green belt of Natura 2000 and Ramsar sites

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VITORIA GASTEIZ 2012 EUROPEAN GREEN CAPITAL

Natura 2000

Peri-urban GI

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5. Green Infrastructure

Carefully designed and strategically placed green infrastructure can maximise street level benefits, providing valubale relief in high risk areas.

Example: **Mayor of London (GLA) & Transport for London (TfL) clean air initiatives**. London 10,000 deaths annually from air pollution (KCL 2015). TfL and GLA invest >EUR 15 million, including in green walls at sites with high PM.

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Transport for London

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6. Capitalising on benefits

Actor	Tools	Example
City authorities	Air quality and green infrastructure strategies, tree planting campaigns, green roof policies/finance	Lyon, France: Berges du Rhône (2007)
Transport bodies	Funding for green infrastructure and research	London, UK: TfL Clean Air Fund (2012)
Citizens	Citizen science, mobile applications, guerrilla gardening, advocacy	Berlin, Germany: Initiative '100% Tempelhofer Feld' and referendum (2014)
Science	Research, dedicated mapping and climatology teams	Stuttgart, Germany: StadtKlima
Designers	Innovative projects	Milan, Italy: Bosco Verticale (2014)

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Next in Session…

- Barcelona's Green Infrastructure and Biodiversity Plan, **Laura Zapata Gonzales**, Municipality of Barcelona, Spain
- StadtKlima and Nature Conservation for Clean Air, **Ulrich Reuter**, City of Stuttgart, Germany
- With a floor contribution from **Tajana Ban Ćurić**, Medvednica Natural Park, Croatia

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Barcelona, a city committed to Nature and Biodiversity

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Laura Zapata González
Energy and Environmental Quality
Barcelona City Council

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Location:	41º23’ N / 02º12’ E
Precipitation:	598 mm
Average Temperature:	16,5ºC
Solar radiation:	1.502 kWh/sq m
Hours of sun:	2.583h/year

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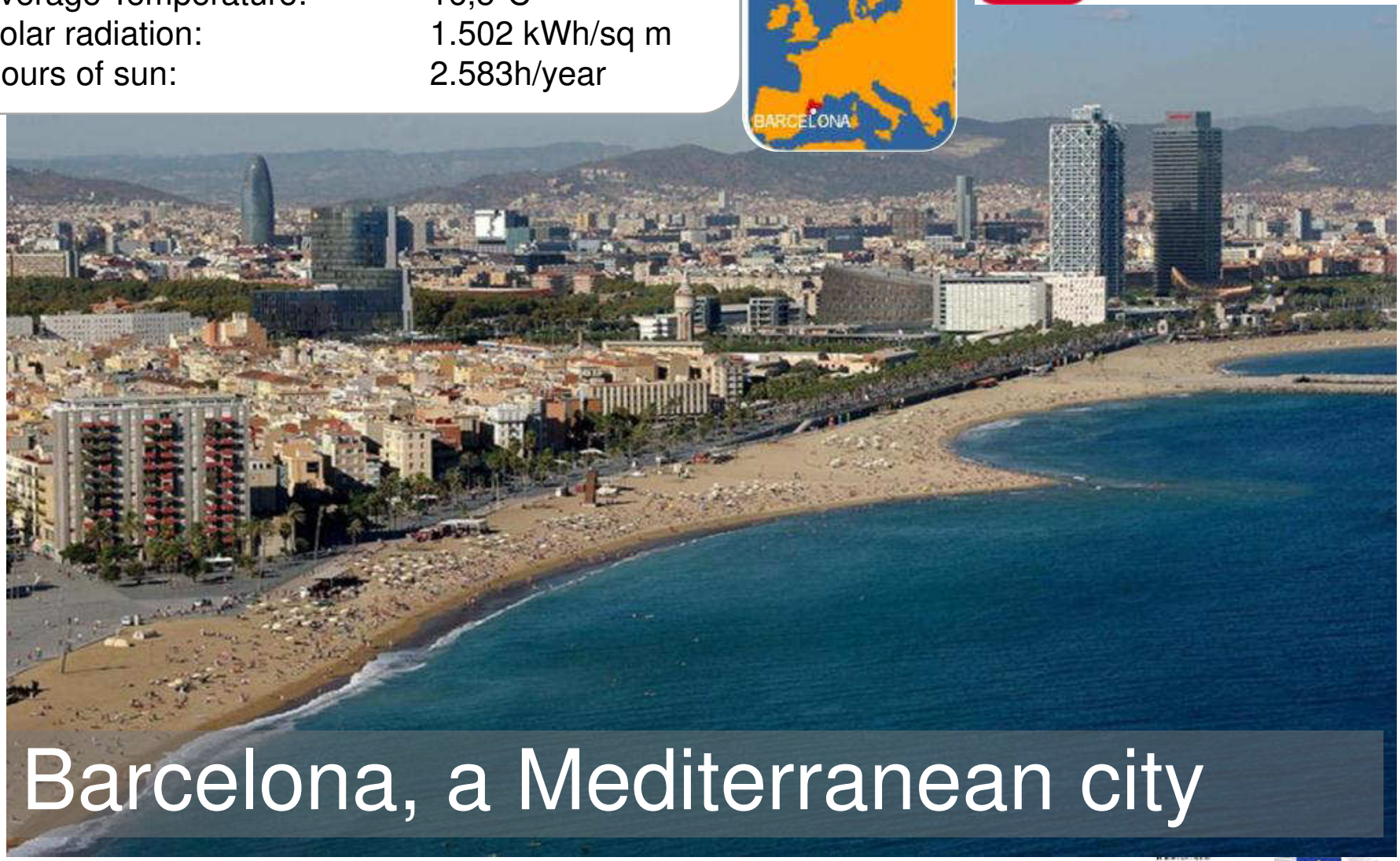

Barcelona, a Mediterranean city

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Barcelona, a dense and compact city

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Population:	1.619.337 hab.
Surface:	104 km^2
Density:	15.570 hab./km^2
Metropolitan Area:	4.720.951 hab.

