For IoTWeek 2019

IoT for Future Cities:

Challenges and Possibilities

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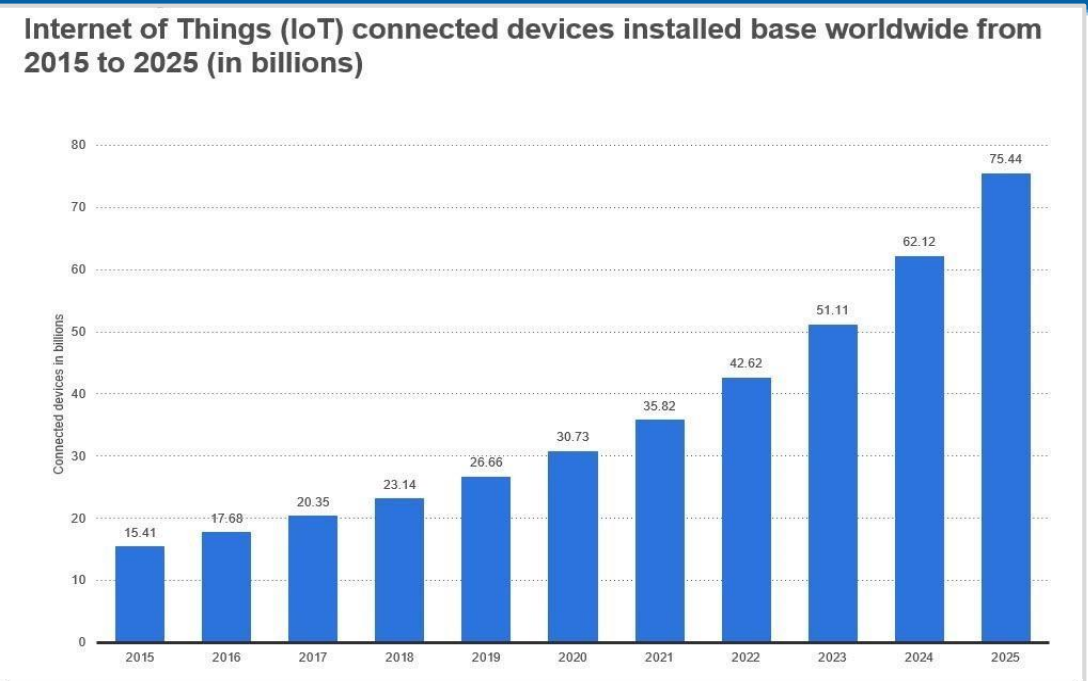
1:

… It was the epoch of belief, it was the epoch of incredulity …

(“A Tale of Two Cities”)

IoT was supposed to change everything, including our cities. But the reality is…

IoT Numbers Look Impressive, Until We Look At Other Aspects



10 Largest Cities in the World: 2015

Rank	Urban Area	Population Estimate	Land Area: Square Miles	Density	Land Area: Km2	Density
1	Tokyo-Yokohama	37,843,000	3,300	11,500	8,547	4,400
2	Jakarta	30,539,000	1,245	24,500	3,225	9,500
3	Delhi, DL-UP-HR	24,998,000	800	31,200	2,072	12,100
4	Manila	24,123,000	610	39,500	1,580	15,300
5	Seoul-Incheon	23,480,000	875	26,800	2,266	10,400
6	Shanghai, SHG-JS-ZJ	23,416,000	1,475	15,900	3,820	6,100
7	Karachi	22,123,000	365	60,600	945	23,400
8	Beijing	21,009,000	1,475	14,200	3,820	5,500
9	New York, NY-NJ-CT	20,630,000	4,495	4,500	11,642	1,800
10	Guangzhou-Foshan	20,597,000	1,325	15,500	3,432	6,000

Urban Areas, from *Demographia World Urban Areas*

Some Numbers To Think About

- Earth Total Land Areas: 148,940,000 km^2
- Earth Urban Areas (est): ~1,000,000 km^2
- At 70 billion Urban IoT devices, we get
- IoT Urban Density: 70,000 [dev/km2]
- What could these numbers imply?
  - Is this enough density?
  - Can these many devices be economically managed?

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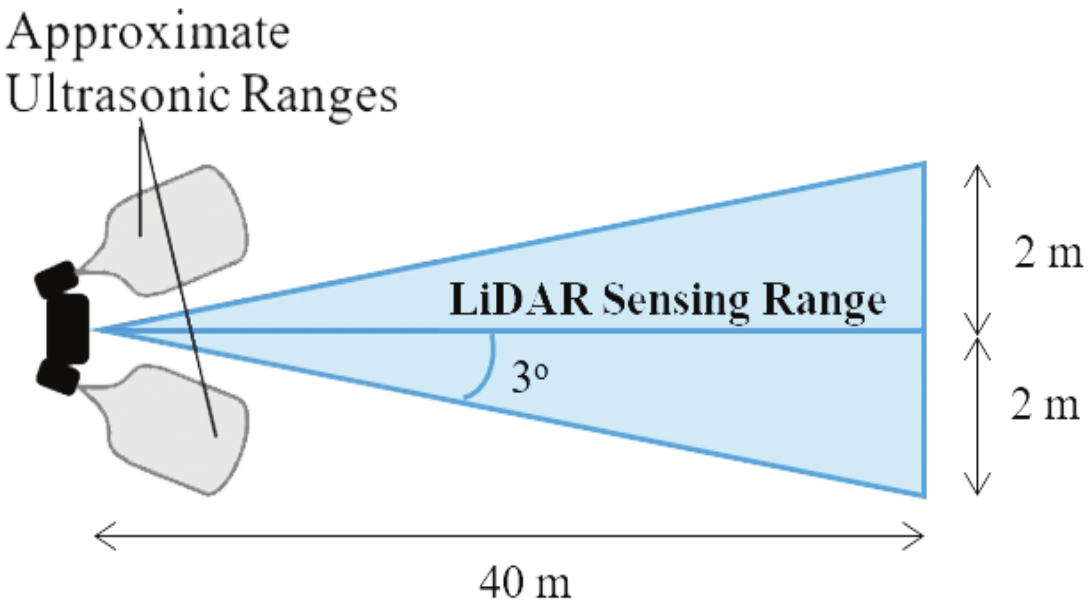
Functional Density vs. Cost



