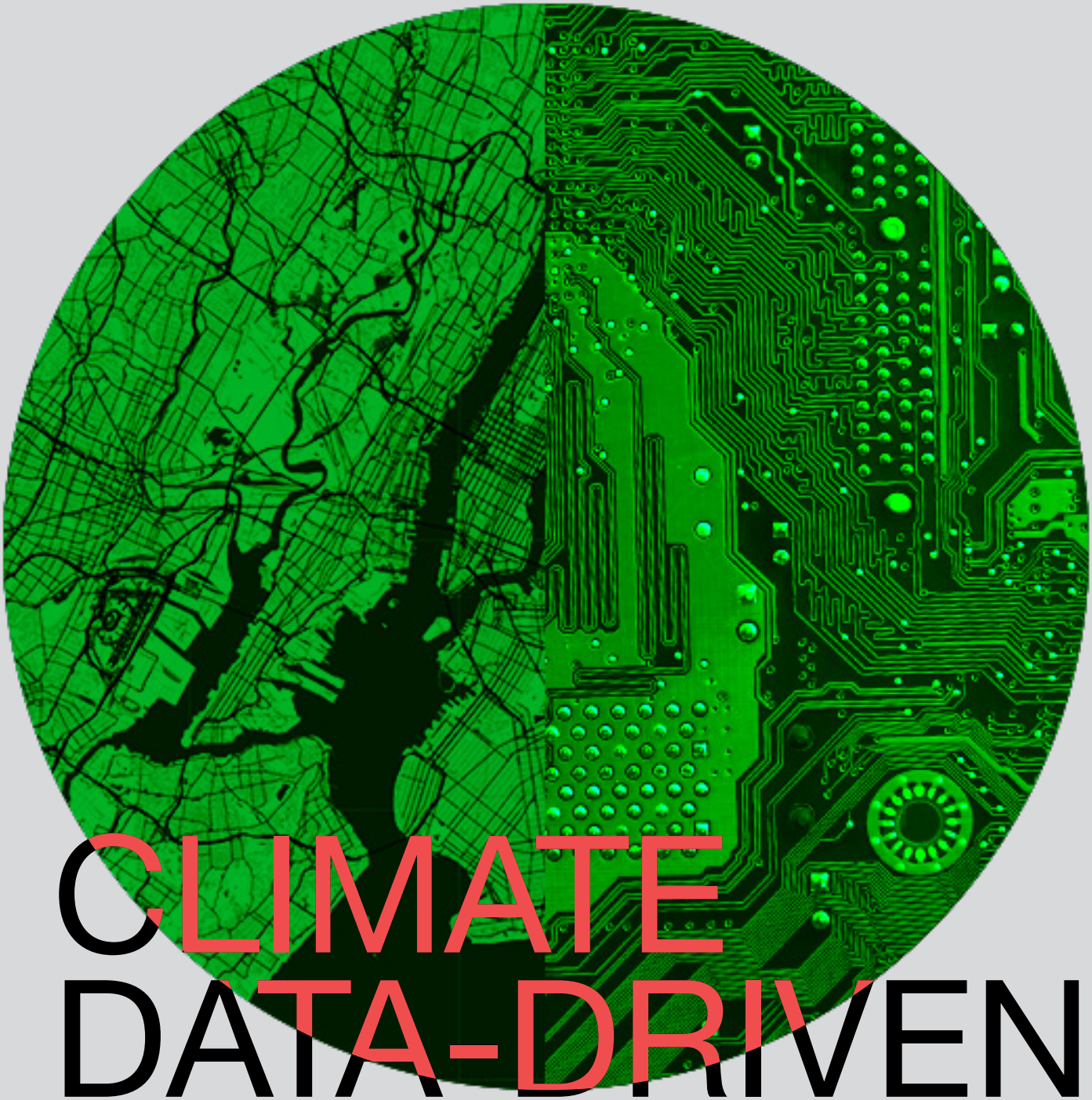

CLIMATE DATA-DRIVEN CITIES

How cities are leveraging real-time data to mitigate and adapt to climate change

MIT senseable city lab. SecDev

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How cities are leveraging real-time data to mitigate and adapt to climate change

