



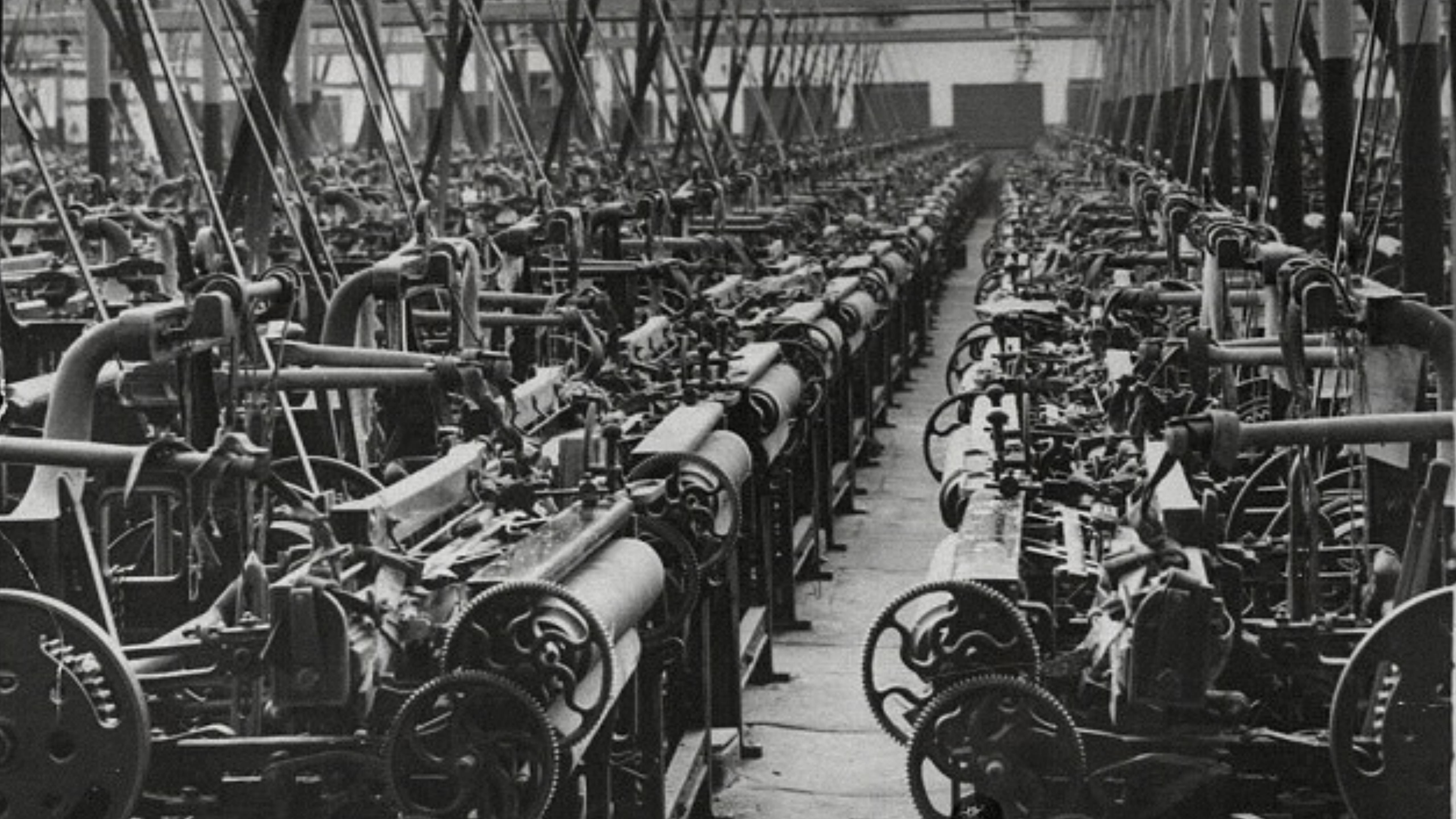
Rapid Prototyping of Urban Sensors

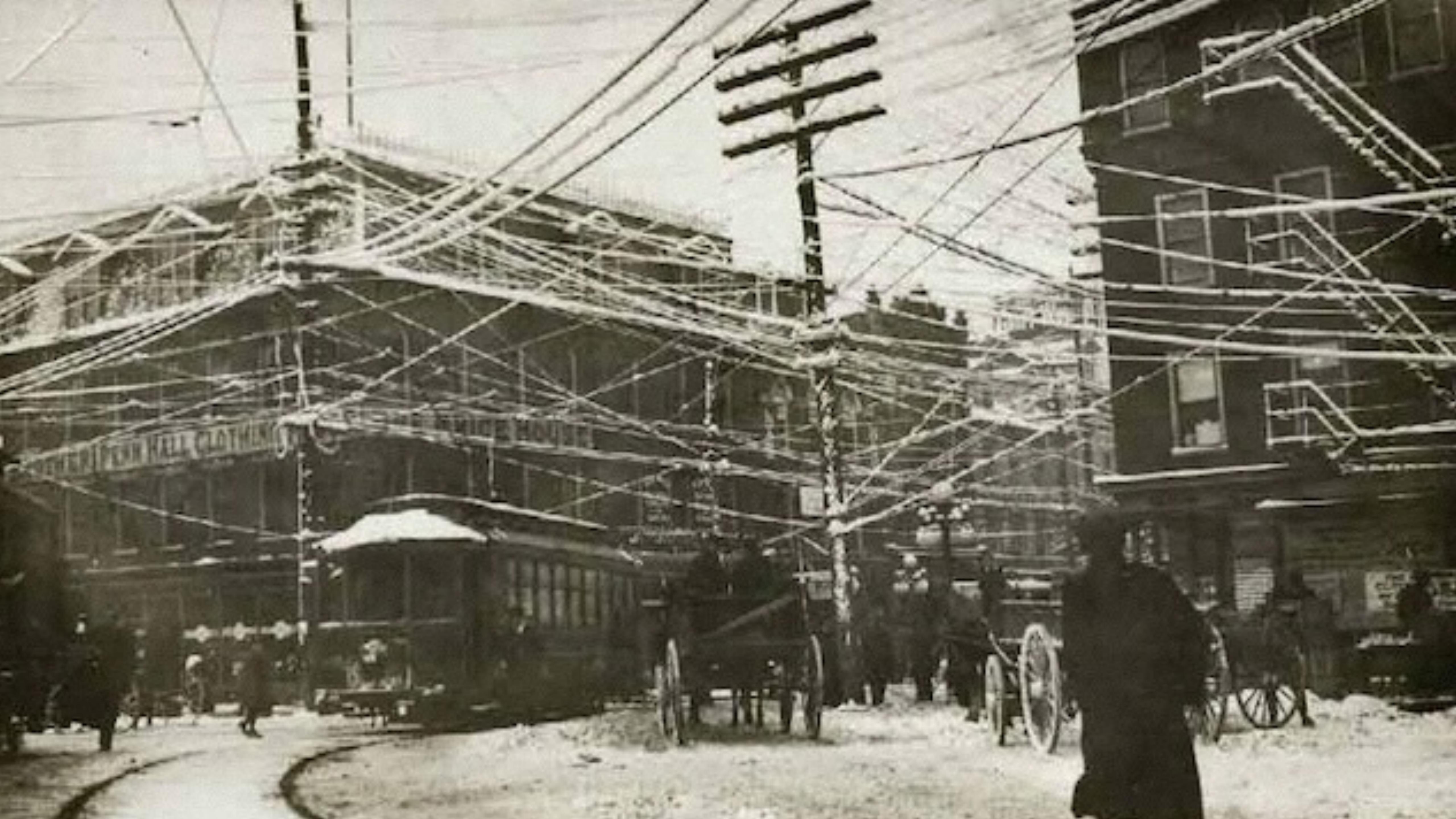
Bottom-up techniques for deploying urban sensors

Outline

- History of Technology in cities
- Designing utopias with technology in mind? or around technology?
- What is a smart city?
- What are sensors?
- What is the sensor society?
- What are we doing in this class? Our goals?