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CHALLENGES
1.Climate change

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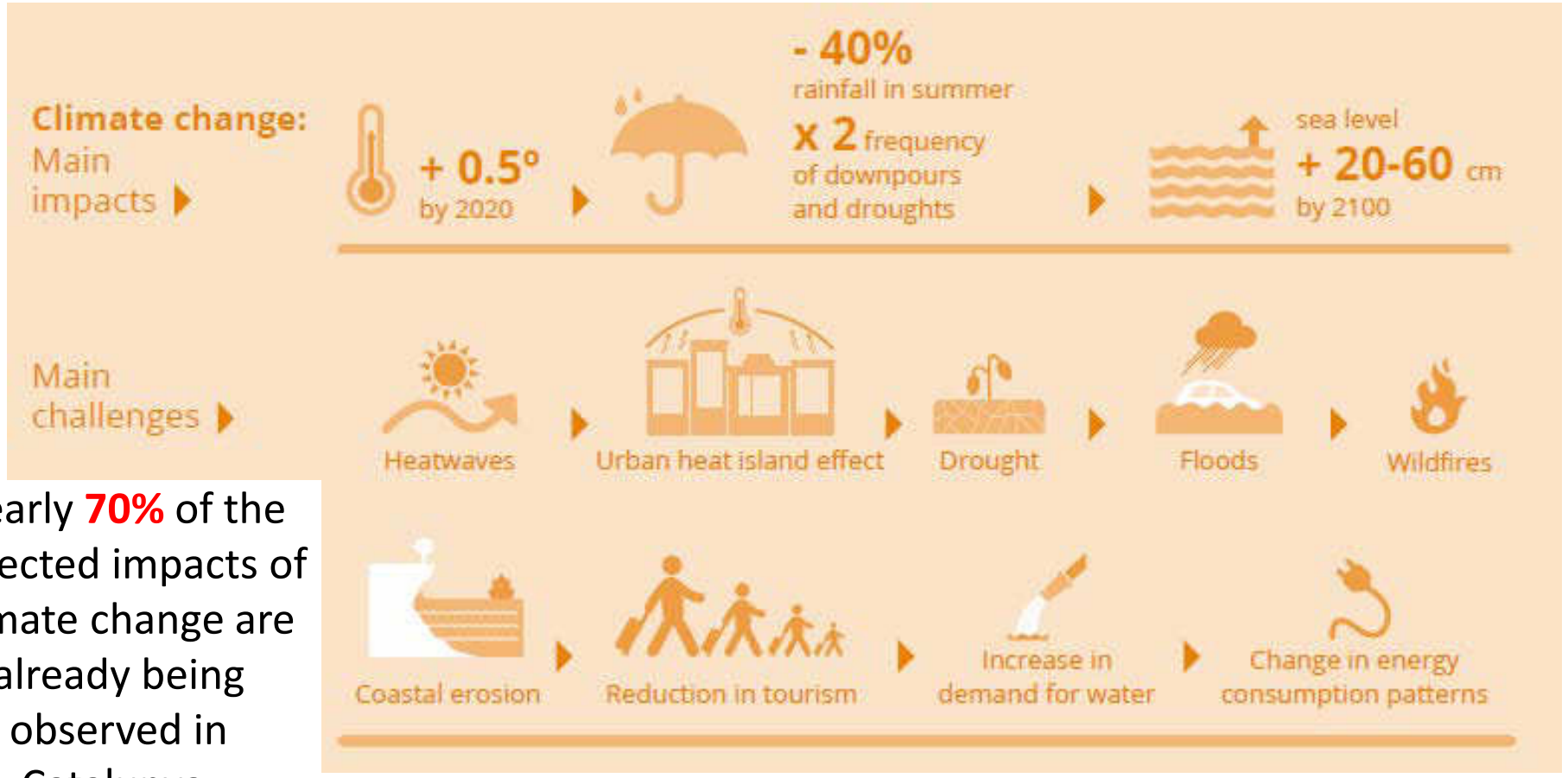

Nearly **70%** of the expected impacts of climate change are already being observed in Catalunya.

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CHALLENGES

2.Air quality

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Pollutants monitored

Carbon monoxide(CO)	
Lead (Pb)	
Arsenic (As)	
Cadmium (Cd)	
Nickel (Ni)	
Sulphur dioxide(SO_2)	
Benzo[a]pyrene ($C_{20}H_{12}$)	
Benzene (C_6H_6)	
Ozone (O_3)	
PM2.5	
PM10	
Nitrogen dioxide(NO_2)	

Annual limit value	40 µg/m3
Daily limit value *Can be exceeded 35 times a year*	50 µg/m3

Annual limit value	40 µg/m3
Hourly limit value *Can be exceeded 18 times a year*	200 µg/m3

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CHALLENGES

3.Urban Heat Island

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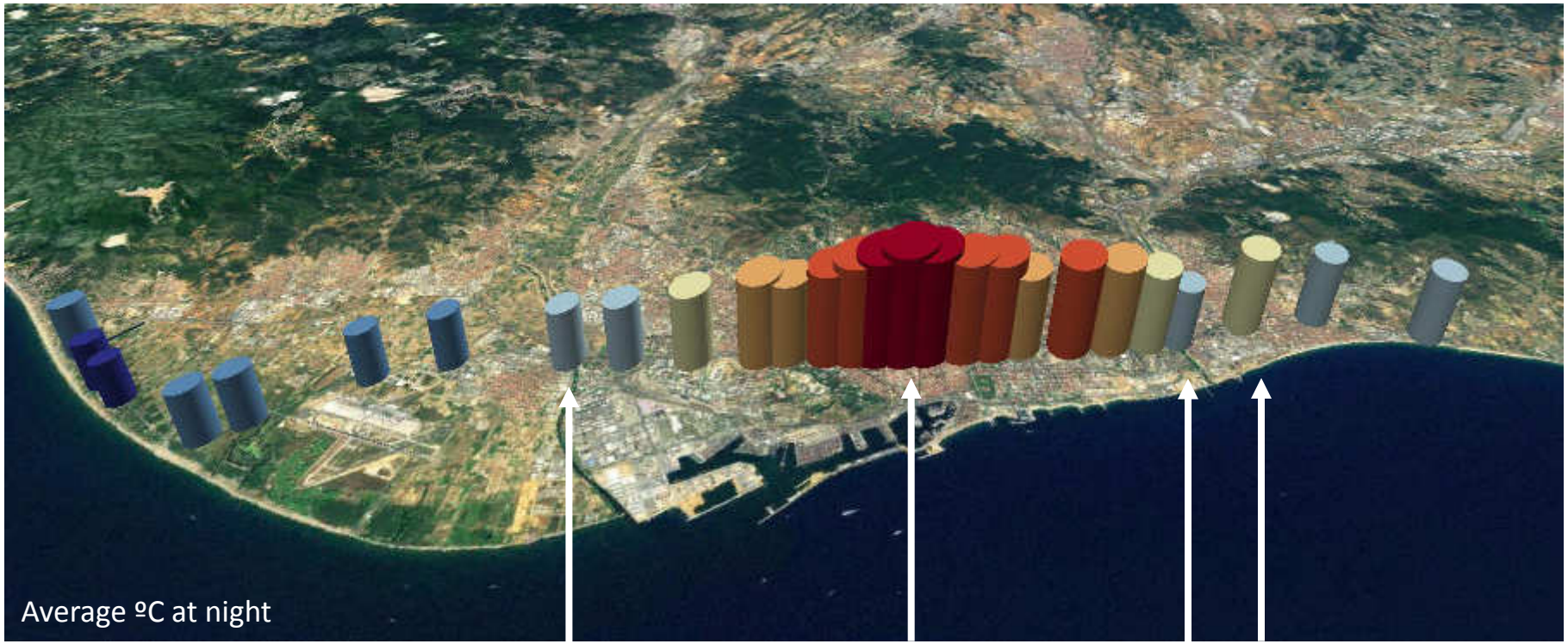

