TONY BLAIR INSTITUTE FOR GLOBAL CHANGE

Are Energy Clocks the Smart Way to Make Cities Cleaner?

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Key Takeaways

- Cities trying to go cleaner by cutting emissions often find smart technologies –despite their huge potential benefits – challenging to implement and manage.
- At the heart of the challenge lies the need to develop holistic data solutions to support smart technologies.
- Energy clocks present an opportunity to address the gap. Energy clocks are dynamic open-access data systems which can unlock up to 12 per cent emission reduction while saving cities more than $100 billion in annual energy costs.
- Cities must align incentives on energy clocks, recalibrate administrative institutions and create viable channels to turn data into impact.

Getting Smarter With Tech

Most cities with a commitment to reducing emissions have not figured out a way to best implement and manage smart technologies despite their huge promise. From smart charging networks to smart parking apps, there is a wide range of technologies to help cities get smarter about reducing emissions and building cleaner communities. But the failure of some smart-city projects has led many to conclude that smart technologies are expensive, complex and, in some cases, incapable of addressing any real problems.

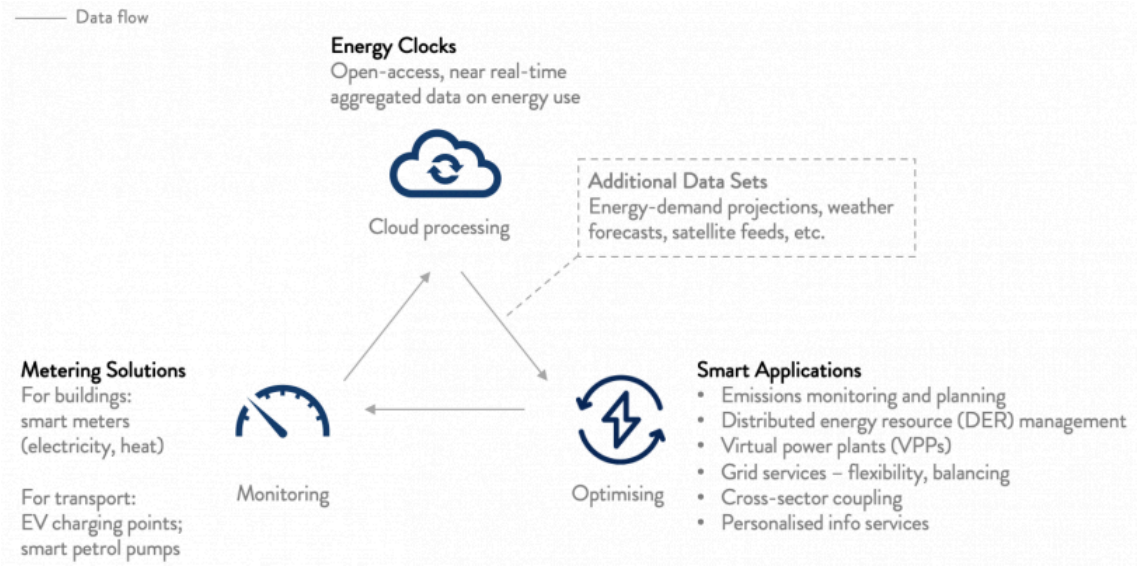
With more than half the world's population living in cities and millions more migrating to them each week, cities are responsible for over two-thirds of global energy use and three-quarters of the world's CO_2 emissions. Without prompt action, their emission rates will only continue to rise, plunging the world deeper into climate crisis.

Cities need better approaches to optimise energy use and mitigate emissions. They also urgently need a clear understanding of the available smart technologies and how best to use them to cut emissions. No doubt there are several challenges confronting smart-technology projects in cities, from gaining political alignment and attracting investment to the challenge of steering through legislative impasses. But after years of experimentation, what are the lessons learned that can help cities in the bid to slash emissions and become cleaner?

The Need for Energy Clocks

A key lesson from the world's collective experience with smart technology and energy decarbonisation is the centrality of data. Data is the lifeblood of every smart energy system. The ability to securely process and apply insights from energy data remains a central challenge. For cities committed to driving better use of data solutions to reduce emissions, having a holistic data strategy is what bridges the gap between theoretical strategy and effective implementation. But how exactly can data help cities achieve emission targets? This is where energy clocks come in.