Technology, Society and the City

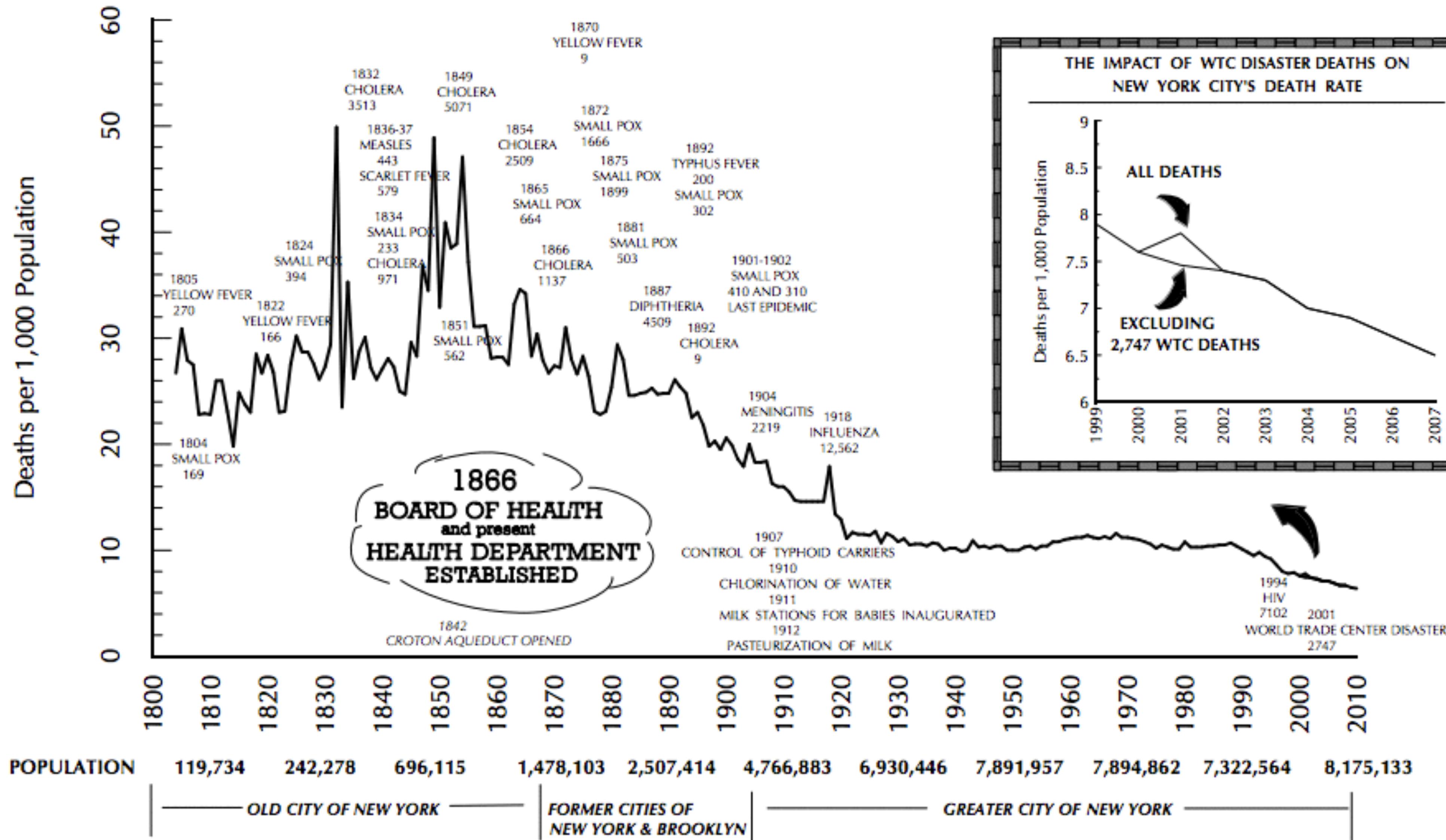






The Conquest of Pestilence in New York City

...As Shown by the Death Rate as Recorded in the Official Records of the Department of Health and Mental Hygiene.

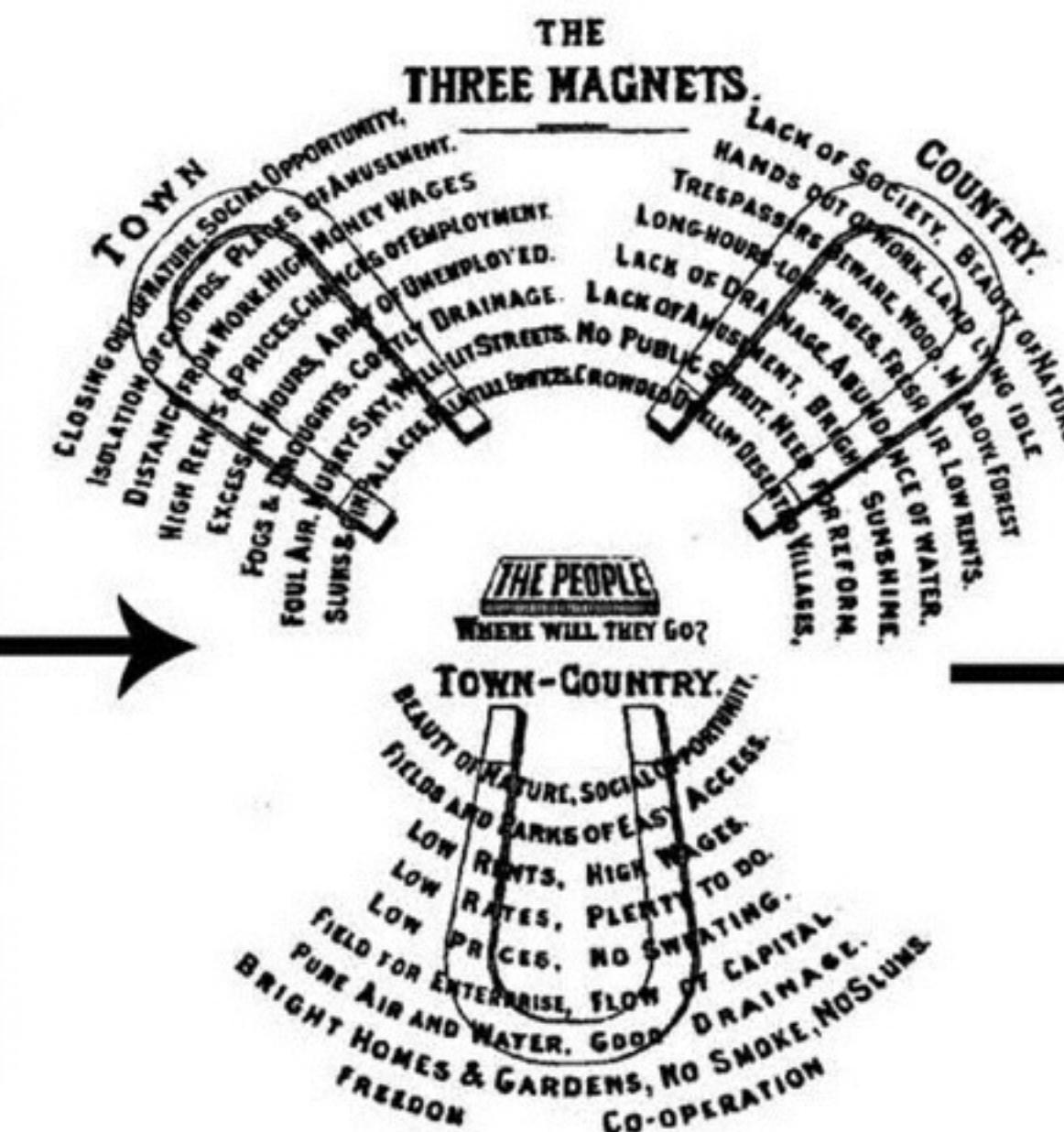


The Garden City Movement

• and Influence of Ebenezer Howard •

Although there are many highlights of the Industrial Revolution, we are often left with an image of cities plagued by pollution, smog, and overcrowding. London during the 1890's was no different, and it was because of these social conditions that Ebenezer Howard wrote his book, *Garden Cities of To-Morrow*. Howard describes a utopian-esque alternative community that offers the best of city and country life. He names his community "Garden City" with specific design characteristics including: strict growth regulations, preservation of periphery green space, shared open space, organization by building use, and the implementation of super-blocks.

