

An aerial night view of a city with glowing digital lines connecting buildings. The lines are yellow and white, forming a network of arcs and straight paths across the cityscape. The buildings are illuminated with various colors, and the overall scene is a mix of blue, yellow, and white tones.

# Cities ‘Going Digital’

Introducing Bentley’s OpenCities Connected Data Environment

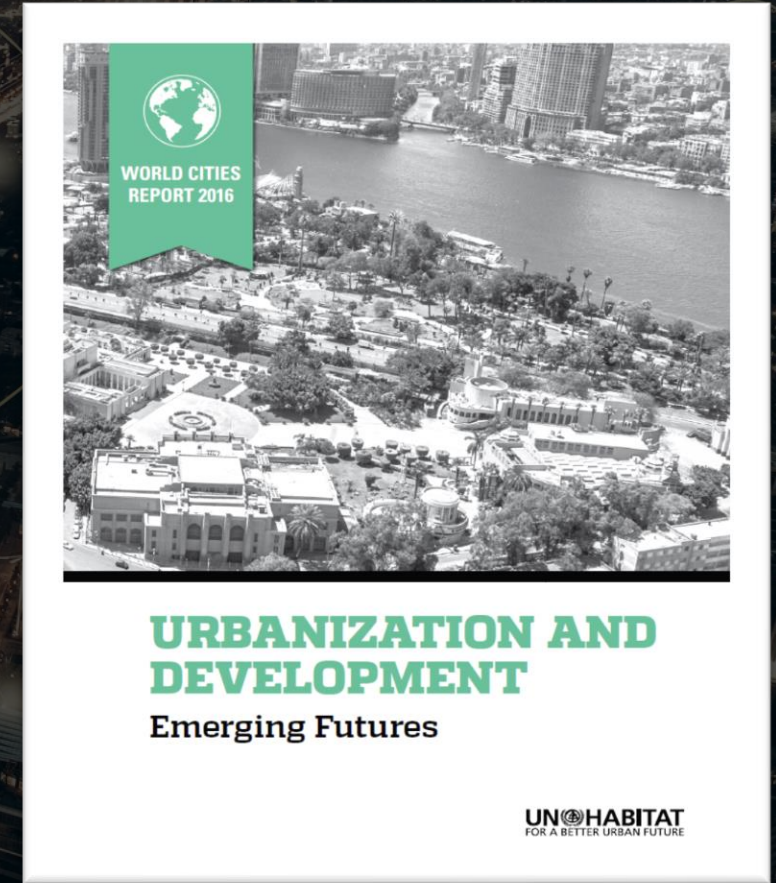
*Ton de Vries, Senior Director Business Development*



# Urbanization

# Decarbonization

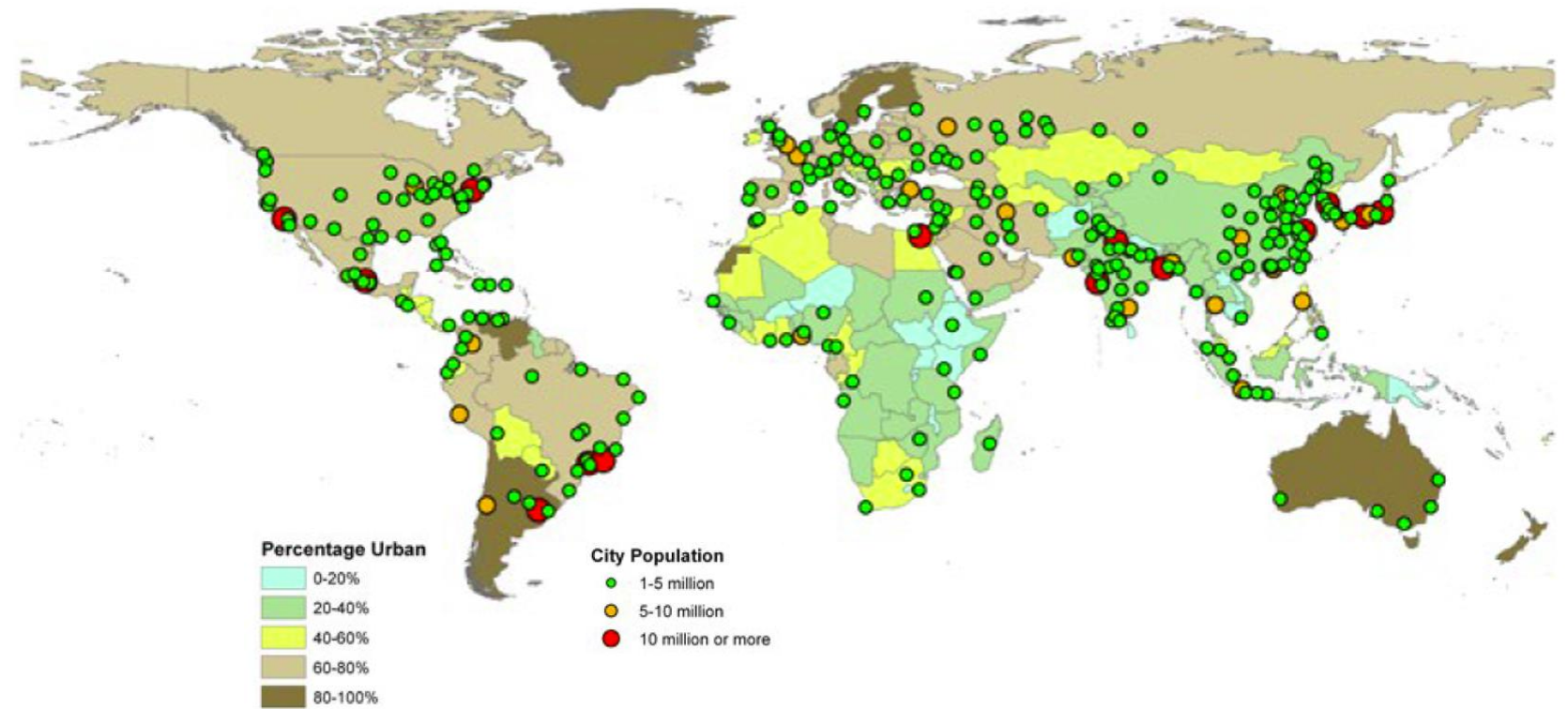
# Digitalization





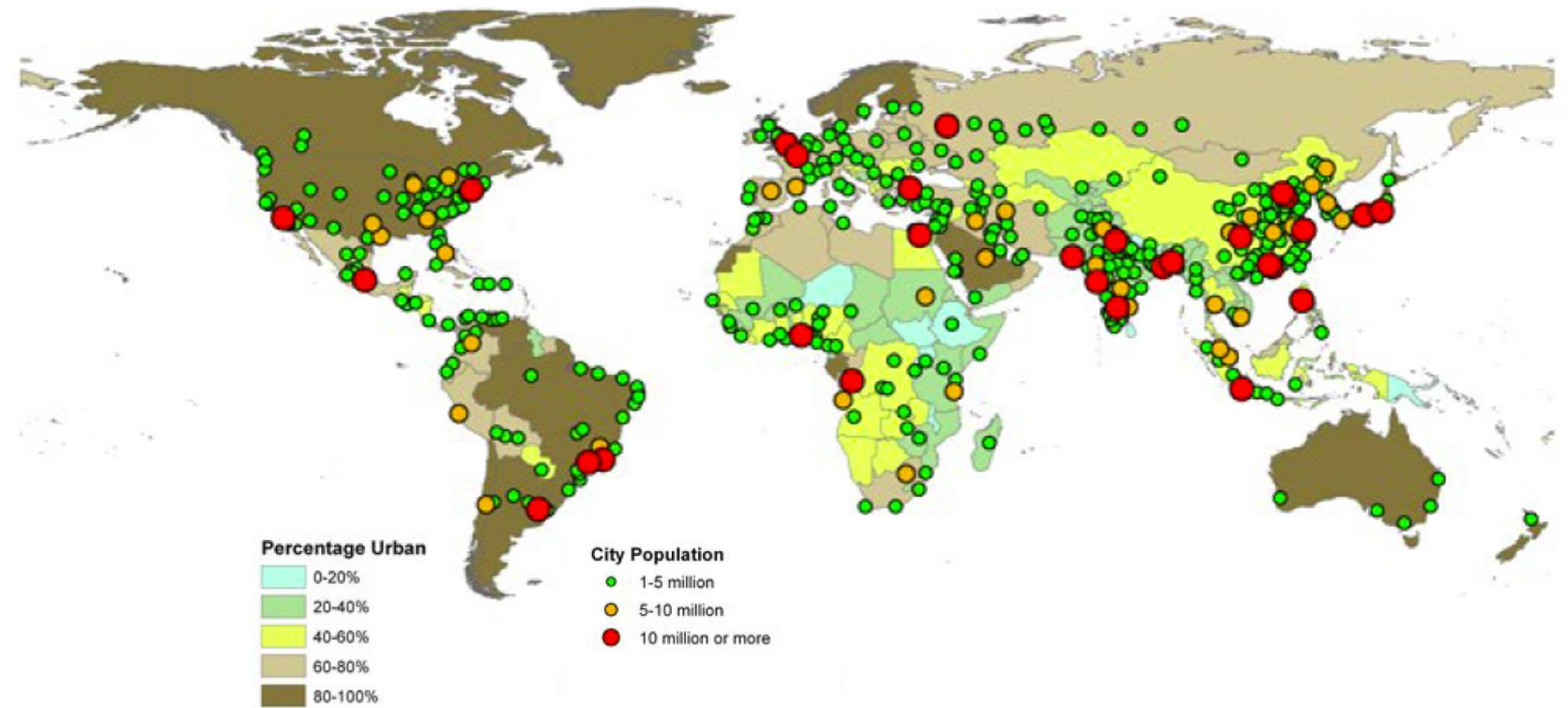
# Urbanization

## Global Pattern 1995



# Urbanization

## Global Pattern 2015



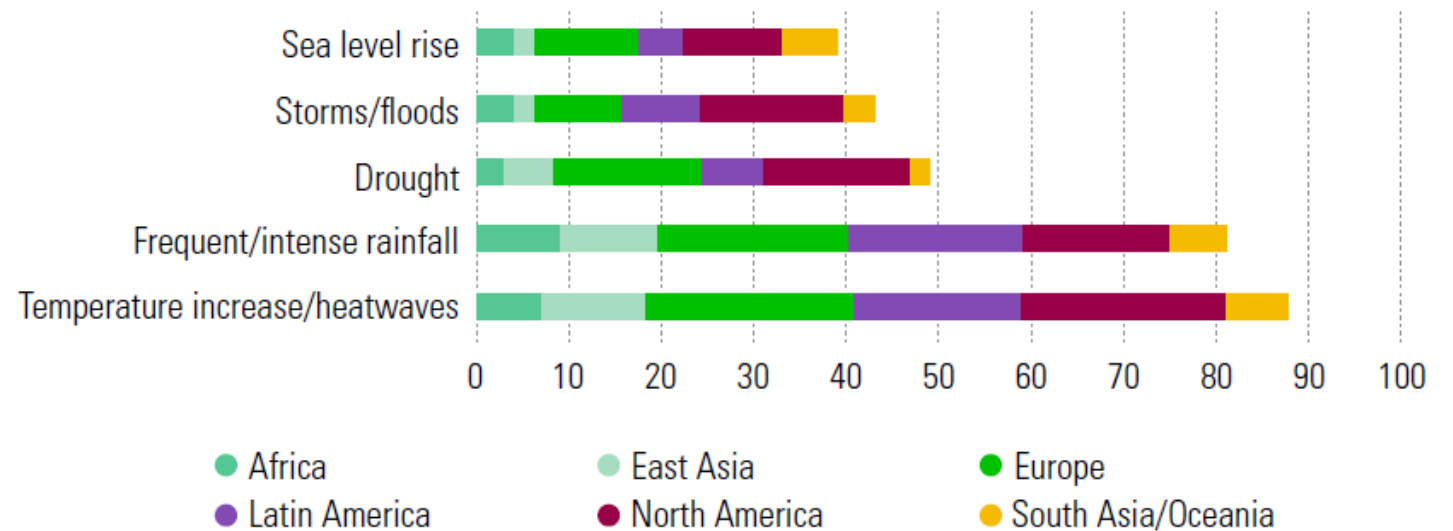
Source: "World Cities report 2016"  
United Nations Habitat



# Decarbonization

## Figure 5.2: Risks from climate change, as reported by 110 cities to the Carbon Disclosure Project (CDP)

Source: Based on data from <https://www.cdp.net/CDPResults/CDP-Cities-2013-usage-summary.pdf>.



  
**Cities** 70%  
are responsible for more than of global carbon dioxide emissions.

Source: "World Cities report 2016"  
United Nations Habitat

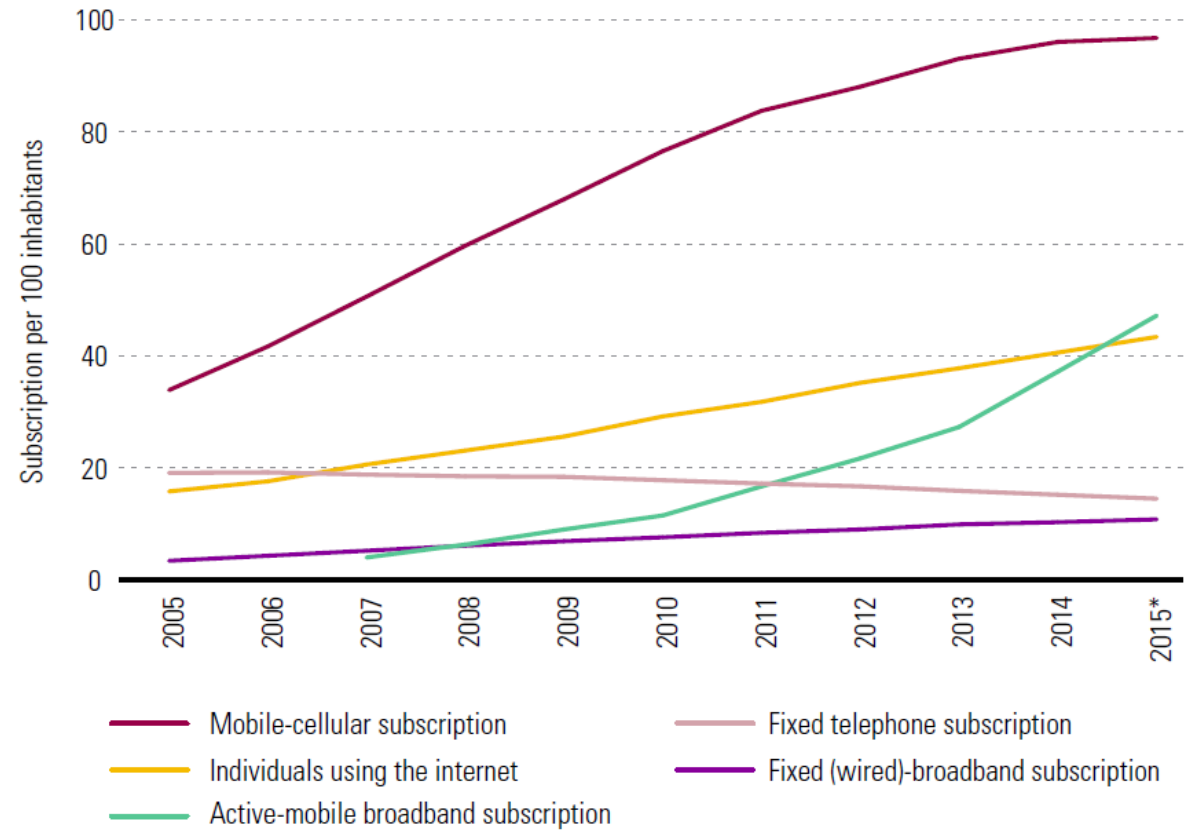


# Digitalization

## Global Pattern 1995

**Figure 2.5: Global ICT developments (2005-2015)**

Source: ITU World Telecommunication /ICT Indicators database, last accessed 16 March 2016.





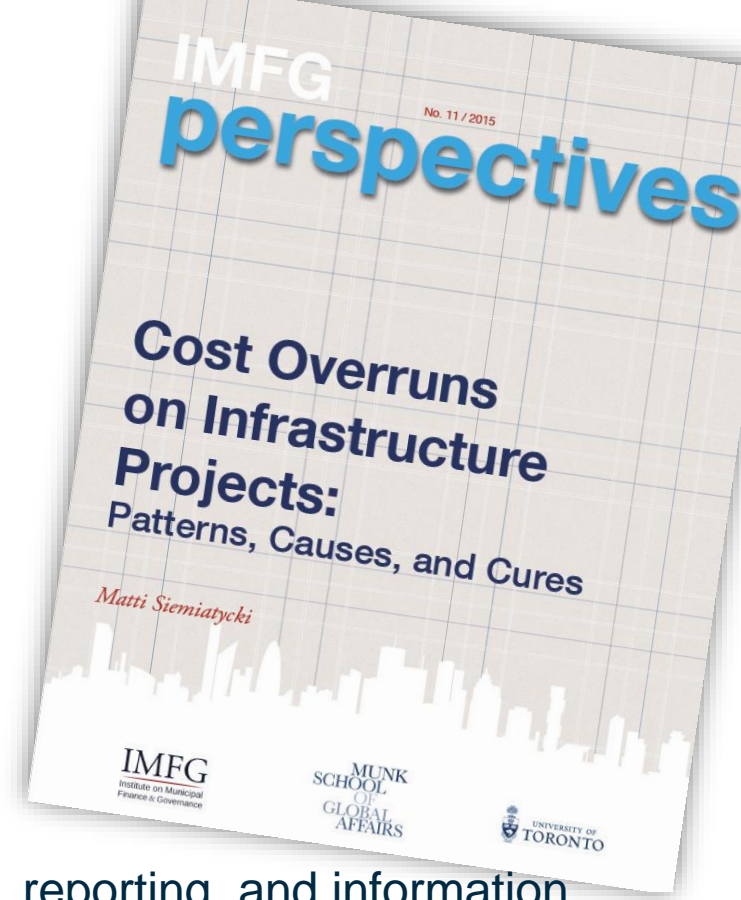
# Infrastructure Projects Overruns

International research on infrastructure project cost overruns has identified a lack of systematic tracking across government departments of how project cost and schedule estimates at the time of project approval compare with the outcome.