Figure 1 – Energy-clock system overview

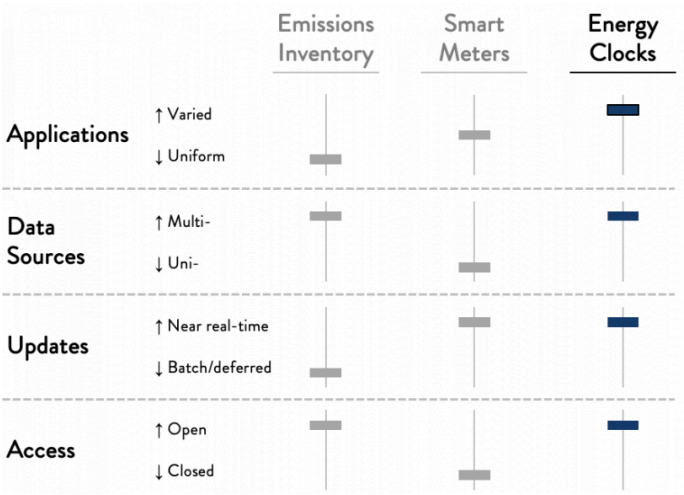


Energy clocks are an example of how frontier cities are using smart technologies to speed up their decarbonisation efforts. Energy clocks are open data platforms providing real-time (or near real-time) visibility on energy use at the city level. Like regular clocks, energy clocks embody the characteristics of simplicity, openness and adaptability. They provide a common interface for city planners, utility providers, software developers and other system actors to co-develop solutions for more efficient energy use. While regular clocks tell time, energy clocks indicate how much energy is used at different connection points across the city's energy grid. Bayernwerk's EnergyMonitor is an example of an energy clock that is gaining popularity: it is already in use across 70 Bavarian districts and municipalities.

Energy clocks are cloud-based solutions harnessing the power of the digital revolution – big-data analytics, blockchain, artificial intelligence – in extracting value from city energy data at scale. They may be fed by information from electricity meters, EV charging points and other key connection points across the city. Data from energy clocks can be harnessed, combined with data from other sources, and

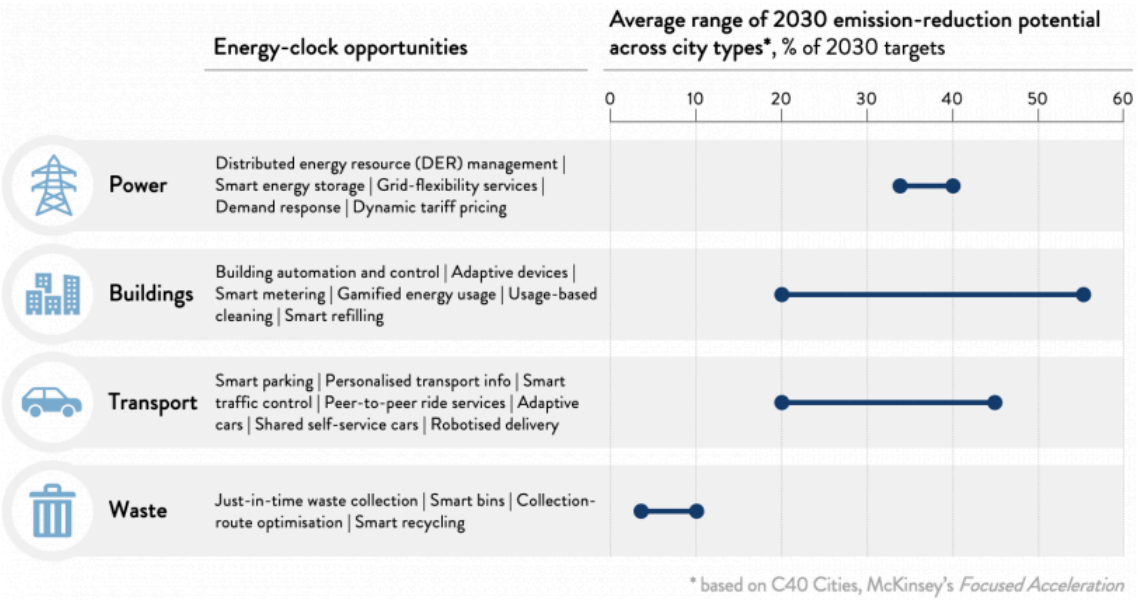
used to develop smart applications ranging from emissions planning and budgeting to providing better electric grid services (see Figure 1, above).

Figure 2 – Difference between energy clocks and comparable digital systems



Energy clocks are not entirely new. From the smart meters found in most urban homes to emission dashboards like Google's Environmental Insights Explorer, there are existing systems that are partly comparable to energy clocks. The difference, however, is that energy clocks are more holistic and more versatile. They combine the open-access nature of emissions dashboards with the near real-time nature of home smart meters and operate at a city level. The clocks not only provide the data needed to optimise energy use in cities, but also offer a way to improve understanding of the opportunities – and challenges – of energy efficiency across a broad range of application areas. They aggregate a city's most important energy data with a view to enhancing interoperability and ensuring holistic solutions can be developed.