London - Late 19th Century



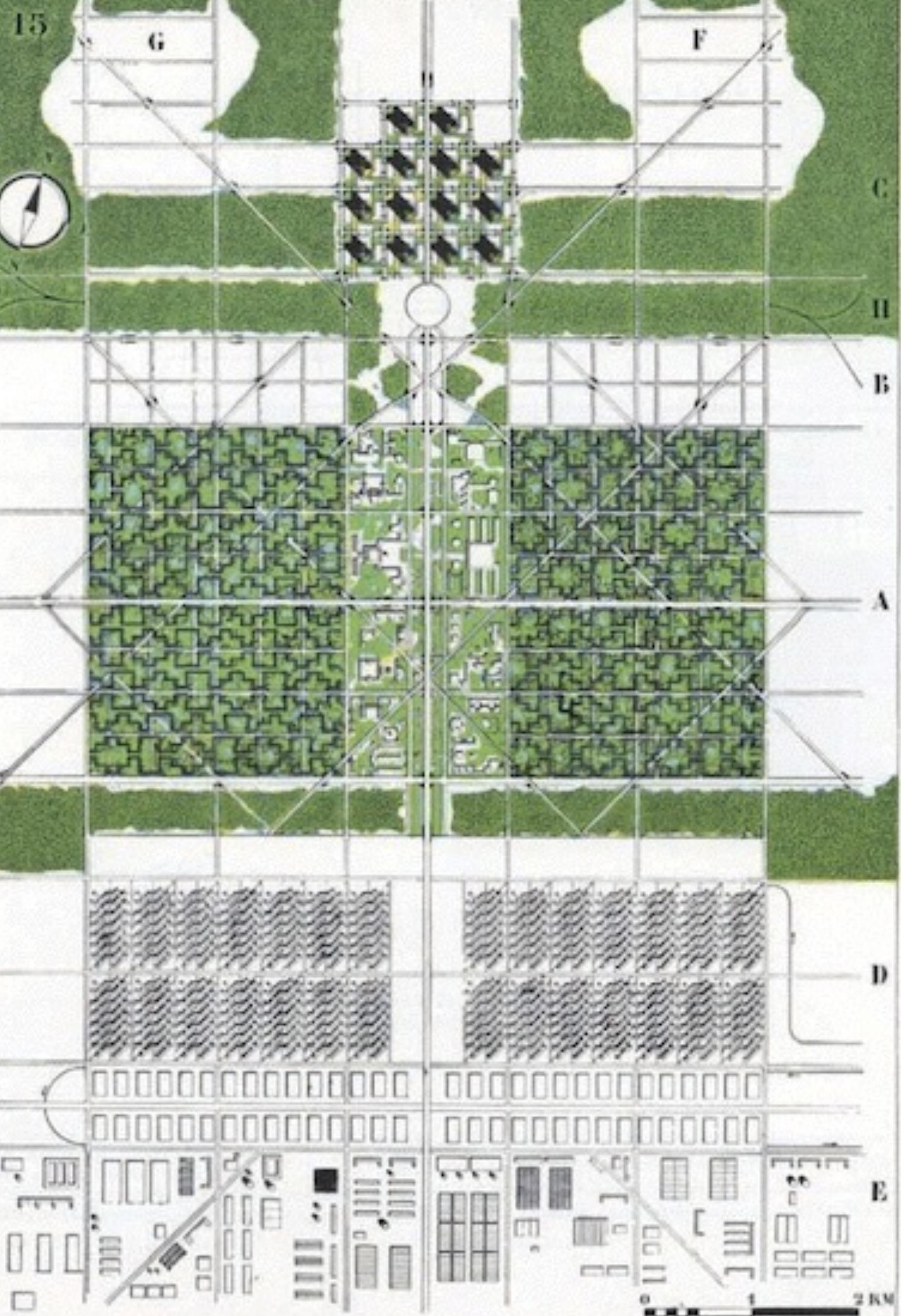
- Garden City Characteristics
- Roughly 5-8 units/acre (often a limit of 10)
 - "Inward looking" cul-de-sacs and cottages
 - Shared and public garden/park space
 - Organization by building use: agriculture, residential, commercial, etc.
 - Super-blocks, grand avenues, and boulevards
 - Peripheral ring of "country" or green space surrounding this city



VR

LA VILLE RADIEUSE

(ZONING)



Satellite cities. e.g.: government buildings or center for social studies, etc.

The business center

Railroad station and air terminal

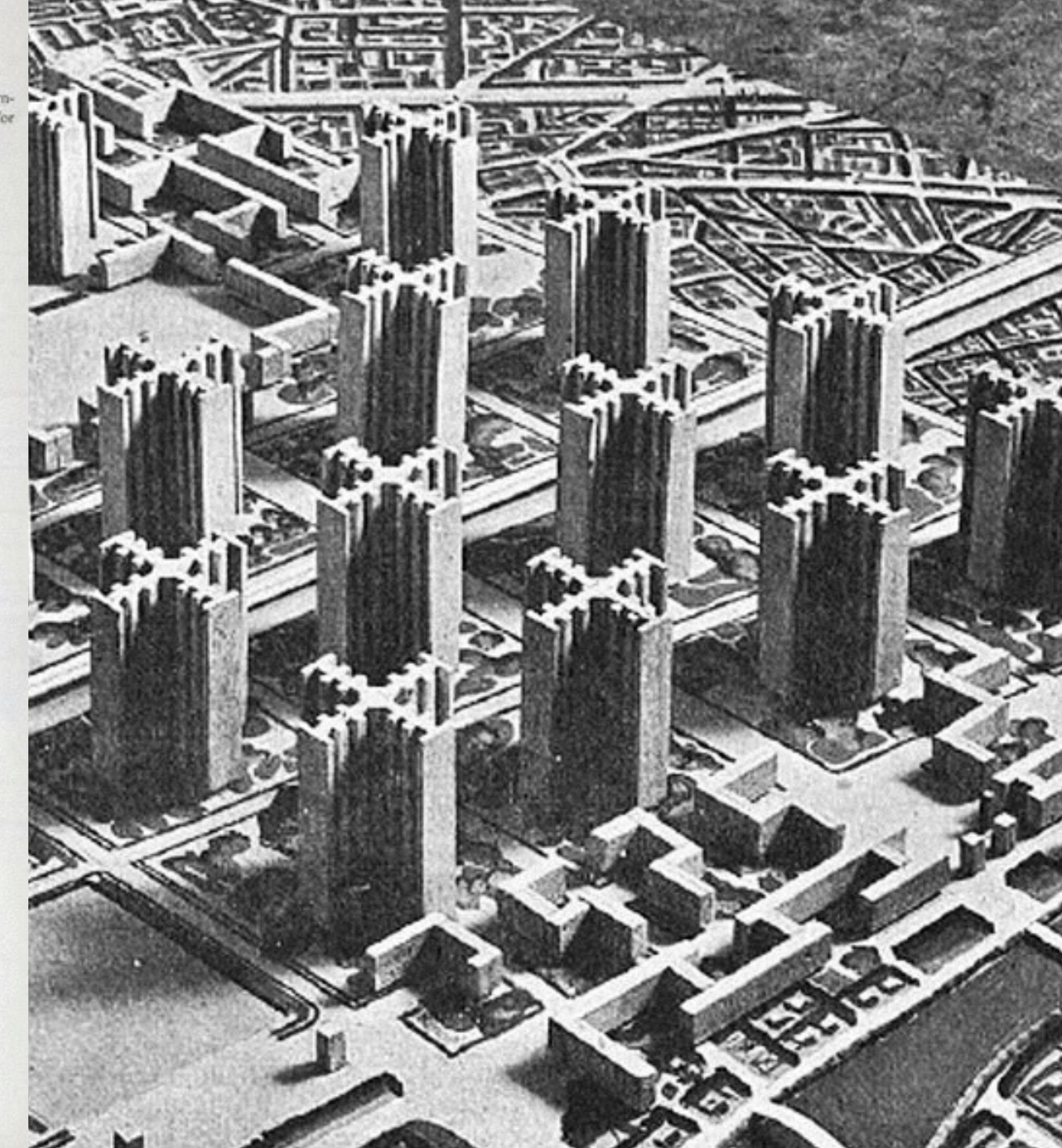
Hotels
Embassies

Housing

Factories

Warehouses

Heavy industry





MOTOR VEHICLE TRAFFIC FATALITIES & FATALITY RATE: 1899 - 2003

(BASED ON HISTORICAL NHTSA and FHWA DATA)

MANHATTAN BRIDGE

CROSS MANHATTAN ARTERIALS AND RELATED IMPROVEMENTS

LOWER MANHATTAN EXPRESSWAY
MID MANHATTAN EXPRESSWAY

DOWNTOWN REDEVELOPMENT
THE CENTRAL CITY
POST OFFICE
THE NEW EAST SIDE

Looking east along route
of Lower Manhattan
Expressway from Hudson
River to East River