Inductive 	<4-40 mm	Any close-range detection of ferrous material	Iron Steel Aluminum Copper etc. 
Capacitative 	<3-60 mm	Close-range detection of non-ferrous material	Liquids Wood Granulates Plastic Glass etc. 
Photoelectric 	<1mm- 60 mm	Long-range, smalll or large target detection	Silicon Plastic Paper Metal etc. 

More Numbers To Think About

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And There May Be Much More Economical Alternatives

Global Satellite Analytics Fleet

- Total # of Sats: ~500 (2018)
  ~25,000 (2030)
- Sat Covered Areas:
- At 70 billion Urban IoT devices, we get
- IoT Urban Density: 70,000 [dev/km2]
- What could these numbers imply?
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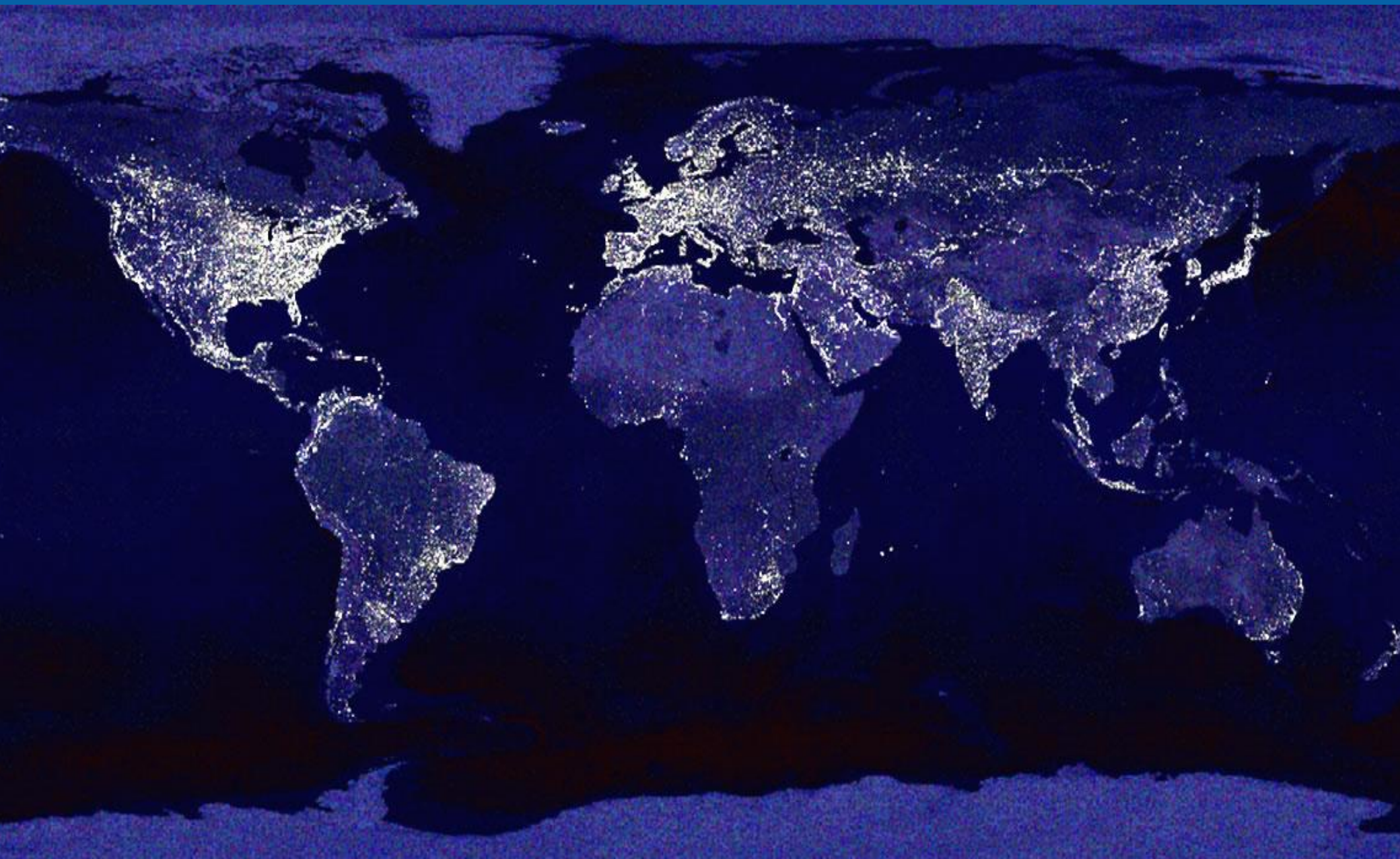
1b:

Regardless, our cities need to change for the smarter very fast,

for one SINGLE key aspect

The Cities of Our World

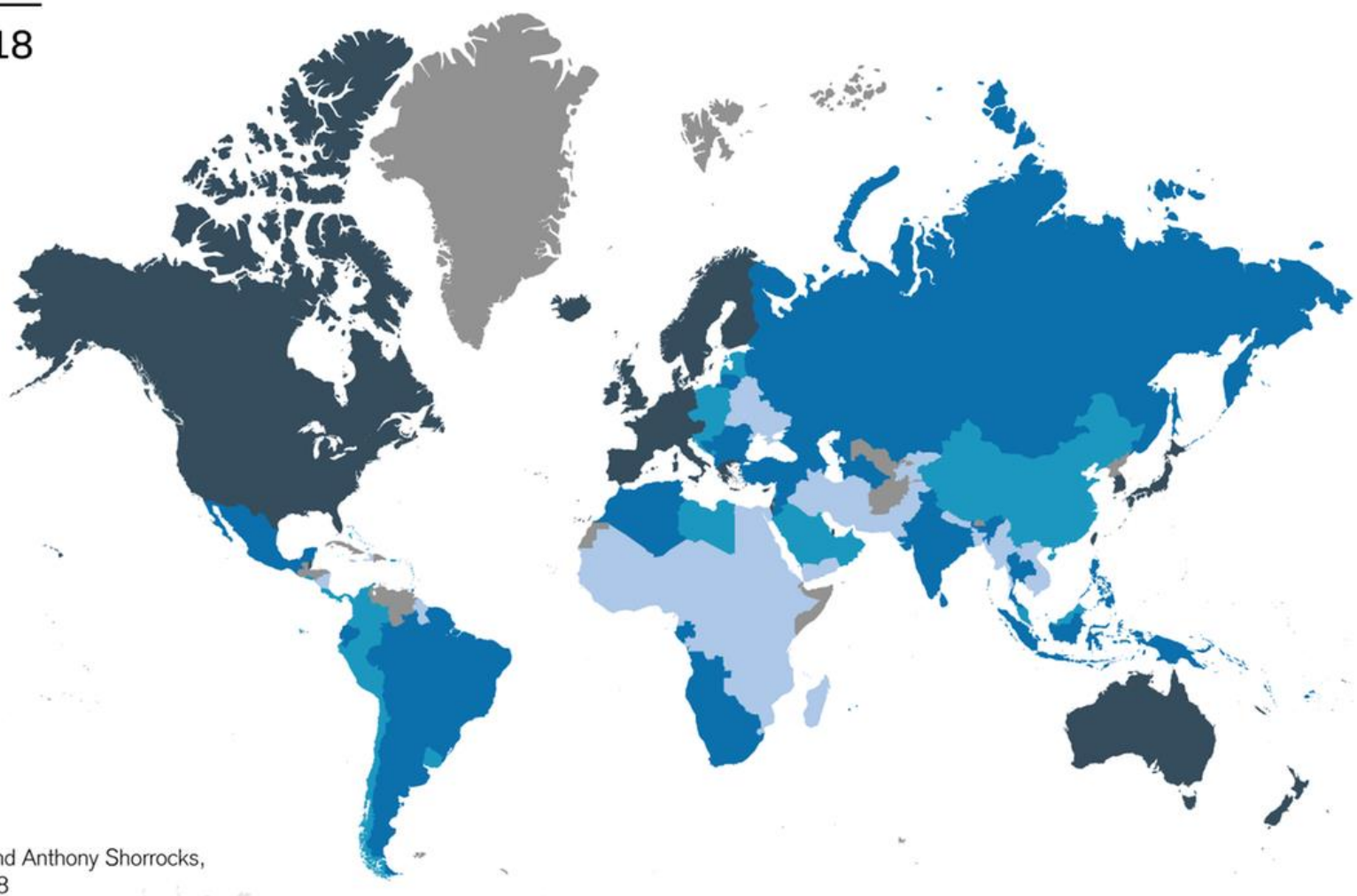


The Ultimate Symbols Of Our Achievements

Letting Us Develop As Collectives, with Speed and Scale

Representing Most Of Our Wealth

World Wealth Map 2018

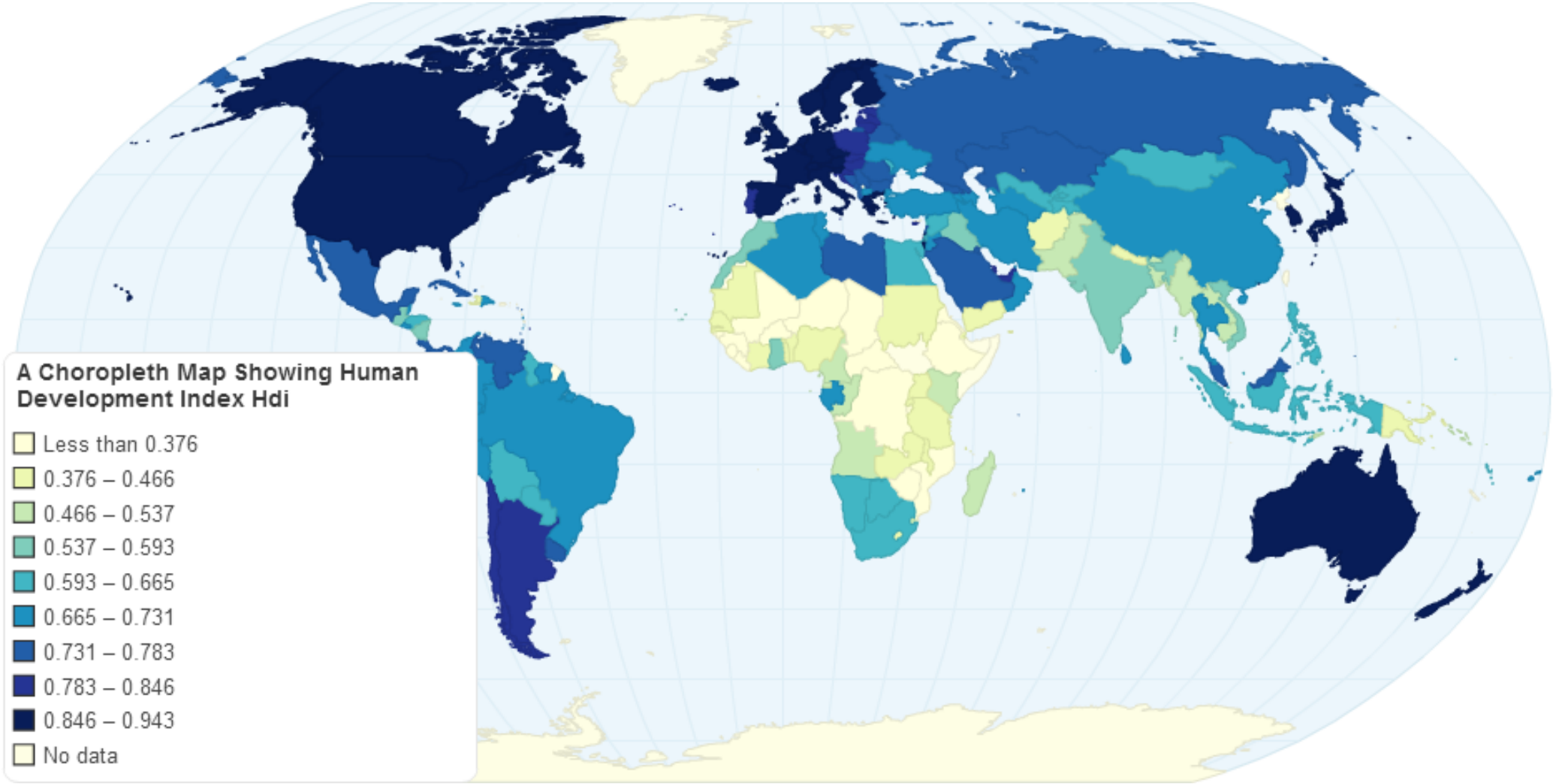