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STRATEGIES & ACTIONS

Green Infrastructure and biodiversity plan

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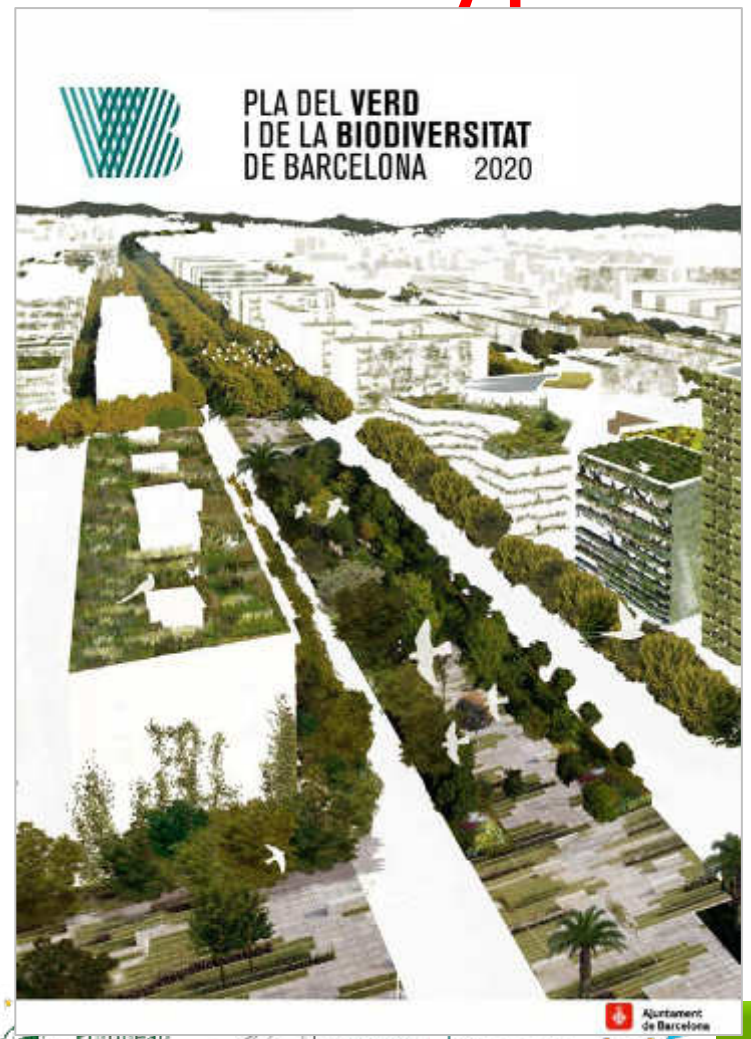

