Climate change adaptation from the perspective of Copenhagen – As a pioneer city in urban water management

COPENHAGEN TOGETHER

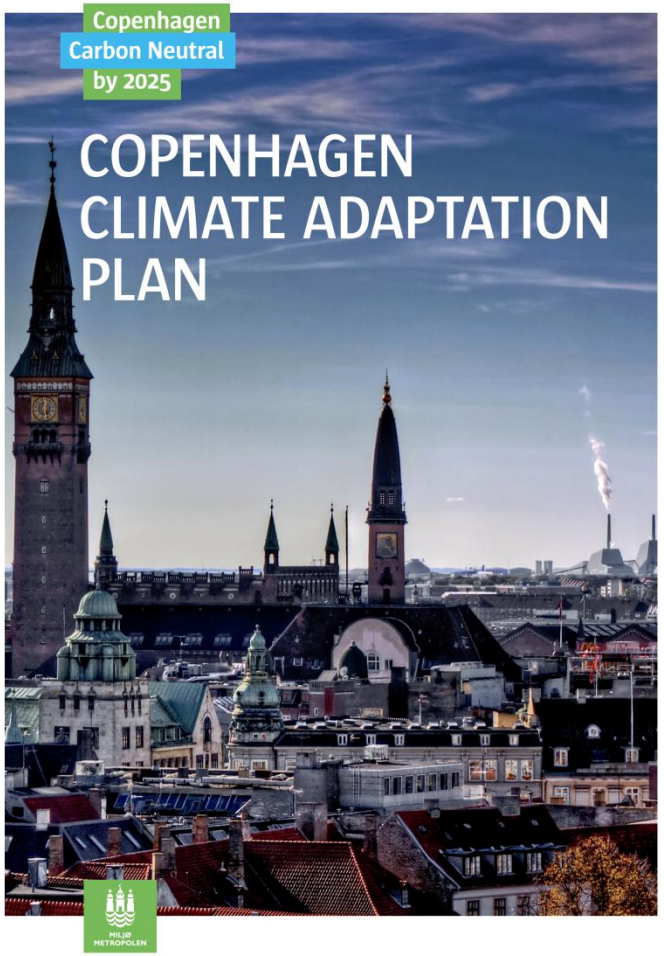
CITY OF COPENHAGEN
The Technical and Environmental Administration

Copenhagen brief

- 550.000 inhabitants
- 1.5 mio in Greater Copenhagen
- We expect a 20% increase in the next 10-15 years

The climate change adaptation plan (2011)

- Inspired by cities like New York, London and Rotterdam
- Work started in 2009
- Plan finally approved by City Council in August 2011



The weather is changing

- The most immediate threat is from rain
- But rising sea levels will increase the risk of storm surges

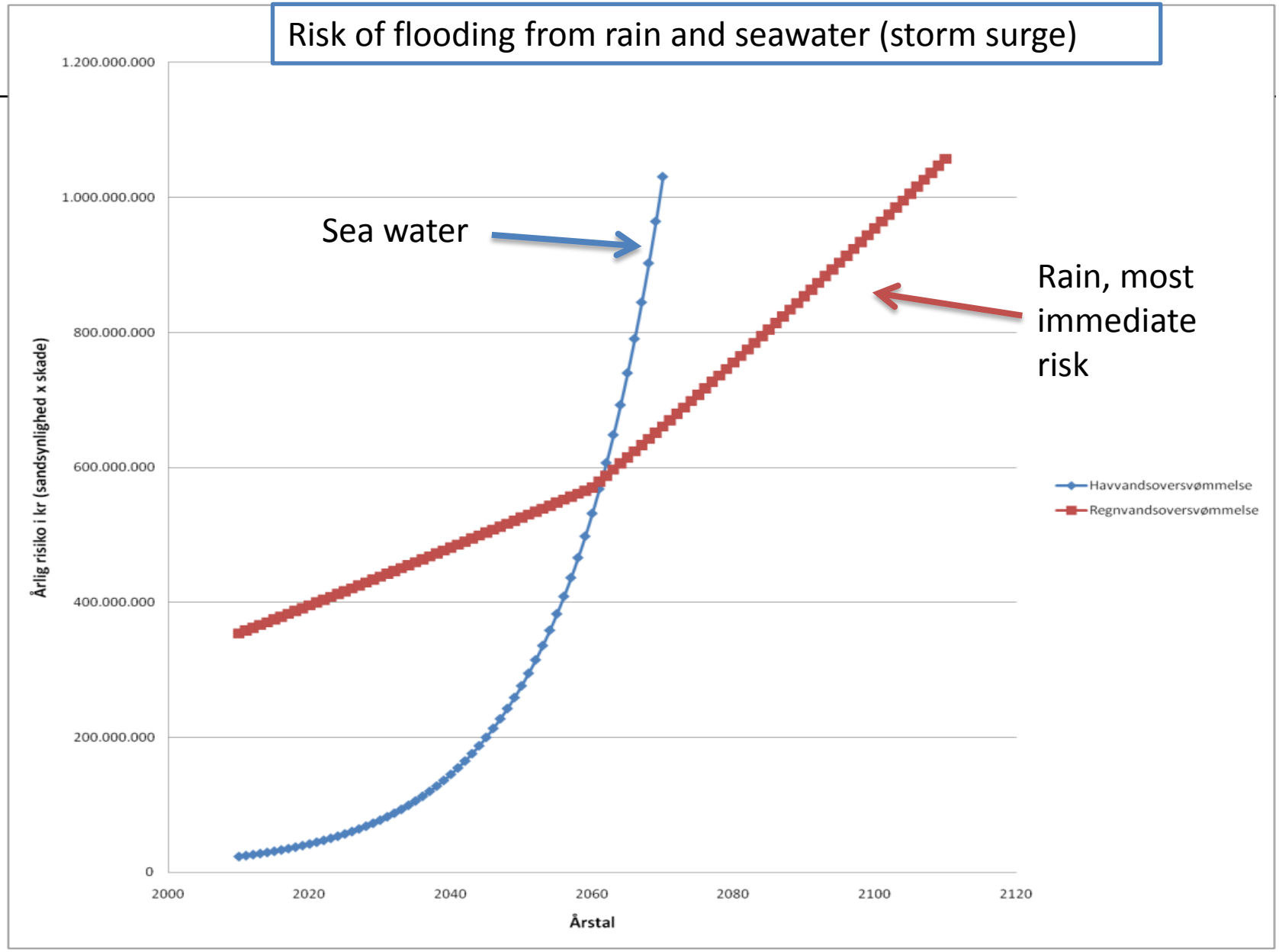
Adaptation Plan - contents

- Impact of future weather in Copenhagen
- Risk assesment
- Strategies for action
- Suggestion of first actions
- An estimated implementation period of 30-50 years
- Focus on opportunities of climate change