Global City average +28%  
Rail: +45%  
Bridge/Tunnel: +34%  
Road: +20%

## Remedies:

1. Improved performance monitoring, reporting, and information sharing
2. Track and reward the best-performing companies
3. Staff overseeing megaprojects can be better trained in management skills
4. More precise forecasting techniques
5. Public-private partnerships can make it easier to control costs and deadlines



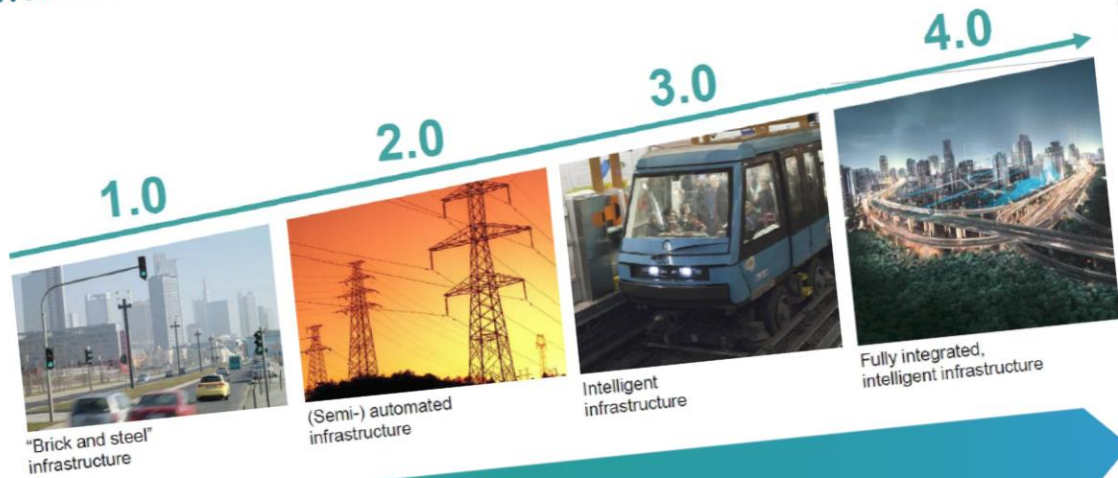


# Smart Cities need Smart Infrastructure

Grid Connected

SIEMENS  
Ingenuity for life

The evolution of a city infrastructure



Targeted investments drive increase in productivity, efficiency, capacity, resilience and quality of life

unrestricted © Siemens AG 2017  
Page 4 September 2017

*“Smart infrastructure provides the foundation for all of the key themes related to a smart city...”*

United Nations - Economic and Social Council  
Report of the General Secretary – February 2016



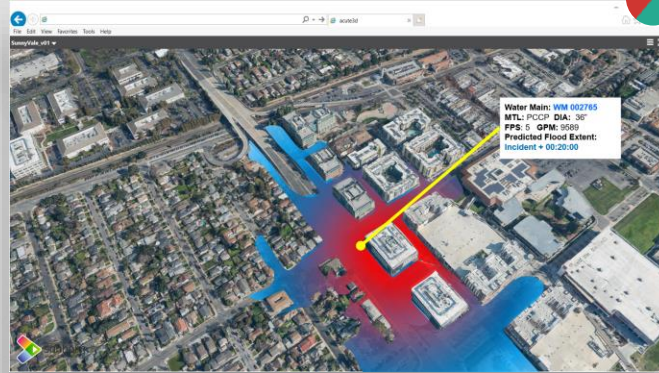
# Disconnected Infrastructure & Use Cases





# Connected Infrastructure Opportunity

Water



Flooding



Inspections

Storm Drain Condition Assessment Report  
200-400 Block Matilda Ave. Sunnyvale  
Survey date: 180202  
Report date: 180207

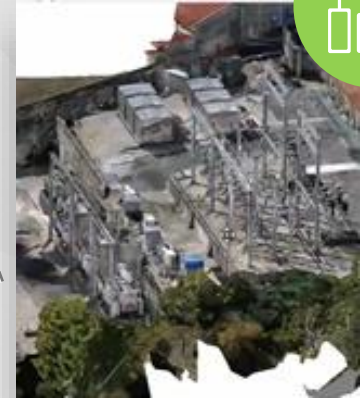
		SD 326 Matilda E Surveyed: 180202 Condition: Poor WO Issued: 180210 Completed: No
		SD 321 Matilda W Surveyed: 180202 Condition: Fair WO Issued: 180210 Completed: No
		SD 338 Matilda W Surveyed: 180202 Condition: Good WO Issued: Completed:



Storm

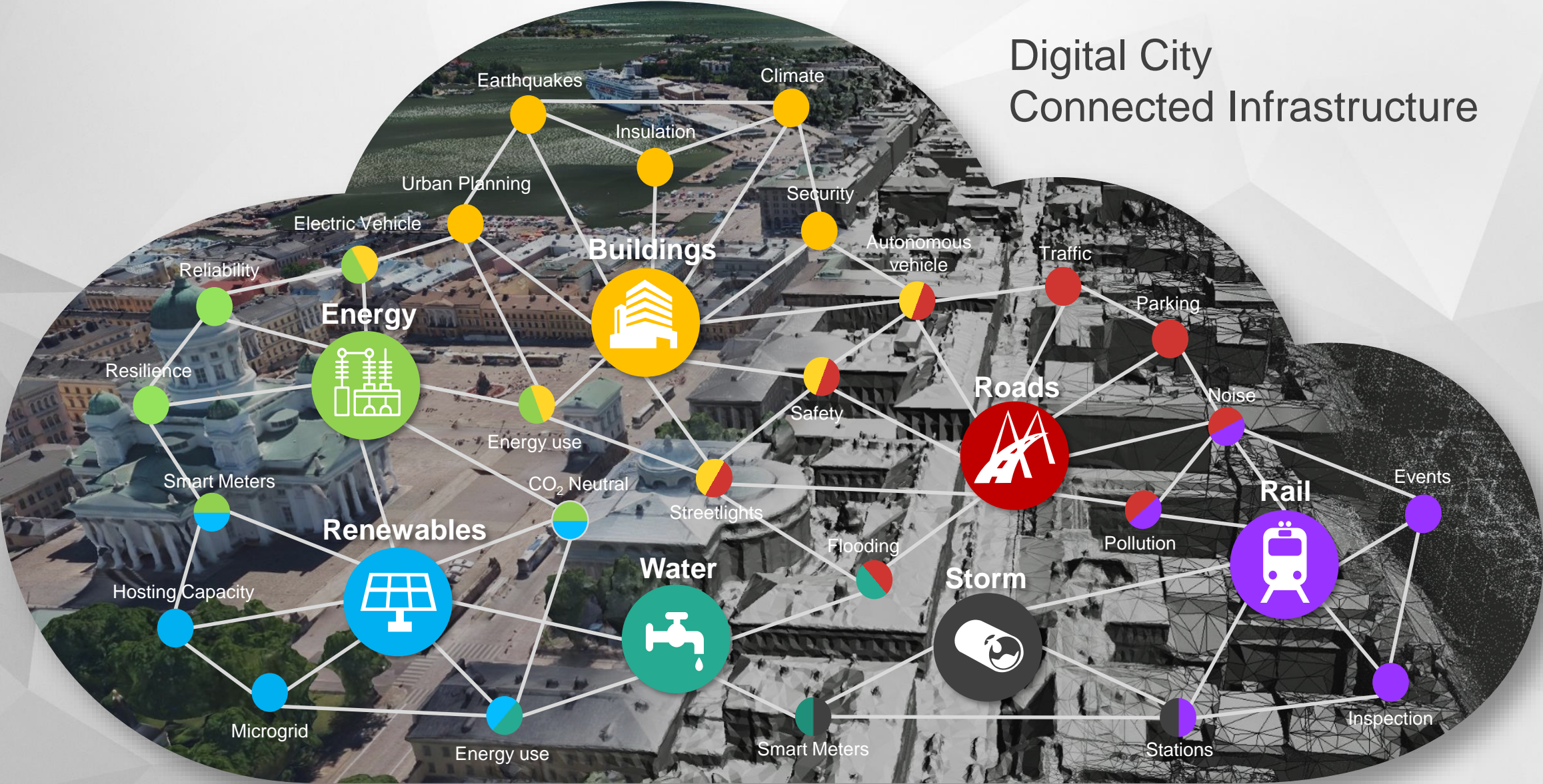


Energy



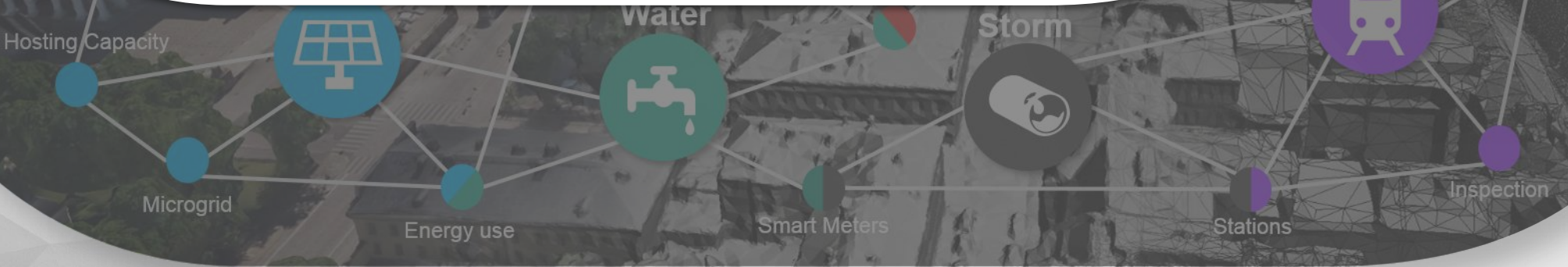


# Digital City Connected Infrastructure



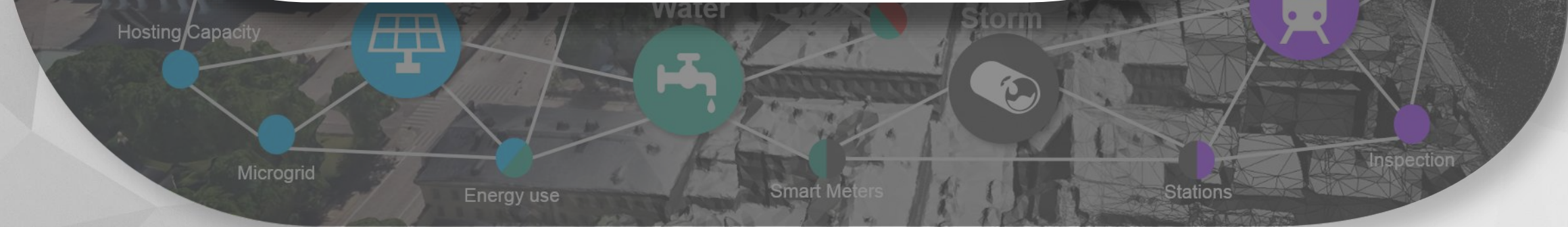
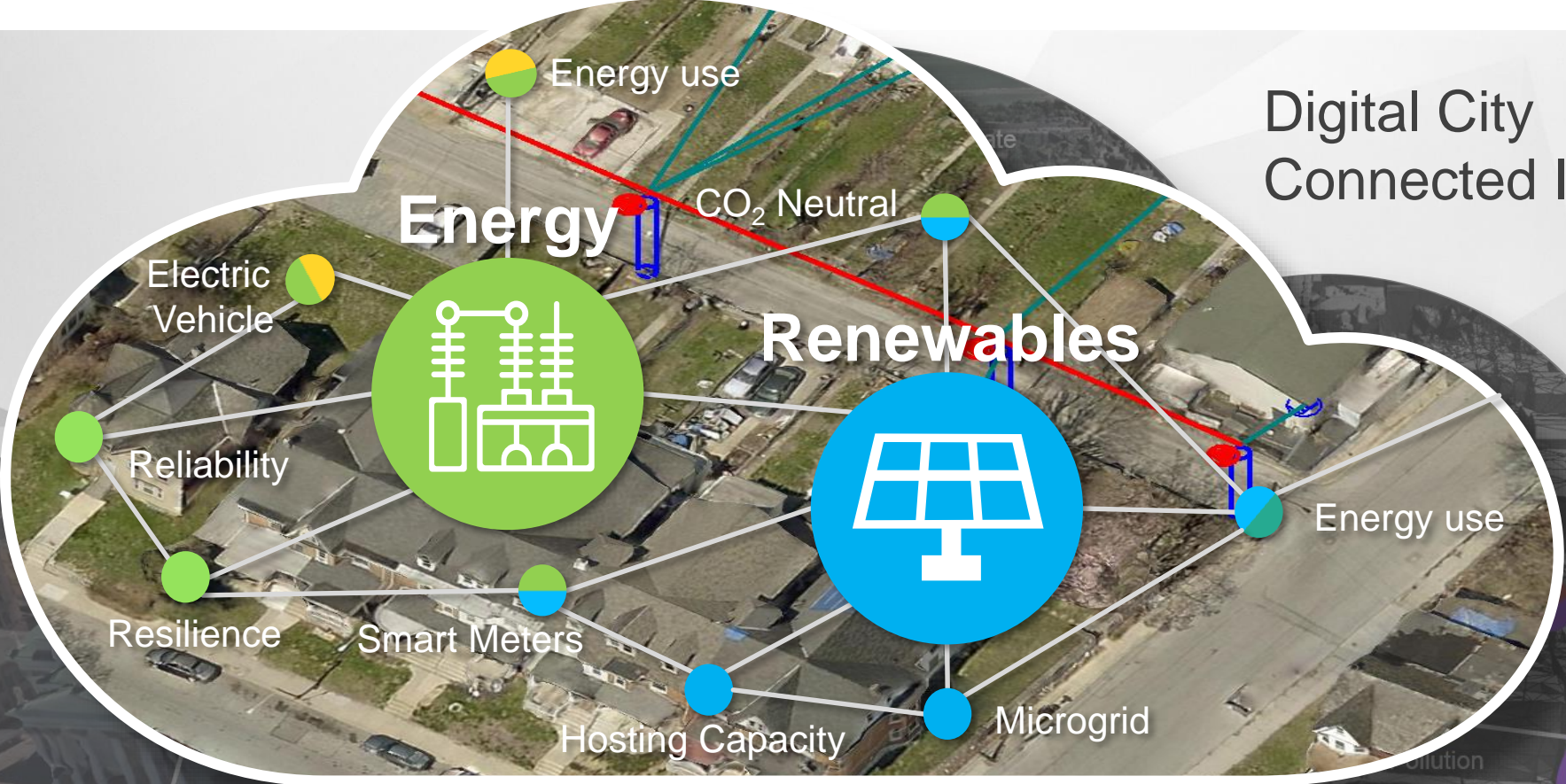


# Digital City Connected Infrastructure





# Digital City Connected Infrastructure







# Connected Data Environment



OpenRail CDE    Components Center    ContextShare    **OpenCities CDE**  
iModelHub    365 Services

Navigator (Web, Desktop, Mobile, ...)



- CAMPUSES**
- Map
  - Descartes
  - AECOsim
  - RAM
  - STAAD
  - OpenRoads
  - gINT
  - SITEOPS
  - ContextCapture
  - LumenRT
  - Haestad
  - OpenUtilities
  - Communications
  - OpenSite
  - PLAXIS

- MINING**
- MineCycle
  - OpenPlant
  - STAAD
  - Promis.e
  - Map
  - Descartes
  - ContextCapture
  - OpenRoads
  - OpenRail
  - gINT
  - Haestad
  - PLAXIS
  - SoilVision

- WATER & WASTEWATER**
- Haestad
  - OpenPlant
  - AECOsim
  - STAAD
  - RAM
  - gINT
  - OpenUtilities
  - OpenRoads
  - Descartes
  - ContextCapture
  - PLAXIS

- CITIES**
- Map
  - Descartes
  - OpenRoads
  - OpenRail
  - OpenUtilities
  - Communications
  - AECOsim
  - ContextCapture
  - LumenRT
  - SITEOPS
  - OpenSite
  - ACTION Flood

- NUCLEAR POWER**
- AutoPIPE
  - OpenPlant
  - AECOsim
  - STAAD
  - SITEOPS
  - Descartes
  - ContextCapture
  - OpenSite

- ROADS**
- OpenRoads
  - OpenBridge
  - gINT
  - Descartes
  - SITEOPS
  - ContextCapture
  - LumenRT
  - Map
  - Haestad
  - SUPERLOAD
  - PLAXIS

- BUILDINGS**
- AECOsim
  - RAM
  - STAAD
  - ProStructures
  - speedikon
  - gINT
  - OpenRoads
  - OpenUtilities
  - Communications
  - Haestad
  - ContextCapture
  - LumenRT
  - Descartes
  - PLAXIS

- COMMUNICATIONS NETWORKS**
- Communications
  - STAAD
  - Descartes
  - ContextCapture

- BRIDGES**
- OpenBridge
  - OpenRoads
  - gINT
  - ProStructures
  - ContextCapture
  - LumenRT
  - LARS
  - Descartes
  - PLAXIS

## Application Playbooks

- CONSTRUCTION**
- Navigator
  - ConstructSim
  - ProStructures
  - AECOsim
  - Descartes
  - OpenRoads
  - SITEOPS
  - ContextCapture
  - LumenRT
  - OpenSite
  - PLAXIS
  - SoilVision

- SUBSURFACE UTILITIES**
- OpenUtilities
  - Communications
  - Haestad
  - OpenRoads
  - gINT
  - Descartes
  - ContextCapture
  - PLAXIS

- POWER PLANTS**
- OpenPlant
  - AutoPIPE
  - Promis.e
  - STAAD
  - ProStructures
  - AECOsim
  - gINT
  - Descartes
  - ContextCapture
  - OpenRoads
  - ConstructSim
  - PLAXIS

- UTILITY NETWORKS**
- OpenUtilities
  - Communications
  - Substation
  - Haestad
  - STAAD
  - Descartes
  - SITEOPS
  - ContextCapture
  - LumenRT
  - OpenSite

- RAIL & TRANSIT**
- OpenRail
  - OpenBridge
  - gINT
  - Promis.e
  - SITEOPS
  - ContextCapture
  - Descartes
  - LumenRT
  - Map
  - AECOsim
  - STAAD
  - RAM
  - ComplyPro
  - Substation
  - OpenSite
  - PLAXIS

- WIND FARMS**
- SACS
  - MOSES
  - MAXSURF
  - ProSteel
  - OpenPlant
  - gINT
  - ContextCapture
  - Descartes
  - PLAXIS