Robert Muggah and Carlo Ratti

Introduction

Although most cities face disastrous climate change in the coming years, surprisingly few have prepared serious mitigation and adaptation strategies. Environmental disasters are becoming more routine yet many municipal leaders and residents are still not fully aware of the scale and dimensions of the risks in the not-so-distant future. Part of the problem is that, with exceptions, many urban authorities are still not collecting the kind of information that could help inform short- to longer-term decision-making. A few still believe that they are simply not at risk. This is dangerous. As the management guru Peter Drucker observed: "you can't manage what you can't measure."

The lack of data collection is surprising since a growing number of cities are loudly declaring their intentions to reduce their emissions. More than 11,000 cities have signed on to a global covenant to reduce carbon emissions and speed up the transition to clean energy. With more and more cities committing to ambitious climate goals, many city executives are starting to change gears. Cities aligned to networks such as the C40 intend to reach net-zero carbon before their national counterparts. Yet many of them still lack the basic toolkits to monitor progress. Notwithstanding recent advances in the production of high-resolution climate data by public and private satellites, most cities are still lagging when it comes to processing and converting this information in a way that can improve lives and save the planet.

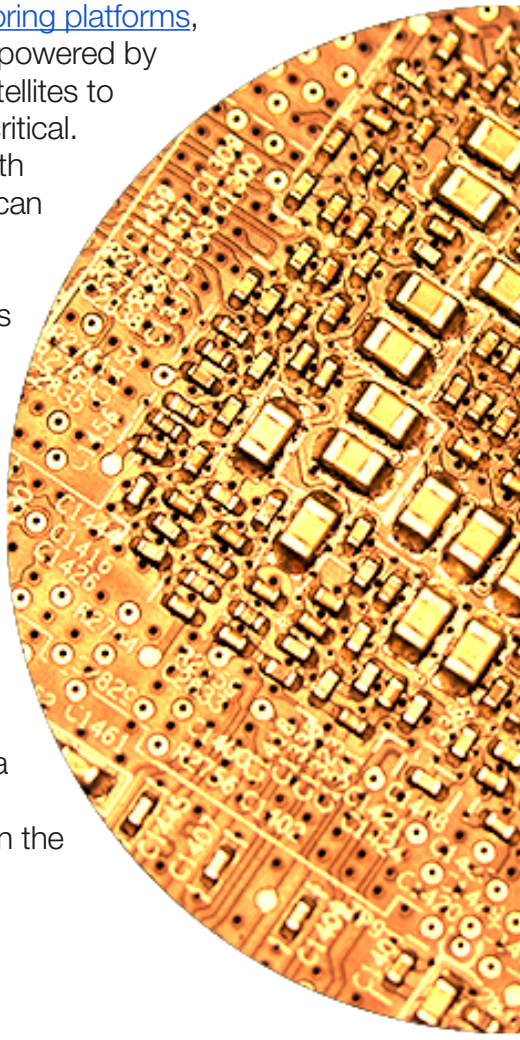
Cities on the frontline of climate change

The stakes could not be higher – climate change is ruthlessly disrupting cities around the world, especially in lower- and middle-income settings. Many of them are buckling under the frequency and intensity of extreme weather events such as heat waves and hurricanes. Coastal cities are experiencing increasingly severe flooding connected to sea-level rise. Entire cities and their peripheries are being evacuated altogether, relocated to safer ground. More than ever, climate change is emerging as a key determinant determining whether and where younger people decide to live. With more than half of humanity living in cities built on concrete, absorbing solar radiation, and making the effects of heat waves and heavy rains more severe, they are literally on the front line.

Although most cities are facing significant threats of urban heating, water scarcity and flooding, only a minority have formulated plans to adapt. By one estimate, more than 40 percent of all cities - home to over 400 million people - have not yet installed a climate preparedness strategy. Only a handful of the world's fastest-growing Asian and African cities have done so, which is worrying since these regions are where more than 90 percent of all future urbanization is set to occur over the next three decades. And yet such plans are strongly correlated with the likelihood that cities will invest in climate action. Indeed, cities are potentially the world's best bet in the fight against climate change.