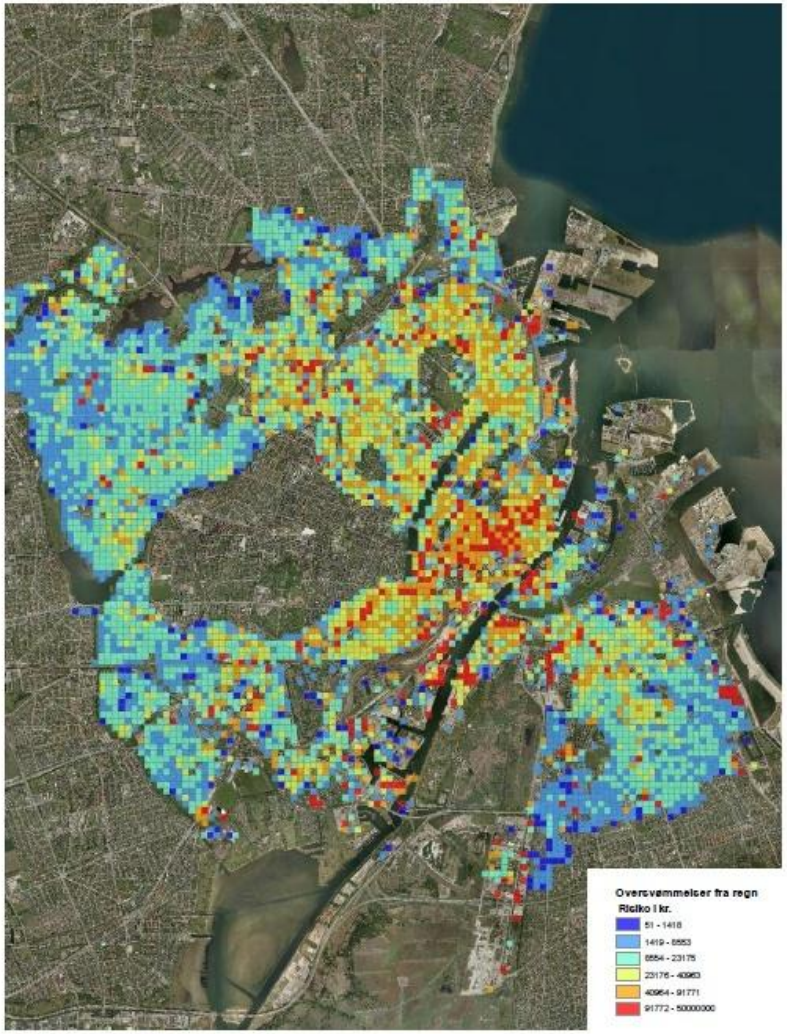
Risk calculation

Probability * cost

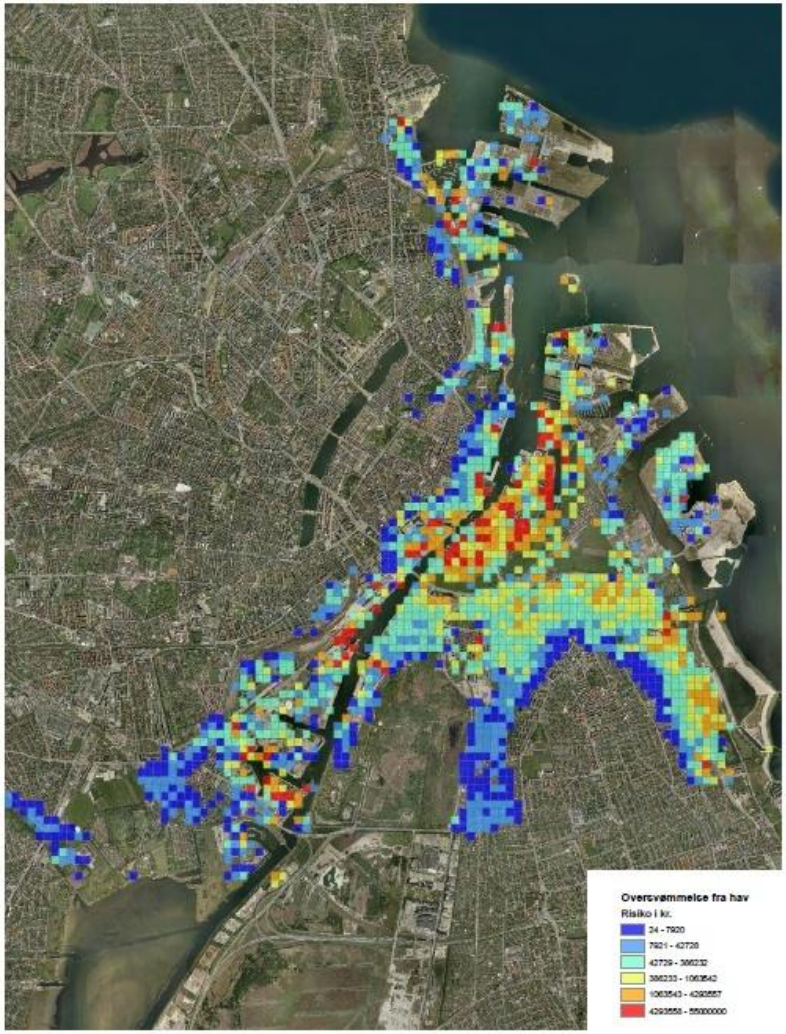
Risk calculation



Climate change impacts



Risk map for flooding caused by rain in 2110



Risk map for storm surges from the sea in 2110

Cloudburst over Copenhagen

Cloudburst over Copenhagen, 2. Juli 2011

Cloudburst over Copenhagen

20-03-2015

Cloudburst over Copenhagen

20-03-2015

Cloudburst over Copenhagen

20-03-2015

FLOODING OF BASEMENTS


FLOODING OF UNDERSGROUND PARKING

MAN HOLES ARE DEATH TRAPS

Modelling

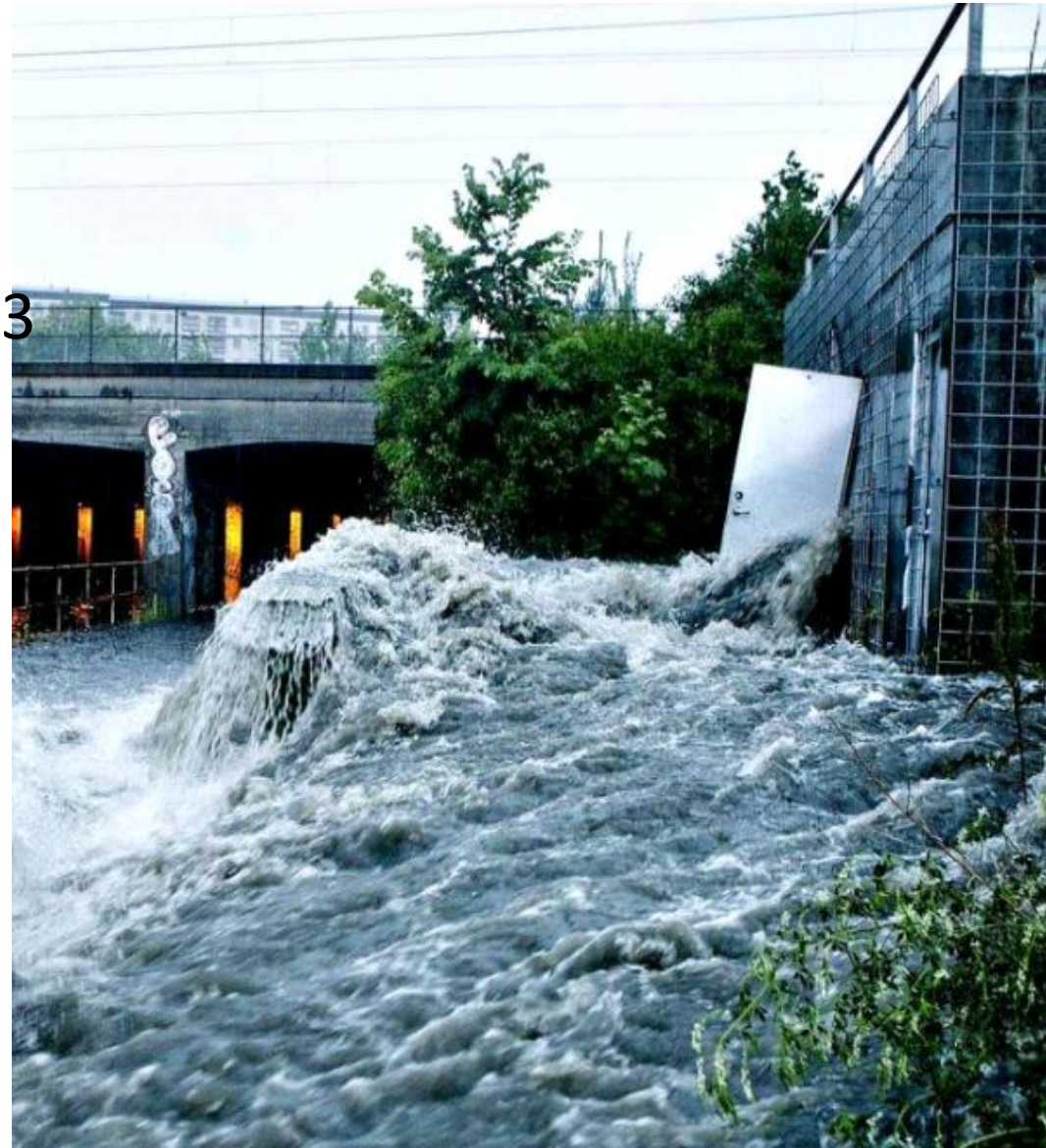
Reality check

July 2011 – the city is very vulnerable

- 150 mm rain in 2 hours
- Damages close to 1 billion euro
- Damages to critical infrastructure

CONSEQUENCES OF THE CLOUDBURST

- Op to 150 mm rain within 3 Hours
- intensity 3,1 mm/min
- T ~1.000 year
- 90.000 damages reported
- Insurance out pays exceeding 800.000 EUR!!!



2nd of July - Consequences

- **Flooding in main hospital, emergency power system did not function, Serious considerations of evacuation**
- **Technical breakdown in police communication**
- **Flooding in main emergency phone center**
- **Flooding in prisons**
- **Flooding of major infrastructure components**
- **70% of the critical IT operation in the city, threatened b water and lack of power**
- **Up to 800.000 euro in damages and insurance cost**
- **Damage on public buildings estimated 60 million euro**
- **Thousands of flooded basements**
- **Loss in income/turnover??**
- **Big losses for industry, private businesses, science Around 90.000 listed damage location**

CLIMATE CAPITAL COPENHAGEN

The game changer - **to hell with uncertainties**

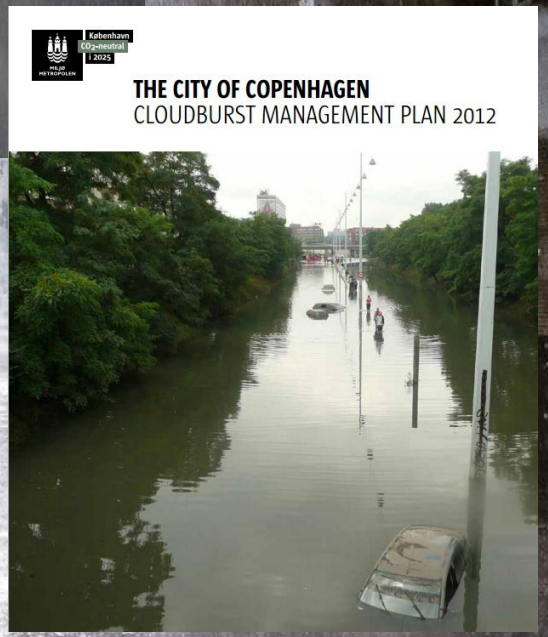
- High political attention (nationally and local)
- More speed - and to hell with uncertainties
- Change in legislation - new finance mechanisms to enable surface solutions

Emergency outlets

- **Water accumulating behind harbor quays and flooding basements**

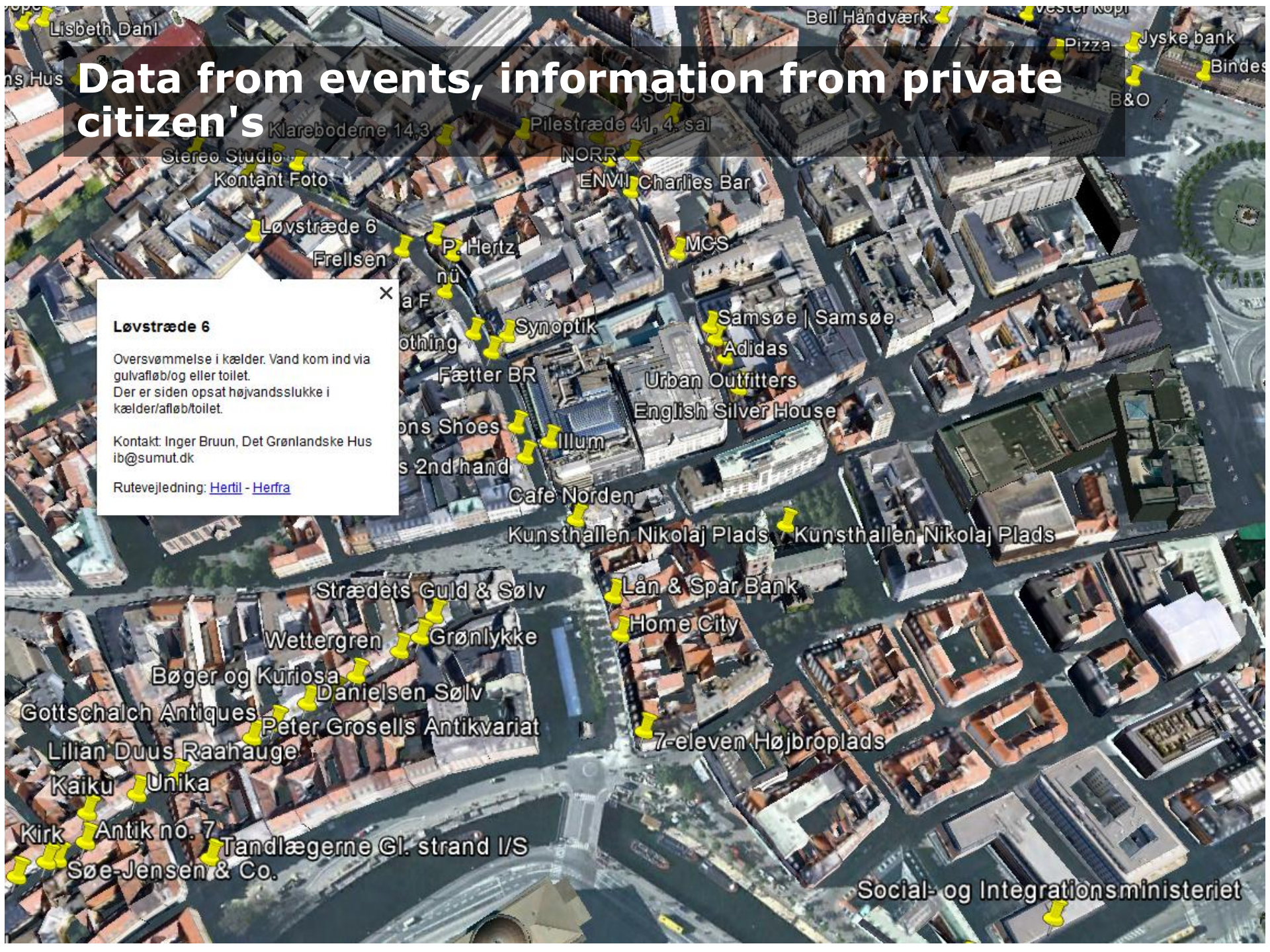
Cloudburst Management Plan

- New service level
- Protection against a 100 year event
- Cost benefit analysis
- Principles of solutions