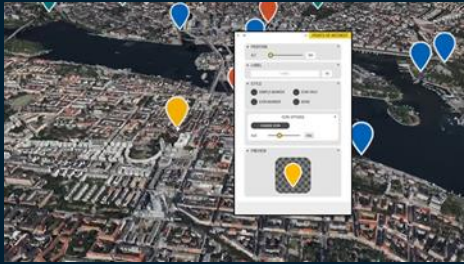
- OFFSHORE STRUCTURES**
- SACS
  - MOSES
  - MAXSURF
  - AutoPIPE
  - ProSteel
  - ConstructSim
  - OpenPlant
  - gINT
  - ContextCapture
  - PLAXIS

- PROCESS PLANTS**
- OpenPlant
  - AutoPLANT
  - AutoPIPE
  - PlantWise
  - Promis.e
  - AECOsim
  - ProStructures
  - STAAD
  - gINT
  - OpenRoads
  - SITEOPS
  - ContextCapture
  - LumenRT
  - Descartes
  - ConstructSim
  - OpenSite
  - PLAXIS



# OpenCities Connected Data Environment (CDE)

Plan



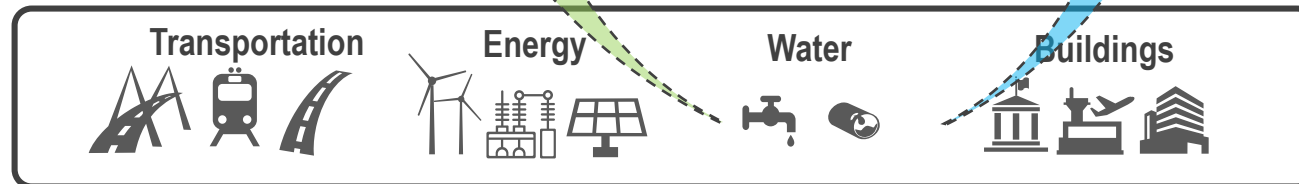
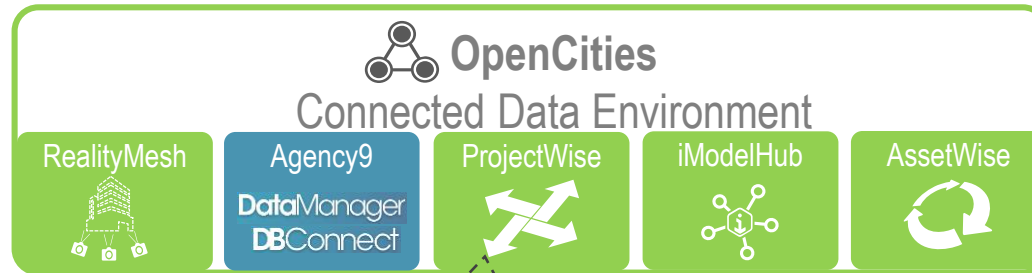
Design



Build



Operate





# Use cases Summary

Use Case	Example of an Application	Lifecycle stage	Minimum level from a Bentley perspective			
			Reality Model	Authentic 2D (GIS)	3D classification (level)	3D Identification
4.1.1 Estimation of the solar irradiation	Determining the suitability of a roof surface for installing photovoltaic panels	Operation	Yes	yes	1	No
4.1.2 Energy demand estimation	Assessing the return of a building energy retrofit	Design	No	yes	3	Yes
4.1.3 Aiding positioning	Map matching	Operation	Yes	no	No	No
4.1.4 Determination of the floorspace	Valuation of buildings	Operation	No	yes	3	yes
4.1.5 Classifying building types	Semantic enrichment of data sets	Operation	Yes	yes		
4.2.1 Geo-visualisation and visualisation	Flight simulation	All	Yes	better	No	No
4.2.2 Visibility analysis	Finding the optimal location to place a surveillance	Operation	Yes	better	No	No
4.2.3 Estimation of shadows cast by urban features	Determination of solar envelopes	planning, operations	Yes	better	No	No
4.2.4 Estimation of the propagation of noise in an urban environment	Traffic planning	planning, operations	Yes	No	better	No
4.2.5 3D cadastre	Property registration	lifecycle	No	yes	3	Yes
4.2.6 Visualisation for navigation	Navigation	lifecycle	Yes	better	No	No
4.2.7 Urban planning	Designing green areas	planning	Yes	better	No	No
4.2.8 Visualisation for communication of urban information to citizenry	Virtual tours	lifecycle	yes	yes	better	better
4.2.9 Reconstruction of sunlight direction	Object recognition	NA				
4.2.10 Understanding SAR images	Interpretation of radar data	NA				
4.2.11 Facility management	Managing utilities	Operation	Yes	yes	better	better
4.2.12 Automatic scaffold assembly	Civil engineering	construction	Yes	no	No	No
4.2.13 Emergency response	Planning evacuation	Operation	Yes	yes	better	better
4.2.14 Lighting simulations	Planning lighting of landmarks	design	Yes	no	2	No
4.2.15 Radio-wave propagation	Optimising radio infrastructure	planning	Yes	no	better	No
4.2.16 Computational fluid dynamics	Predicting air quality	planning, operations	Yes	no	better	better
4.2.17 Estimating the population in an area	Crisis management	Operation	No	yes	No	No
4.2.18 Routing	Understanding accessibility	Operation	Yes	no	better	better
4.2.19 Forecasting seismic damage	Insurance	planning, operations	Yes	yes	better	better
4.2.20 Flooding	Mitigating damage to utility management	planning, operations	Yes	yes	better	better
4.2.21 Change detection	Urban inventory	Operation	Yes	yes	No	No
4.2.22 Volumetric density studies	Urban studies	planning, operations	Yes	yes	No	No
4.2.23 Forest management	Predicting tree growth	NA				
4.2.24 Archaeology	Visualising ancient sites	NA				