A growing number of organizations are supporting cities to accelerate climate action including installing climate adaptation and mitigation plans, tracking greenhouse gas emissions and preparing for climate shocks. Groups such as the Business of Cities have identified hundreds of public benchmarks and datasets to facilitate tracking of everything from air quality to building materials. The World Resource Institute along with C40 and ICLEI - have developed a greenhouse gas protocol to help cities inventorize their pollution, set baselines and reduction targets and measure changes in scope 1, 2 and 3 emissions.[1] Predictably, these data assets vary in quality, time-series and spatial coverage and can lead to over and under-reporting.

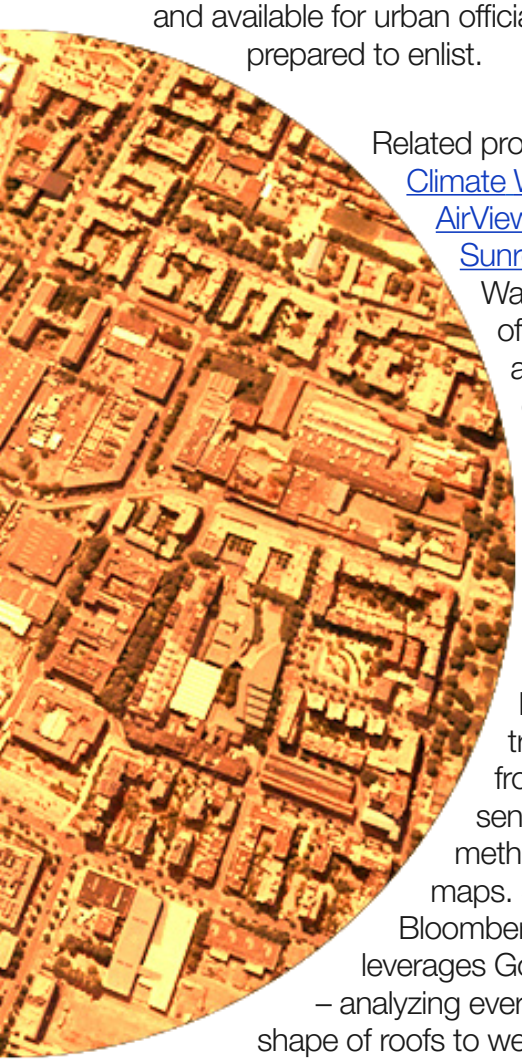
An urban climate action plan is necessary, but insufficient, to deliver meaningful changes in greenhouse gas emissions and related targets. Data-driven monitoring platforms, including systems powered by everything from satellites to sensors, are also critical. When deployed with fidelity, such tools can help determine the concentration of greenhouse gasses such CO2, NO2 and PM2.5 at an extremely high level of resolution. They can also detect temperatures during the day and night within, outside and around homes and buildings. Data analytics are an essential weapon in the city arsenal.



1 Scope 1 includes GHG emissions from sources located within the city boundary. Scope 2 covers emissions emerging as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within a city boundary. Scope 3 includes all other emissions that occur outside the city boundary as a result of activities taking place within it.

The climate datification of cities

Over the past few years an array of platforms have started emerging to improve city awareness about climate risks. Many of the big tech companies have already waded in. For example, Google recently launched the Environment Insights Indicator, or EIE, which is designed to help local governments aggregate data on building and transportation-related emissions, a wide range of greenhouse gasses including HFCs, PFCs, SF6 and NF3, as well as air quality and solar potential. Data is available since 2018 and available for urban officials who are prepared to enlist.



Related projects include Climate Watch, Project AirView and Project Sunroof. Climate Watch, for example, offers up a large and diverse pool of data sources extending back over a century, ostensibly for researchers to model subtle changes in climate over time. Project AirView tracks emissions from cars using sensors and features methane leakage maps. Supported by Bloomberg, Project Sunroof leverages Google Earth data – analyzing everything from the shape of roofs to weather patterns – in order to compute cost savings from using solar for any address in the US.