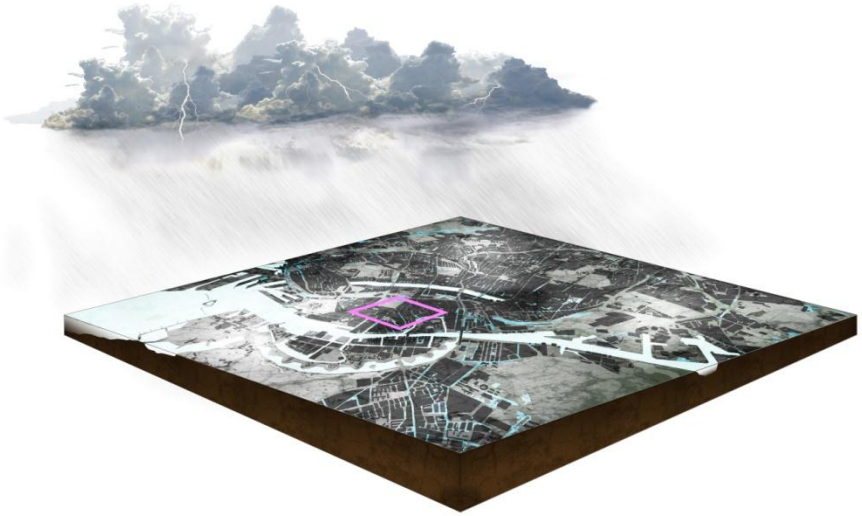


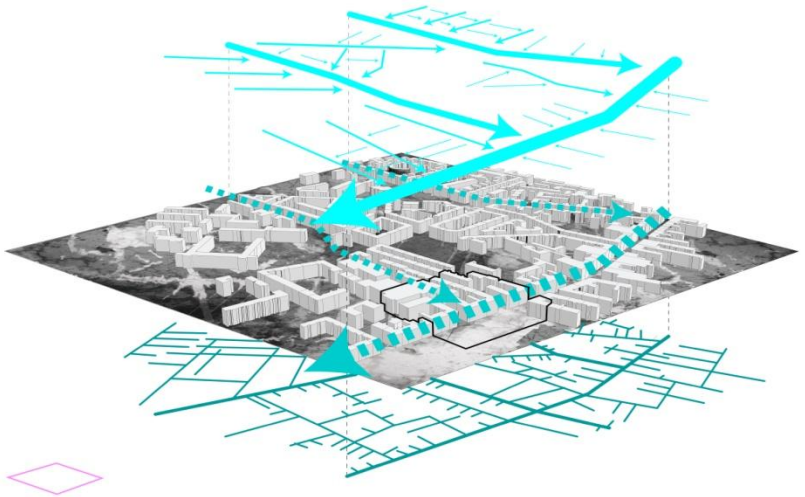
The cloudburst management plan

- The utility takes care of the water management on public land – and runoff from private that is connected to sewer system
- The city takes care of urban space improvement in connection with adaptation measures – and its own buildings
- Private landowners have to protect their own building and finance measures on private land

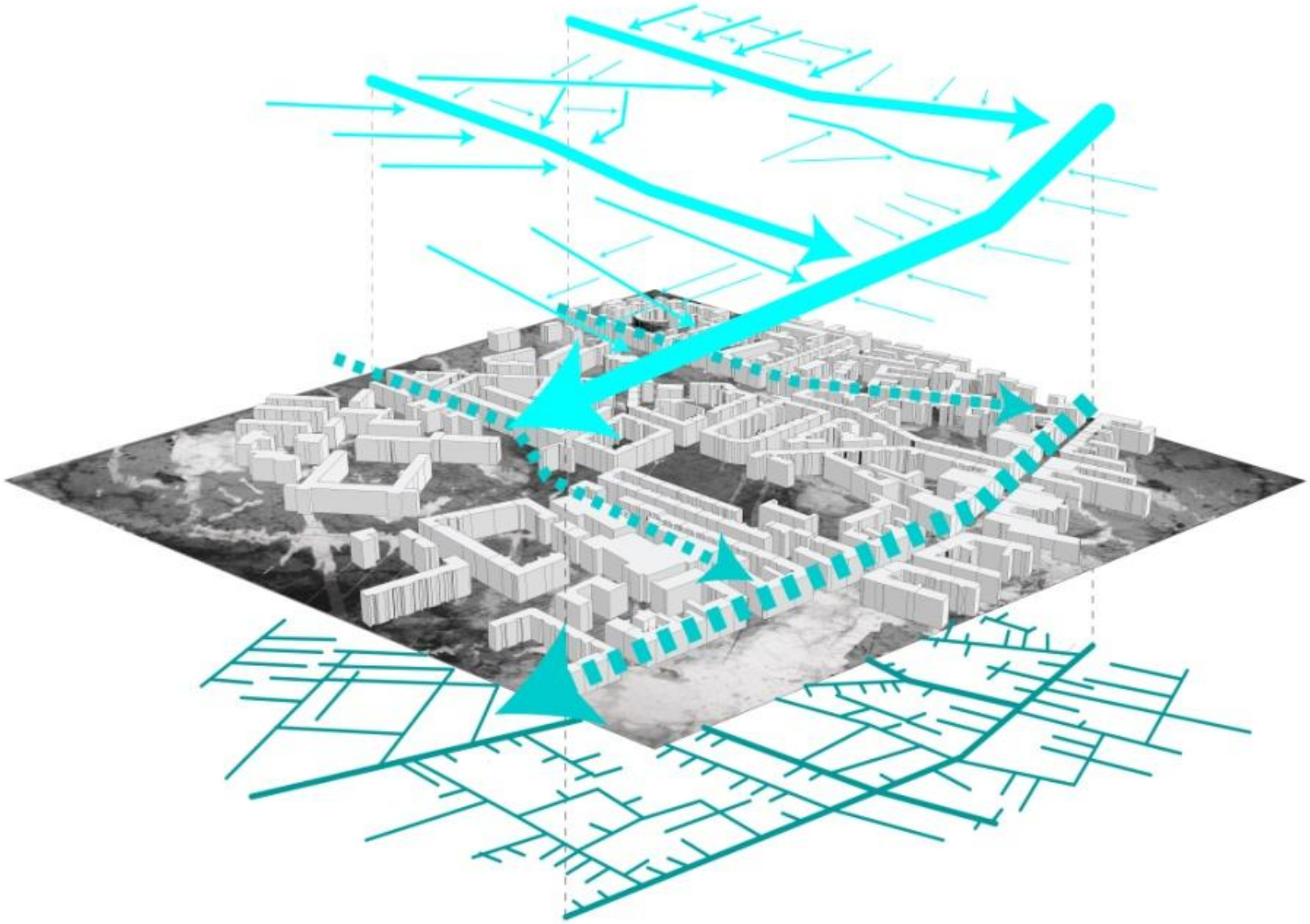

Data from events, information from private citizen's
Lisbeth Dahl
Bell Håndværk
Pizza
Jyske bank
B&O
Klareboderne 14,3
Pilestræde 41, 4. sal
Stereo Studio
Kontant Foto
NORR
ENVII
Charlies Bar
Løvstræde 6
Frellsen
P. Hertz
MCS
Løvstræde 6
Oversvømmelse i kælder. Vand kom ind via gulvafløb/og eller toilet.
Der er siden opsat højvandsslukke i kælder/afløb/toilet.
Kontakt: Inger Bruun, Det Grønlandske Hus
ib@sumut.dk
Rutevejledning: Hertil - Herfra
Synoptik
Samsøe | Samsøe
Adidas
Fætter BR
Urban Outfitters
English Silver House
Illum
Cafe Norden
Kunsthallen Nikolaj Plads
Kunsthallen Nikolaj Plads
Strædets Guld & Sølv
Lån & Spar Bank
Home City
Wettergren
Grønlykke
Bøger og Kuriosa
Danielsen Sølv
Gottschalch Antiques
Peter Grosells Antikvariat
7-eleven Højbroplads
Lilian Duus Raahauge
Kaiku
Unika
Kirk
Antik no. 7
Tandlægerne Gl. strand I/S
Søe-Jensen & Co.
Social- og Integrationsministeriet