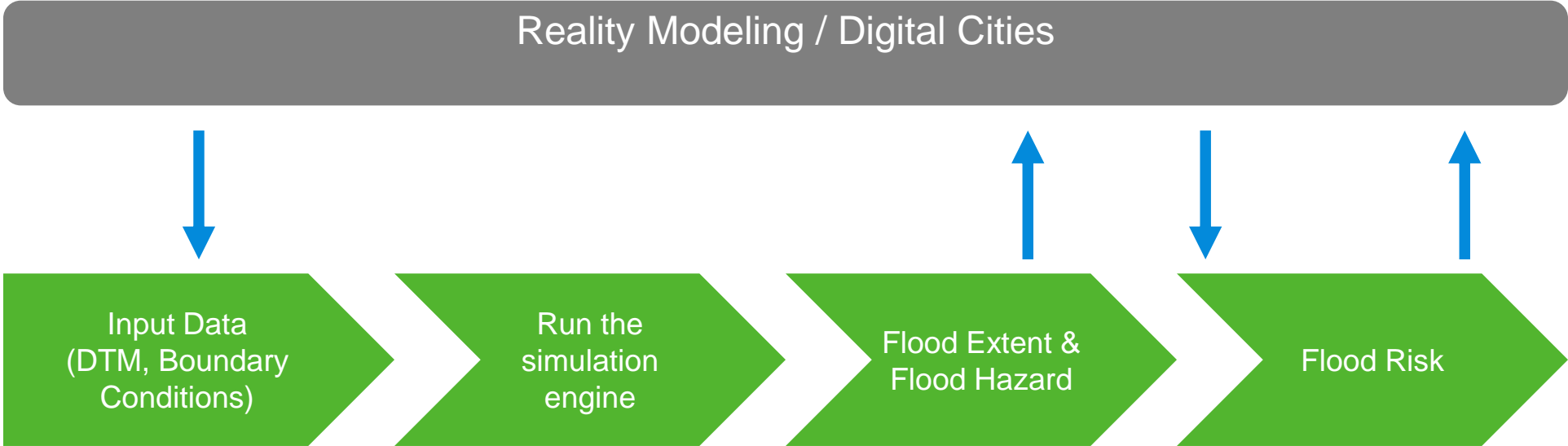




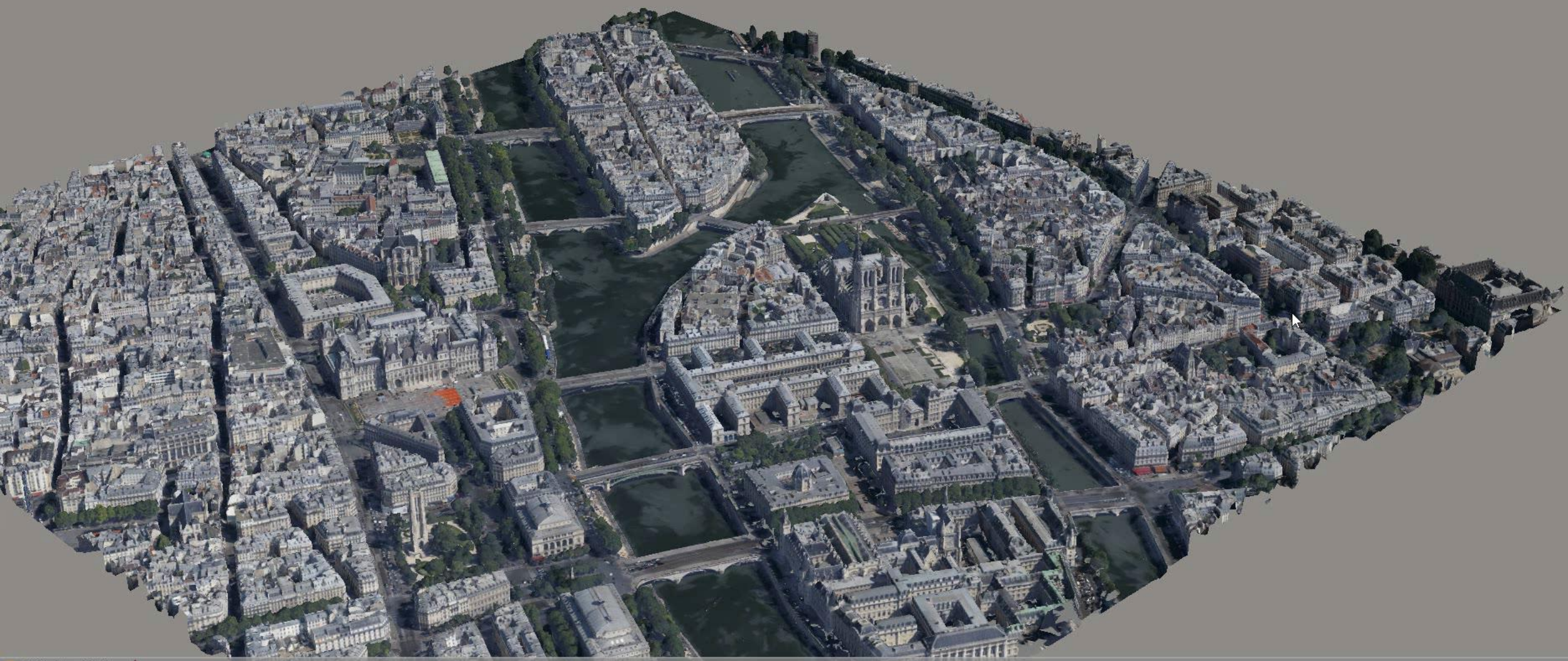
# OpenFlows FLOOD



# OpenFlows FLOOD – How it Works





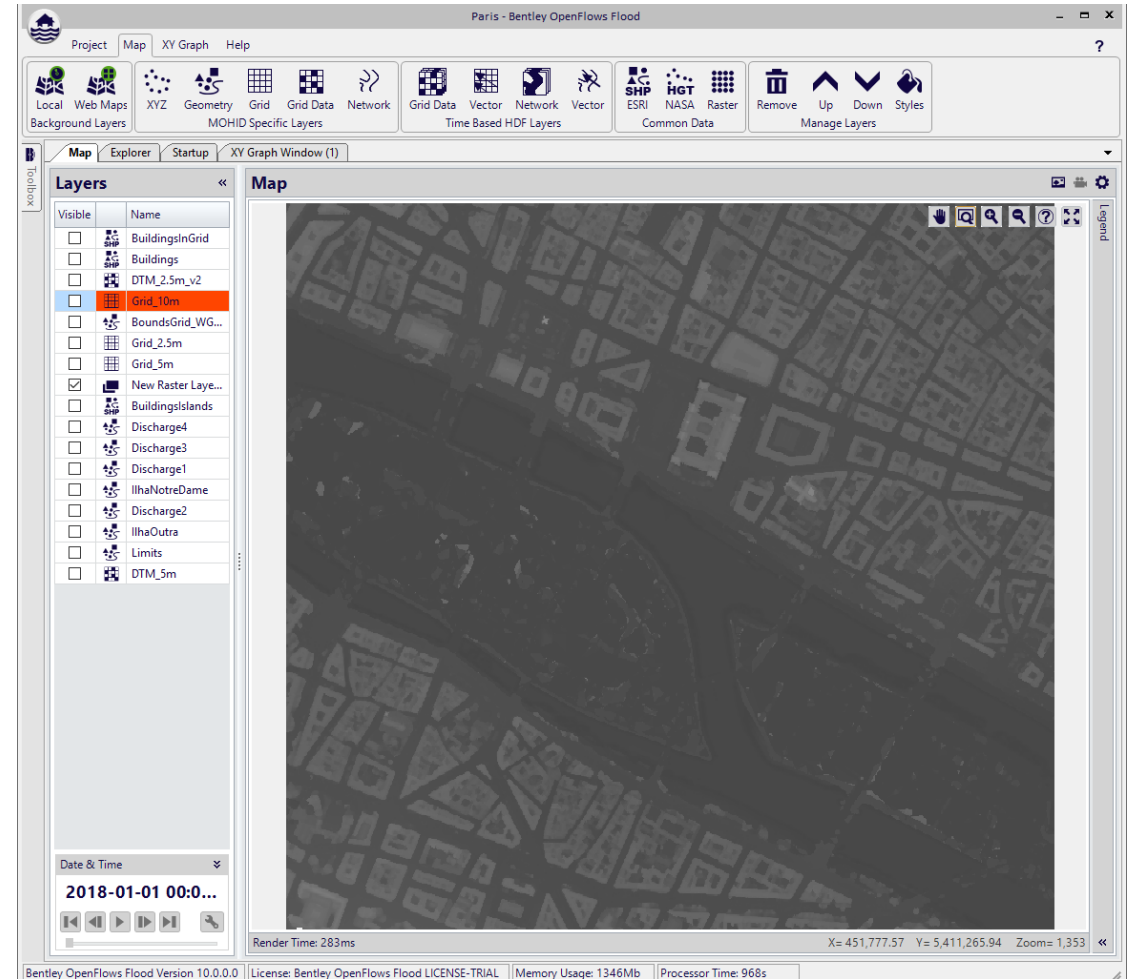


Altitude: 1041m



# OpenFlows FLOOD – ContextCapture to Flood Model

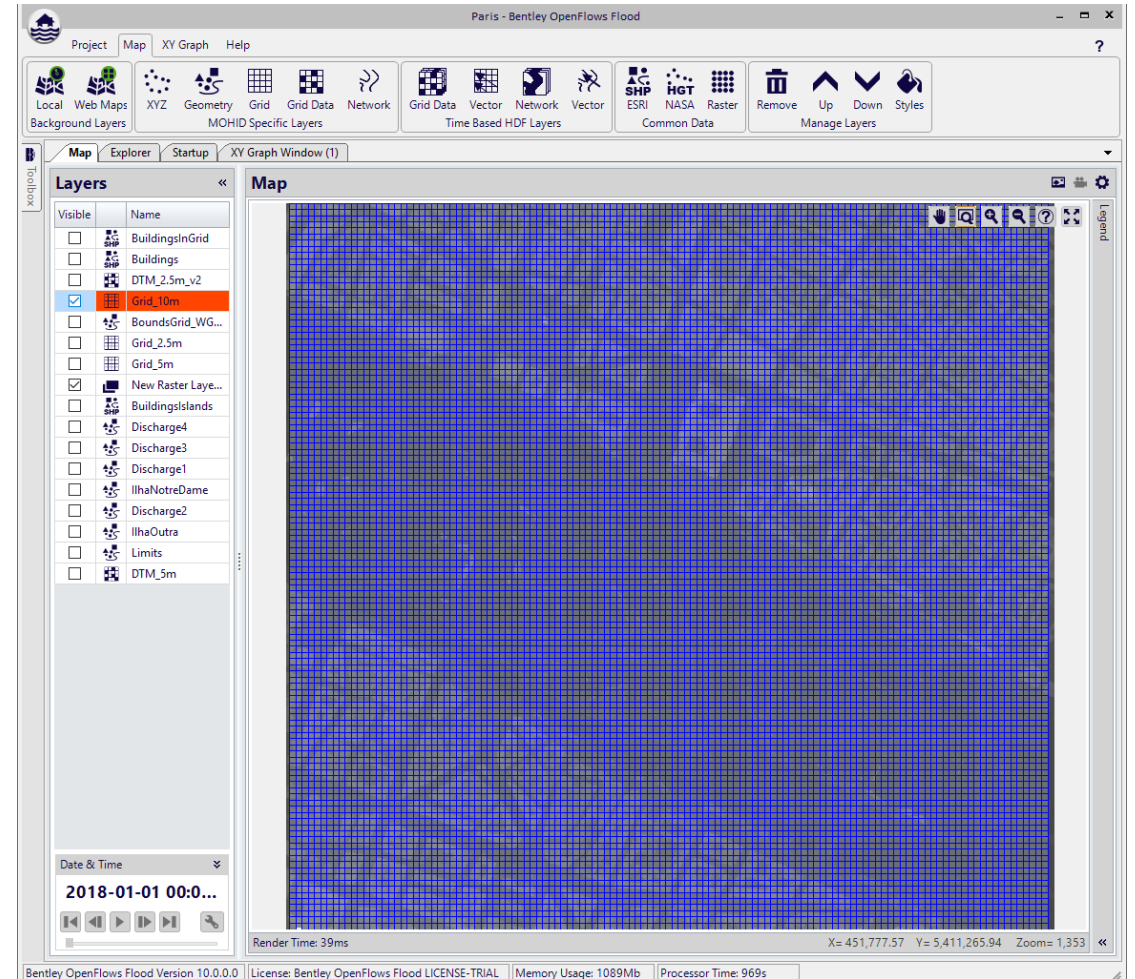
- Import Data from ContextCapture





# OpenFlows FLOOD – ContextCapture to Flood Model

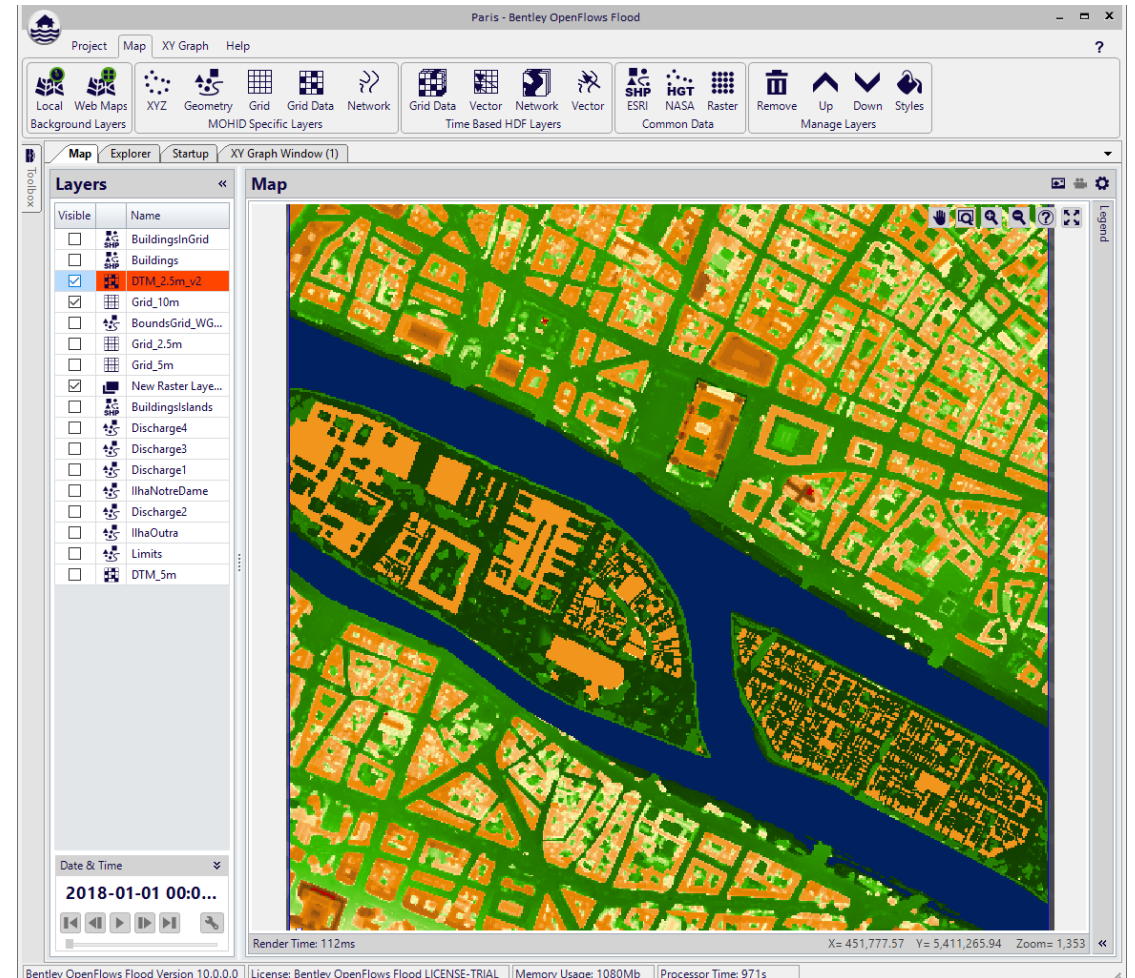
- Import Data from ContextCapture
- Create Computational Grid





# OpenFlows FLOOD – ContextCapture to Flood Model

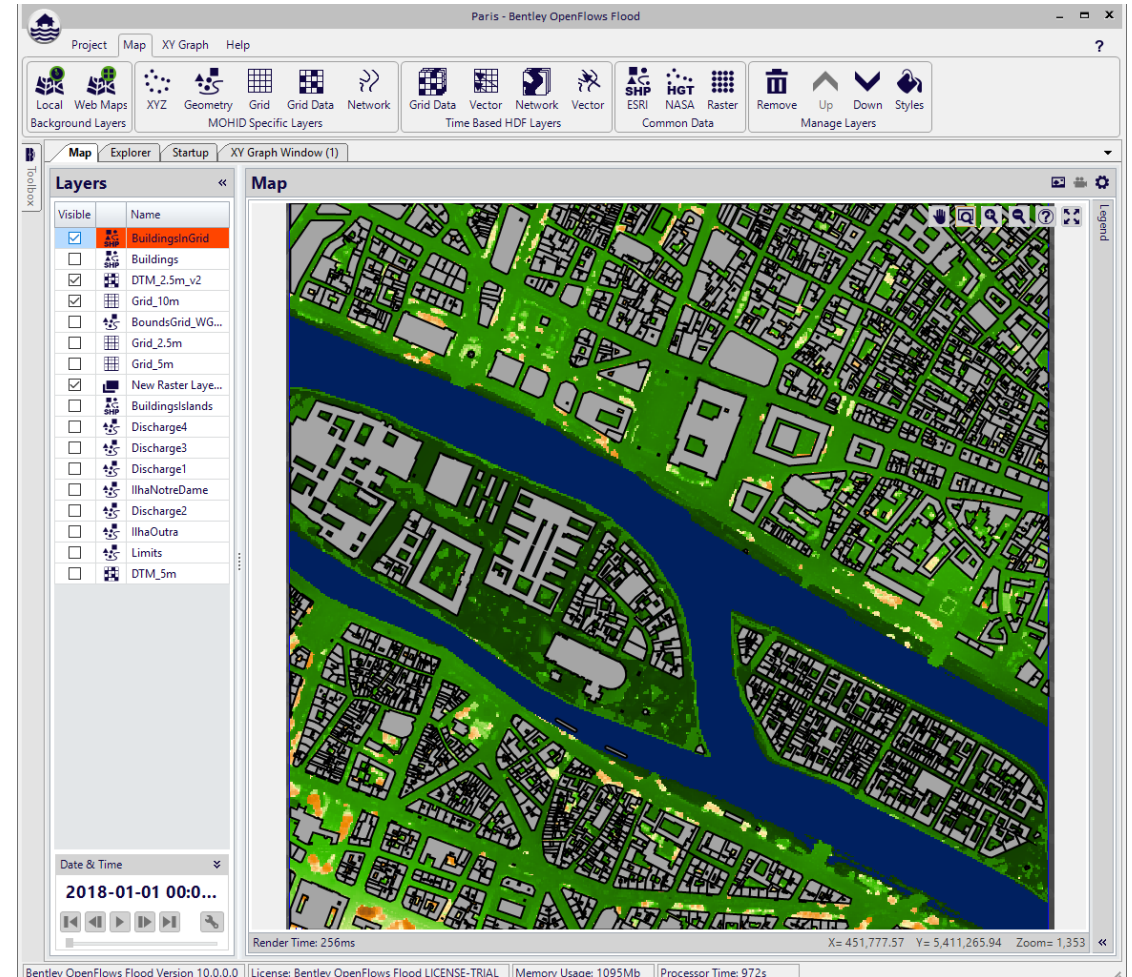
- Import Data from ContextCapture
- Create Computational Grid
- Create Digital Terrain Model





# OpenFlows FLOOD – ContextCapture to Flood Model

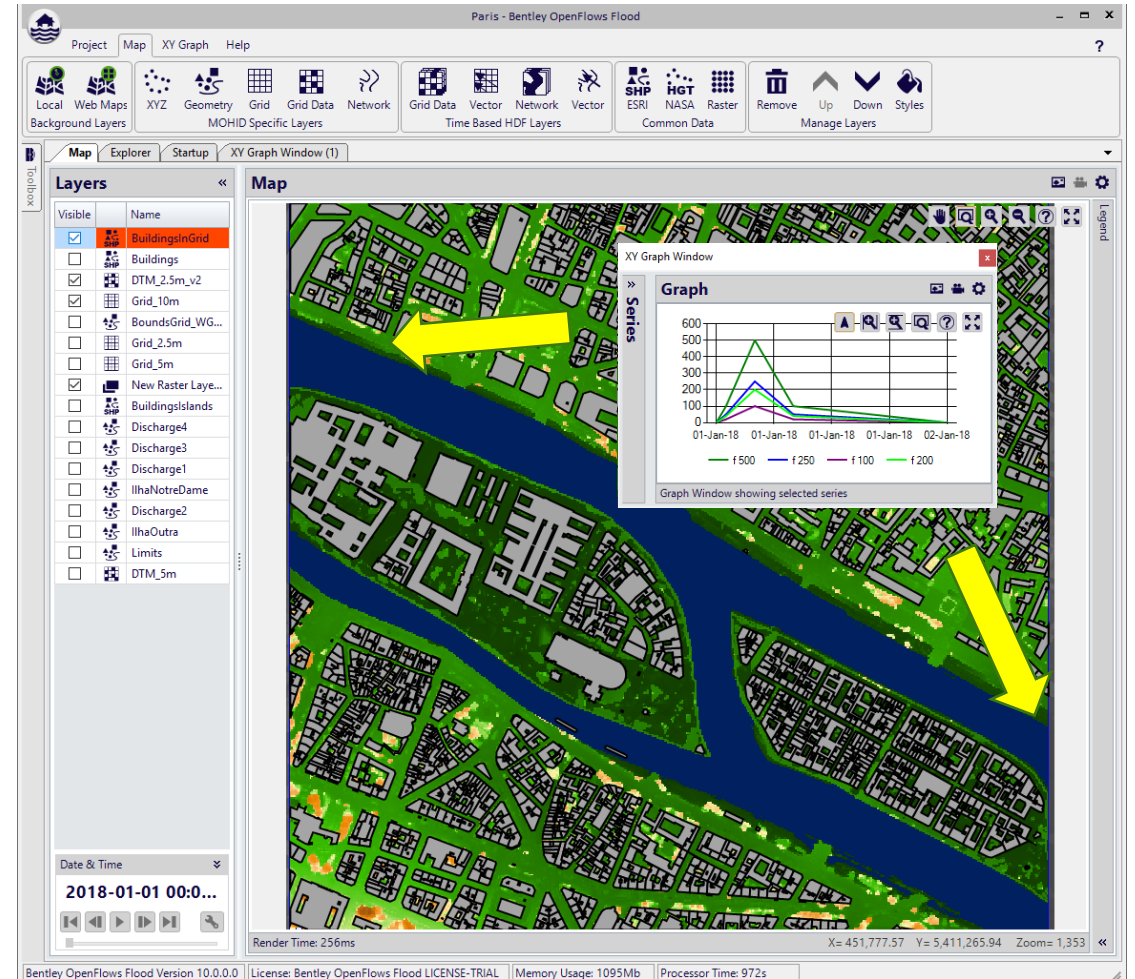
- Import Data from ContextCapture
- Create Computational Grid
- Create Digital Terrain Model
- **Overlay with Additional Information**





# OpenFlows FLOOD – ContextCapture to Flood Model

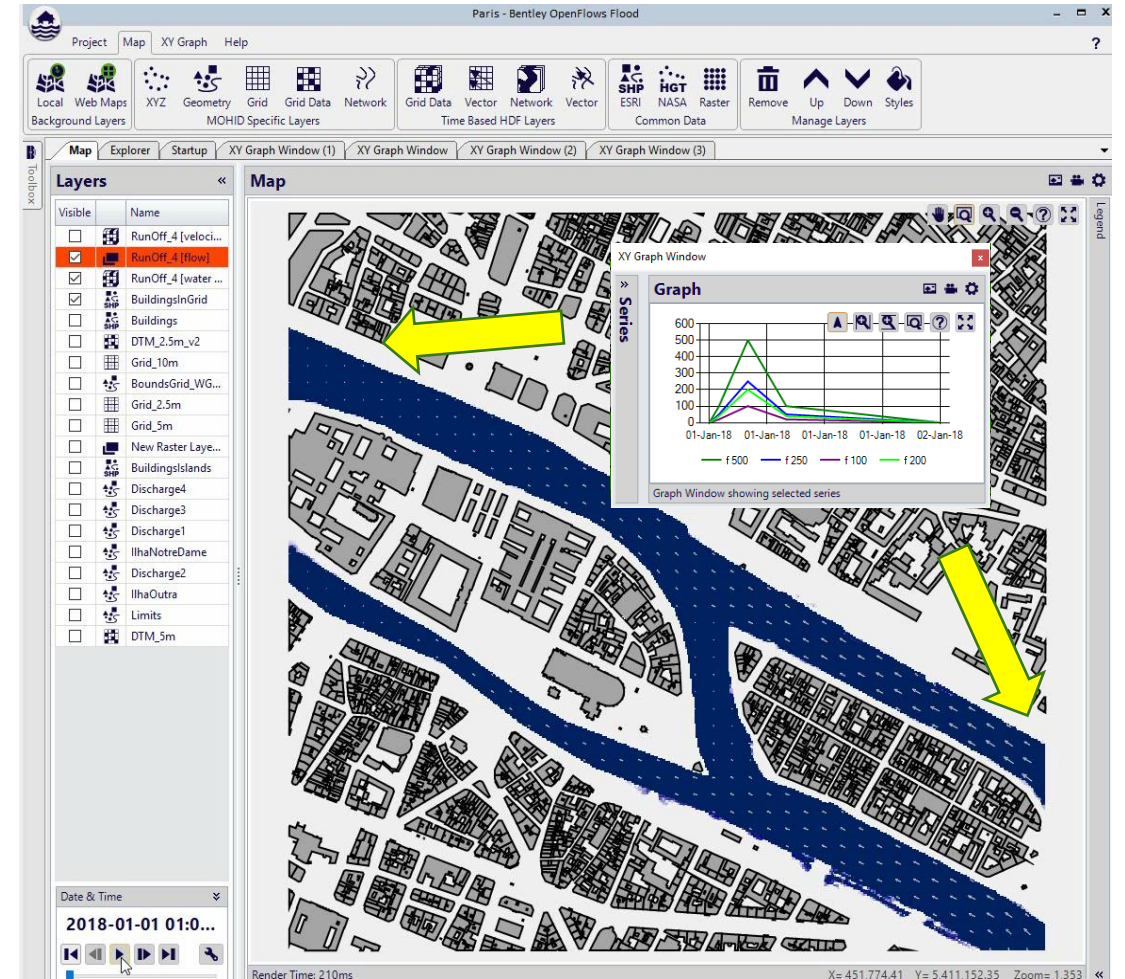
- Import Data from ContextCapture
- Create Computational Grid
- Create Digital Terrain Model
- Overlay with Additional Information
- Define Boundary Conditions





# OpenFlows FLOOD – Explore Results

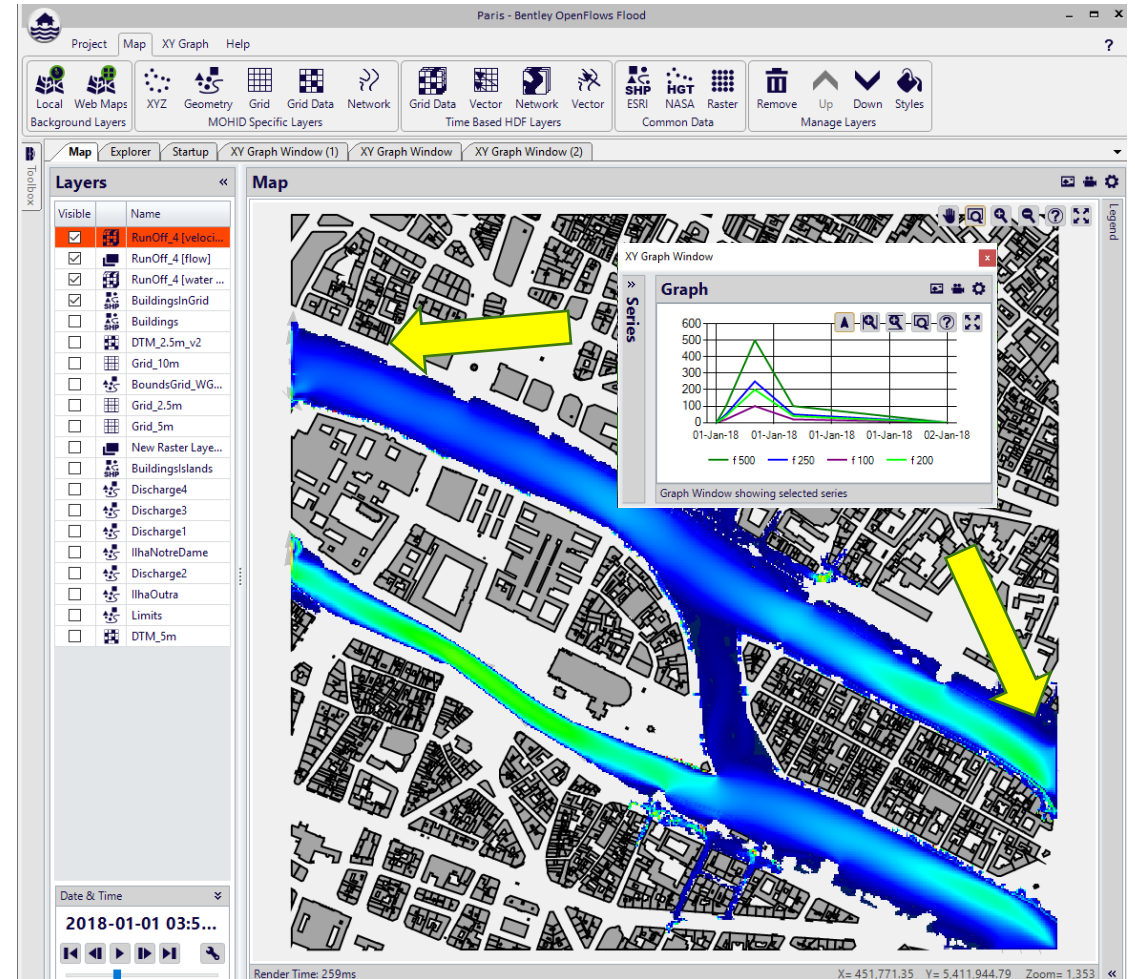
- View Results in the form of animated map