Figure 3 – Opportunities for reducing emissions with smart technologies enabled by energy clocks



Energy clocks could play an enabling role for several smart solutions across different cities (see Figure 3). From our analysis, the clocks could unlock up to a 12 per cent reduction in emissions while saving cities worldwide more than $100 billion annually in energy costs. Estimates of emissions savings from a full deployment of smart technologies range from 10 per cent to nearly 25 per cent. For example, demand-side response – a method of using real-time data to reduce energy use at peak times so there is less strain on the grid – could provide 185 gigawatts (GW) of flexibility and eliminate the need for $270 billion of investment in new electricity infrastructure. Smart grids alone can accelerate renewables' share of the energy mix in the US from 20 per cent to 70 per cent. By developing energy clocks, cities would have the data platforms to unlock the promise of several smart-energy solutions.

Frontier cities are already developing versions of the energy clock. The city Reno, Nevada is considered one of the fastest-warming cities in the US. But as part of its climate-action plan, it recently launched a real-time dashboard to monitor energy use and emissions. Copenhagen has been a leader in implementing smart and cleaner-city projects. Since adopting a climate plan in 2012, it has partnered with big-data solution providers to deliver citywide data-driven solutions to reduce emissions. Malmö, Sweden – often referred to as the Green Digital City – has developed multiple smart-technology projects, with clear impacts on emissions. The Finnish city of Lahti implemented personal carbon budgeting – a concept that was described as "ahead of its time" and later shelved by the UK due to limited political popularity – using local energy-clock data with positive results.

When the Clock Ticks

Energy clocks might be a seemingly straightforward way to frame a complex solution, but developing them will require cities to be proactive in driving implementation.

Aligning Incentives Is Key

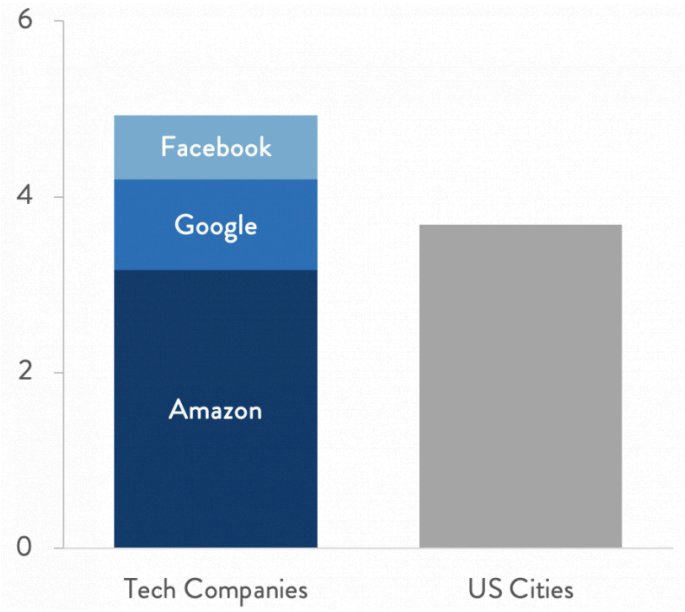
A city may have car-hailing operators with robust data systems covering hundreds of vehicles running the roads – complete with real-time location, vehicle model, engine type, age and emission. Utility providers supplying electricity to the city may have rich data from smart-meter installations. Large tech companies with satellite infrastructure may have visibility on traffic flow in and out of the city and congestion locations, with data to visualise emission heat maps in real time. Several other companies may have different kinds of general and specialised data on energy-user behaviours throughout the city.

But these entities have no incentive to initiate or drive the collaboration needed to build energy clocks, even though this would prove valuable. This is where city administrators must step up – providing an innovation platform, facilitating engagement and aligning incentives between parties. The DOLL (Danish Outdoor Lighting Lab) programme in Albertslund, a suburb of Copenhagen, provides an example of how government can play an active role. DOLL is one of Europe's largest test fields and showrooms for smart-city solutions. The host municipality Albertslund, in collaboration with the Technical University of Denmark, non-profit association Gate 21 and several private partners, invites visitors from around the world to "experience the latest trends in intelligent urban development". The municipality provides an "innovative playground" that attracts tech companies, other municipalities and international investors.