Principles of catchment analysis

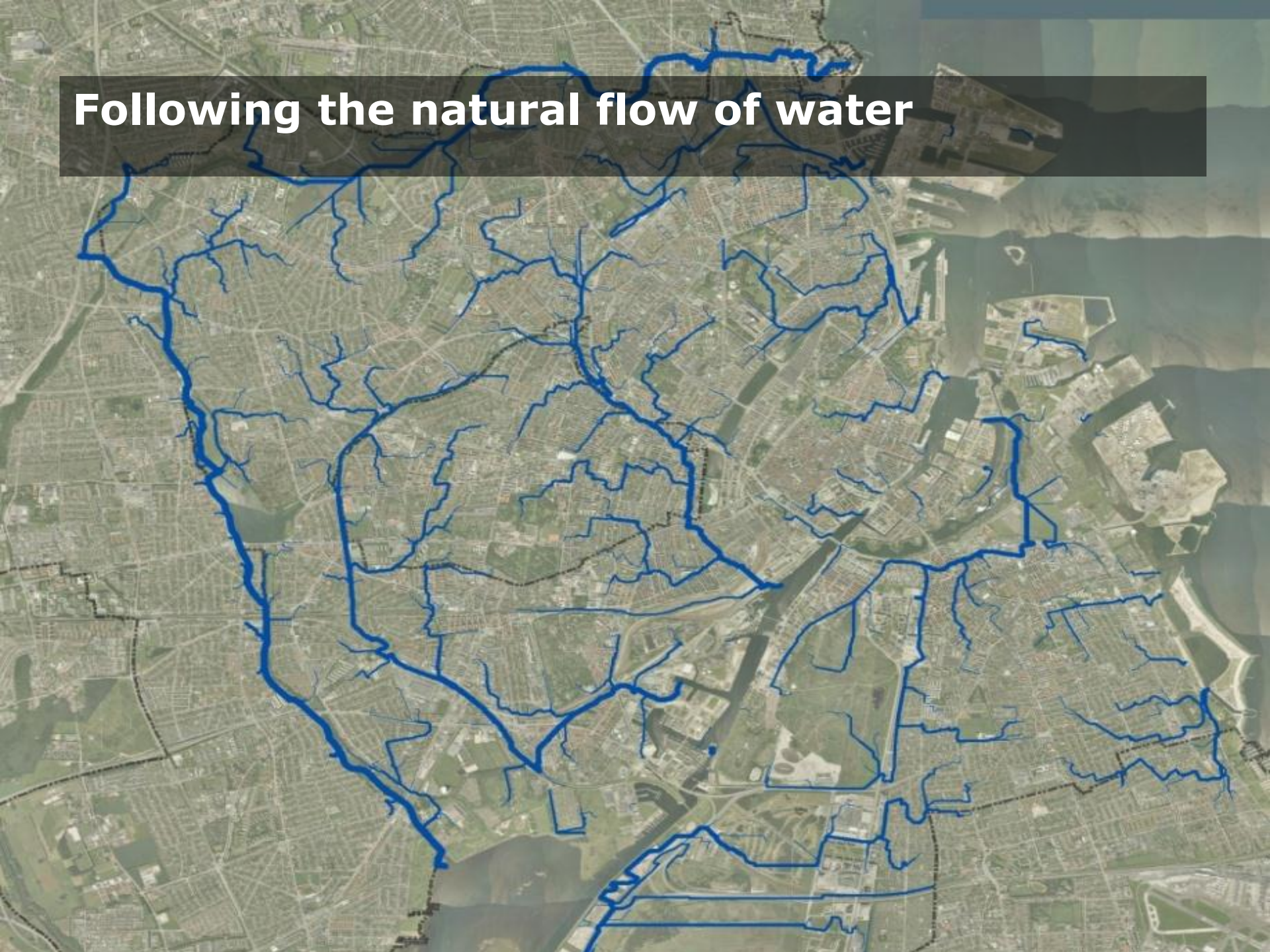




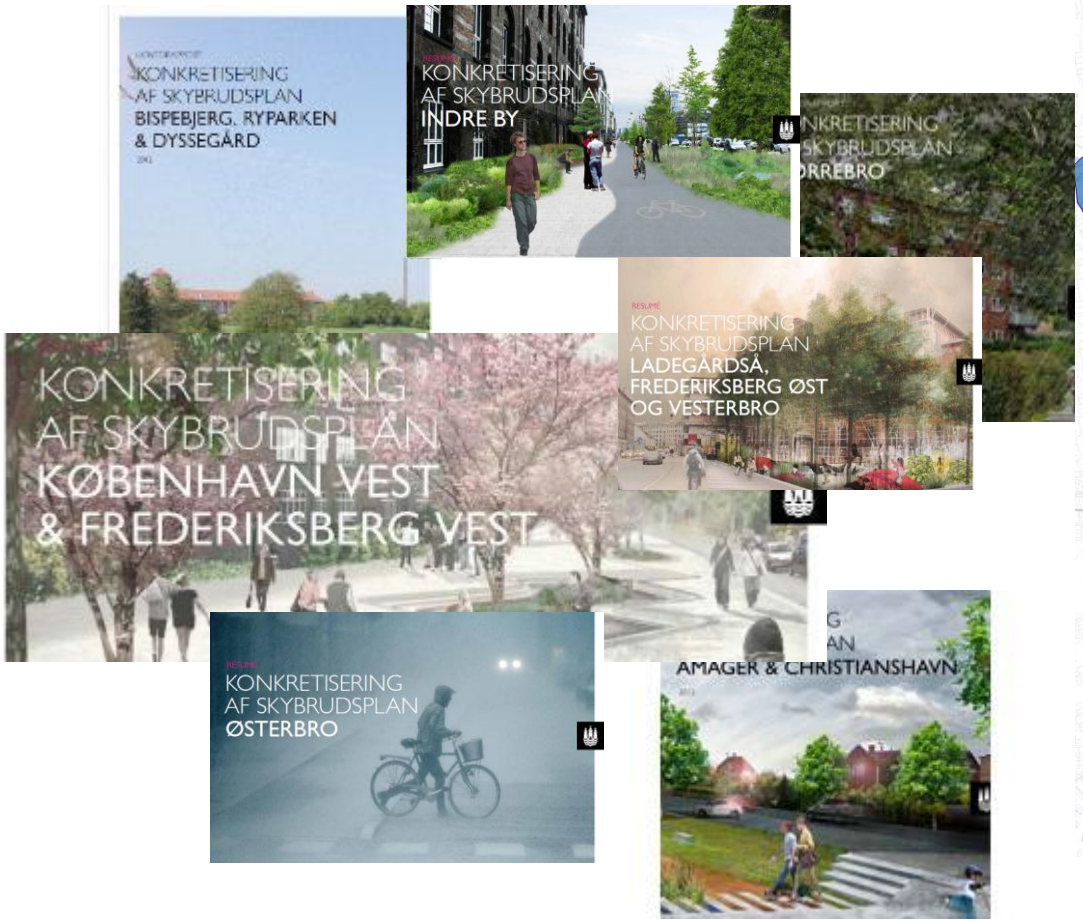
A new infrastructure



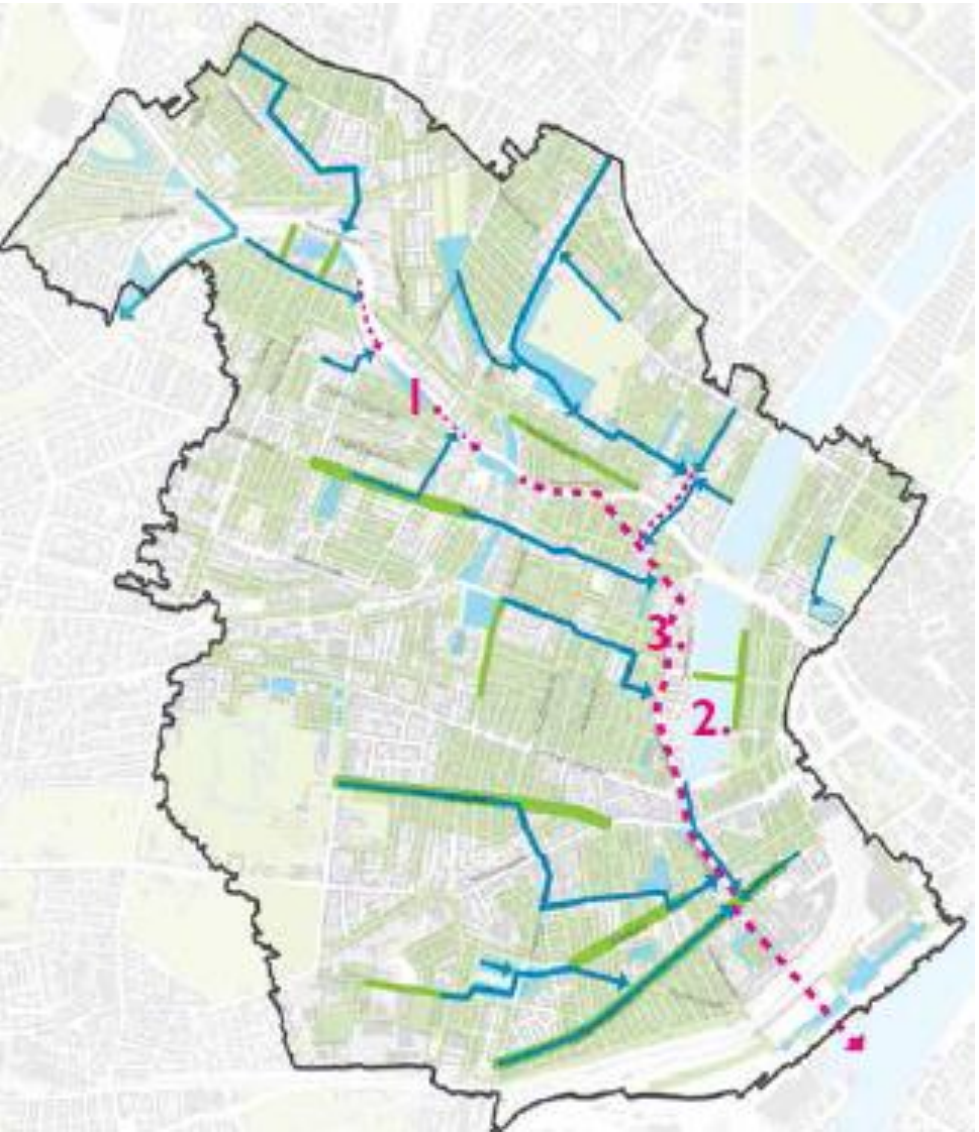
Following the natural flow of water



7 water catchments in the city

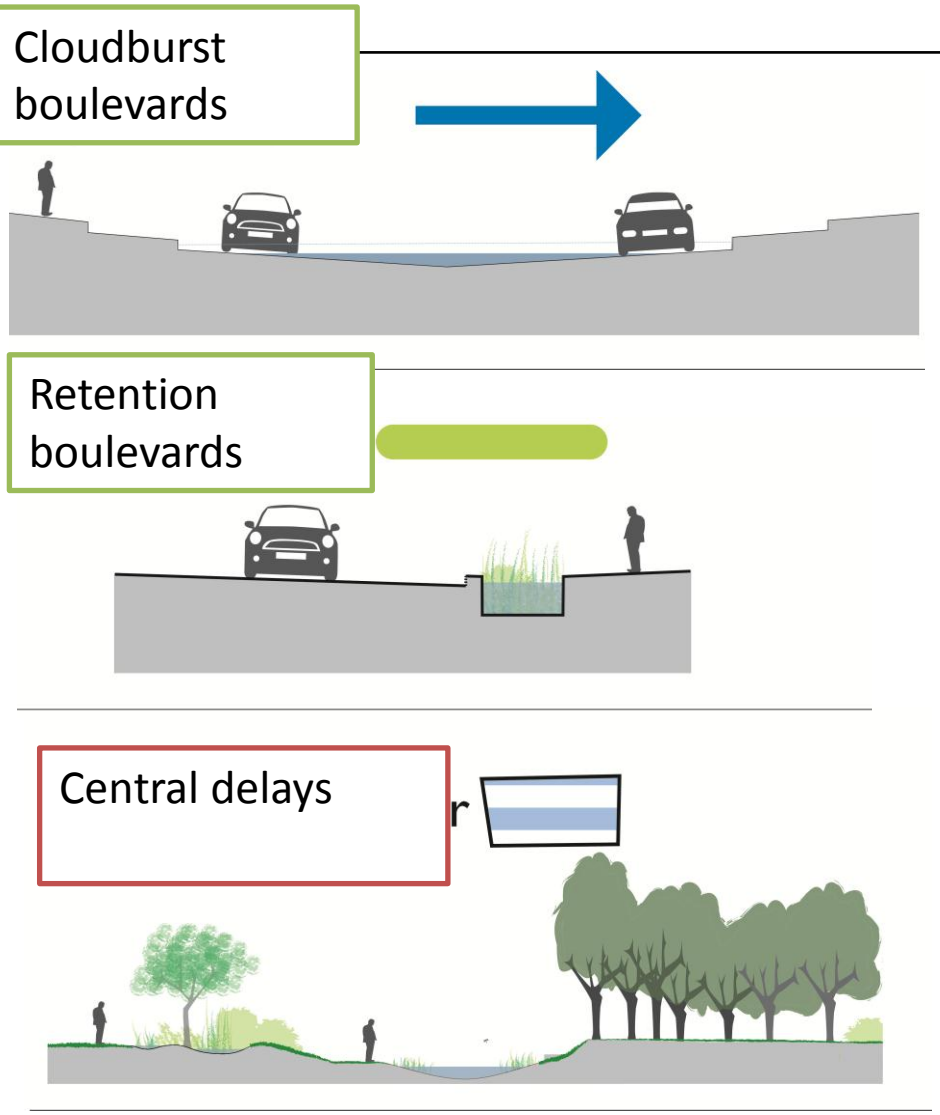


Different options for each catchment



Types of generic solutions

- Cloudburst boulevards – transporting water
- Retention boulevards – delaying water
- Central delays – for storing water