+ green surface
+ biomass
+ quality

1. STUDIES ON ENVIRONMENTAL SERVICES
2. GREEN CORRIDORS AREAS OF OPPORTUNITY
3.TREES MASTER PLAN
4. BIODIVERSITY GARDENS

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STRATEGIES & ACTIONS

1. STUDIES ON ENVIRONMENTAL SERVICES

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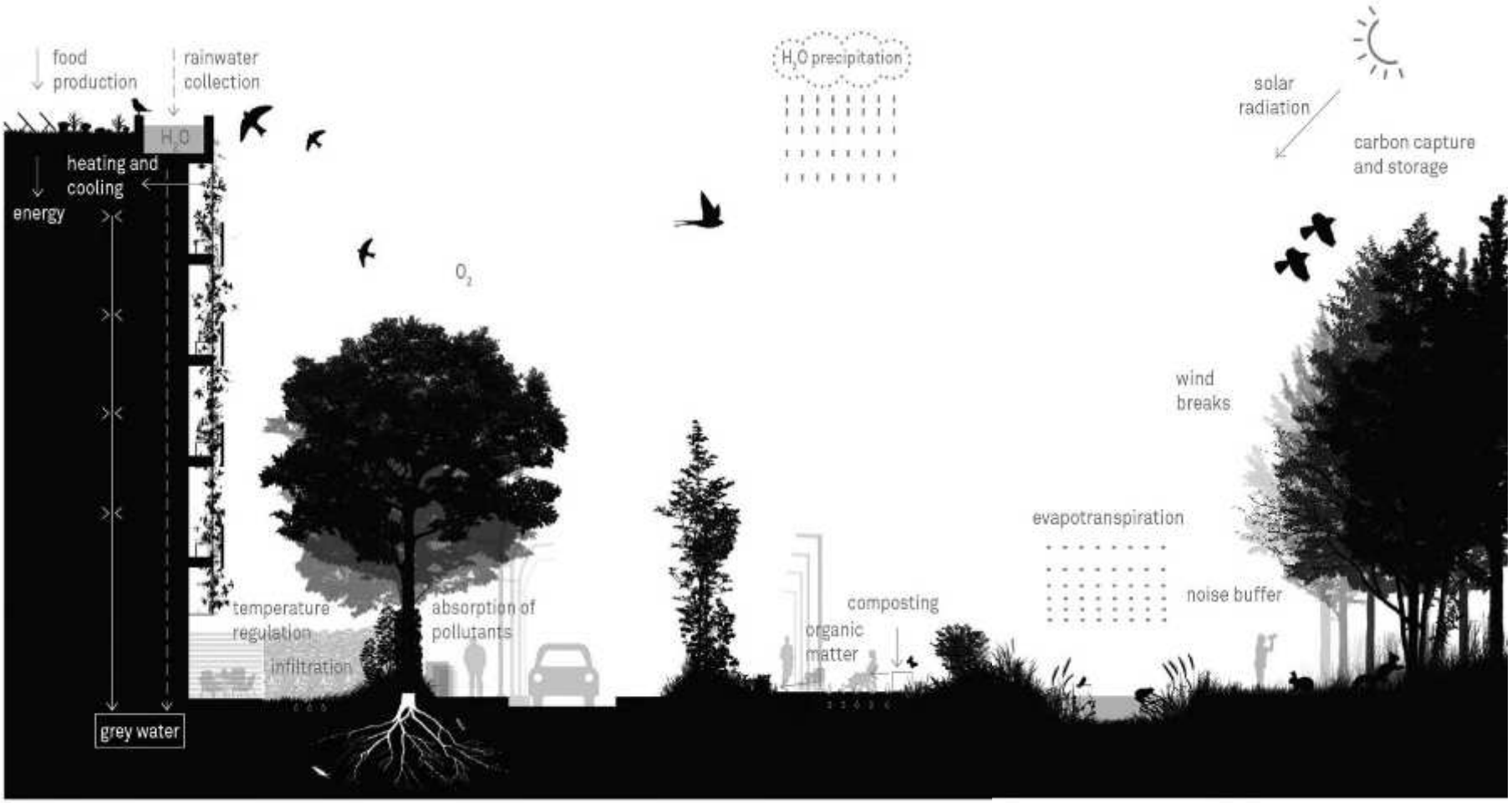

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STRATEGIES & ACTIONS

1. STUDIES ON AIR QUALITY SERVICES

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Air Quality Plans do not consider green infrastructure to meet policy targets, it focuses mainly on technical measures (reduction of traffic, promotion of less polluting fuels)

Contribution of Barcelona urban forests to air quality (*Baró F. et al, 2014*):

- Contribution to NO_2 removal is low (0,52% to total emissions)
- Contribution to PM_{10} removal should not be neglected (22,31%) but considering background pollution levels removal drops to 2,66% of total.

Contribution of urban forests in Barcelona (most in Collserola, Natura 2000) to abate **pollution is substantial in absolute terms, yet modest when compared to overall city levels.**
To be effective, green infrastructure **efforts have to be coordinated at broader spatial scales, at metropolitan leve**l.

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STRATEGIES & ACTIONS

2. GREEN CORRIDORS

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STRATEGIES & ACTIONS

2. GREEN CORRIDORS

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STRATEGIES & ACTIONS

3. AREAS OF OPPORTUNITY

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STRATEGIES & ACTIONS

4. TREE MASTER PLAN

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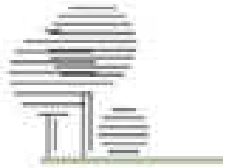
Giving conditions to increase its environmental services

STRATEGIC VISION OF STREET- TREES

- ✓ Biologically diverse mature, native, healthy, sustainable
- ✓ Best growing conditions available.
- ✓ Adapted to urban ecosystem providing high quality of life.



200.000 urban trees (2014)

Sp selection

- No one species to exceed 15% of the total of street-trees → to avoid pests and disease
- Resilient to environmental conditions, water and heat stress
- Preferably native

Space

- Aerial space
- Transforming individual tree pits into continuous pits
- Improve soil conditions (permeability, volume)

Water

- Use of alternative water
- Appropriate irrigation according each sp.
- Automatic irrigation systems and leak control

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STRATEGIES & ACTIONS

5. TOWARDS ECO-MANAGEMENT

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- Management and maintenance incorporates good practices considering biodiversity

✓ Including shrubs and dry herbaceous layers

✓ Less pruning, more biomass in street-trees

✓ Achieve a more abundant, mature and stratified vegetation

✓ Improve habitats in parks and gardens introducing species to attract native fauna (pollinators, birds)

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STAKEHOLDERS

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Understanding and taking into account the priorities and concerns of different stakeholders to plan innovative solutions and set communication strategies.

- ✓ **Participation processes: Barcelona's Commitment to the climate**
- **Green Infrastructure and Biodiversity Plan**
- ✓ **Citizen Commitment to Sustainability**
- ✓ **Air quality municipal board**

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COMMITMENT

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Green Infrastructure and Biodiversity Plan

- The Plan has a **2020 horizon**, taking as benchmarks the EU Biodiversity Strategy to 2020, and the United Nations' Convention on Biological Diversity (CBD), as expressed in the Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets.
- **A Green Spaces and Biodiversity Program was created** to carry out the Plan
- It was introduced by consensus by the municipal government in 2013 **to ensure political commitment and long-term success**
- **Fundings come from all municipal skateholders** (only partially controlled)

Barcelona's Commitment to the climate

Through collective action,the aim is that **by 2030 Barcelona**:

→ as regards adaptation, will have increased its urban green by 1.6 km², i.e. by 1 m² per current city resident.

verd urbà

+1 m² per current city resident

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NEEDS

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ACHIEVE ECO-MANAGEMENT OF GREEN INFRASTRUCTURE AND INCREASE URBAN GREEN SURFACE

STRENGTHEN POLICIES AT MUNICIPAL AND REGIONAL LEVELS. HOW TO COORDINATE MULTIPLE FINANCIAL SOURCES

ECONOMIC ASSESSMENT OF BENEFITS ARE NEEDED IN GREEN INFRASTRUCTURE (COST-EFFECTIVE STRATEGIES)