HOLLAND TUNNEL

WEST SIDE ELEVATED HIGHWAY



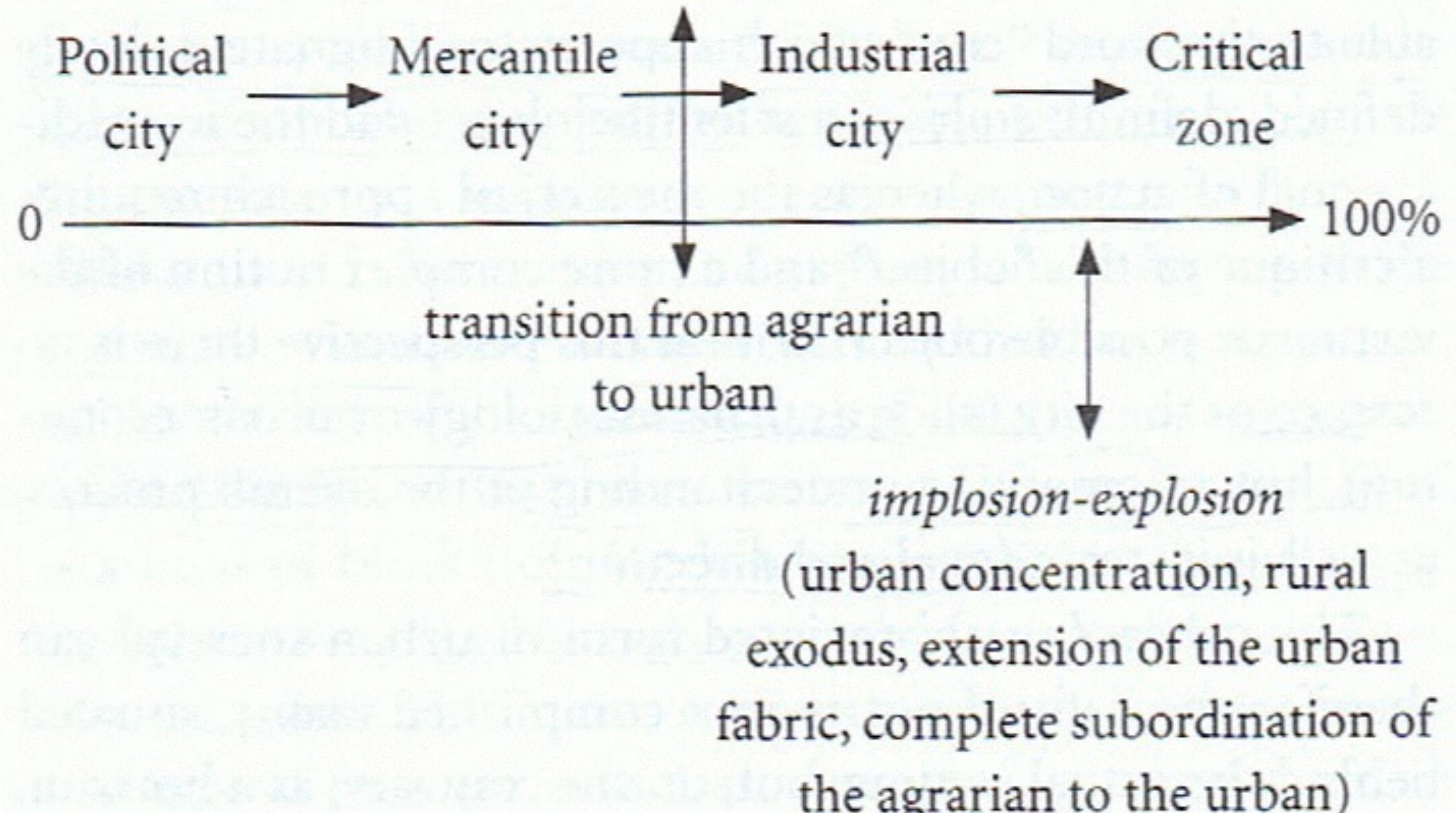
Urban Dynamics

- an attempt to create a generic model of how cities work (Forrester)
- was deployed in New York to evaluate the fire department:
 - based only on response times
 - assumed availability and clear traffic
 - led to the closings of fire houses
 - fires displaced half a million people that year

Technological Determinism

- belief that technology is the agent and driving force behind social change
- technology molds society and changes our behavior and interactions
- society is shaped by its dominant technologies
- Karl Marx is considered a technological determinist
- Not universally agreed upon: some argue technologies are extensions of human capabilities





Henri Lefebvre: The Urban Revolution & The Right to the City

EVERYBODY IS URBAN





EVERYBODY IS WIRELESS



EVERYTHING IS CONNECTED

Smart Cities

Smart City

- “uses **digital** technologies to enhance performance and well being, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens.”
- use of ICT for automation and intelligent functions allowing cities to function and perform more accurately and reliably than what could have been done by humans(?)

use of digital technology to...

- use the physical infrastructure efficiently
- effectively engage citizens in decision-making and governance
- adapt to changing circumstances



CENTRO DE OPERAÇÕES
PREFEITURA DO RIO







Smart Cities

- Solution looking for a problem?
- Big tech companies selling ‘Jetson life-style’
- what about the data?
- what about people?



Sensors

Sensors

- sensors measure physical, chemical, biological phenomena and output electrical signals that can then be read and processed by computers.
- scientific instruments have always existed, but sensors compress this process into a very short process and makes it accessible to everyone

Enabling

- Sensors connect the real world via internet
- enable 24/7 monitoring, control, locating etc..

Sensors

- what makes sensors valuable is that they can do all of this quickly and efficiently
- they are becoming cheaper as well as distributed - i.e....a thermometer has always been used for one-off things..

Sensor

- Sensors can be **active** and **passive**:
 - active sensors provides a feedback loop between the sensors and the user and changes behavior
 - passivity is important for some sensors because if we know they are sensing something, we will change our behavior
- the more sensors that are deployed the more data which is collected. The more data, the more utility. The more utility the more deployment of sensors