Another promising project is the Surface Particulate Matter Network, or SPARTAN, which is accelerating knowledge about PM2.5 dynamics in cities. The network examines particulate matter and releases data on its mass, chemical composition and optical characteristics to improve air quality management. Supported by Bloomberg Philanthropies, ClimateWorks Foundation and the National Science Foundation, SPARTAN leverages the MAIA satellite operated by NASA to provide hourly data to over 200 countries including cities such as Buenos Aires, Santiago de Chile, Palmira and Toronto.

The World Air Quality Index project is a network bringing together information for 130 countries, covering some 30,000 stations in at least 2,000 cities. Founded in China, the project is essentially a repository of global data sources and APIs designed to improve information-sharing across jurisdictions. Similar initiatives have been launched at the national scale, such as Urban Emissions and SAFAR in India. Urban Emissions reportedly provides district-level meteorological data across the subcontinent with a one-hour temporal resolution. In the US, AirNow offers state-level ozone and PM2.5 data.

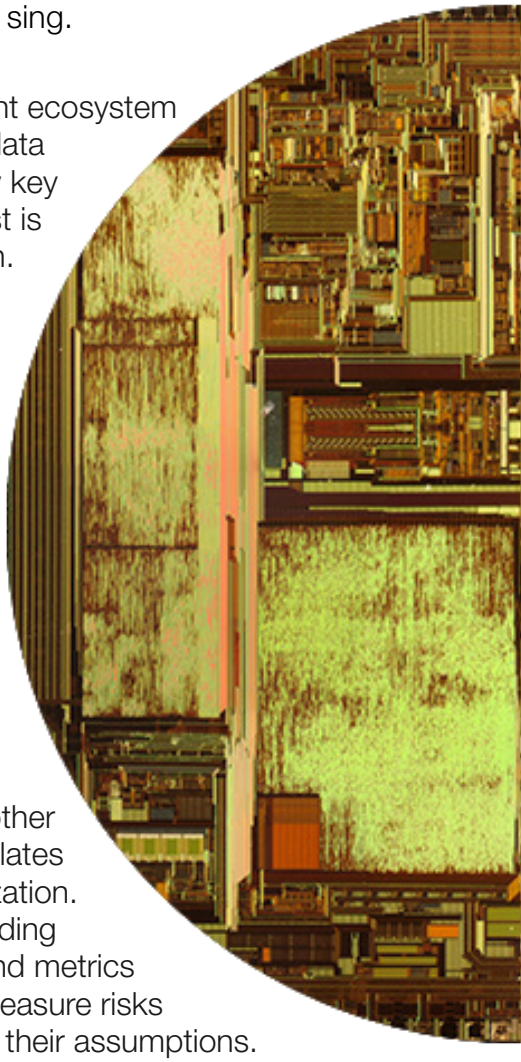
Many of these initiatives are built on the back of large-scale, publicly-supported programs that generate climate-related data. The most well known of these are led by NASA, which uses satellite data together with chemical dispersion and meteorological models to track emissions and predict the movement of pollutants. Likewise, NOAA tracks wildfires, among other hazards, to extrapolate future weather for its National Center for Environmental Prediction. The European Satellite Agency generates five-day forecasts through its Copernicus Atmosphere Monitoring Service that tracks aerosols, atmospheric pollutants, greenhouse gasses and UV-indices.

International institutions are also mobilizing public datasets to drive action at the national level. A good example is the World Meteorological Organization's Global Air Quality Forecasting and Information System. It has set up a host of partnerships with international, regional and national organizations to track everything from dust storms to fire and smoke pollution. The UN Environment Program also oversees a Global Environment Platform with high-resolution and real-time forecasts and products.