MORE INFORMATION ABOUT SOCIAL AND HEALTH SERVICES IS NEEDED

IMPROVE MONITORING SYSTEMS AND INDICATORS OF GREEN AND BIODIVERSITY

CHANGE CULTURE, ACTIVE POLICIES OF COMMUNICATION AND NATURE AWARENESS

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StadtKlima and Nature Conservation

for optimized Microclimate and Clean Air

Dr. Ulrich Reuter

City of Stuttgart, Office for Enviromental Protection, Germany

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Contents

- The problem
- The strategy to use nature
- The Activities
- Benefits
- Stakeholders
- Recommendations/ Challenges

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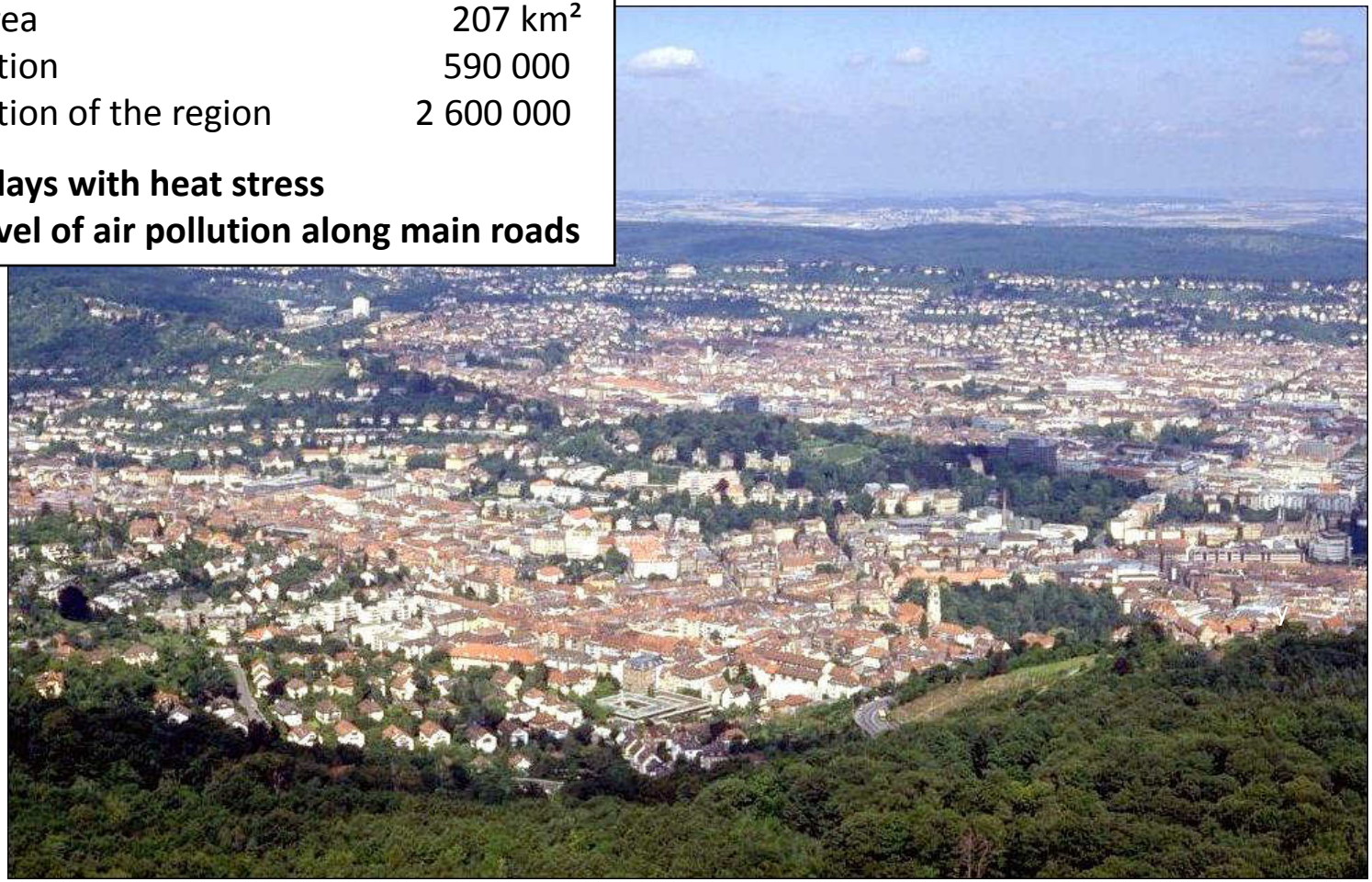
The Problem

STUTTGART

lowest point	207 m
highest point	549 m
total area	207 km²
population	590 000
population of the region	2 600 000

many days with heat stress
high level of air pollution along main roads



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STUTTGART

Section of Urban Climatology

The activity of the urban climatology in Stuttgart has a long tradition.
In the year 1938 the municipal council decided to employ a meteorologist, to investigate the special urban climate of Stuttgart and the connection to town planning.

Since that time urban climate is a very important factor for town planning in Stuttgart, especially concerning ventilation and thermal effects.

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STUTTGART

Federal building code

Baugesetzbuch - BauGB

- The requirements of environmental protection
- Ecological balance in nature, and of water, the air, and the climate
- Contribute to an environment which is good for human being, protect the natural basis of life, promote climate protection and climate adaptation.

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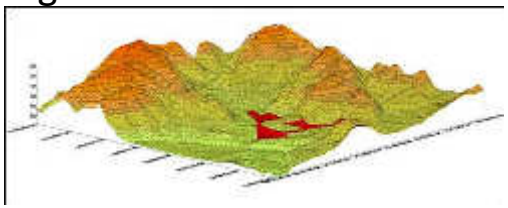
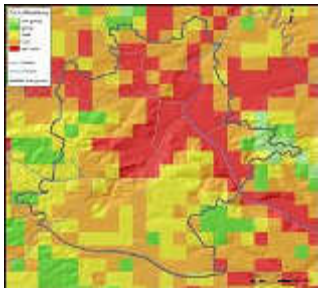
Measurement