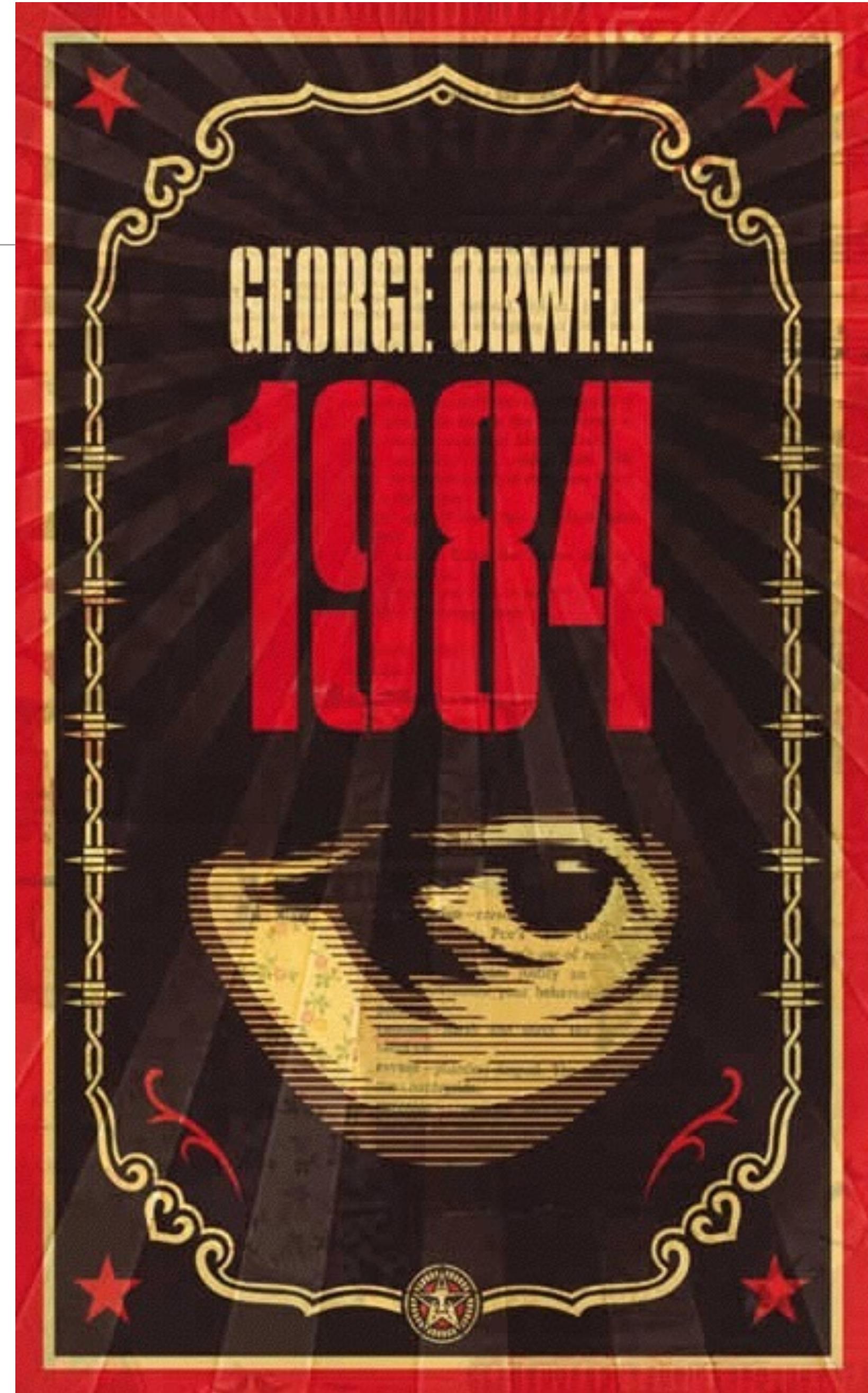
Sensor Society or Surveillance Society

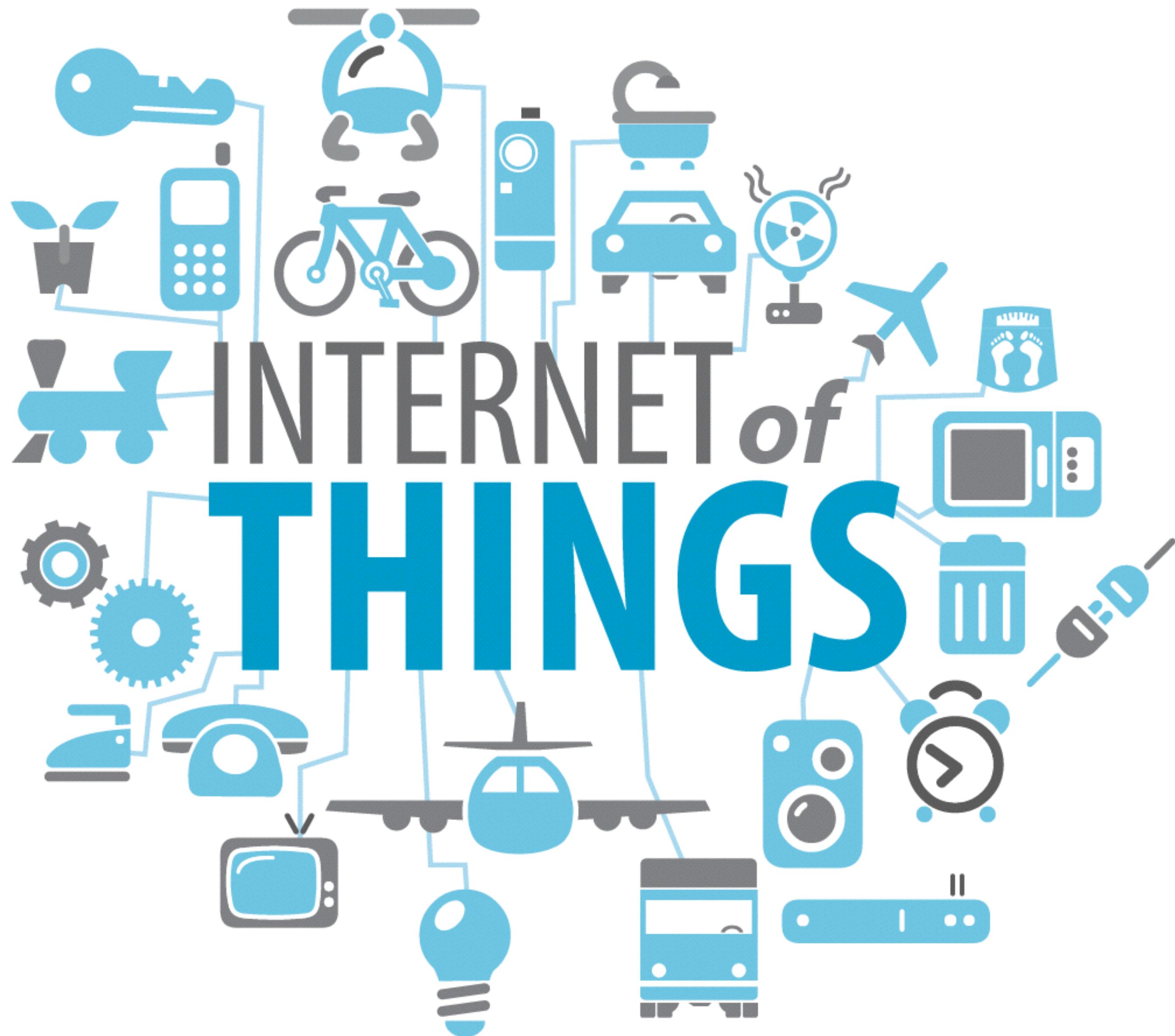
Sensor Society

- About the our relationship to our devices, the data they produce, the understanding of that data and the infrastructure which enables all of this
- about non-purposeful collection - collecting data about environments or a room, not the people in a room.
- What are the impacts and repercussions

Surveillance Society

- Infrastructure gives sense to sensors but who owns and controls the sensors and infrastructures?
- routine and systematic targeting of individuals or groups for a specific purpose.





Internet of Things

- “The “Internet of Things” is the general idea of things, especially everyday objects, that are readable, recognizable, locatable, addressable, and controllable via the Internet - whether via RFID, wireless LAN, wide-area network, or other means.”
- This is more broad than just phones and computers being connected...it applies to everyday objects

Class Approach/Goals

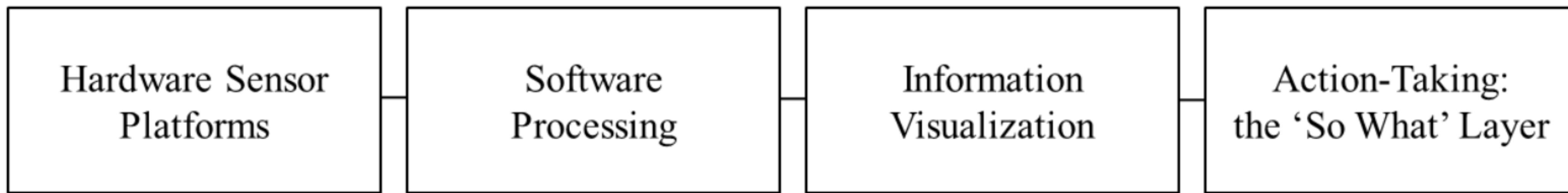
What are the benefits of rapid prototyping

- low cost:
 - allows for larger deployment for more data points
 - more experimenting and collaboration
- scalability, reproducibility, community development of standards
- openness - using non-proprietary tools
- quick trial and error
- special training?

What are the challenges of Rapid Prototyping

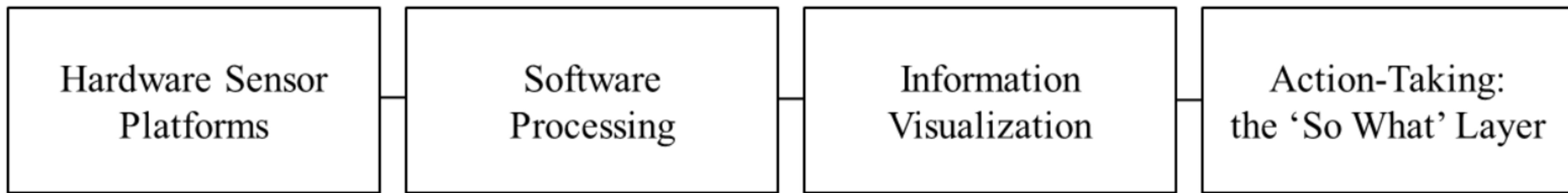
- data quality
- deployment opportunities
- quick failures
- over collection vs under collection
- special training?

Data Acquisition -> Information Creation -> Meaning-making -> Action-taking



Source: Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0 Swan M. Journal of Sensor and Actuator Networks. 2012

Data Acquisition -> Information Creation -> Meaning-making -> Action-taking



Problem
Identification and
goal creation

Sensor Creation/
Deployment

Data
Collection

Data
Analysis

Source: Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0 Swan M. Journal of Sensor and Actuator Networks. 2012

What can be learned?

- Two approaches:
 - I have a question about X
 - What can I learn from measuring X?

What are we sensing?

- Infrastructure:
 - utility consumption, infrastructure quality(usage) etc..
- Environment:
 - air quality, water quality, soil quality etc...
- People:
 - behavior, health, sentiment, etc...

How are we sensing?

- In situ vs mobile monitoring
- single sensor vs a network of sensors?
- sensors are not just individual points. They can be platforms that help understand the city scape over time and space.

Who is benefiting?

- openness for mayors and governments?
- citizens with more social interactions?
- industry with more efficiency?

What are we trying to accomplish?

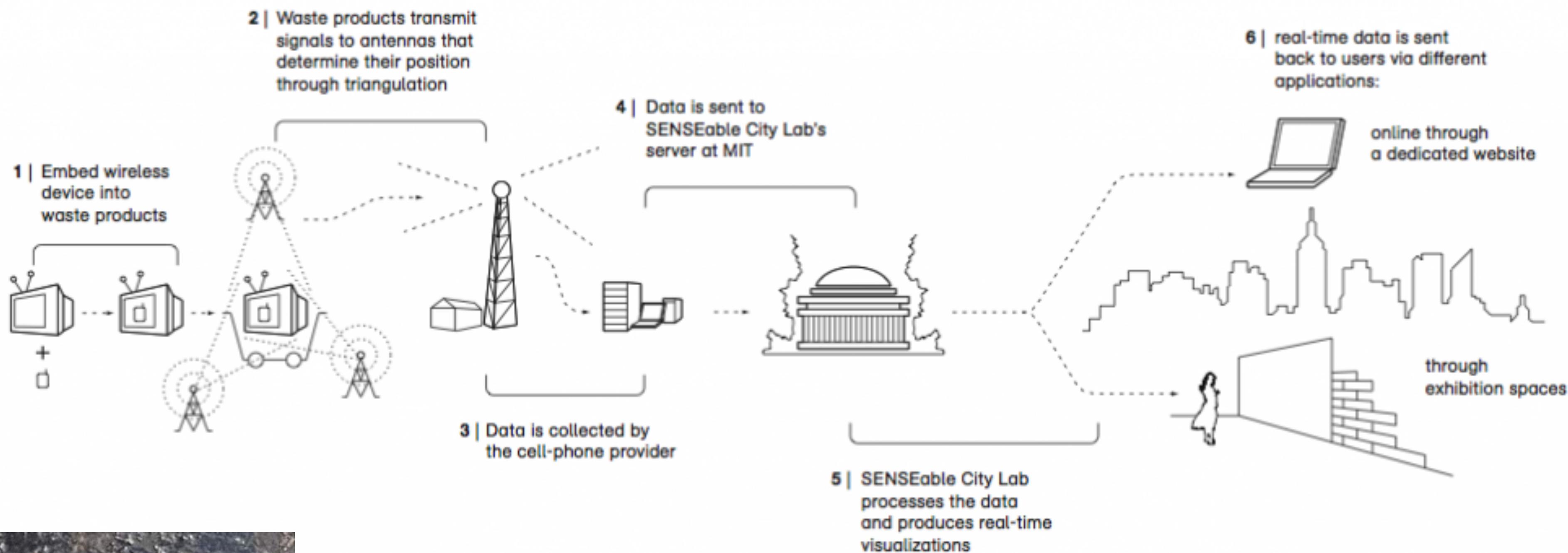
- Convince the EPA?
- Efficiency
- Convince people for X

What do you want the outcomes to be?