Emerging alongside these established actors, a new generation of data providers are promising to revolutionize the climate data game. Companies such as the Paris-based PlumeLabs, for example, are crowdsourcing air quality data through locally-distributed sensors to let citizens know where pollution is concentrated. It also has a forecasting API that helps asthma sufferers avoid pollen clouds. Air Lookout tracks EPA air quality stations and visualizes hourly trends in a mobile phone app. Breeze Technologies is also issuing air quality data, including for levels of ammonia. A plethora of companies are likewise issuing data on indoor air quality, including Awair, Molekule, uHoo, Clarity and NetAtmo.

Making climate data sing

This extraordinary production and proliferation of climate data is a necessary move in the right direction, but is insufficient on its own. Datasets are often fragmented across multiple platforms, reducing the ability of government leaders, entrepreneurs and citizens to drive effective policymaking. For the most part, metrics are neither standardized nor compatible with one another. Even when urban leaders agree that the climate emergency is rapidly escalating, they find it difficult to drill down into the details. Cities around the world are generating a chorus of climate data but have yet to learn how to make it genuinely sing.



Building a coherent ecosystem of urban climate data depends on a few key principles. The first is data consolidation. It is essential to assemble a wide range of metrics to track emissions, temperatures and sea levels on unified platforms. This could help users more comprehensively understand and respond to the climate crisis. Another critical principle relates to data standardization. The rapidly expanding array of studies and metrics used to climate measure risks vary immensely in their assumptions. An effective data system would streamline

information. To the extent possible, metrics need to be standardized from city to city making it easier to compare inputs, outputs, outcomes and impacts.

Better data management will not only improve the decision-making of policymakers and politicians; it will also empower ordinary citizens — those charged with keeping their leaders accountable — to hold their local governments accountable. Scientists, journalists and activists are struggling to communicate the implications of climate change and how to mitigate and adapt to it over time. Part of the enormous challenge ahead lies in synthesizing competing narratives and streamlining metrics. With well-curated, real-time data on hand, citizens are better able to assess the actual impact of the crisis — and the efficacy of solutions.

Standardized climate data platforms can facilitate inter-city and cross-national awareness, collaboration, and even competition in the name of saving the planet. For example, global rankings of decarbonization progress could encourage city governments to emulate each other. Not only would this foster a sense of neighborhood pride in their contributions to a sustainable city, demonstration effects could generate the scale needed to make a real difference in climate action.

Notwithstanding its desirability, standardization has certain downsides. For example, consolidated data platforms risk curbing innovation when it comes to data collection methods. Moreover, fixating on a small number of metrics for every city risks invoking Goodhart's Law: once a measure becomes a target, it ceases to be a good measure. What is more, political and corporate interests would have massive incentives to skew centralized climate data in their favor. For these reasons, cities should also be encouraged to experiment with promising metrics, always with the vision of driving sustainability.

Faced with catastrophic risks on the near horizon cities cannot continue to fly blind through a storm of climate changes that are poorly understood. Nor will cities be in a position to deliver on progressive climate targets without a dramatically scaling-up of monitoring measures. Cities need to collect more data, and especially need better ways to interpret what is collected. Careful attention is likely needed to ensure such data is kept private, protected and avoids reproducing bias and discrimination so as to ensure climate justice and stave off backlash. None of us will manage the climate crisis until we measure it - but first we must set out to manage the measures themselves.

About SecDev

SecDev Group is an agile research and innovation firm helping clients navigate digital-geopolitical, geospatial and geodigital risk. SecDev builds value through innovation in strategic foresight, data science and urban analytics. SecDev's team is fluent in technology, global in scope and results-oriented. SecDev empowers clients, such as national governments, technology companies and international organizations, to make informed choices that deliver value in the digital-urban age.

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About Senseable City Laboratory

Senseable City Lab is a cutting–edge multidisciplinary research group studying the interface between cities, people and technologies. The Lab investigates how the ubiquity of digital devices and telecommunication networks augmenting cities are impacting urban living.

Situated at MIT's School of Architecture and Planning and in partnership with external organizations, the Lab works on groundbreaking ideas and innovative real–world experiments. Partner cities offer test cases, industry members provide technical expertise and funding and the Lab unites public and private sectors with a shared vision of the future. In this way, the Lab captures the multi-disciplinary nature of urban problems in order to deliver research and applications that empower citizens to make choices that result in more liveable urban conditions.
https://senseable.mit.edu/

senseable city lab.