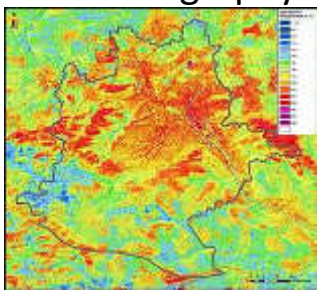
Digital Elevation Model



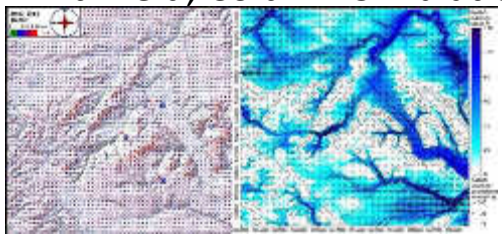
Spatial distribution of emissions



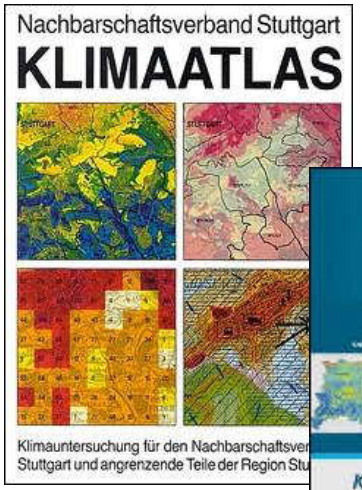
IR Thermography



Wind Field; Cold Air Simulation

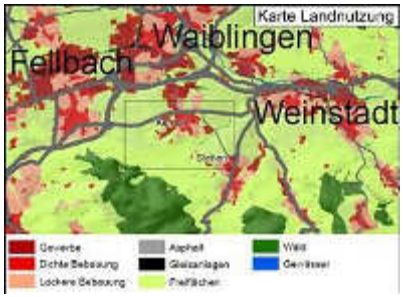


Climate Atlas



Climate Atlas Region Stuttgart

Land Use Data



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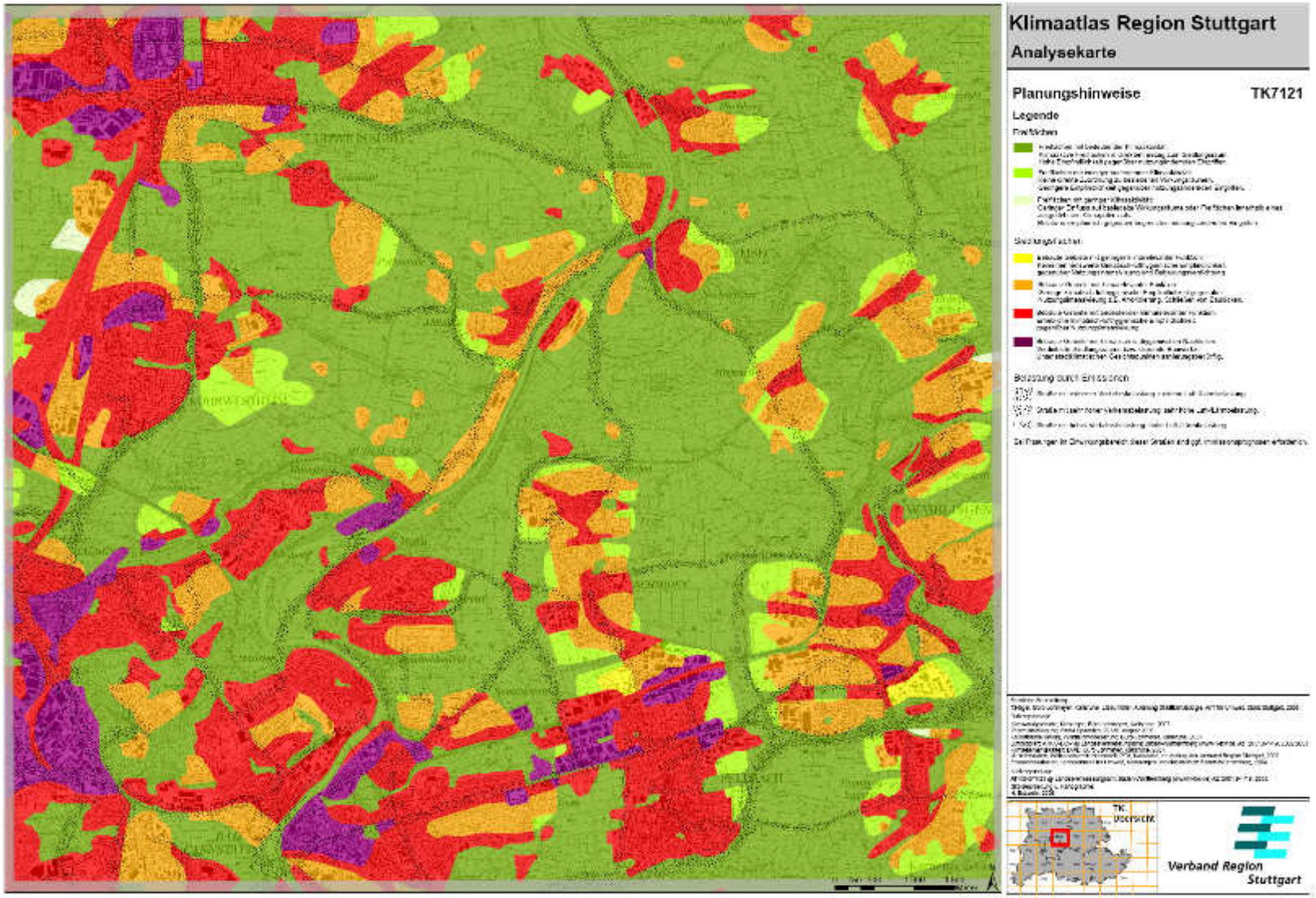
Map with hints for the planning

STUTTGART



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Green in the city

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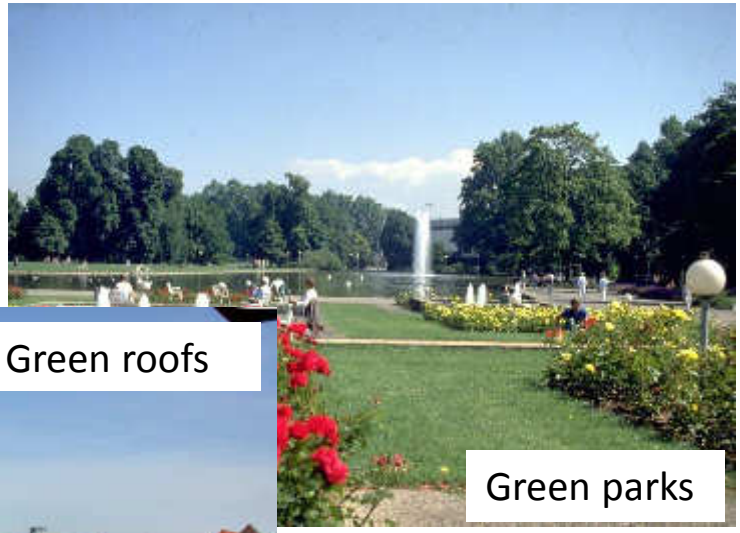