- Who access the data
- information flow?
- Is this for yourself, community, for some agency? Federal?
- Is there a model for that?

Urban Sensing Examples

MIT TRASH TRACK

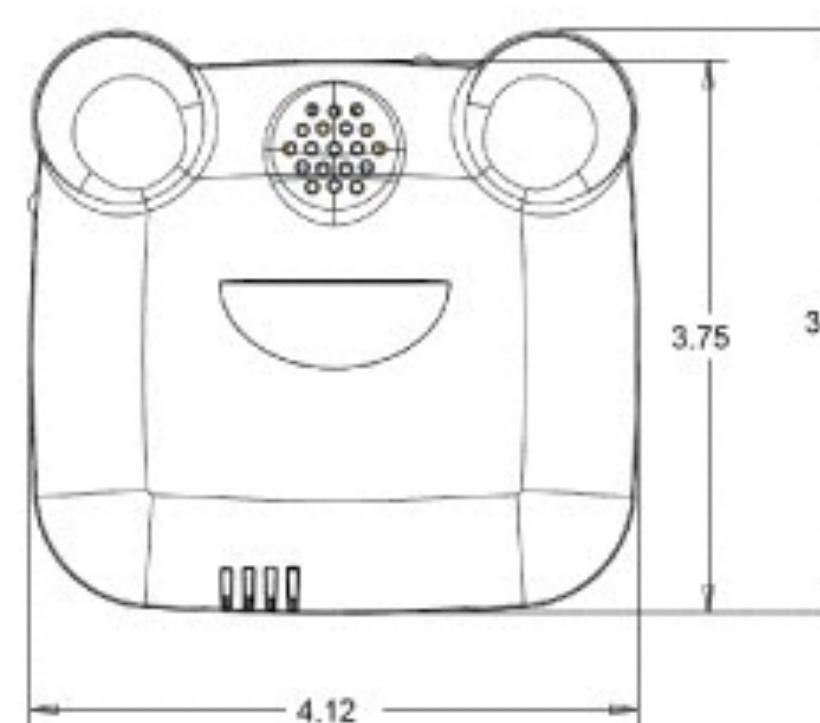
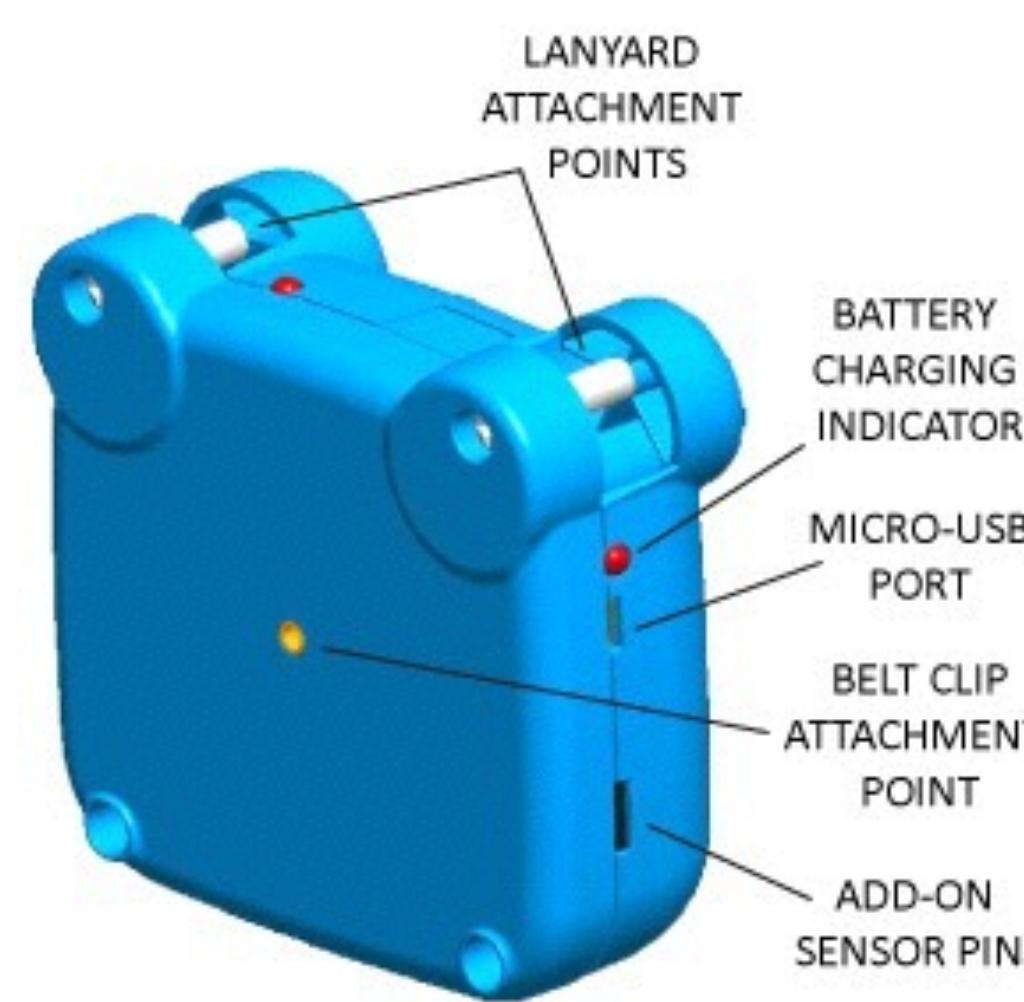
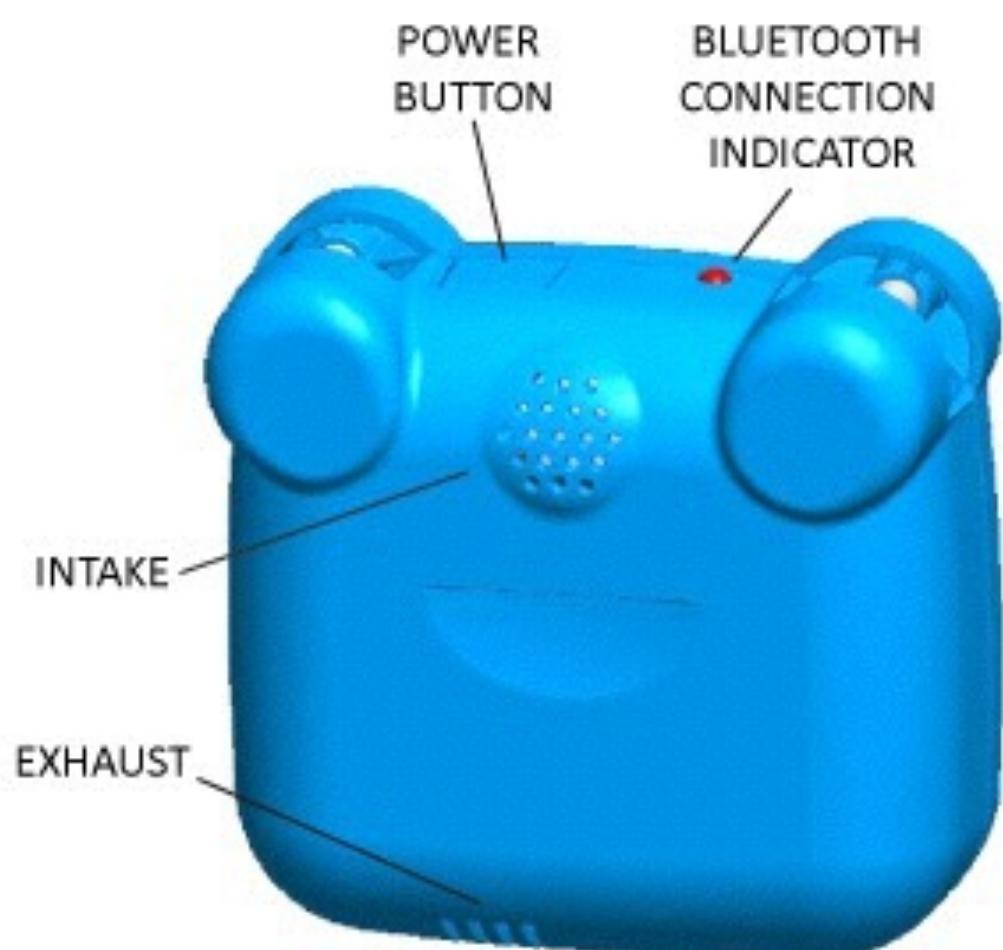