Wealth per adult (USD):

- Below USD 5,000
- USD 5,000 to 25,000
- USD 25,000 to 100,000
- Over USD 100,000
- No data

Source: James Davies, Rodrigo Lluberas and Anthony Shorrocks, Credit Suisse Global Wealth Databook 2018

And Human Development

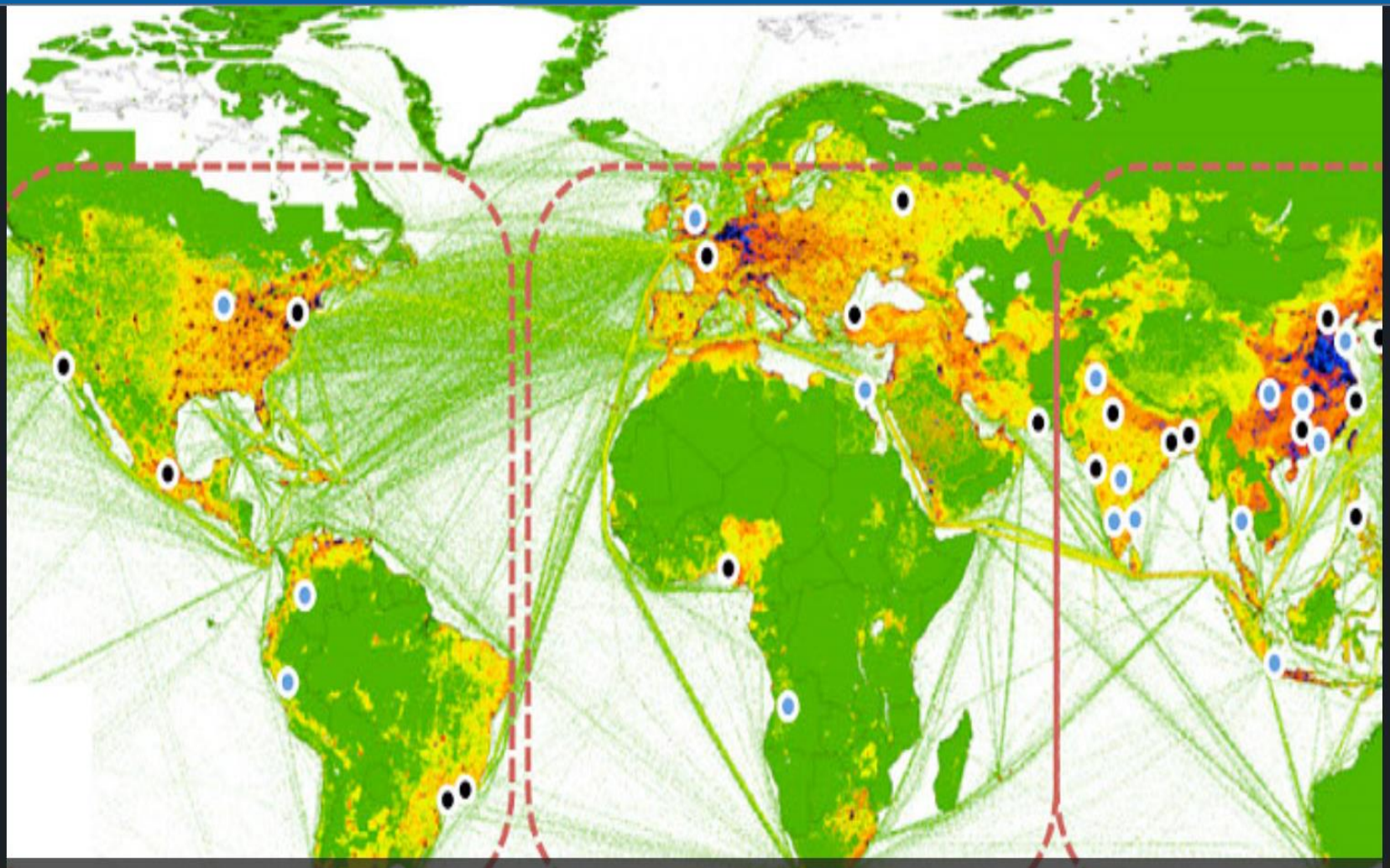


But They Also Represent Our Greatest Crisis

2:

The Climate Crisis

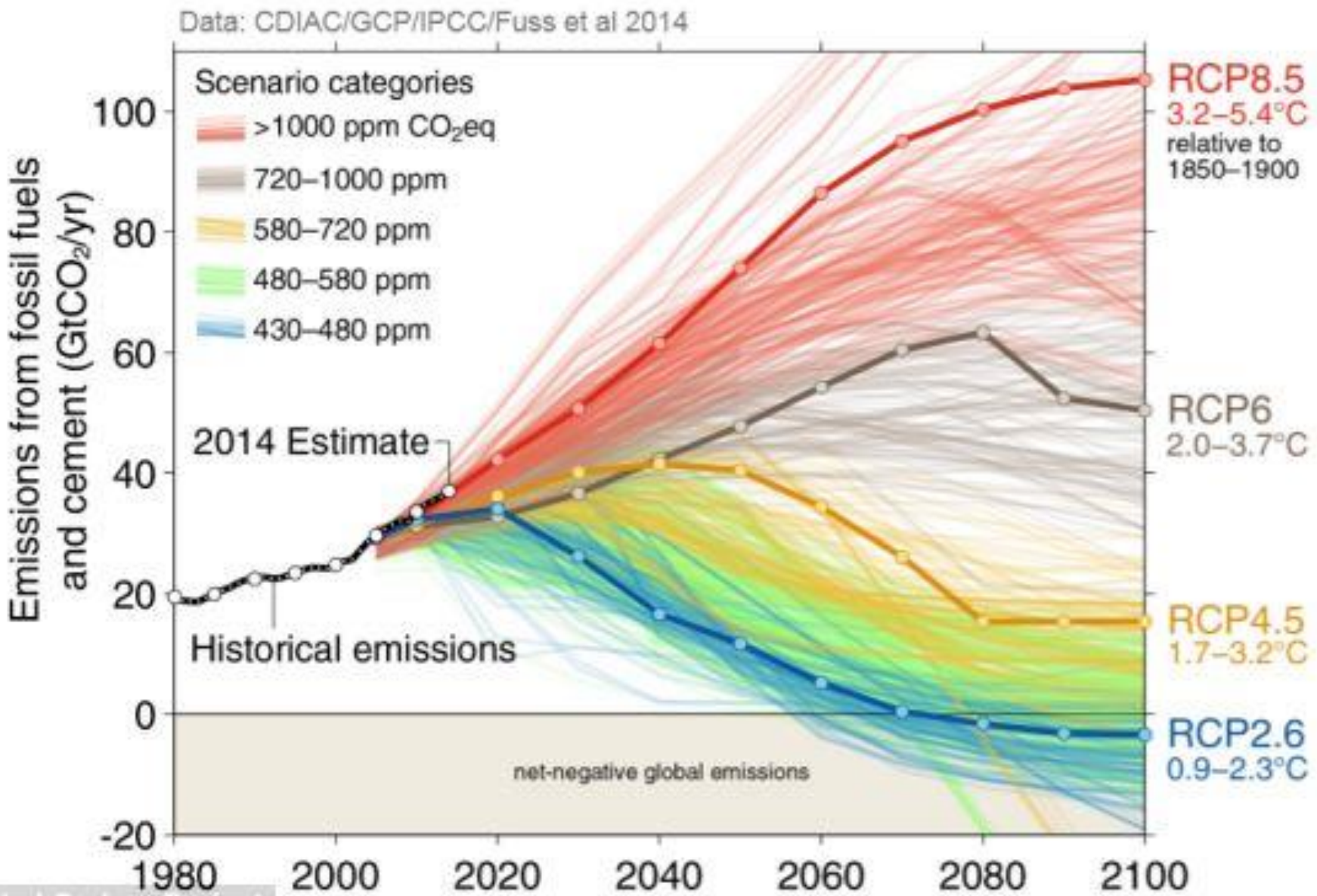
Our Cities Generate 70% of World's CO2 Emissions