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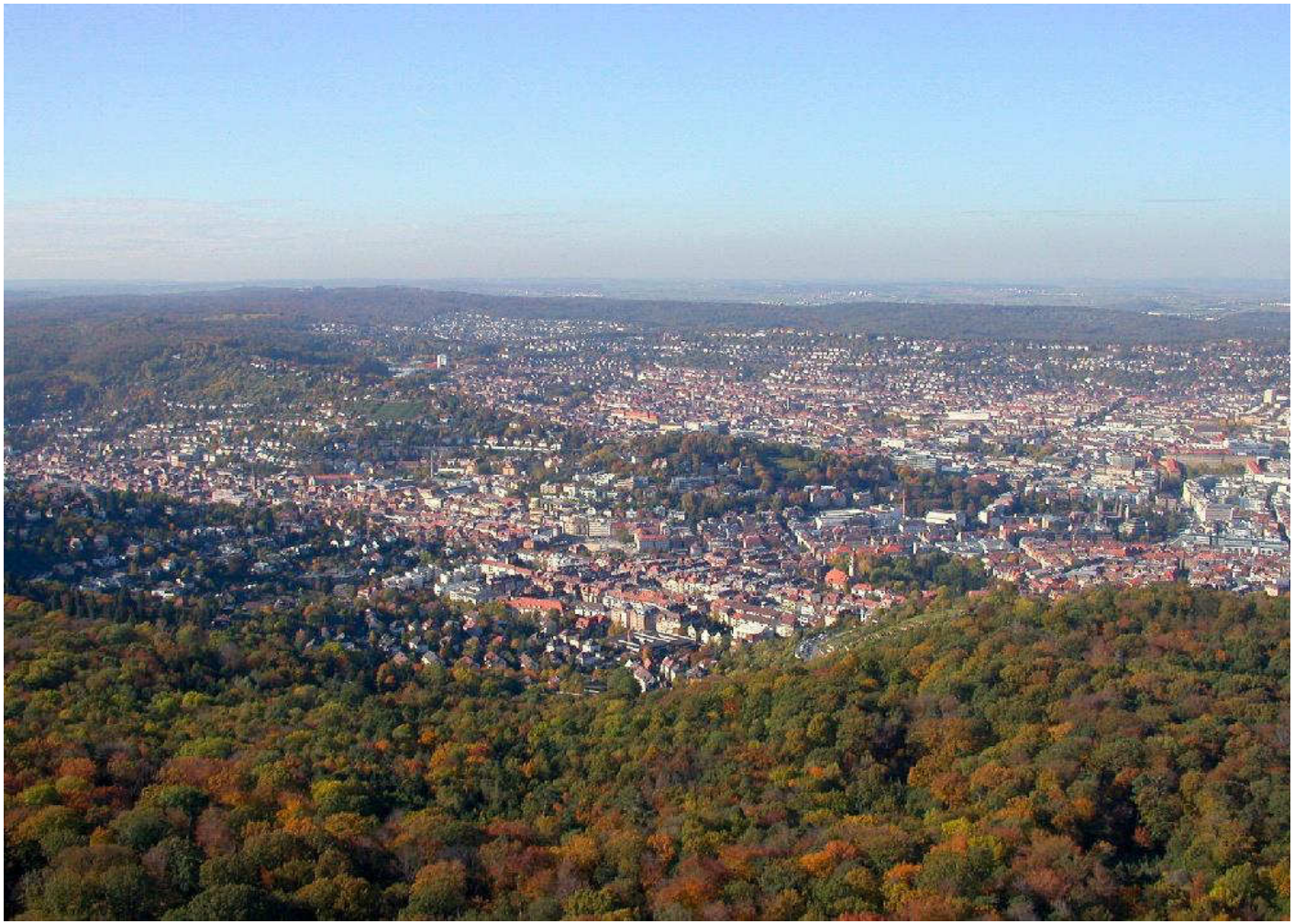
STUTTGART

Forest (25%), Protected Landscape (40%)



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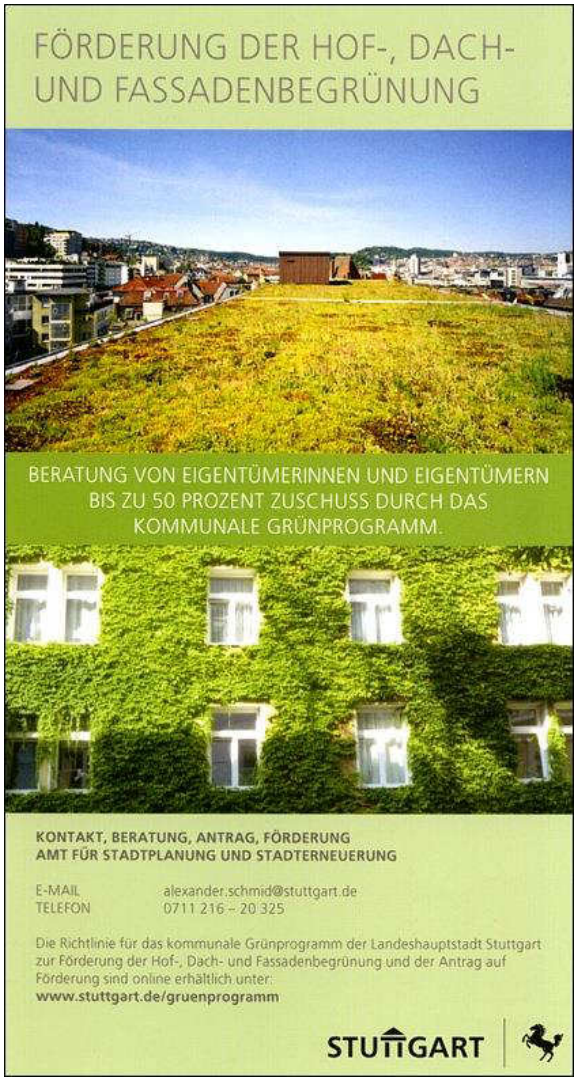
Funding program