Bridge Cam

- [https://engineering.purdue.edu/CAI/SBRITE/Spotlights/
web-based-bridge-monitoring-of-truck-impacts](https://engineering.purdue.edu/CAI/SBRITE/Spotlights/web-based-bridge-monitoring-of-truck-impacts)



AIRBEAM



HABITAT MAP

The screenshot shows the homepage of the HabitatMap website. At the top, there is a navigation bar with links for Home, About, Maps, Forums, Profiles, Blog, and Donate. To the right of the navigation bar, there are links for Log In, Create a Profile, and Contact Us. Below the navigation bar, there is a large green starburst graphic with the text "GET YOUR AIRBEAM ON KICKSTARTER!" and a "KICKSTARTER" logo. To the left of the starburst, there is a map of a "FARMER'S MARKET" with several people standing around tables. Below the map, there are several call-to-action boxes: "Be Aware of Your Environment" (with a "Look, Listen and Watch" icon), "Flag Things That Impact Quality of Life" (with a "Start a Profile, Add a Map Marker and Create Your Own Map" icon), "Share" (with a "Share a Marker or Map with Friends, Fellow Activists, Colleagues, or Classmates" icon), "Bring HabitatMap Home" (with an "Add a Map to your Website or Blog" icon), and "Donate" (with a "Become a Friend and Support Our Quest for Sustainable Cities" icon). To the right of the main content area, there is a sidebar titled "Recent Activity" which lists recent user profiles and activities. At the bottom of the page, there are three featured map sections: "Drip, Drop, the Water Don't Stop" (a map of the New York City water system), "Creek Speak: Voices from Newtown Creek" (an oral history project map), and "Where Does My Toilet Flush To?" (a map showing sewer overflow outfalls in New York Harbor).

Home | About | Maps | Forums | Profiles | Blog | Donate

Log In • Create a Profile • Contact Us

FARMER'S MARKET

GET YOUR AIRBEAM ON KICKSTARTER!

KICKSTARTER

Recent Activity

- pmerriam started a profile
- steadyprocleaning1 started a profile
- AirBeam test map
- terry.gordon@nyumc.org started a profile
- tedsmithphd started a profile
- niestalk started a profile
- Las Condes
- Assaf96 started a profile
- HumbertoGainey started a profile
- Fort Greene Farmer's Market
- Michael King
- NYC Commercial Waste Transfer Stations

Be Aware of Your Environment

Look, Listen and Watch

Flag Things That Impact Quality of Life

Start a Profile, Add a Map Marker and Create Your Own Map

Share

Share a Marker or Map with Friends, Fellow Activists, Colleagues, or Classmates

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Drip, Drop, the Water Don't Stop

This is the Green School's map of the New York City water system. The students used HabitatMap's "Go With the Flow" toolkit to master maps based research methods and apply them to uncover the workings of New York City's water storage, filtration, delivery, and disposal infrastructures. They learned that the water system in place today has been shaped as much by social forces - people's habits, needs, and demands - as it has been by people's labor and the physics of water itself.

Creek Speak: Voices from Newtown Creek

Creek Speak is an oral history project that uses HabitatMaps to present the stories of people and places near Newtown Creek. To listen to peoples stories or read about some of the places they mention simply click on a marker. The Creek Speak Project is not intended to prove causality between the environmental burdens in Newtown Creek neighborhoods and public health concerns. Rather, its purpose is to highlight and document the experiential knowledge of individuals who are inside narrators of day-to-day life in these communities.

Where Does My Toilet Flush To?

Every day, nine million New Yorkers discharge 1.5 billion gallons of liquid waste into their sewer system. Underground and out of sight their urine, feces, and food scraps combine with litter and pollution from the street. This nasty brew then navigates 6,000 miles of pipe towards two possible futures: decontamination at one of 14 treatment plants or discharge into New York Harbor via one of 494 sewer overflow outfalls. A sewage overflow can be triggered by as little as a tenth of an inch of rain, which essentially means that almost every time it rains, your toilet flushes directly into New York Harbor.



Open source technology for citizens' political participation in smarter cities

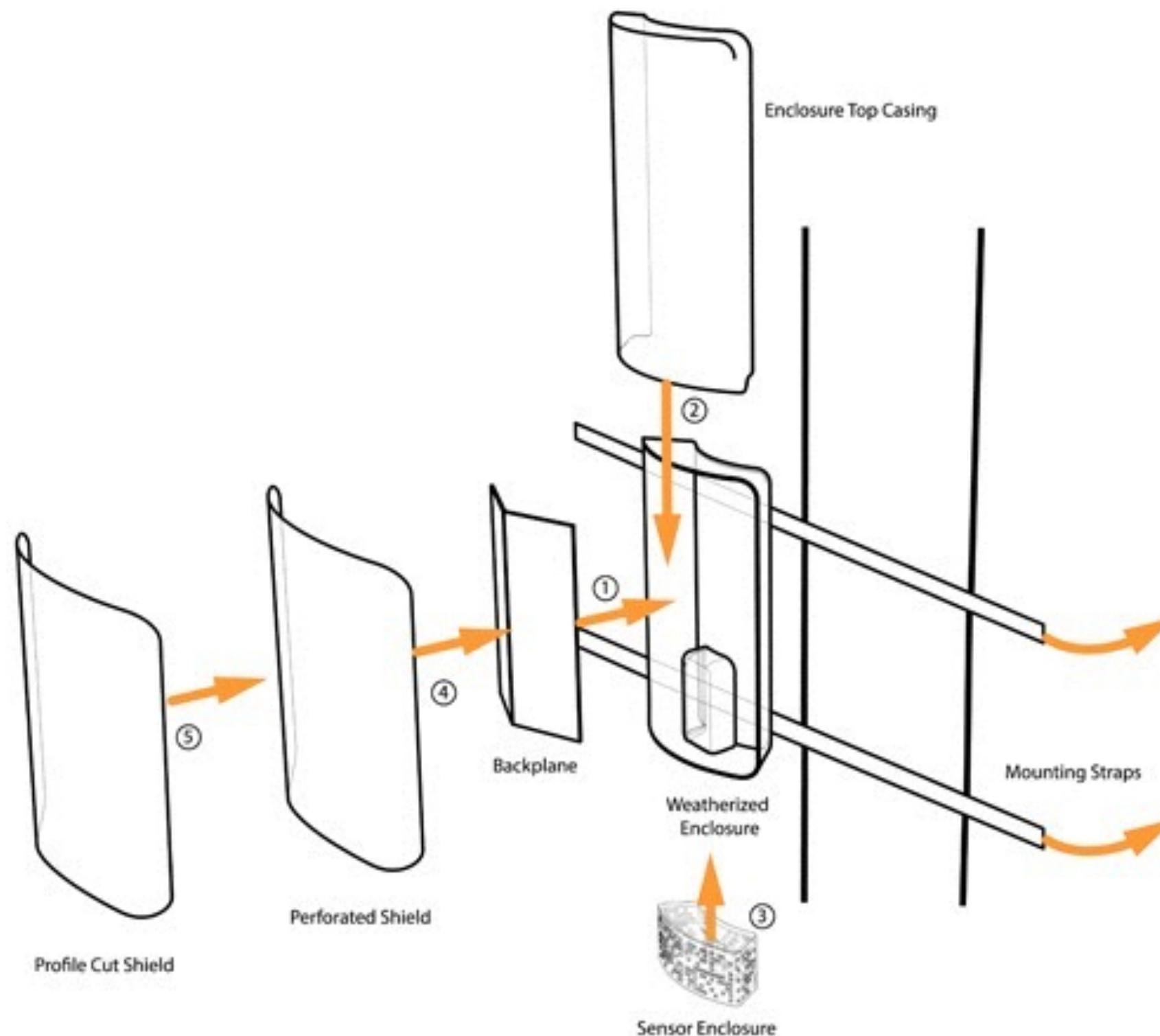
Based on geolocation, Internet of Things, Open Source hardware and software for data collection and sharing

SIGN IN

REGISTER

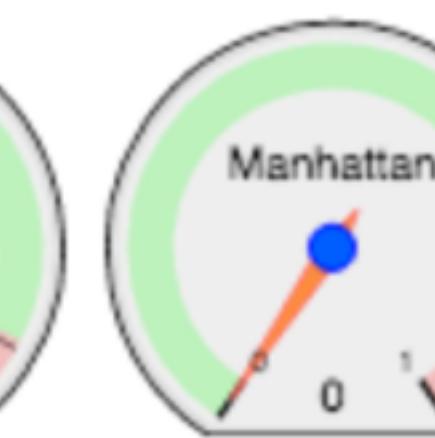
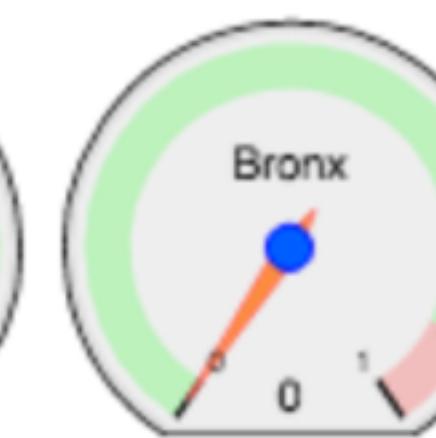
SMART CITIZEN