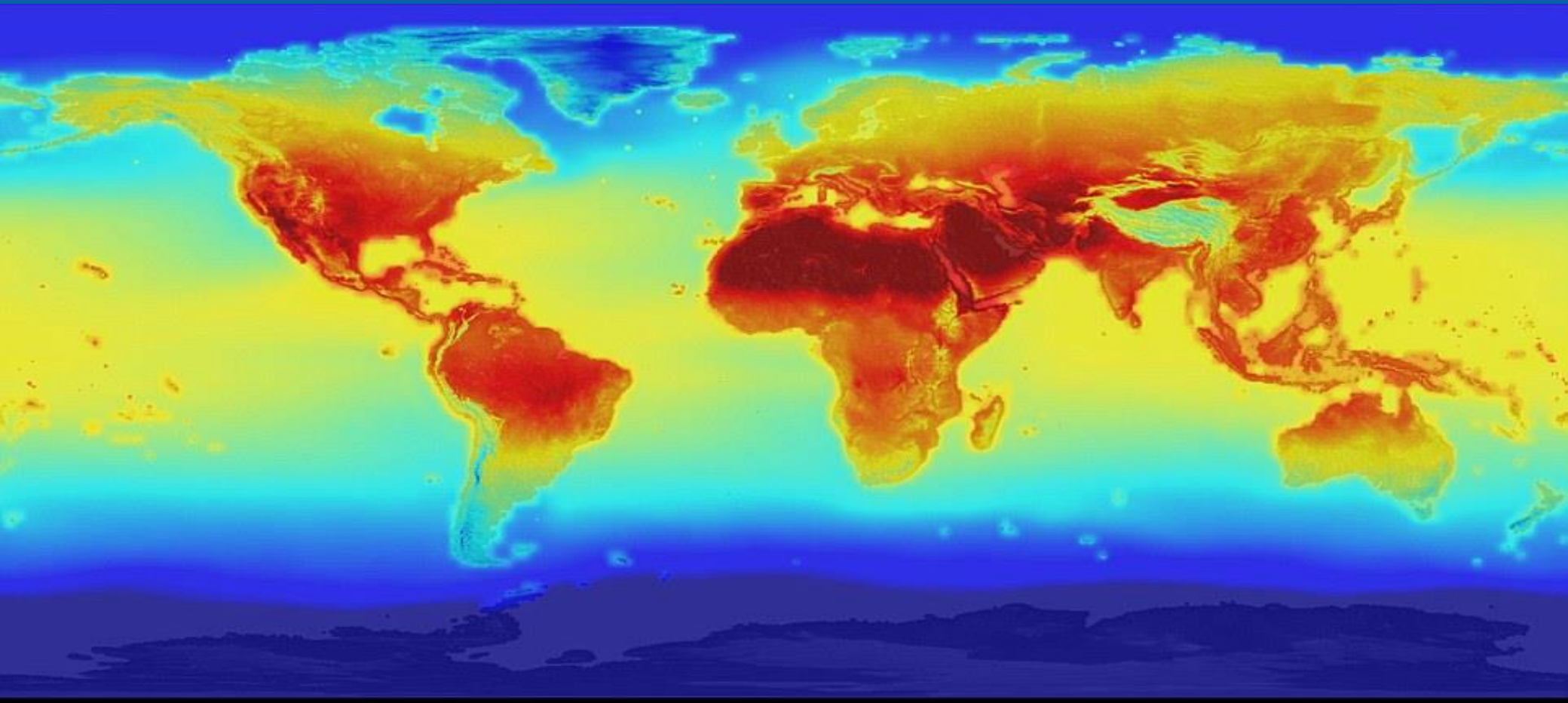
CITIES PRODUCE 70% OF ALL FOSSIL-FUEL CO2 EMISSIONS

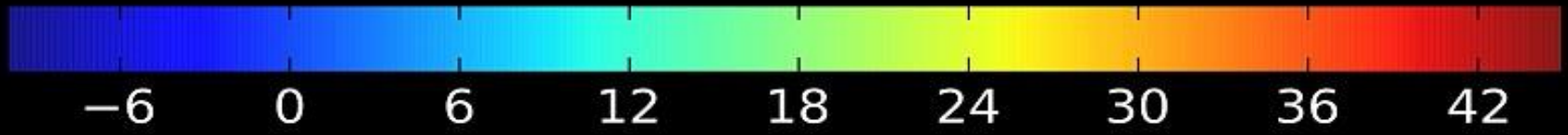
A 10-km-resolution map indicates the distribution and intensity of fossil fuel CO2 emission sources. The regions with greatest emission intensity are indicated by red and black (urbanized areas and associated large power plants). The black circles indicate a vision for future surface measurement networks concentrated within the 23 existing megacities. Blue circles indicate the 14 additional megacities projected to exist by 2025. The dashed rectangles indicate the fields of regard of three remote-sensing instruments that if hosted on geostationary satellites would offer sustained, wall-to-wall mapping of nearly every emission source. The satellite and surface network data, integrated with improved high-resolution emission estimates would provide a robust system for assessing and informing policies. Map: (EDGAR version 4.0) 2009.

CO2 Will Increase Massively, with More Cities to Come



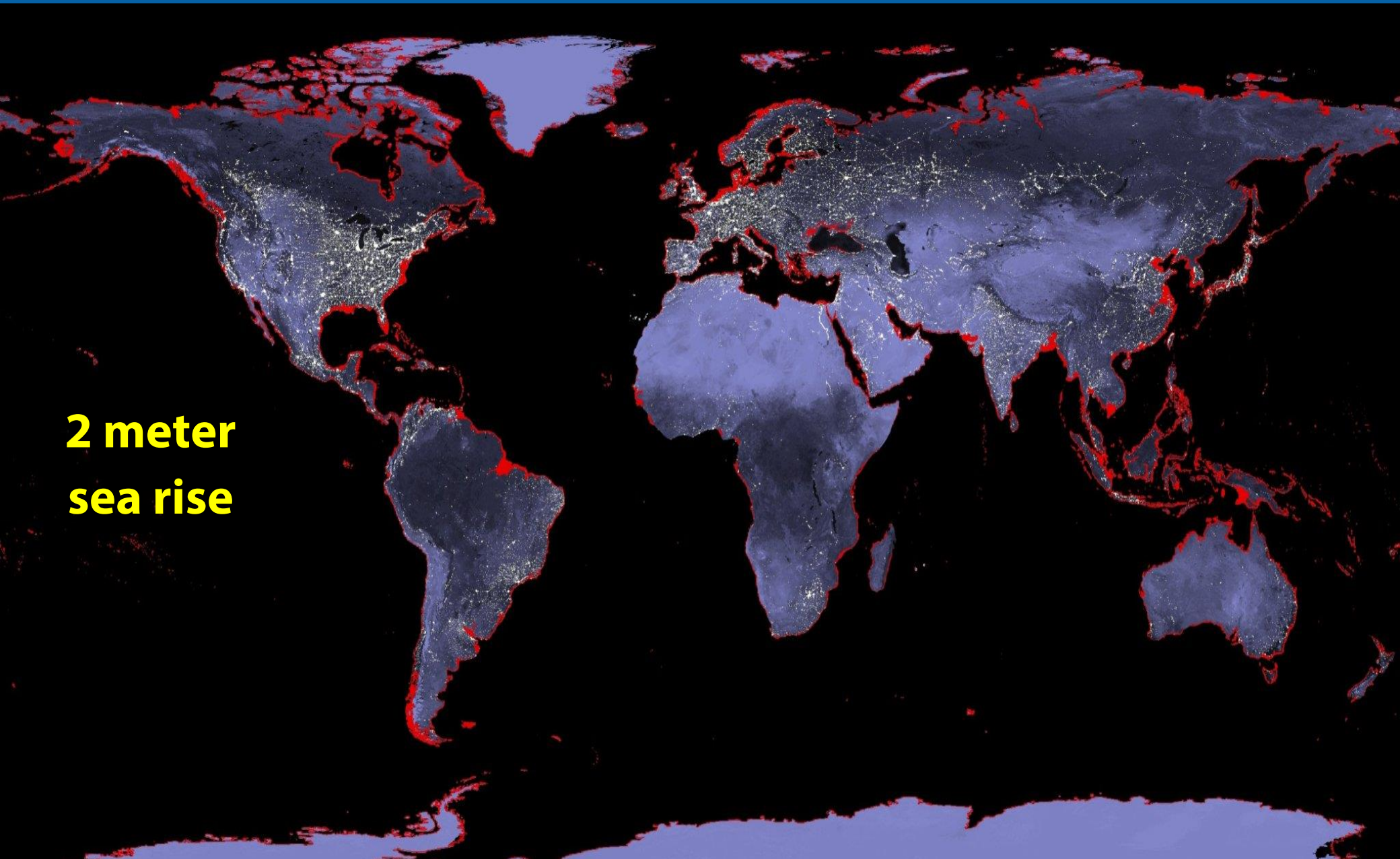
By 2100, Most Cities may become Too Hot to be Inhabitable