„More trees and plants in the city“

Budget:
1.800.000 Euro

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Planting for local climate and to reduce air pollution

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Moss wall planned; about 500.000 Euro

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Quarter „Das Rosenberg“

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Slopes

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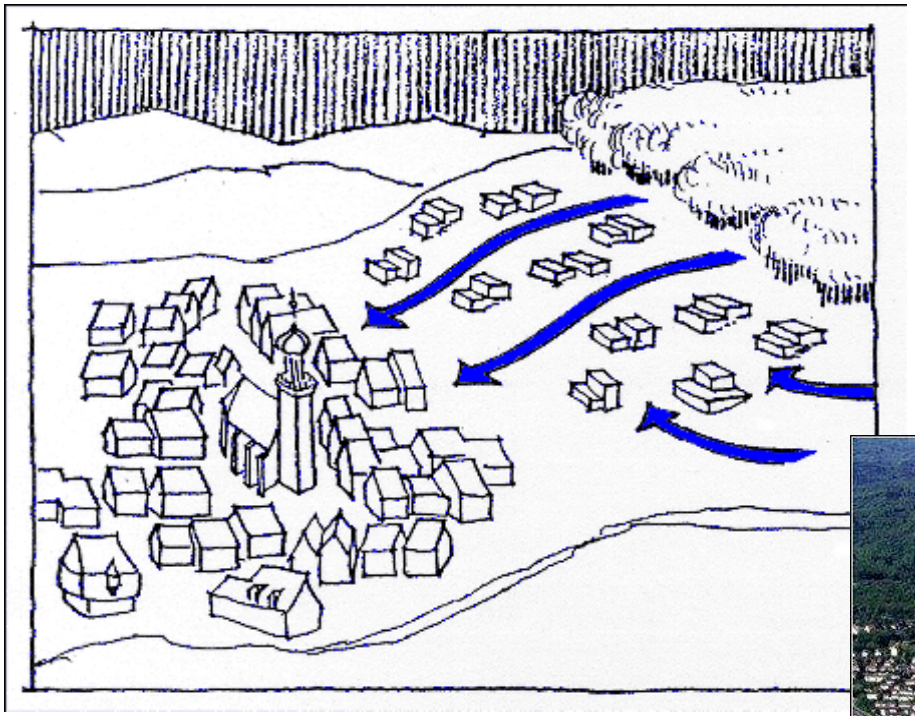

Strategy plan for the slopes

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Contents

- The problem
- The strategy to use nature
- The Activities
- Benefits
- Stakeholders
- Recommendations/ Challenges

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Costs/ Benefits

- **Nature in urban planning means no additional costs, if you have municipal experts.**
- **Personal costs and investigation costs.**
- **The municipality sometimes works together with universities.**
- **Funding from the national and EU level.**
- **The role of nature for climate and air pollution: costs of prevention are much less than the costs of repairing the consequences.**

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Benefits

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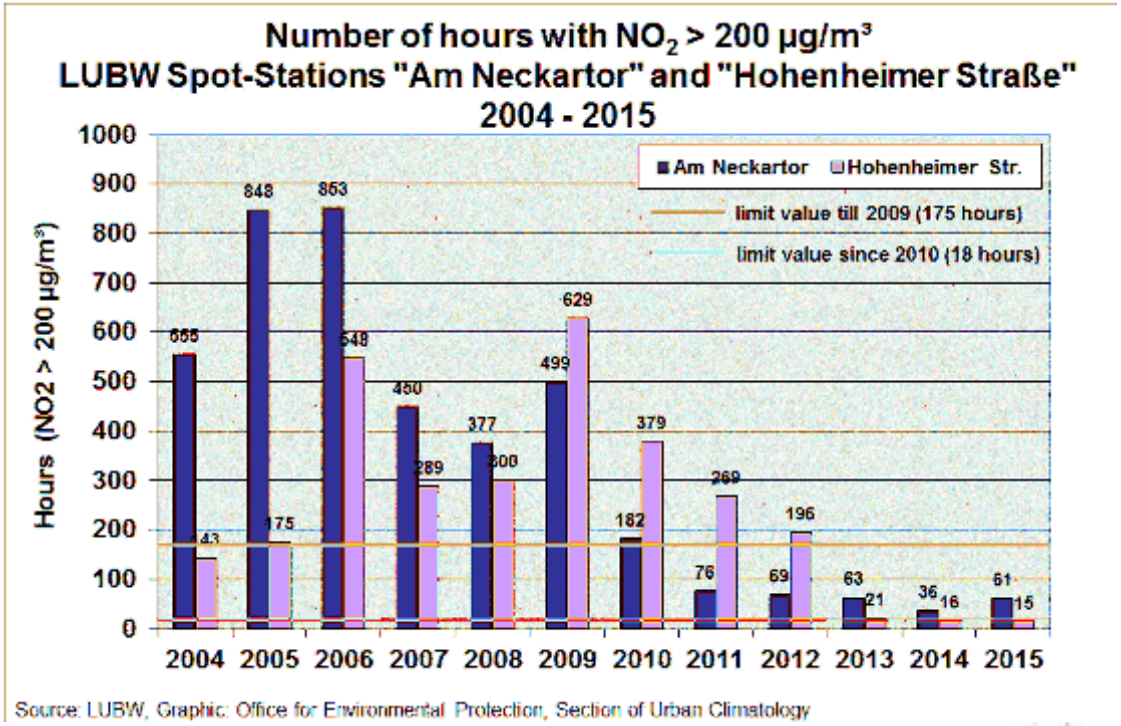
- Less than 300 m distance from a green space

- Green infrastructure
- Ventilation corridors
- Traffic measures

} lead to reduced air pollution



Source: LUBW, Graphic: Office for Environmental Protection, Section of Urban Climatology

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Involved stakeholders

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- health and social department for heat warming strategies

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Recommendations/ Challenges

Green infrastructure and ventilation corridors reduce heat stress and air pollution. The strategy of the city of Stuttgart shows: That works.

Interdisciplinary working of the different stakeholders and engaged employes are necessary and the key for success.

The impacts of global climate change and the need to adapt make this more and more important.

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Thank you for your attention!

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#naturehealth

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