Array of Things: Chicago



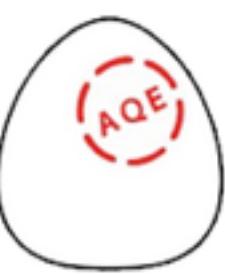
<https://arrayofthings.github.io/node.html>

dontflush.me



SAFE TO FLUSH SAFE TO FLUSH SAFE TO FLUSH SAFE TO FLUSH SAFE TO FLUSH

Leif Percifield

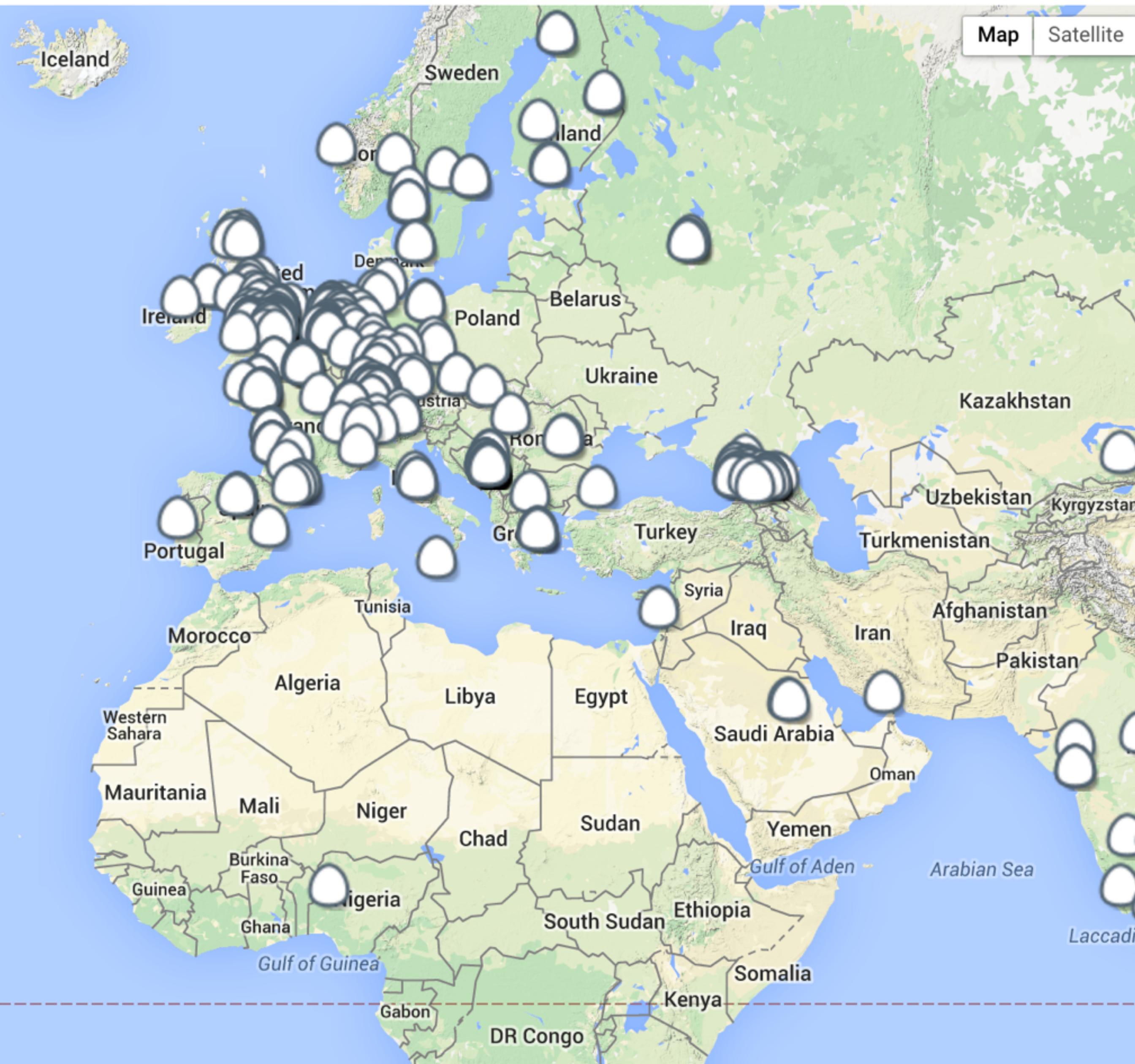
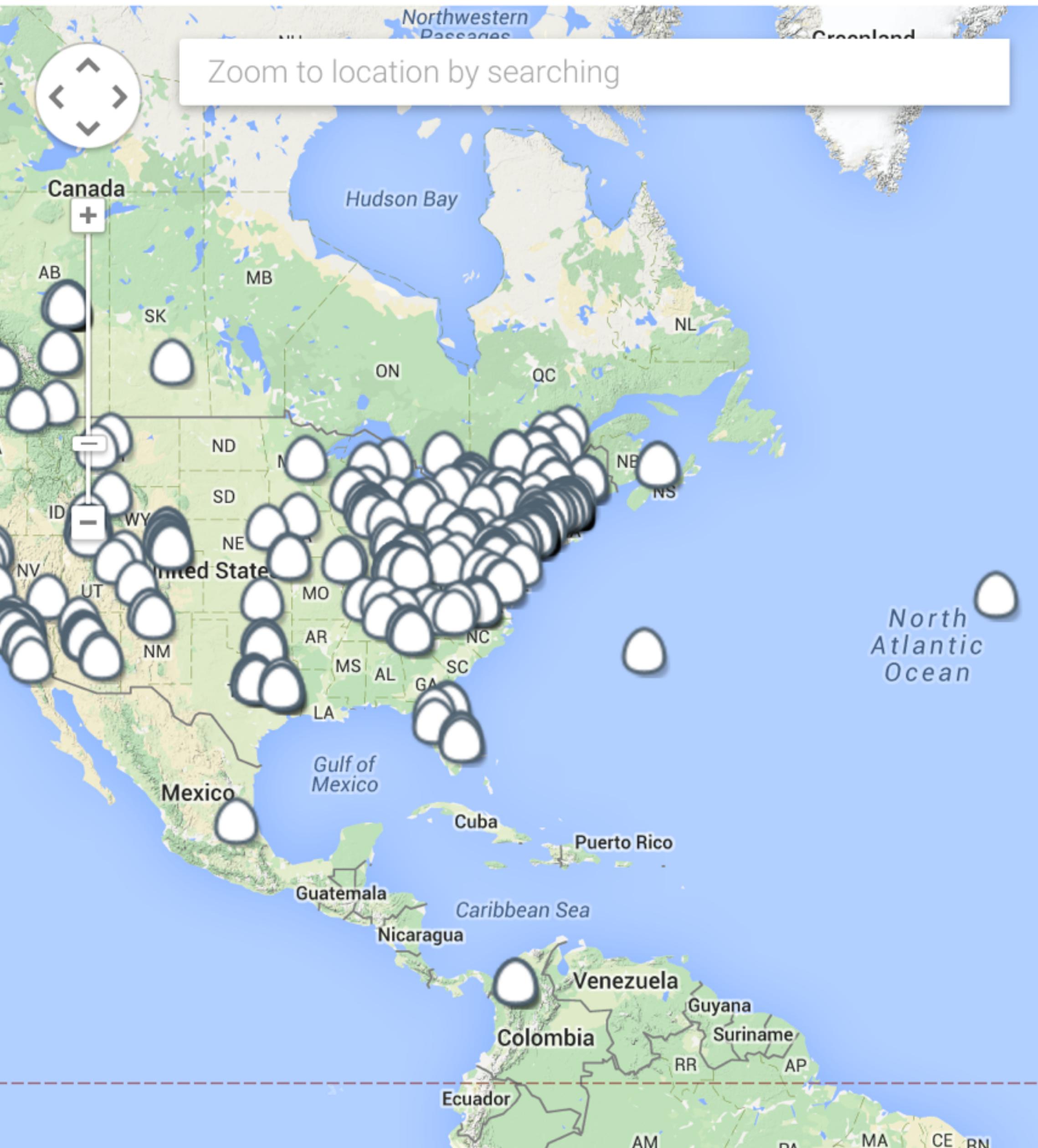


Air Quality Egg

community-led sensing network

Serial Number

ADD MY EGG



Projects › Water Quality Monitoring

CATTfish

CATTfish is a cost effective device that monitors changes in the quality of a private well or public water source from inside the home. These sensors measure real-time parameters of water quality, including conductivity, temperature and total dissolved solids. This information can then be compared to known data sources and government guidelines for water quality. You can now purchase CATTfish from MellonHead Labs! Along with the sensor, you will have access to powerful data exploration tools.

[**Purchase Now!**](#)

[**CATTfish Website**](#)

[**The Lemonade Project**](#)

[**Get involved**](#)

CATTfish Stats

701 People

11 Organizations



eCan

- trash can which has a touch-screen interface and sensors inside to recognize when someone throws something away
- provide a financial award based on the material being thrown away



Let's get started...