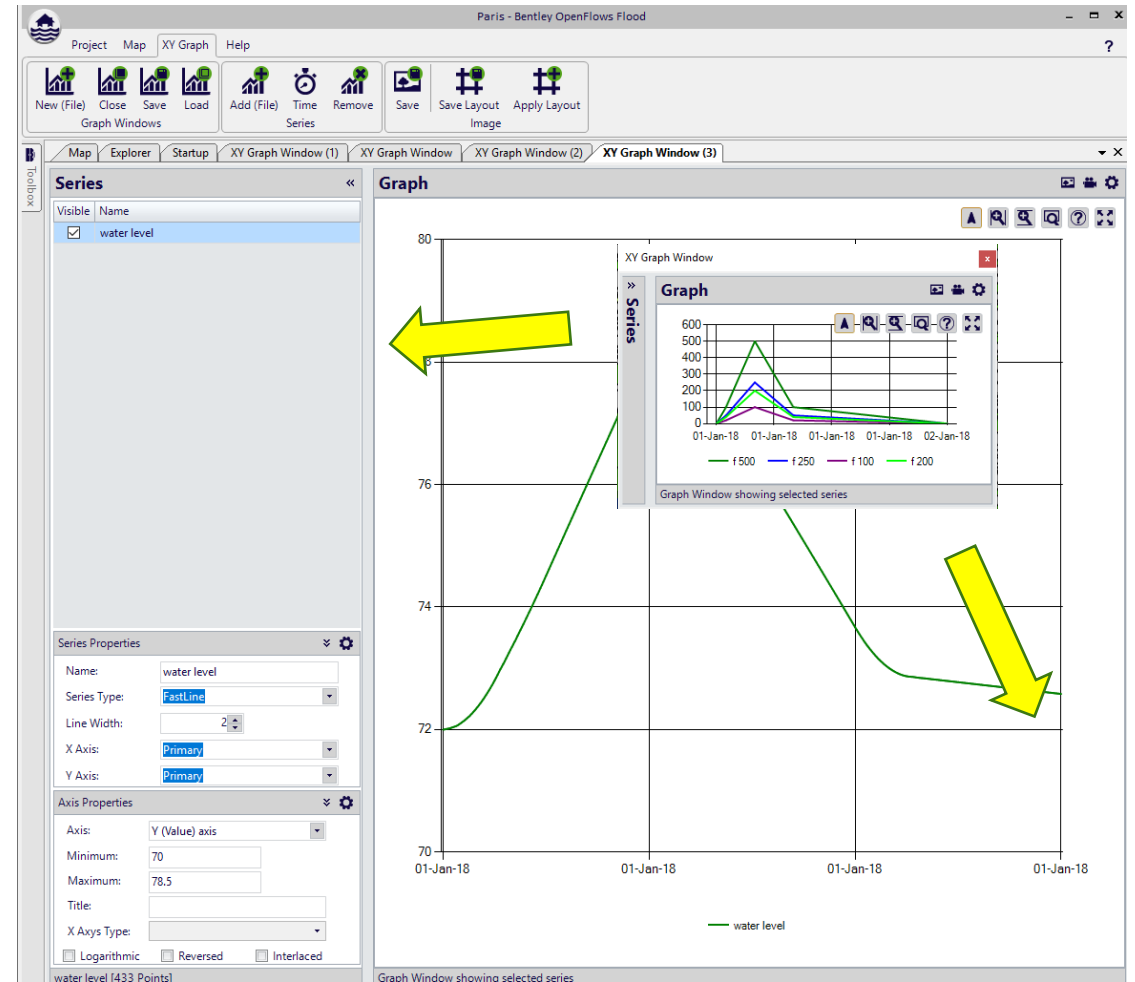
# OpenFlows FLOOD – Explore Results

- View Results in form of animated map
- Display different properties...
  - water column, velocity, etc



# OpenFlows FLOOD – Explore Results

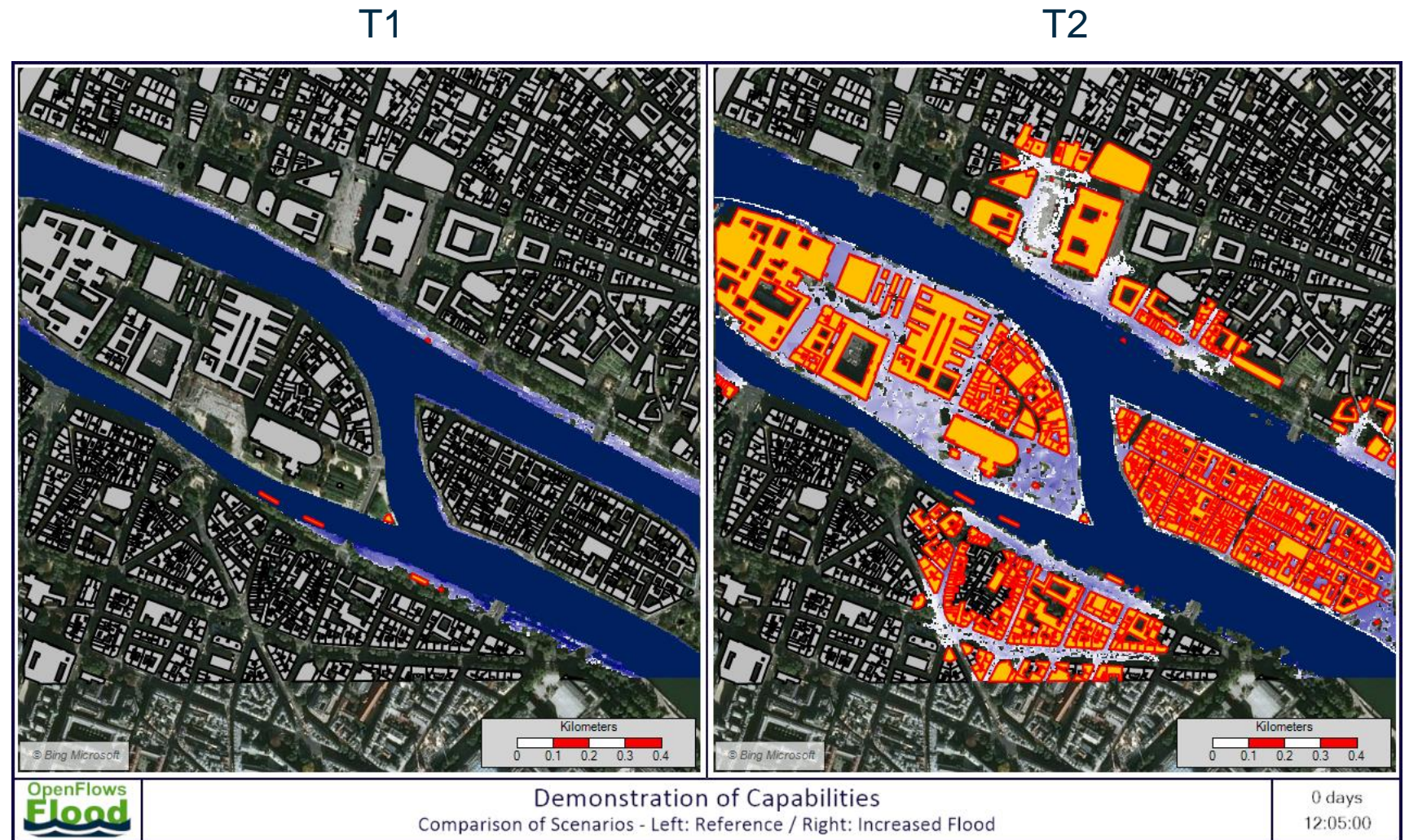
- View Results in form of animated map
- Display different properties...
  - water column, velocity, etc
- ... in different formats
  - Maps, graphs





# OpenFlows FLOOD – Flood Risk Assessment

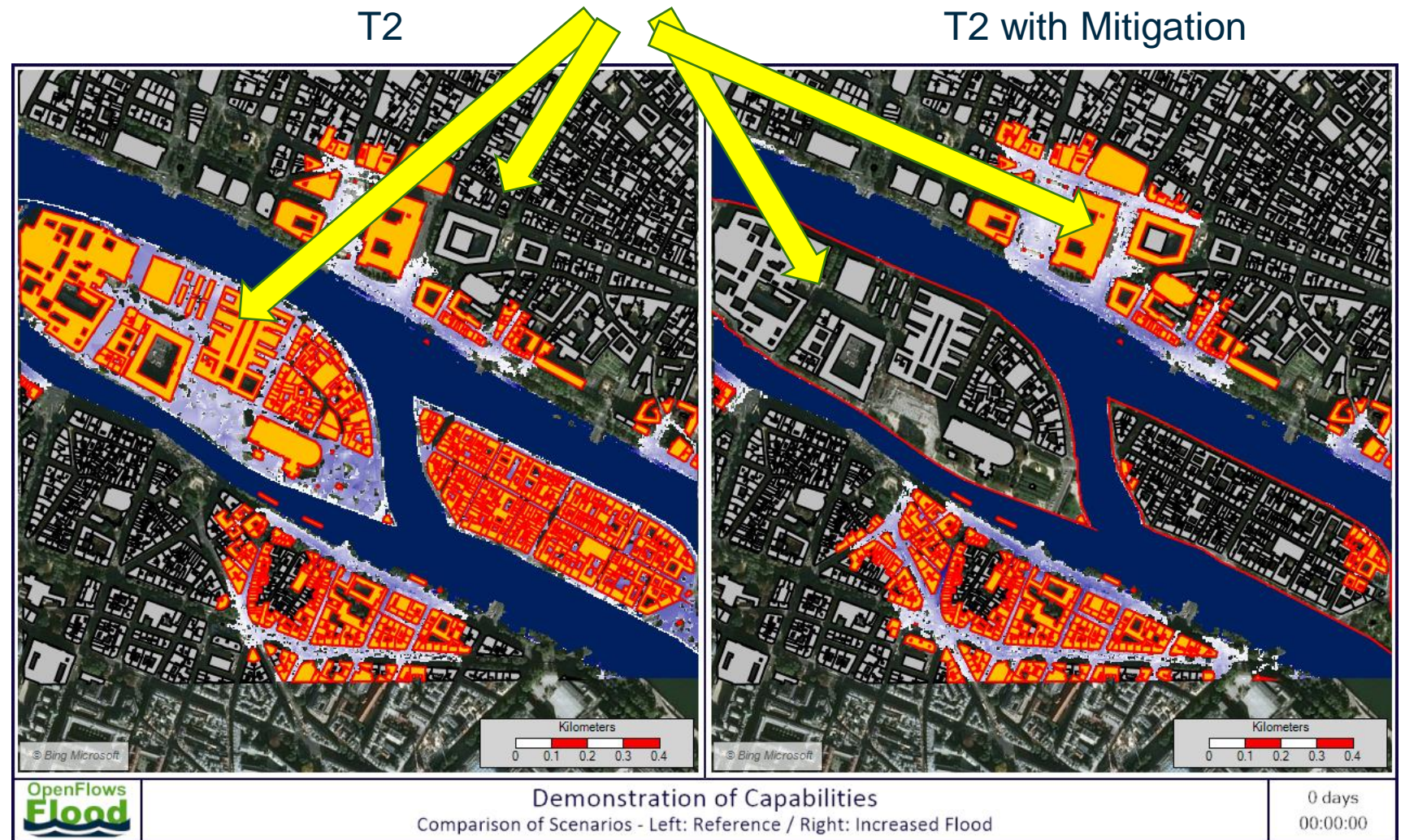
- Comparison of Scenarios
- Analysis of Losses





# OpenFlows FLOOD – Flood Risk Mitigation

- Implement Mitigation Measures
- Comparison of Scenarios



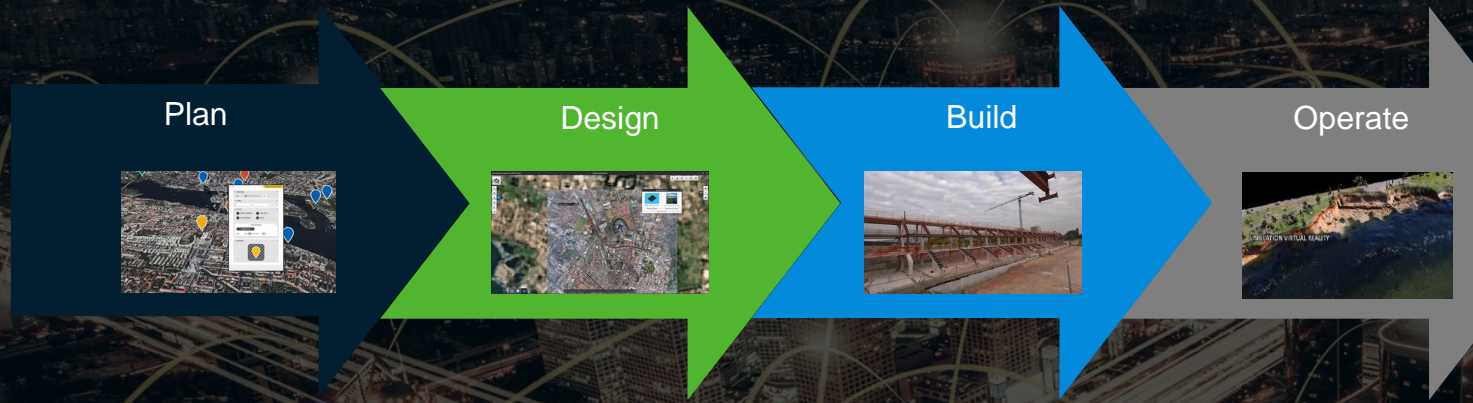










# OpenCities Planner



# OpenCities Planner



 **OpenCities**  
Connected Data Environment

 RealityMesh	 Agency9 DataManager	 ProjectWise	 iModelHub	 AssetWise
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News Release  
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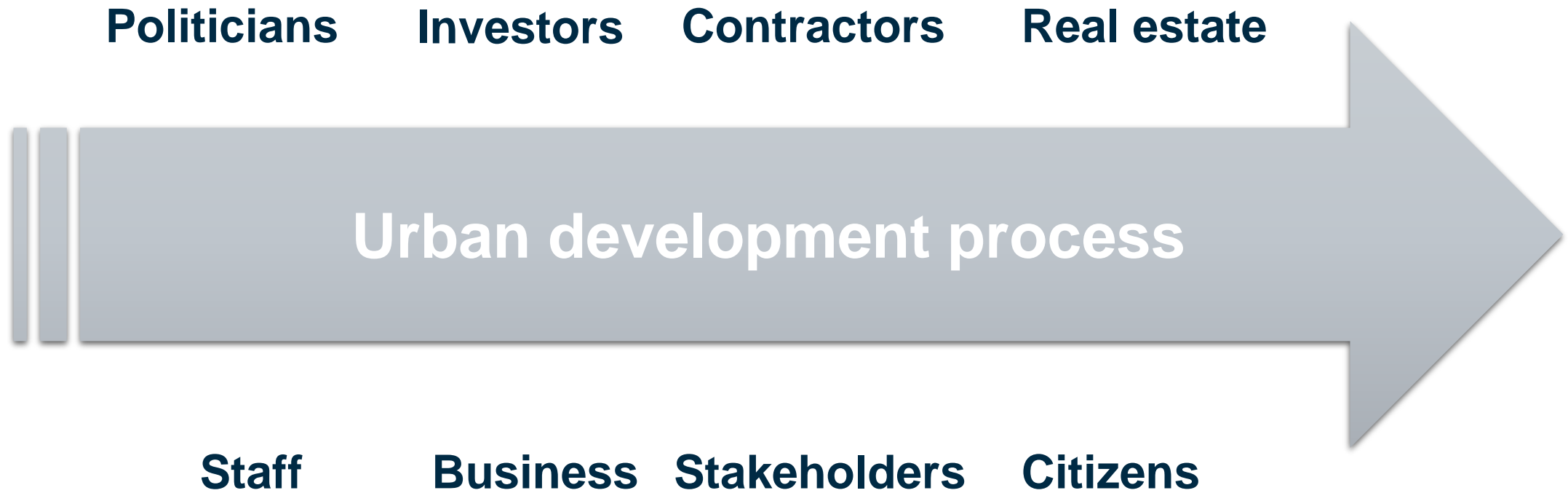
## Bentley Acquires Agency9 to Realize Digital Twins for Every City

*OpenCities Planner takes advantage of city-scale reality modeling to span GIS and BIM*

**The Year in Infrastructure 2018 Conference, London, U.K.** – Oct. 15, 2018 – the leading global provider of comprehensive software solutions for advancing the design, construction, and operations of infrastructure, today announced the acquisition of Agency9, based in Stockholm. Agency9 has already provided nearly half of Sweden’s larger municipalities with city-scale digital twin cloud services for city planning and related web-based 3D visualization. Since 2012, Agency9 has taken advantage of reality meshes created by Bentley’s *ContextCapture* reality modeling software as the digital context for visualizing urban infrastructure assets represented in GIS data, terrain surveys, and BIM models. Bentley’s new *iTwin*™ cloud services, introduced at the conference, add digital alignment and change synchronization for infrastructure engineering digital twins, and will enable *OpenCities Planner* (formerly Agency9 *CityPlanner*) to uniquely