Examples of solutions

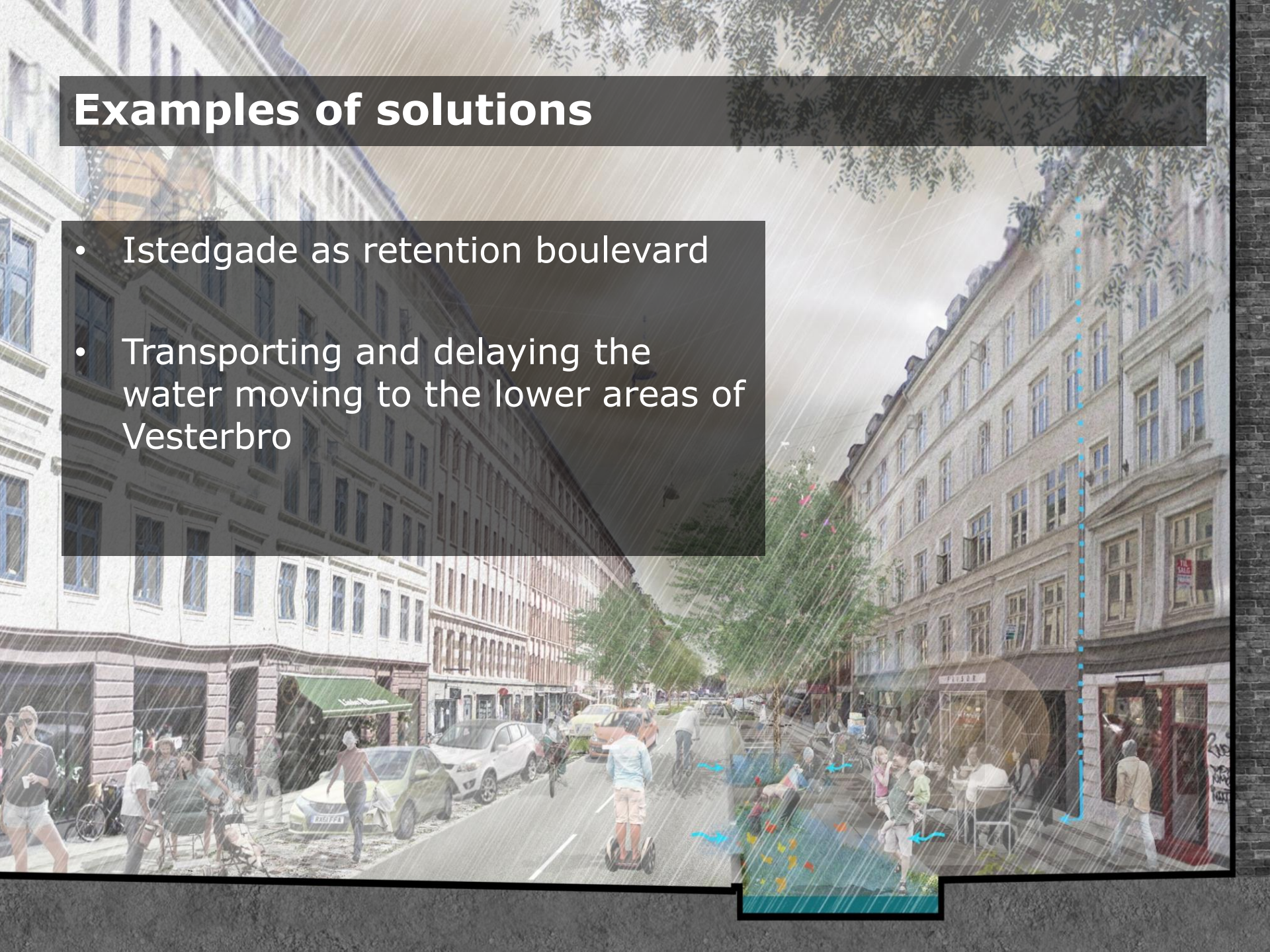
- Cloudburst boulevard at HC Andersens Boulevard
- Traffic important
- Leads the water to the harbour

Examples of solutions

- Vesterbro – a district with high flood risks
- A low point in the city
- No natural run off for the water

Examples of solutions

- Istedgade as retention boulevard
- Transporting and delaying the water moving to the lower areas of Vesterbro



Example of solutions

- Skt Jørgens sø
- Lowering the water level in the lake
- A new park on the wider banks
- Park can store up to 40.000 m3 of water in case of cloudburst
- A pipe empties the lake – and also collects water from Vesterbro

Lake becomes a Cloudburst Park

Sankt Joergens Soe

Dry

Lake becomes a Cloudburst Park

Project proposal

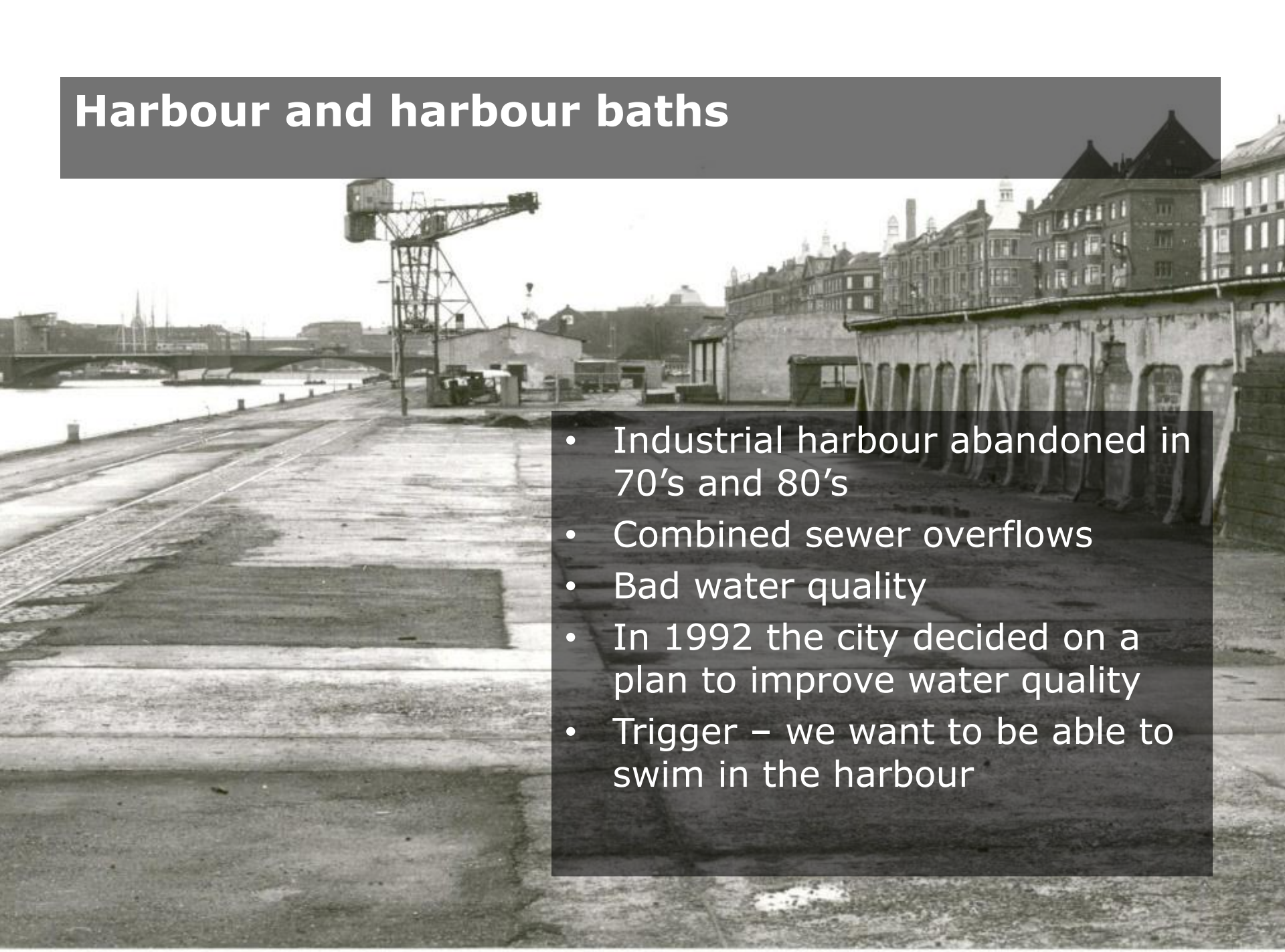
Project when constructed Dec. 2014

Ørestad

- New city district
- Born adapted
- Separated sewer system (3 string system)