Renewables Plus Smart Technologies Are the Key to Success

Increasing numbers of cities are showing greater interest in transitioning to 100 per cent renewables, but this alone will not deliver the optimisation needed to cut emissions. Electric vehicles will make up over half of all new car sales by 2040, and e-bikes, e-scooters, ride-sharing and other new commuter options are becoming a common sight; this is encouraging progress in the race to reduce city emissions. However, buildings are set to drive further increases in energy use as the global stock of air conditioners and heaters – of which cities are responsible for most installations – more than doubles by 2040. More batteries are being connected to the grid. Cities' energy landscapes will be fundamentally different, with new technology and new consumer behaviours. Renewables will contribute to decarbonising, but it will take smart technologies to deal with the complexities of a new energy landscape.

Figure 4 – 2020 renewable energy deals by US tech companies and cities, in gigawatts



Source: American Cities Climate Challenge Renewables Accelerator, Renewable Energy Buyers Alliance

Tech companies can provide a glimpse of what the future will look like. Large tech companies in the US, for example, are the largest renewable bulk-buyers, with the top two purchasers of renewable energy in 2020 exceeding the total bought by cities (see Figure 4). Yet these tech companies are increasingly deploying data-driven solutions to better manage renewables. Microsoft is already adopting a more granular approach to monitoring and making decisions on energy use. It recently launched its hourly energy-procurement strategy to ensure energy consumption in all its data centres is matched by a 24/7 clean-energy supply. Google announced it was making progress on a similar project a few months earlier. The trend here is towards achieving real-time or near real-time holistic visibility on energy use and emissions. This is what energy clocks will do for cities.

Institutions Will Need a Reboot

Energy clocks will face multiple barriers under current institutional setup. Political challenges are only one dimension. Concerns over data security, privacy, storage and use are another challenge to address. Coupled with these is the challenge of limited legislative authority. Cities operate within broader political contexts that can pose legislative and administrative limitations. In some cases, cities may have the capacity to enact new policies in support of specific climate interventions, such as New York City's Climate Mobilization Act. However, in many other instances, cities' legislative abilities can be limited.

From getting more actively involved with statewide policymaking to forming coalitions with other cities, cities will need to reboot institutional approaches to delivering smart tech programmes. Cities must also

take a whole-systems approach to planning – bringing together national, regional and local authorities, and all sectors such as buildings, waste, telecoms, gas, electricity, heat, transport, environment and so on. There can be no siloed working. Rather, multiple stakeholders need to work together, making their data available for the clocks. Finally, each city needs to define its own strategy for building energy clocks. Cities are different in many ways, from their energy-use profiles to the availability of high-speed, modern and secure telecommunications infrastructure. Their differences will impact how energy clocks are developed. While real-time data might be the gold standard for an energy clock, individual cities might find it more pragmatic to take a phased approach to building an energy clock, beginning with historical and static data sets.

Turning Data Into Action

Data-driven innovation is already shaping energy use and emissions in cities worldwide. Tech companies, utilities, fleet operators and other players are emerging with new solutions every day to decarbonise energy through digital technologies. The question is, will cities be proactive by coordinating fast and effective responses to align innovation with city priorities, or will they instead wait and react to the consequences of innovation?

For cities seeking to be at the forefront of the smart-energy revolution, these are the crucial next steps for administrators:

1. Develop a clear incentive structure for large-scale deployment of energy clocks to enable data access across the energy value chain, particularly in the building and transport sectors.
2. Engage utilities, tech companies and other key players with unique value propositions for emission reduction and innovation targets, backed with clear terms of reference.
3. Align protocols for interfacing with energy clocks for system interoperability.
4. Provide straightforward summaries of requirements for deploying solutions that are compatible with the energy clocks at scale.
5. Ensure transparency around third parties, data privacy and usage.
6. Develop enabler systems, such as pervasive wireless connectivity and secure open-data portals.
7. Embed smart energy systems across all public procurement functions.
8. Support promising innovation projects through open partnership models and open data.
9. Provide sourcing support for key resources, including access to skills, capital and partners.
10. Secure devolution of relevant infrastructure and governance powers while coordinating with national and state-level actors.

There is danger in taking a Panglossian view of smart technologies, but equally risky is the tendency to resist these technologies due to the implementation challenges. For progressive city leaders who recognise the importance of addressing climate change with decisive action, the question is not about *whether* smart technologies can help with emissions reduction or not; rather it is about how to best navigate these challenges. City leaders must therefore be willing to confront political barriers and follow the lessons learned from recent global experimentation with smart technologies to effectively deploy energy clocks. They are a critical component of the broader decarbonisation toolkit and a sure way to accelerate the transition to a cleaner future.

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