July 2100 RCP 8.5

And They May Also Be Submerged under Rising Sea Levels



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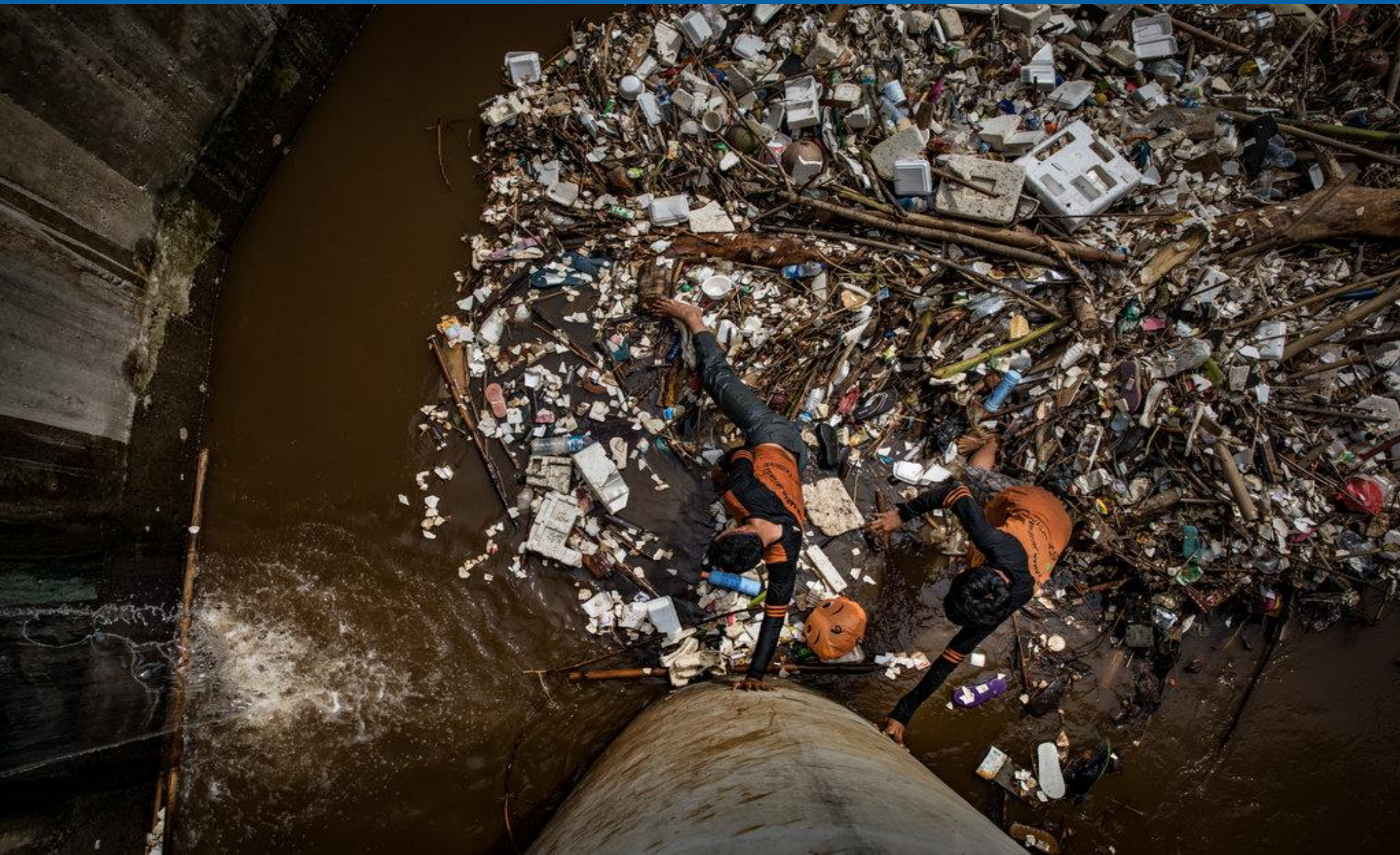


Nobody knows What Harm The Drowned City Infra May Cause Us

3:

We can change

But we need real intelligence to make the changes

Key Points for the "Real" Intelligence

- Sufficient incentives for CO2-reducing policies and behaviors
- Massive, ubiquitous, penetrative, and continuous monitoring of CO2 generation from within and around the Cities
- Ability to optimize complex and large-scale flow of energy, goods, people, and CO2, in and out of the cities
- Responsible and responsive governance
- Trustworthy acquisition, handling and analysis of data (i.e., CO2 levels, social costs, incentives, benefits, etc)

Some Pre-emptive Propositions

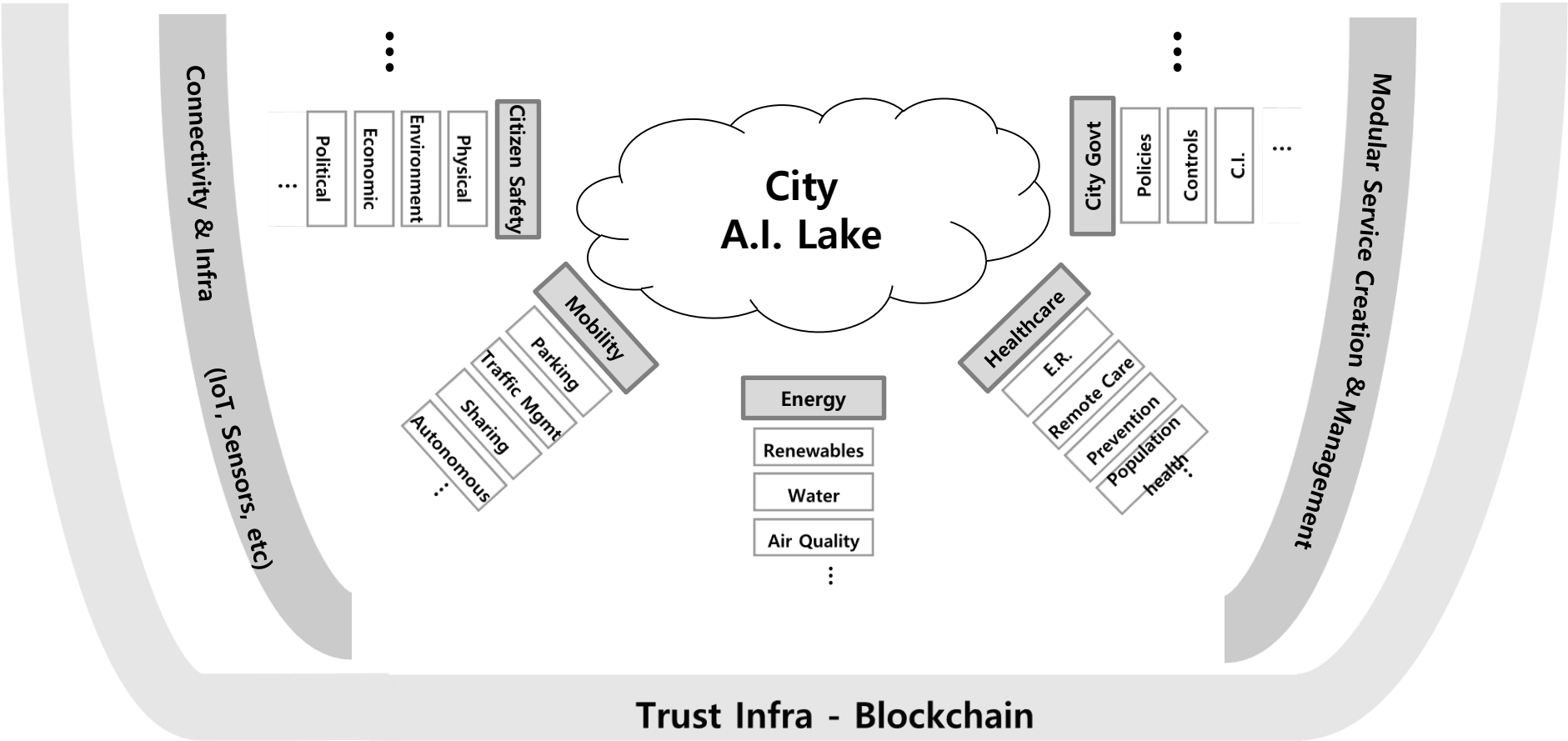
- Cities occupy huge areas needing constant observations. Look for alternatives to IoT (e.g. satellite & aerial imagery) where feasible
- IoT will still be relevant and useful to enable continuous monitoring and control of key nodes and sites. Always inspect if cost < price < benefit
- Trust will be key for successful change. Look for ways to enhance civic trust and effect serious changes at the same time, e.g. blockchains.
- Youths will need to be empowered for the new cities. Look for ways to incentivize the young population, e.g., gamification, blockchains, etc

And One More Thing

- Energy sources and infra for the Future Cities will have to be changed.
- Changing CO2-happy energy infra to CO2-less alternatives is essential
- Learn from and work with the leaders who are changing their nations and cities to become carbon-net-zero (e.g. Denmark with wind and renewable gas, Netherlands with aqua-thermal direct heating/cooling)
- IoT can and should play useful roles to help all of the above, and more.

Example) Penetrative City Intelligence Platform

Continuously create, manage and optimize Innovative Services using a City A.I. Lake and Modular service-creation platform, supported by IoT/Comms Infra & Blockchain trust infra



Example) Artificial Energy Intelligence

Develop **AI that can optimize City-Scale Energy Management**, using components such as renewable energy, smart grid, IoT, zero-energy buildings and others as base technology.

Strategic Global Collaboration

A Few Global MNCs are dominating smart city headlines. Work early with **strategic global partners and use tools such as Multi-national Pilot Cities,** to counter monopolistic dominance

4:

Do not lose why we need to do this

"Will You Join Me?": Greta Thunberg, Davos, Jan 2019

Thank you

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