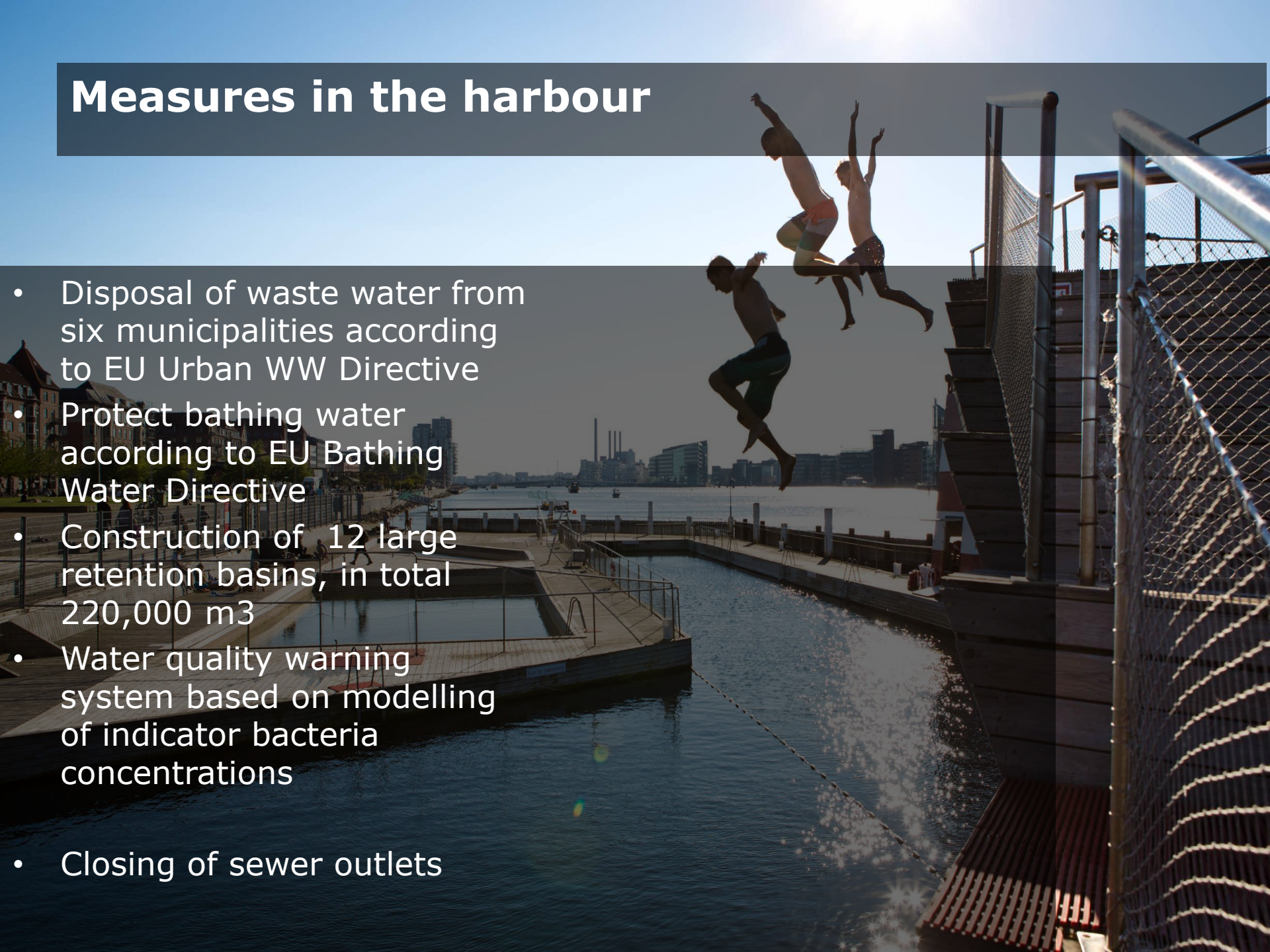
EXAMPLE OF SOLUTIONS

Harbour and harbour baths



- Industrial harbour abandoned in 70’s and 80’s
- Combined sewer overflows
- Bad water quality
- In 1992 the city decided on a plan to improve water quality
- Trigger – we want to be able to swim in the harbour

Measures in the harbour



- Disposal of waste water from six municipalities according to EU Urban WW Directive
- Protect bathing water according to EU Bathing Water Directive
- Construction of 12 large retention basins, in total 220,000 m3
- Water quality warning system based on modelling of indicator bacteria concentrations

- Closing of sewer outlets

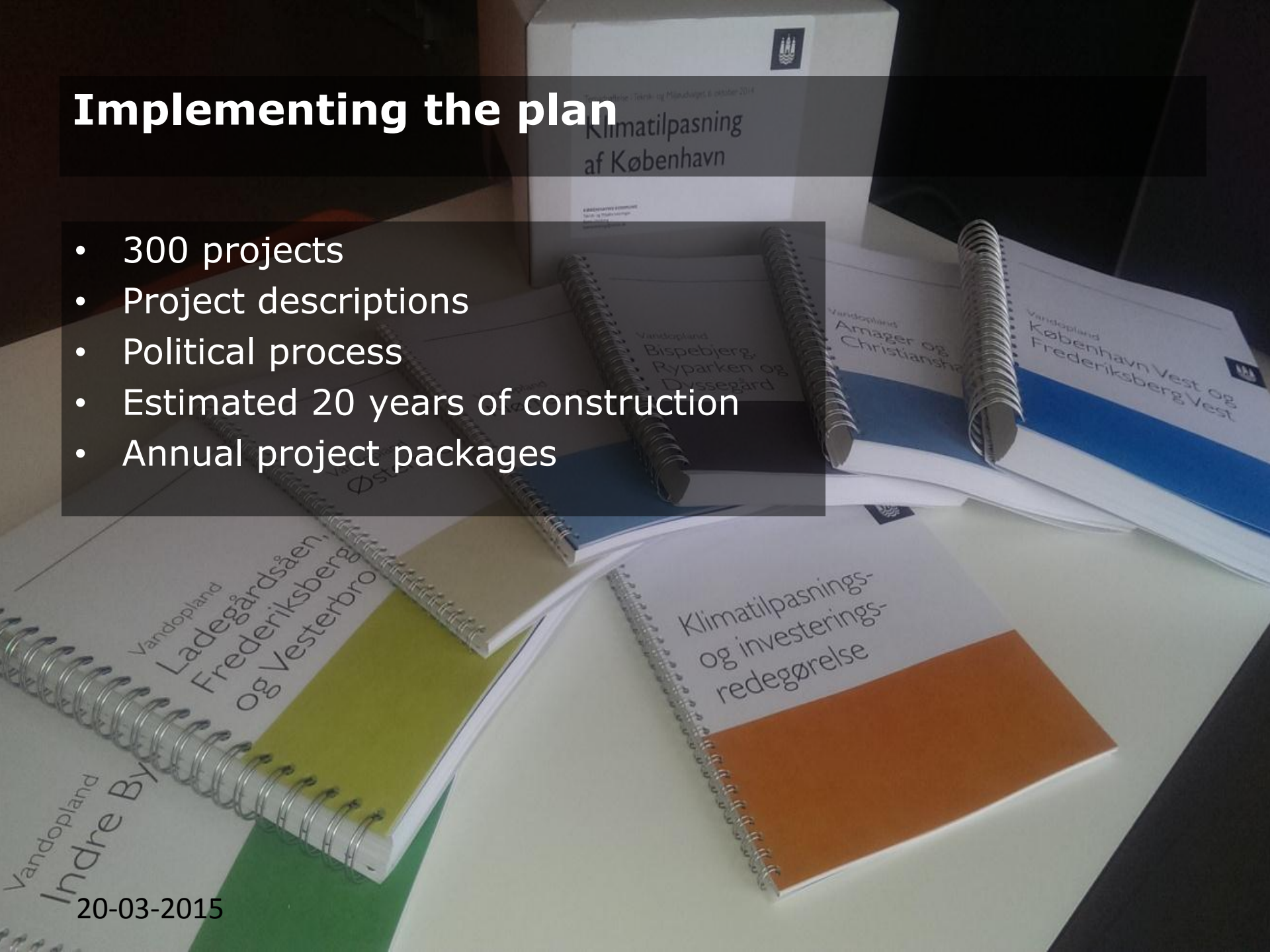
The harbour today

- An urban harbour park
- The center for urban life in the summer
- Increased economic activity
- High rise in house prices

EXAMPLE OF SOLUTIONS

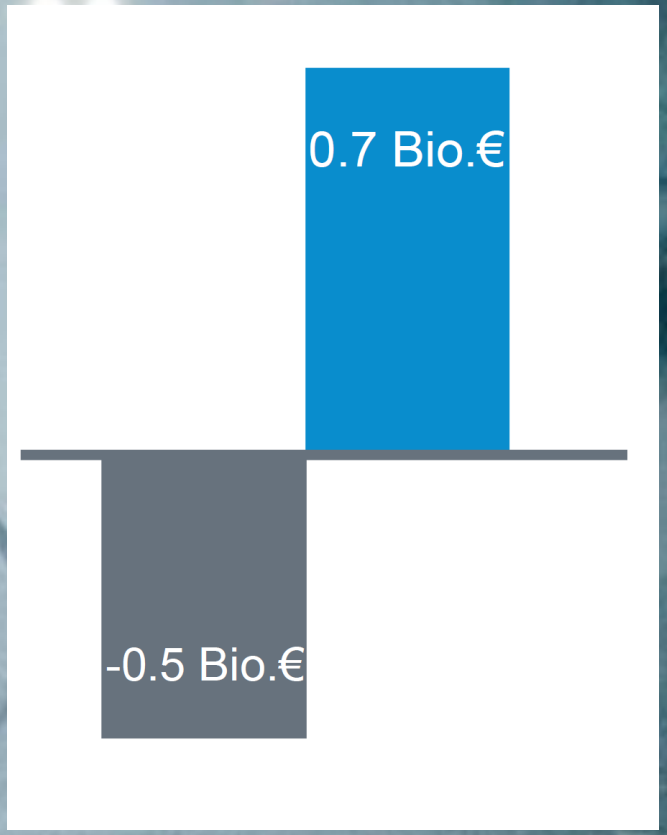
Implementing the plan

- 300 projects
- Project descriptions
- Political process
- Estimated 20 years of construction
- Annual project packages