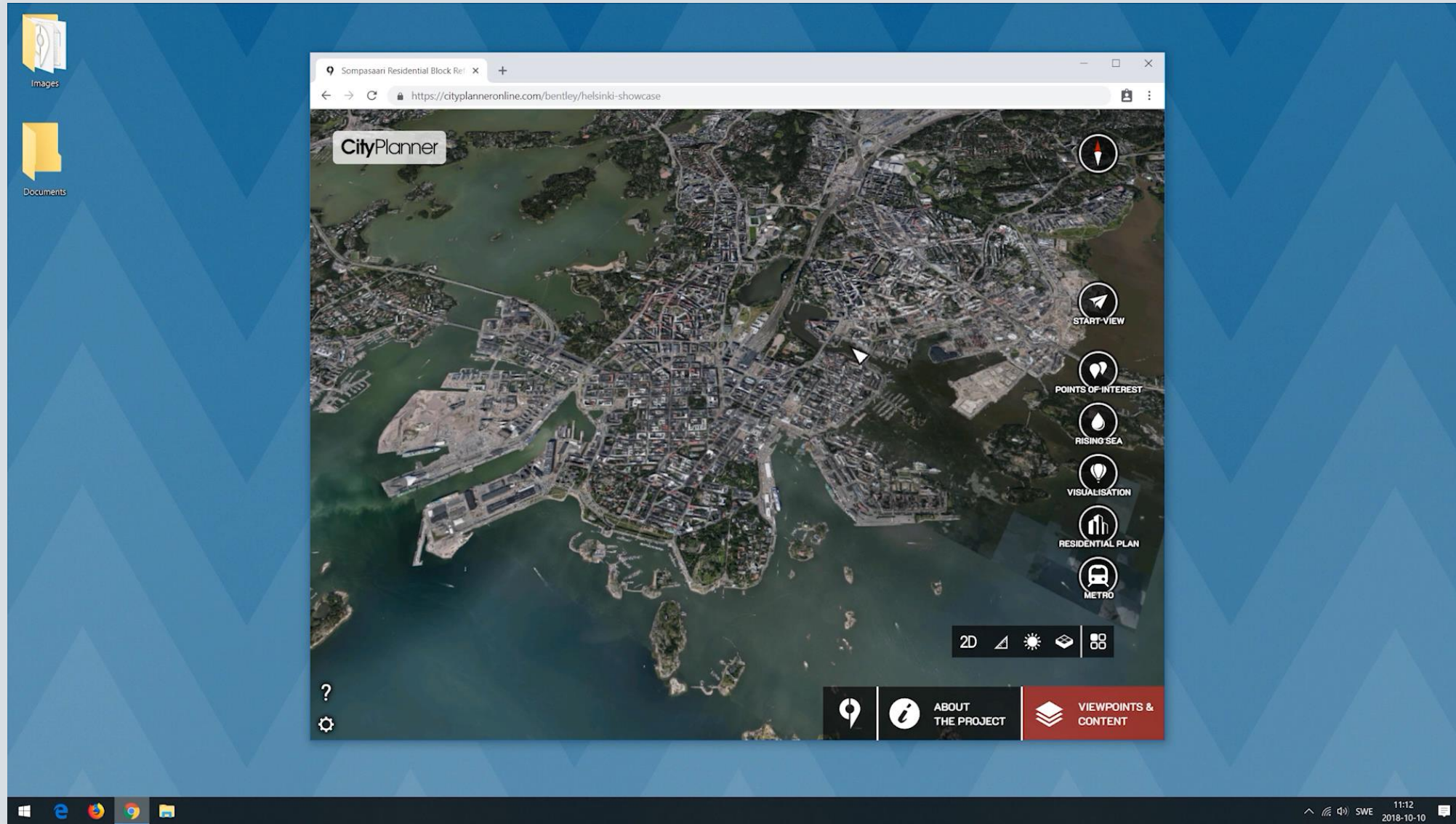


# Transparency and collaboration





# OpenCities Planner





# Bringing Big Data to the user



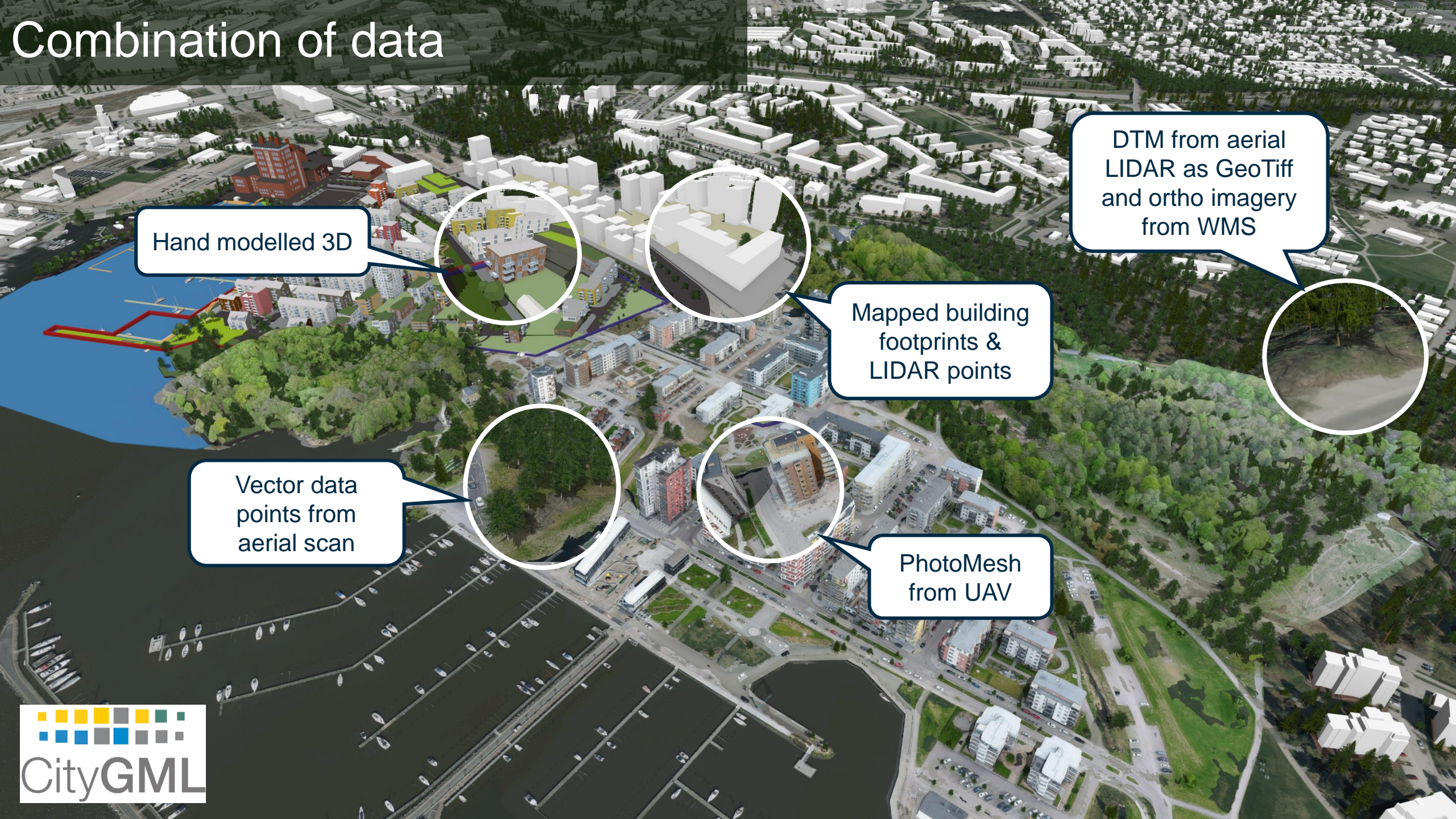


# National and global data





# Combination of data



Hand modelled 3D



Mapped building footprints & LIDAR points

DTM from aerial LIDAR as GeoTiff and ortho imagery from WMS



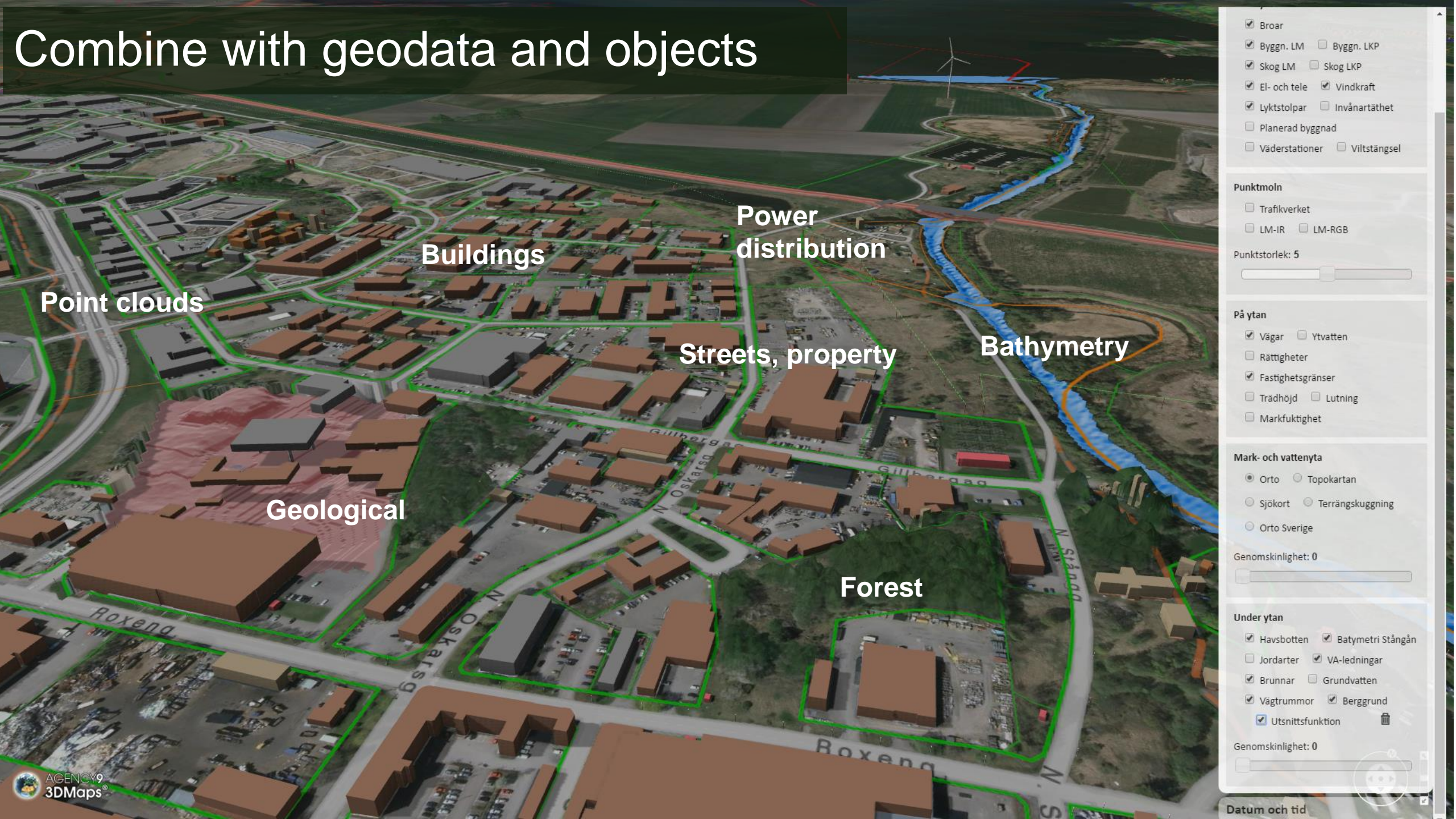
Vector data points from aerial scan



PhotoMesh from UAV



# Combine with geodata and objects



Point clouds

Buildings

Power distribution

Streets, property

Bathymetry

Geological

Forest

- Broar
- Byggn. LM  Byggn. LKP
- Skog LM  Skog LKP
- El- och tele  Vindkraft
- Lyktstolpar  Invånartäthet
- Planerad byggnad
- Väderstationer  Viltstängsel

#### Punktmoln

- Trafikverket
- LM-IR  LM-RGB

Punktstorlek: 5

#### På ytan

- Vägar  Ytvatten
- Rättigheter
- Fastighetsgränser
- Trädhöjd  Lutning
- Markfuktighet

#### Mark- och vattenyta

- Orto  Topokartan
- Sjökort  Terrängskuggning
- Orto Sverige

Genomskinlighet: 0

#### Under ytan

- Havsbotten  Batymetri Stångån
- Jordarter  VA-ledningar
- Brunnar  Grundvatten
- Vägtrummor  Berggrund
- Utsnittsfunktion

Genomskinlighet: 0

Datum och tid





# CityPlanner

- ✓ Sketch, analyse, and export from 3D cities
- ✓ Import CAD, GIS, & other files and web services
- ✓ Share & publish projects and crowdsource ideas