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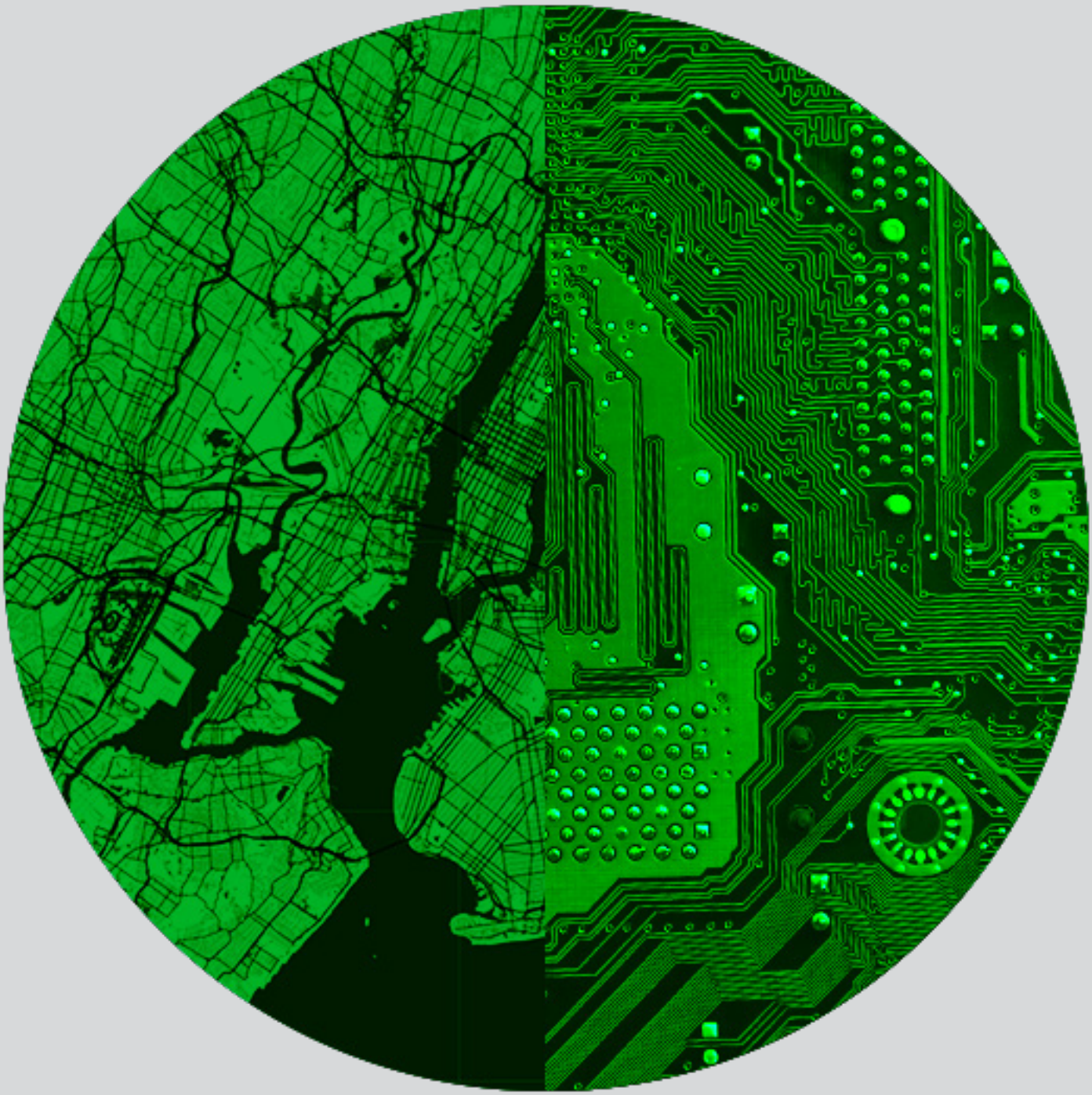

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