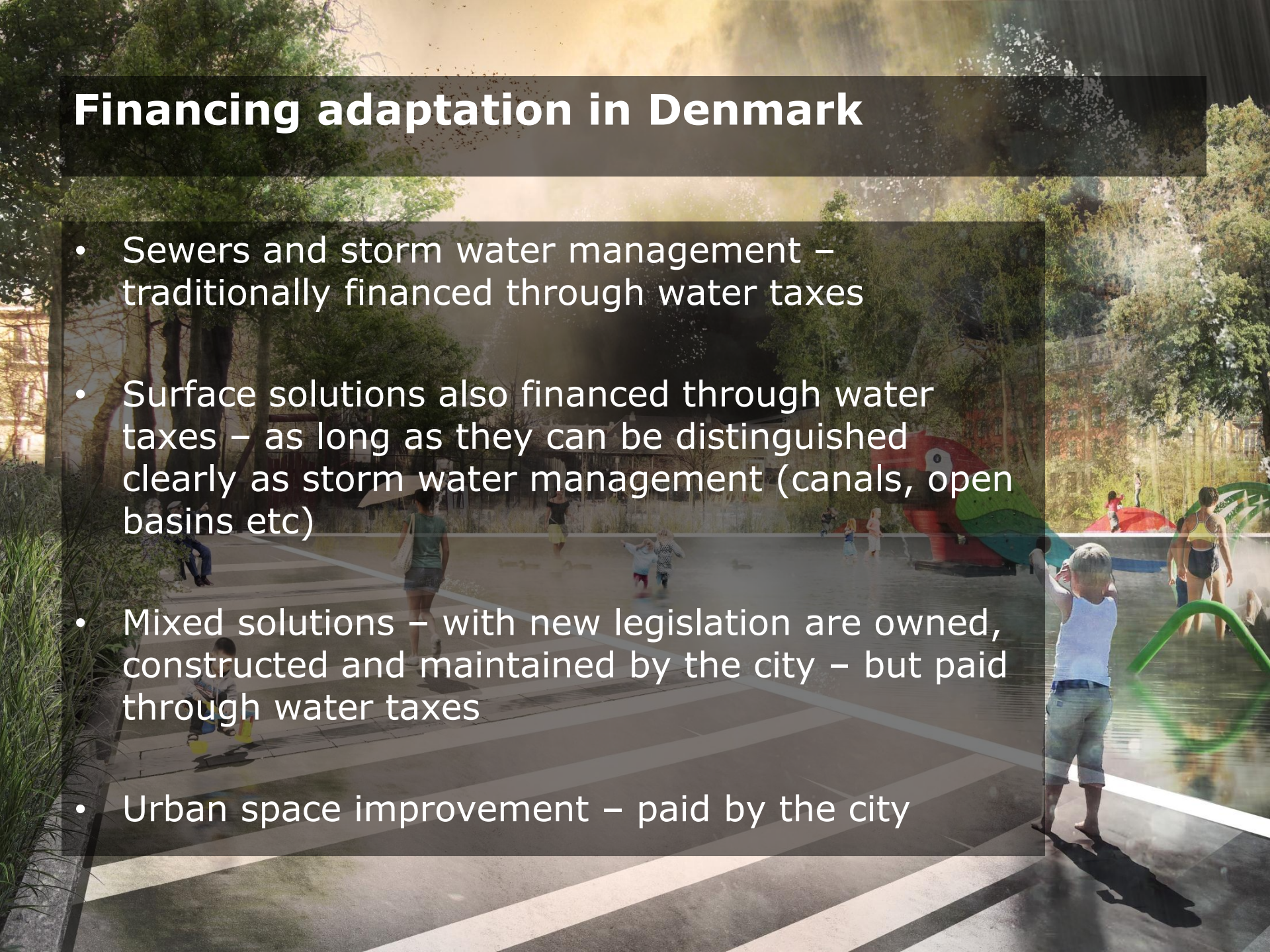
A good business case

- Robust socio economic figures
- Cheaper than traditional solutions
- Less flooding – less damage
- Lower insurance costs
- Higher house prices
- Total costs 1.3 billion euro



Financing adaptation in Denmark

- Sewers and storm water management – traditionally financed through water taxes
- Surface solutions also financed through water taxes – as long as they can be distinguished clearly as storm water management (canals, open basins etc)
- Mixed solutions – with new legislation are owned, constructed and maintained by the city – but paid through water taxes
- Urban space improvement – paid by the city



INVESTMENT STATEMENT - SOCIO-ECONOMIC DATA

- Cost of investments
- Value of estimated damages
- Value of ”green solutions”
- Saved investments in expanding the present sewer system
- Other aspects

INVESTMENT STATEMENT

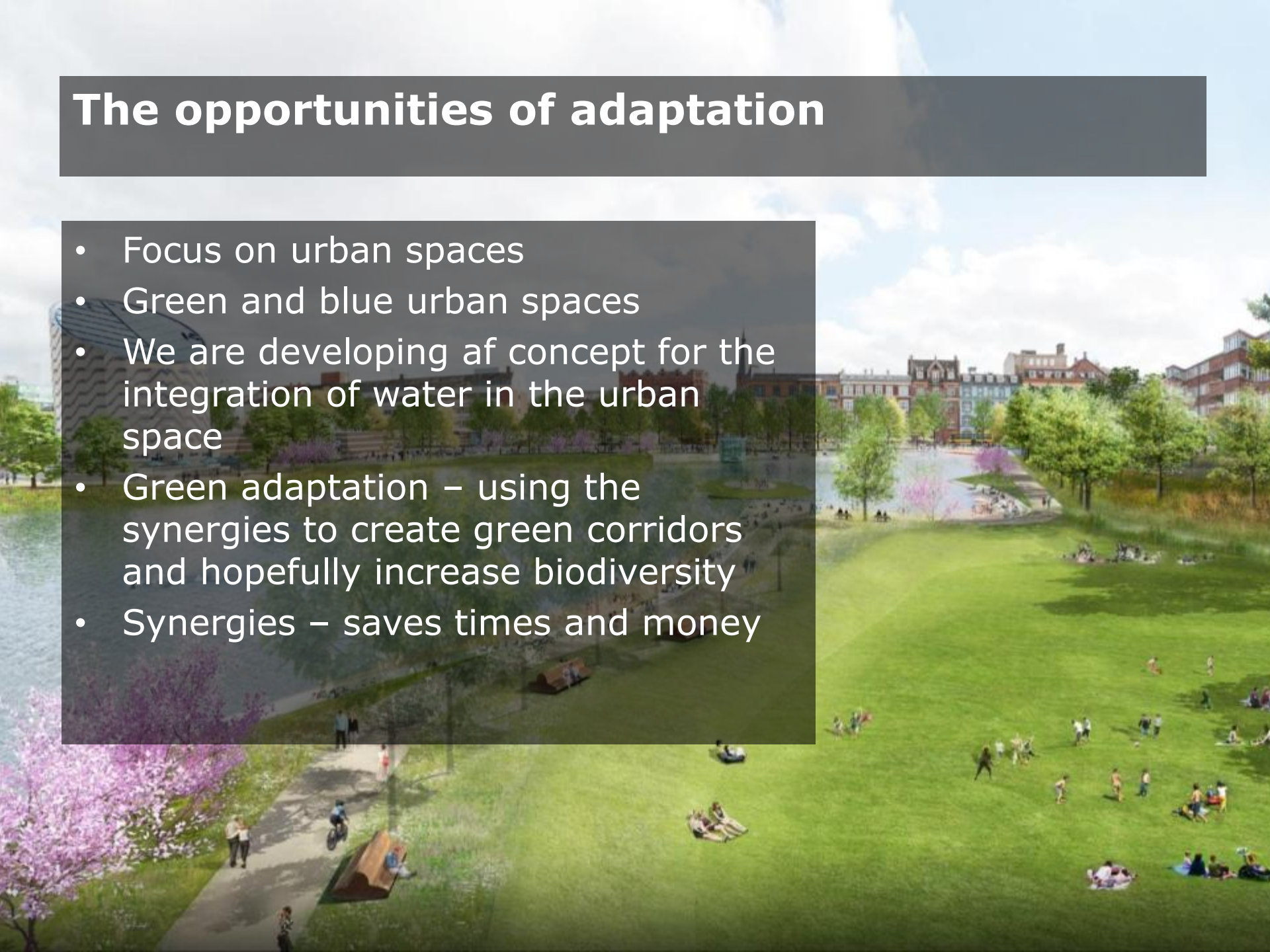
- Total costs of storm water infrastructure – 1.3 billion Euro
- Extra costs for urban improvement (greening etc) 100 mill Euros – or more depending on level of ambition
- Cost benefit analysis still shows that it is a good business case

INVESTMENT STATEMENT - SYNERGIES WITH OTHER PROJECTS

- Saving money through coordination with other construction works in the city (maintenance of roads, district heating improvements etc.)
- Ongoing process that we have already started with projects like Skt. Annæ Plads and on bicycle routes on Amager

The opportunities of adaptation

- Focus on urban spaces
- Green and blue urban spaces
- We are developing af concept for the integration of water in the urban space
- Green adaptation – using the synergies to create green corridors and hopefully increase biodiversity
- Synergies – saves times and money



Cooperation and co-creation

- Utility and water companies, Close partnership in all aspects
- Citizens
  Will be involved in all the projects.
  Partnerships on private land
  Organisations
- Other municipalities
  Key as water does not respect administrative boundaries
- Local commitees and neighbourhood regeneratio
  Local anchoring – and local cooperation with local knowledge

The next steps

- Setting up the organization
- Adaptation is the top priority for our Administration
- Political process – the final decisions during 2015
- Prioritizing projects – the first projects, political decision today!

Organising the work in the city

- Joint steering group with Greater Copenhagen Utility
- No project organisation – we need to handle this within our current organisational structure
- The Climate unit responsible for the program
  - Selects annual project packages
  - In charge of overall urban space improvement in connection with adaptation
  - In charge of hydraulic coordination in cooperation with our utility
- After political approvment projects will be handled by our Department for City Construction
  - Programming
  - Construction
- Environmental regulations and construction coordination will be handled by the Departments for construction and operations

THE DIFFICULT QUESTIONS?

- How can the city administration, their partners and stakeholders (utility company, citizens) secure that the adaptation plans is implemented during the next 10-20 years and beyond?
- How can organization, management systems and technology etc. support the ongoing implementation of the adaptation and cloudburst plans?
- What tools can be used to manage the project? There will be a need to control several hundred projects, their interdependence, and overview of the overall economy and easy methods to monitor progress.

Tensions and conflicts

- **Hotspots** vs **entire city** (strategy)
- **Cost** vs **benefits (unequal distribution of cost and benefits)**
- **Environment** vs **flood prevention**
- **Utility company** vs **city administration**
- **Short term** vs **long term perspective**
- **planning** vs **action**
- **Integration** vs **separation**
- **Problems** vs **solutions**
- **Risks** vs **possibilities**
- **Numbers** vs **logics**

In Copenhagen, hopefully in a few years time this will be the past

- But we need to communicate that citizens need to invest in protecting buildings
- And we need to communicate that it will take time

Key massages

- Climate change adaptation, is not negative – it is a unique opportunity to improve urban life
- Cities need to take action, no one else will
- Cities is leading the development, not states or government
- It will pay off, healthy business case
- It will change urban life
- It will change the way you organize, finance and cooperate
- It will change business models
- it will be a positive change – BUT only if you start planning NOW!!!!
- In the PAST, The Roman empire was the FIRST culture that management water in urban settlements, let not ROME be that LAST to manage urban water in the FUTURE!
- **Take action now!**