LOGIN 

REGISTER 

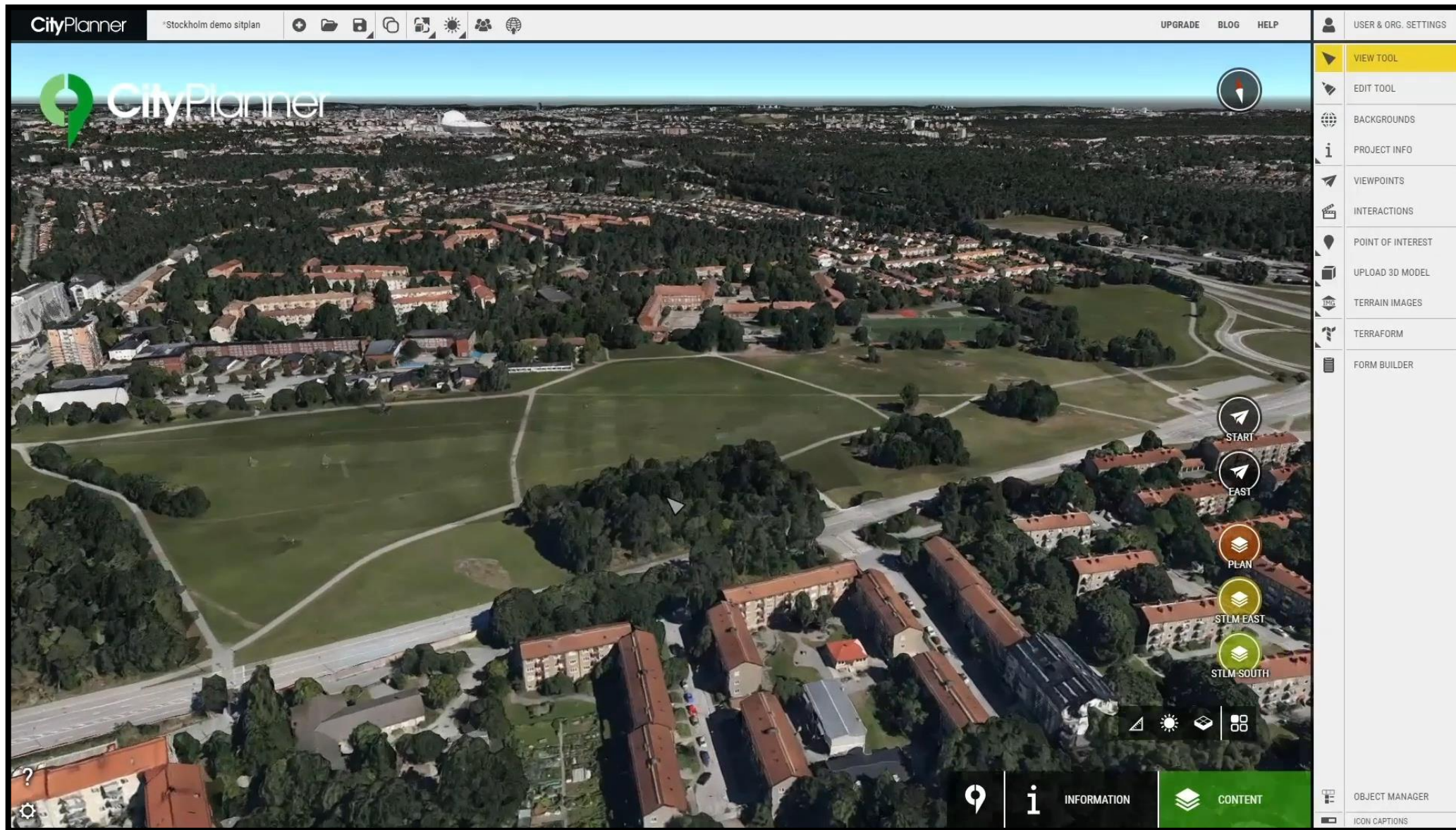
30-DAY TRIAL 

CityPlanner Legacy



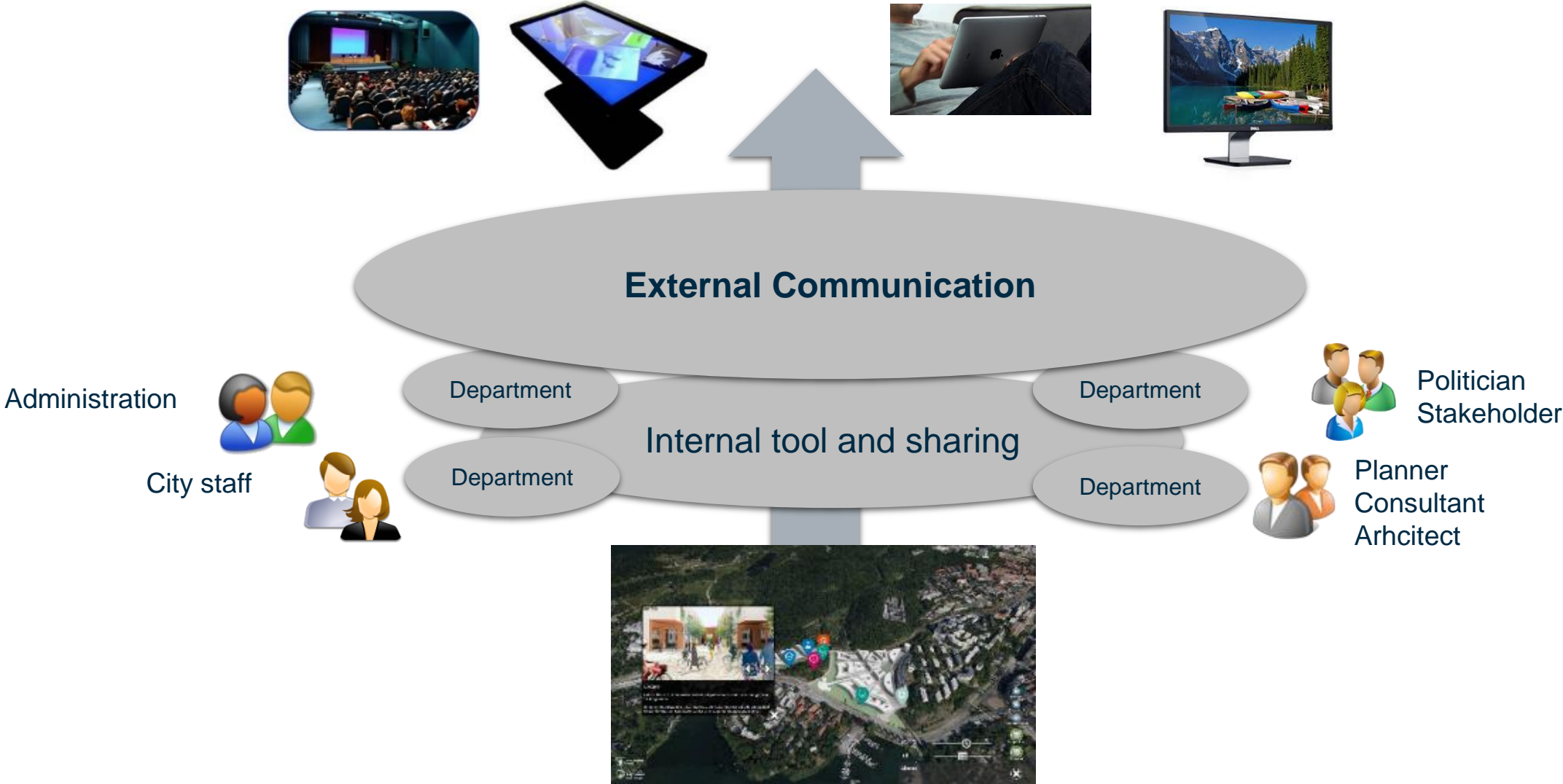


# OpenCities Planner - Create a project and share





# For communication and sharing



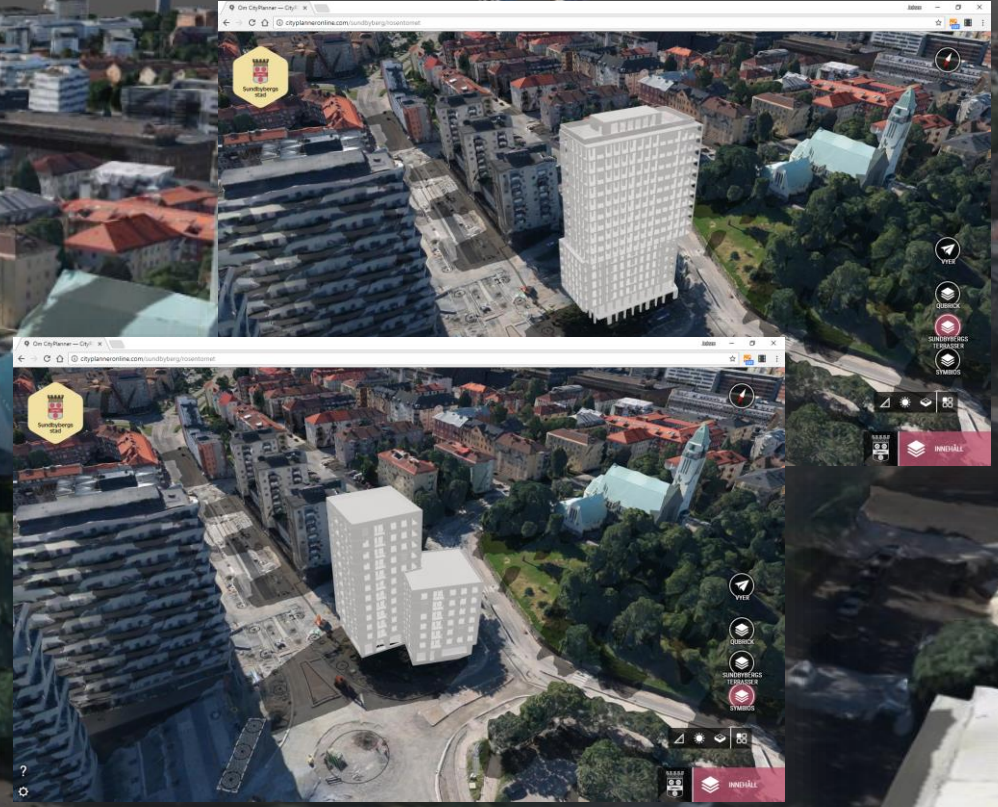
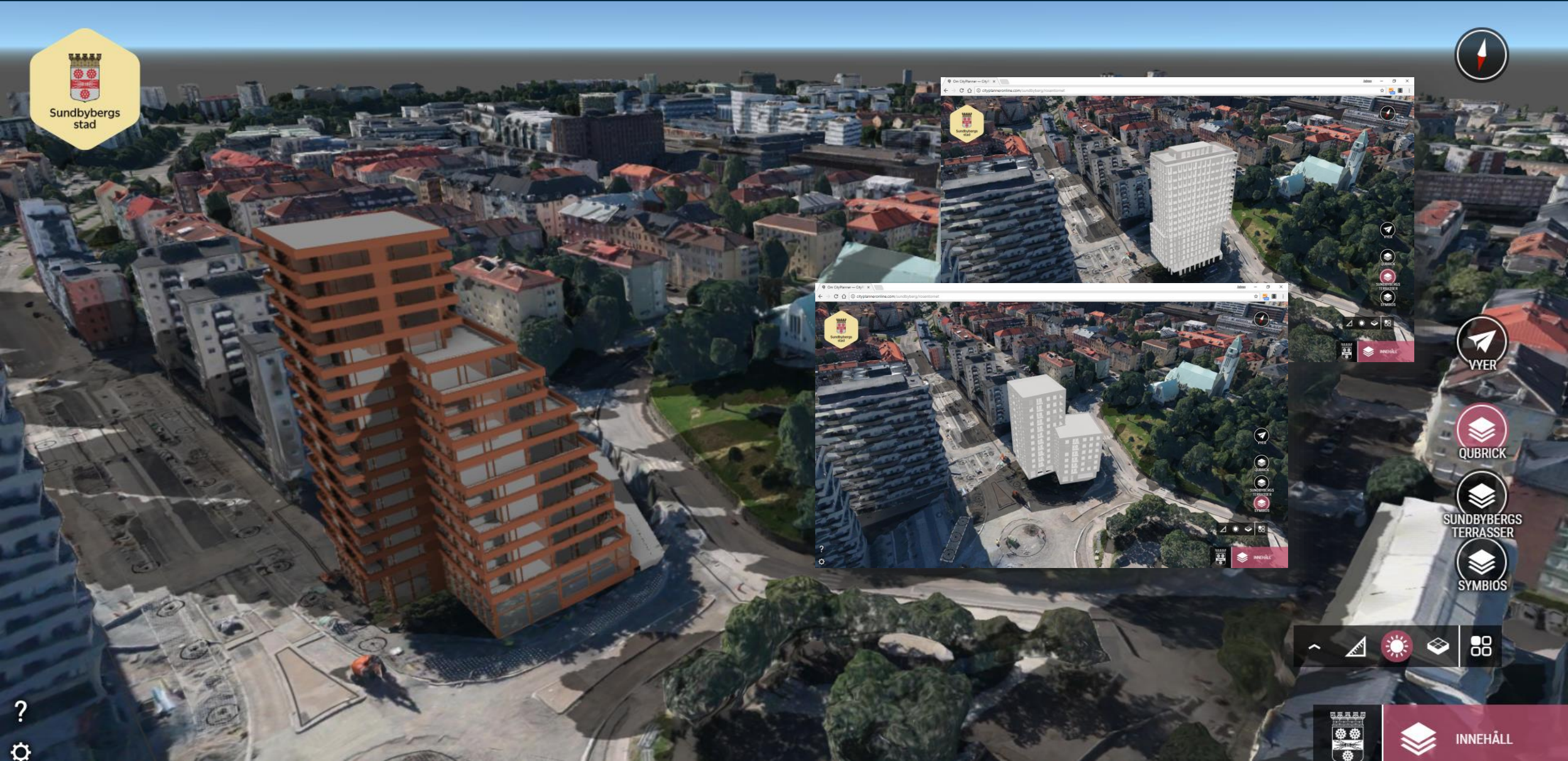




# Examples

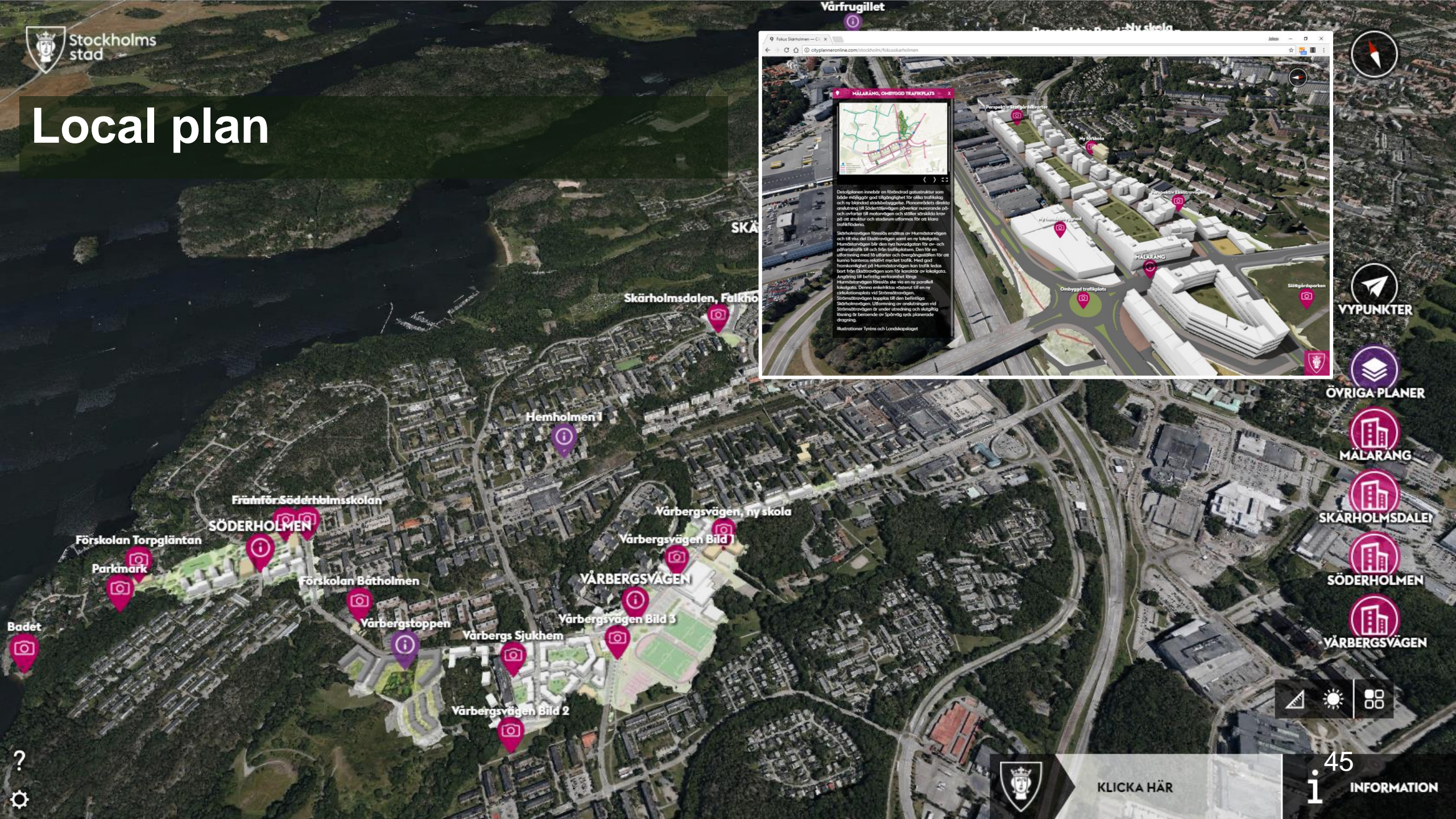


# Architect competition





# Local plan



Fokus Skärholmen - Cityplaneronline.com/stockholm/fokuskarholmen

### MÅLARÅNG, OMBYGGD TRAFIKPLATS



Detaljplanen innebär en förändrad gatustruktur som både möjliggör god tillgänglighet för olika trafikslag och ny bärkraftig stadsbelysning. Planområdet direkt anslutande till Söderholmen överskrider nuvarande på- och avfarter till motorvägen och ställer särskilda krav på ett snitt och stadens utformning för att klara trafikflödena.

Skärholmsvägen föreslås ersättas av Hummelsvägen och till viss del Skärholmsvägen samt en ny lokalgata. Hummelsvägen blir den nya huvudgatan för av- och påfartstrafik till och från trafikplatsen. Den får en utformning med få utfallar och övergångsplaner för att kunna hantera relativt mycket trafik. Med god framkomlighet på Hummelsvägen kan trafik ledas bort från Skärholmsvägen som för knarktrafik och skräck. Anbringning till befintlig verksamhet längs Hummelsvägen föreslås ske via en ny parallell lokalgata. Denna ersätts västerut till en ny trafikplatsplats vid Söderholmsvägen. Söderholmsvägen kopplas till den befintliga Skärholmsvägen. Utformning av anslutningen vid Skärholmsvägen är under utvärdering och slutgiltig lösning är beroende av Spårvägsbyråns planerade dragning.

Illustrationer: Tyréns och Landskapsgöket

Parapetstrått för bilväg  
Ny bärkraftig stadsbelysning  
Ny lokalgata  
MÅLARÅNG  
Ombytt trafikplats  
Skärholmsparken