Thank you for your attention

Framing Vulnerability and adaptive Capacity

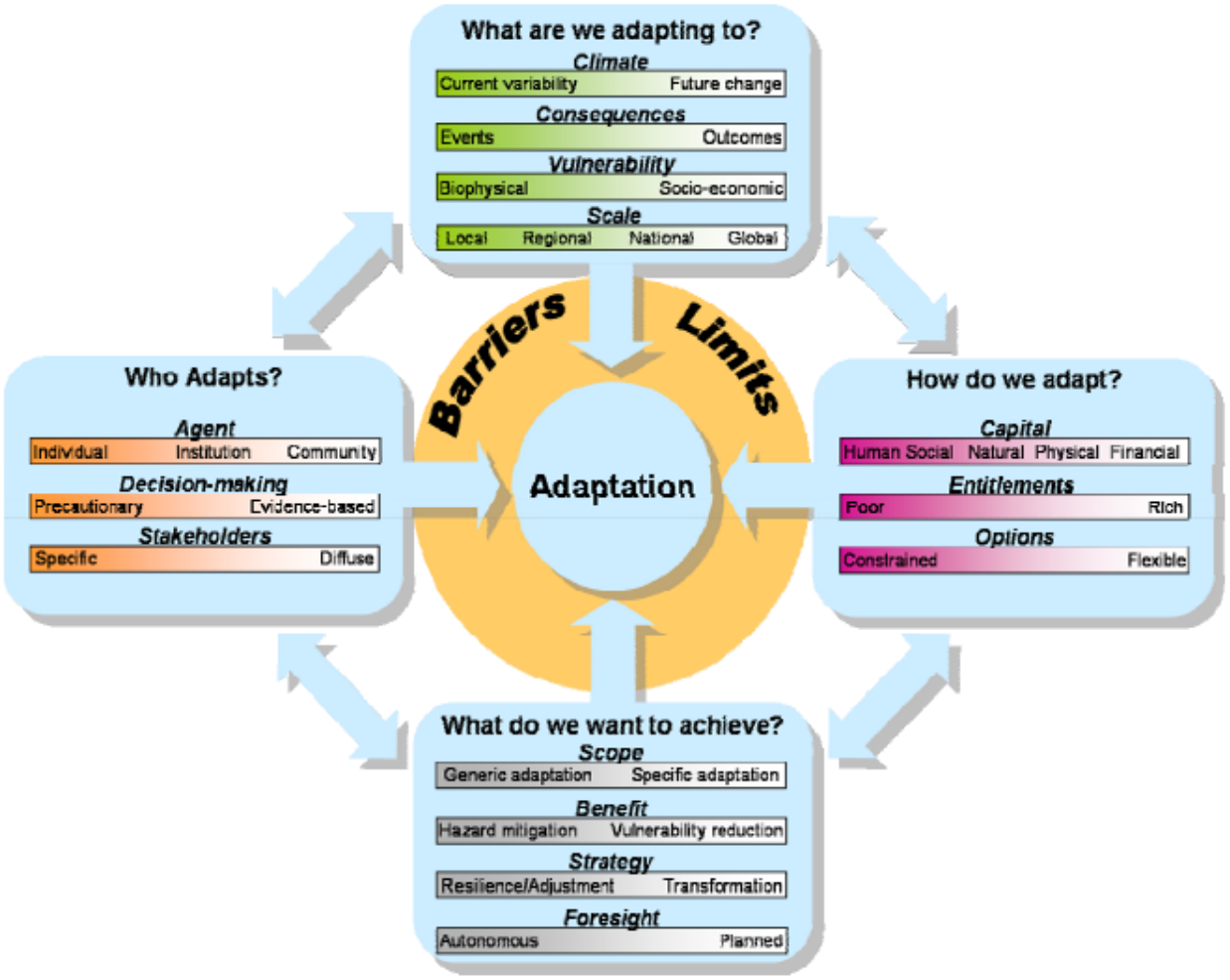
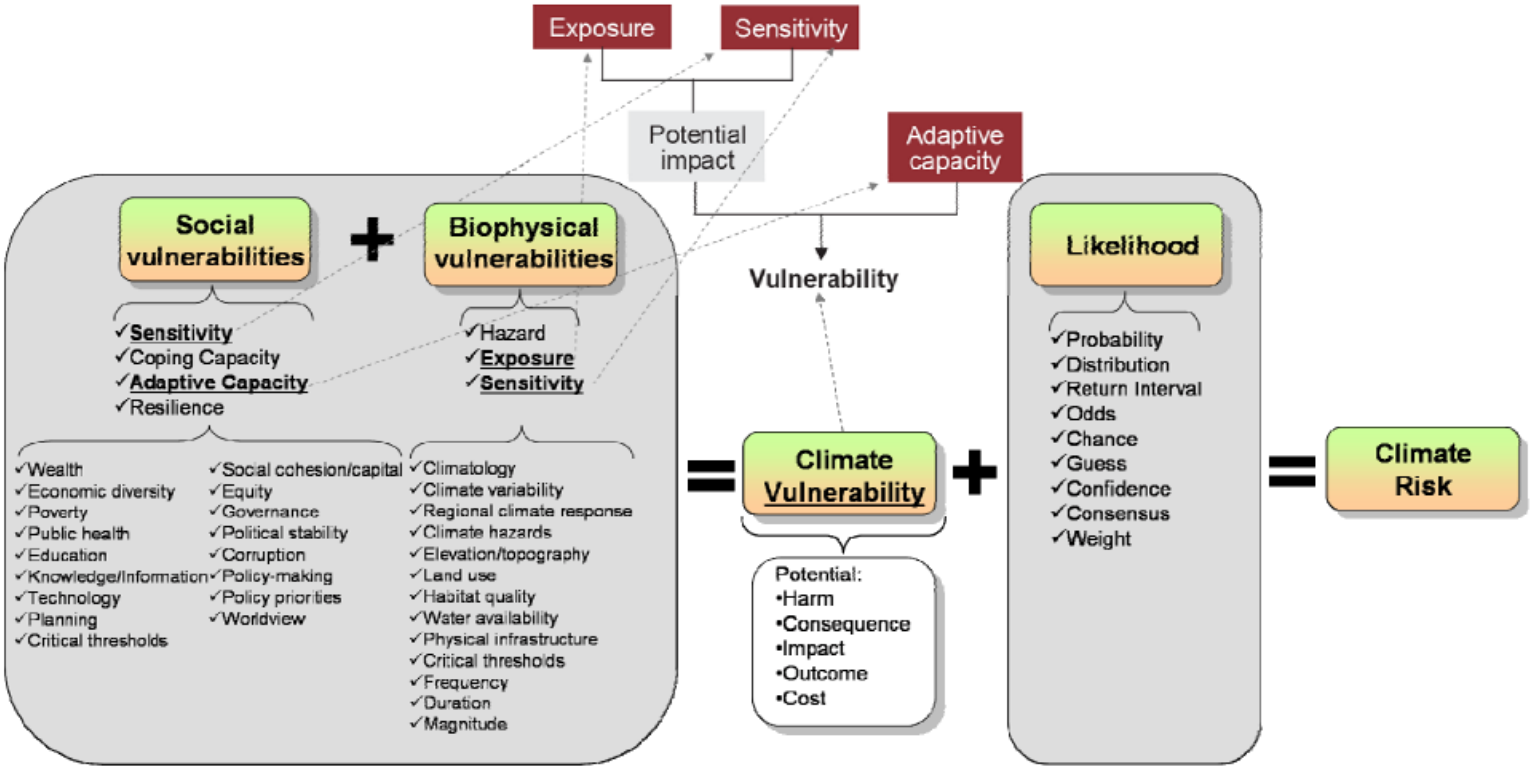
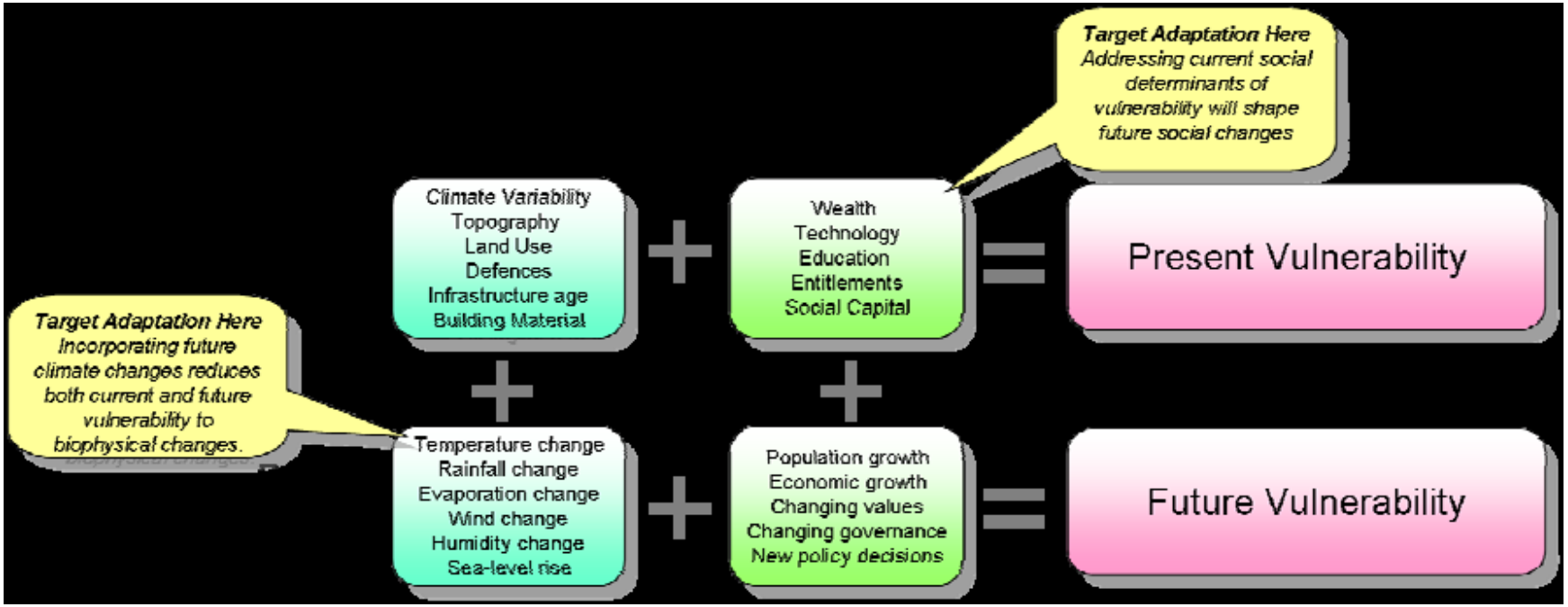


Figure A. Dimensions of adaptation. Adaptation is represented as a process driven by four sets of determinants, with each set comprised of multiple determinants with multiple dimensions. Adaptation barriers and limits disrupt the relationship between determinants and the adaptation process.

Framing Vulnerability and adaptive Capacity



It is NOT ONLY a technical issue, its NOT ONLY a matter of climate change, its ALSO a matter of socio –economy.



I´m sorry if you see this slide because - for sure I have used more than the 15 minutes that I was supposed to speak… But we succeeded, going through 65 slides - Congratulations!

Thank you for your attention once again

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Links

- www.kk.dk/climate
- www.kk.dk/english
- www.klimakvater

- www.klimatilpasning.dk
- www.stateofgreen.dk
- http://www.e-pages.dk/tmf/70/
- www.aqua-add.eu

➢ https://portal.eindhoven.nl/filemanager/cgi-bin/FileManager/Manager.pl?file=added%20values%2024092014.pdf&link=d90e2800d186ccadd92e8b659193ef89&a=162

➢ https://portal.eindhoven.nl/filemanager/cgi-bin/FileManager/Manager.pl?file=Stakeholder%20Engagement%20Handbook%20FINAL.pdf&link=c26c7d648d832dc88a4915cf19aad909&a=162