YPPUNKTER

- ÖVRIGA PLANER
- MÅLARÅNG
  - SKÄRHOLMSDALEN
  - SÖDERHOLMEN
  - VÄRBERGSVÄGEN



KLICKA HÄR

45  
INFORMATION



# Local plan



VÄSTERÅS STAD  
Stadsbyggnadsförvaltningen

Fly to ÖSTER MÄLARSTRAND

kv. Förseglet

DP 3

DP 4



INFORMATION



INNEHÅLL



# Local plan



Culture Casbah

Stadsloopen

Örtagårdstorget

Yalla Trappan

Rosengårdsstråket

Rosens Röda Matta

Rosengård Centrum

OM NYRÉNS NYA FÖRSLAG

Hallarna

Ny busshållplats

Stadskvarteren

Rosengård Sporthall

Rosengårdsbiblioteket

Familjens Plats

Malmö Hälsocentrum

Takparken

Gröna loopen

ARKITEKTFÖRSLAG

NYRÉNS

RADAR

STUDENTER

JJW

INTRESSEPUNKTER

ARKITEKTFÖRSLAG

KOM MED SYNPUNKTER  
OM DETTA PROJEKT

SE ANDRAS  
FÖRSLAG

INFORMATION

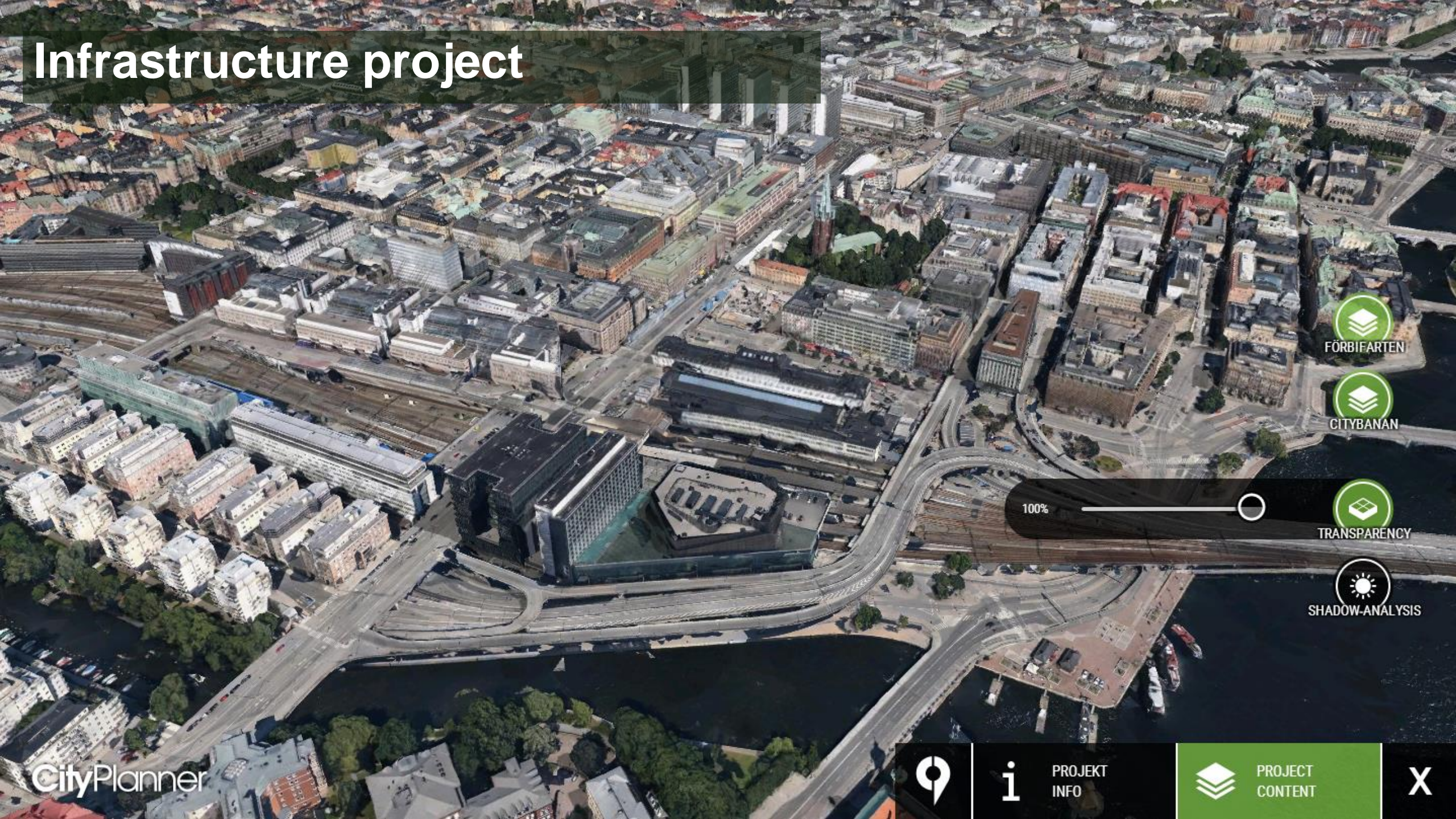
INNEHÅLL







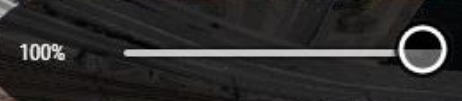
# Infrastructure project



FÖRBIFARTEN



CITYBANAN



TRANSPARENCY



SHADOW-ANALYSIS



PROJEKT  
INFO



PROJECT  
CONTENT





# Infrastructure project



FÖRBIFARTEN



CITYBANAN



TRANSPARENCY



SHADOW-ANALYSIS



# Infrastructure project



VIEWPOINTS



LAYERS



TRANSPARENS



SKÜGGANALYS



PROJEKT  
INFO



PROJEKT  
INNEHÅLL

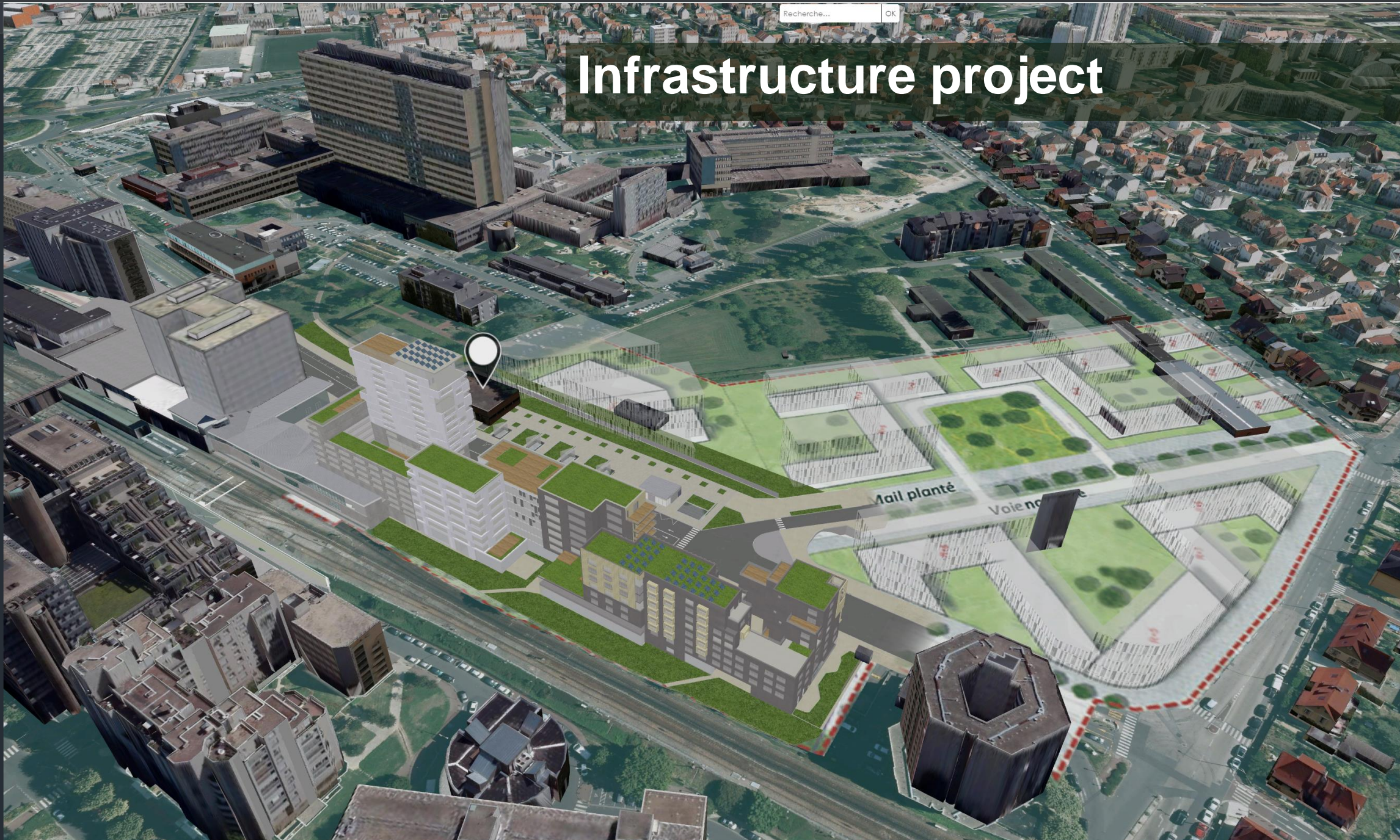


# Infrastructure project

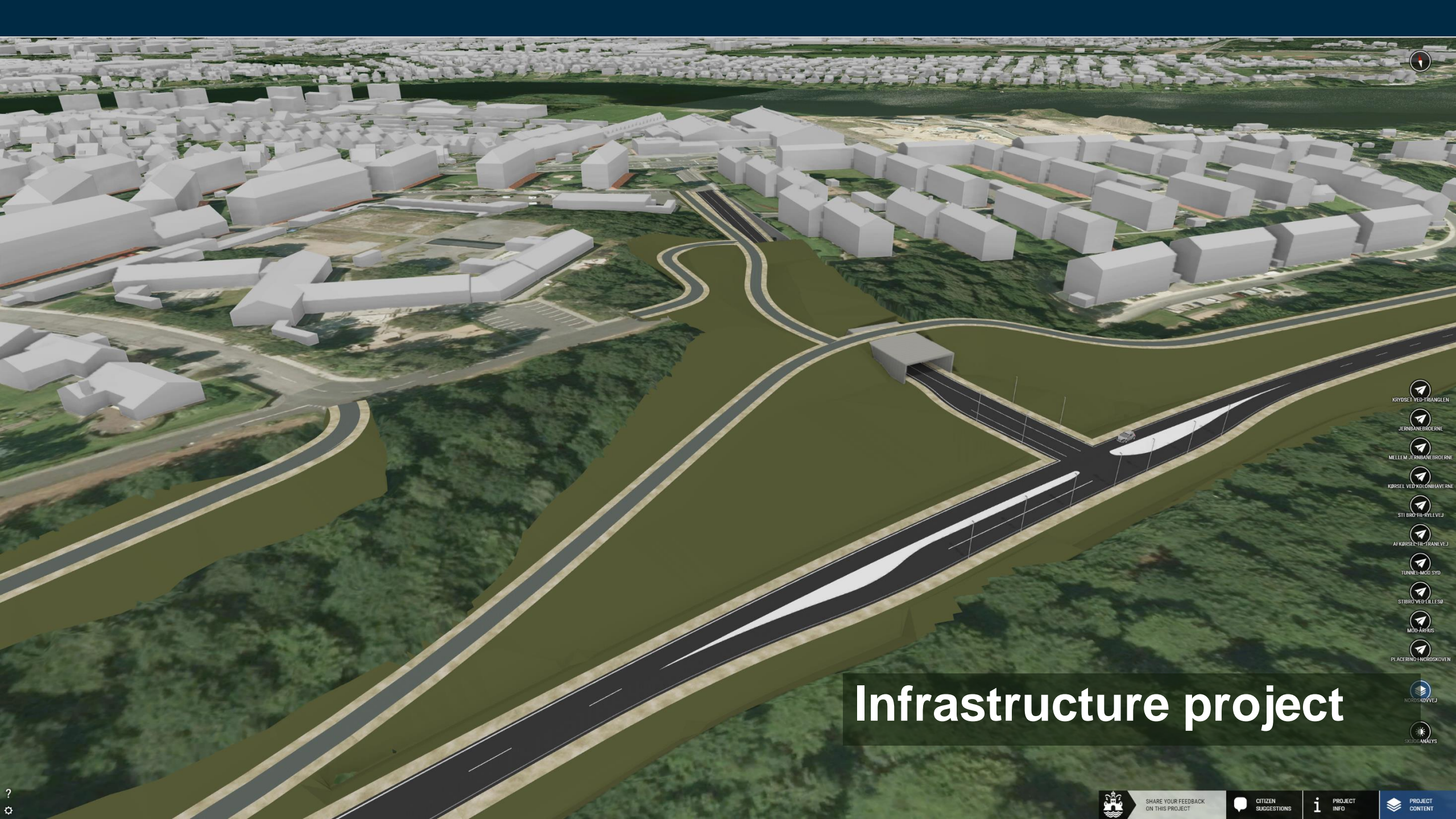
EXPLOREZ  
les lignes du Grand Paris Express  
et les quartiers de gare en 3D

- LIGNE 14 NORD
- LIGNE 14 SUD
- LIGNE 15 SUD  
Bagneux M4  
Bry - Villiers - Champigny  
Champigny Centre  
Châtillon - Montrouge  
Créteil l'Échat  
Fort d'Issy / Vanves / Clamart
- LIGNE 15 EST
- LIGNE 15 OUEST
- LIGNE 16
- LIGNE 17
- LIGNE 18
- LIGNE 11

CALENDRIER DE MISE EN SERVICE  
2019 2022 2023 2025 2027 2030  
2024 Voir tout







- KRYDSET VED TRIANGLEN
- JERNBANEDROERNE
- MELLEM JERNBANEDROERNE
- KØRSEL VED KOLONIHAVEERNE
- STI BRØ HI-RYLEVJ
- AFKØRSEL HI-TRANEVEJ
- TUNNEL-MOD SYD
- STIBRØ VED LILLESØ
- MOD ÅRHUS
- PLACERING I NØRDSKOVEN
- NØRDSKOVVEJ
- SKUGGANALYS

# Infrastructure project



SHARE YOUR FEEDBACK ON THIS PROJECT

CITIZEN SUGGESTIONS

PROJECT INFO

PROJECT CONTENT



# City marketing



Göteborgs  
Stad



KOM MED SYNPUNKTER  
OM DETTA PROJEKT



SE ANDRAS  
FÖRSLAG



PROJEKT  
INFO

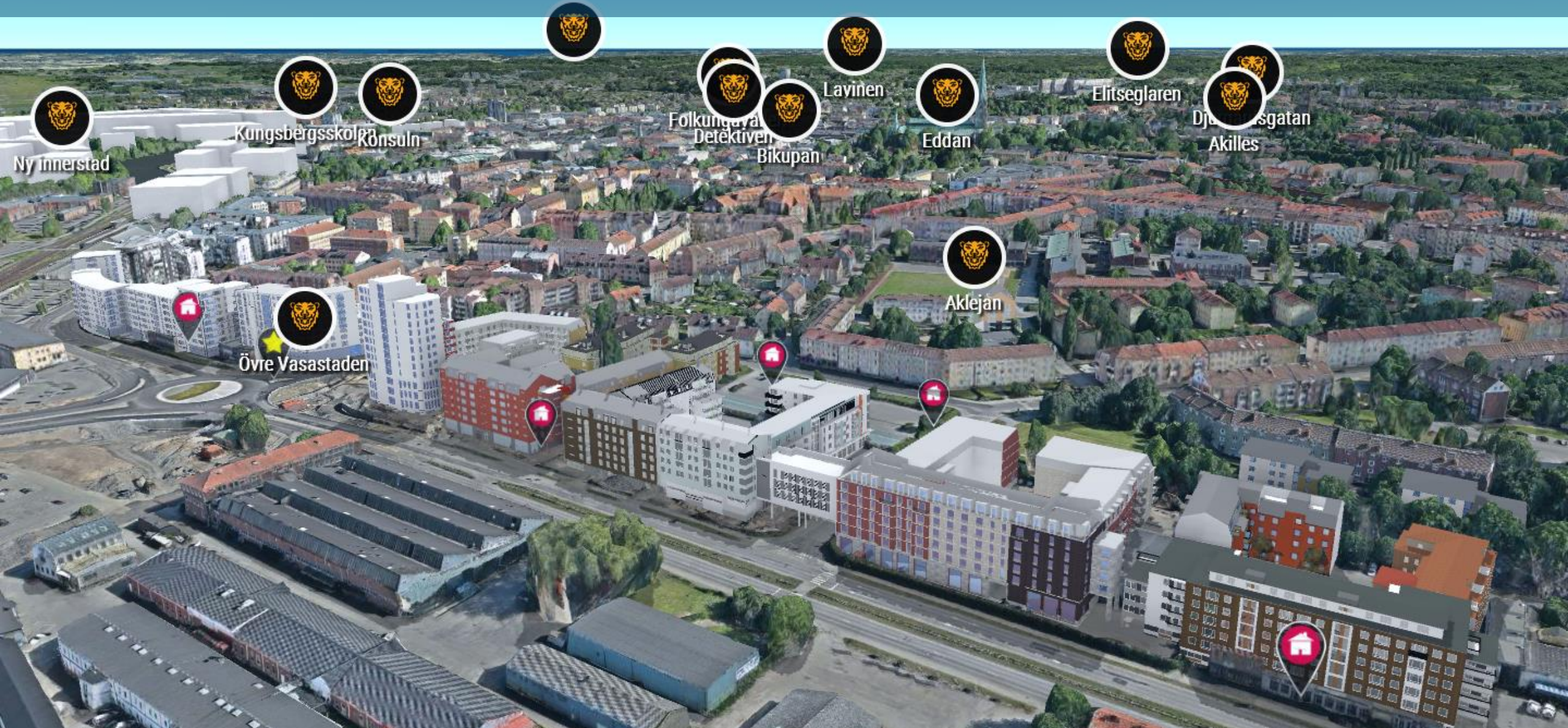


PROJEKT  
INNEHÅLL



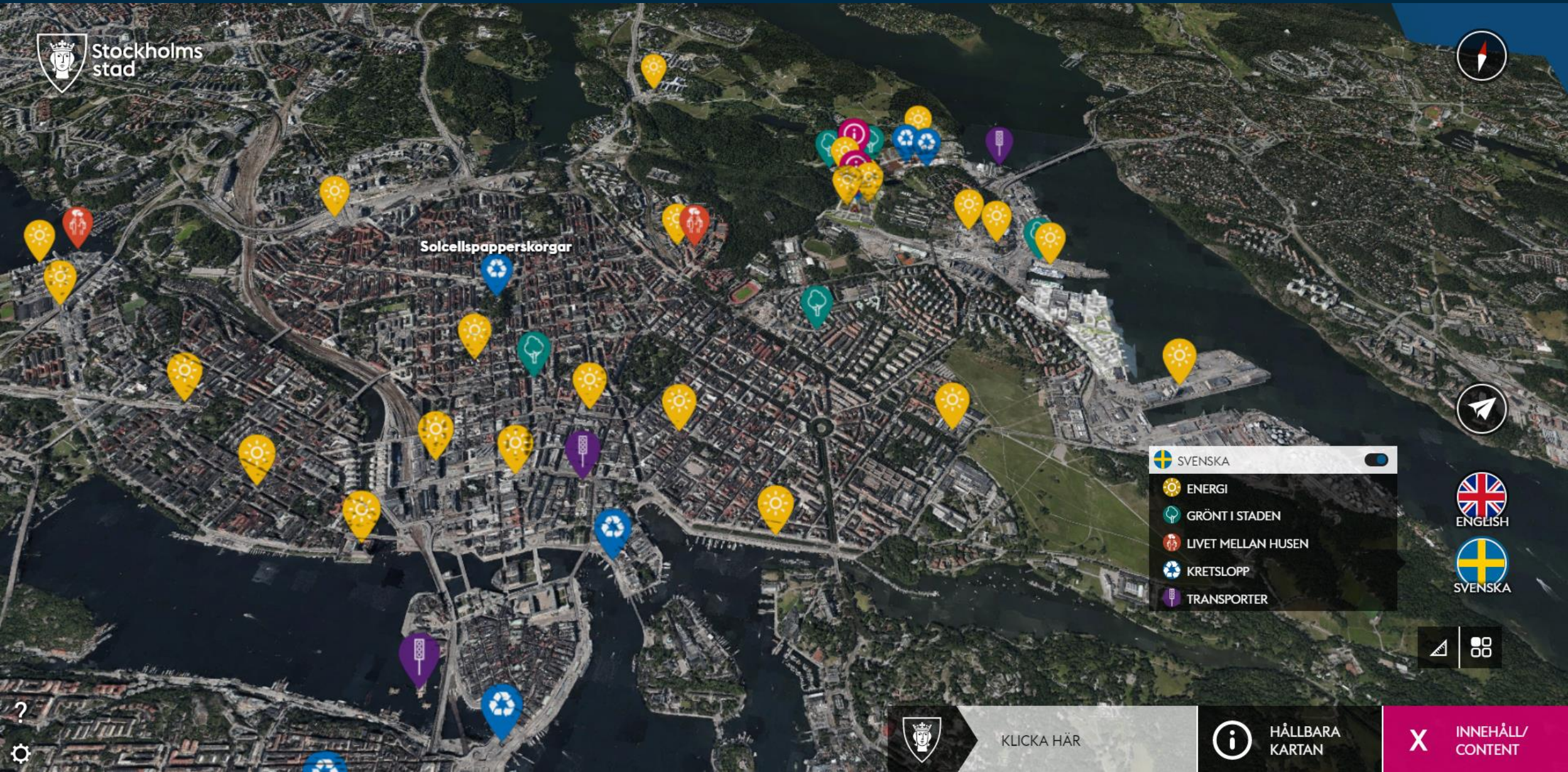


# City marketing





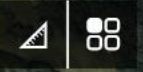
# Engage and inform



Solcellspapperskørgar

SVENSKA

- ENERGI
- GRÖNT I STADEN
- LIVET MELLAN HUSEN
- KRETSLOPP
- TRANSPORTER



KLICKA HÄR



HÅLLBARA KARTAN



INNEHÅLL/  
CONTENT



# Public engagement



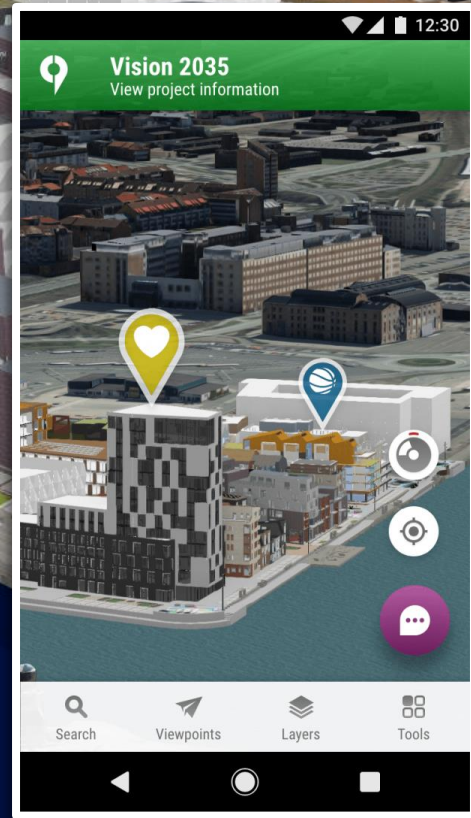
### SUGGESTION LIST

Marta Juhlén ? 🔦	Carmen Juhlén ? 🔦
Anne-Marie Egerö ? 🔦	Anne-Marie Egerö ? 🔦
Anders Egerö 🔥 <sup>17</sup> ?	Anders Egerö ? 🔦
Anders Egerö 🔥 <sup>8</sup> ?	Anders Egerö ? 🔦

89 SUGGESTIONS

SE ANDRAS FÖRSLAG | PROJEKT INFORMATION | PROJEKT INNEHÅLL





Mobile support & 360 panoramas





# Project data coordination



INFORMATION



INNEHÅLL





62 sqm - 14 000 kr/month  
Available from 2018-02-01

84 sqm - 21 000 kr/month  
Available from 2018-03-01









An aerial night view of a city skyline with numerous skyscrapers and illuminated streets. Overlaid on the city are glowing yellow and white digital network lines, including arcs and straight paths, representing a digital infrastructure or data network. The text 'Cities 'Going Digital'' is centered over the image in a white, bold, sans-serif font.

# Cities 'Going Digital'