



THE SHINY CITY AND ITS DARK SECRETS: NANOTECHNOLOGY AND URBAN DEVELOPMENT

ARNIM WIEK and RIDER W. FOLEY

St Pancras station.
Image: Sam Lane/HST Ltd.

If you happen to have a stopover at St. Pancras Station in London, you will most likely recognize the enormous, sparkling-clean glass roof spanning 10,000 square metres and consisting of 17,000 glass panels. The glass is self-cleaning due to a nano-scale titanium dioxide coating. With its nano-coated roof completed in 2007, St Pancras Station has quickly become an iconic location for the synergies between nanotechnology and urban development.

Many more nanotechnologies are entering our cities, some of them with benefits to people and the environment. For example, nano-materials make buildings more resilient to stress and create cool surfaces; nano-layered photovoltaics enhance solar energy efficiency; self-healing nano-systems mend defects in transmission cables; nano-enhanced airbags improve mobility safety; nano-based filters remove pollutants from drinking water and air; and smart, multifunctional nano-devices can be used for urban navigation and planning systems. It is undeniable that such nanotechnologies create value by enhancing safety, reducing contamination and saving energy, materials and resources.

Proponents tirelessly point out the improvements that nanotechnologies make to urban conditions. Yet the benefits are often less significant and

widespread than envisioned, and they come at some cost. There is growing evidence that beneath the shiny surface, nanotechnologies hold some dark secrets. Nanotechnologies are almost exclusively developed to reap profits from commercial sales. They seldom distribute societal benefits equally. Some nano-enhanced products and their manufacturing processes have negative effects on human health and the environment. And it is rare that they are developed with input from people in need of improved living conditions. To exemplify this reality in the context of nanotechnologies in the city, let's get back to St. Pancras Station. While the roof's self-cleaning feature offers some benefits, critical questions include: where was the titanium dioxide extracted, refined and produced; were the workers exposed to the nano-particles; and were byproducts released into the local environment? What was the impact on the workers' jobs who cleaned the glass before? How is broken glass recycled or disposed of? Does the nano-coating erode from wind and rain, and where do the emissions go? As pollutants are more quickly cleaned off the glass surface, what is the impact on stormwater quality? Could the investment have been used for a program or project with broader societal benefits, in particular for vulnerable populations? Not all of these questions might lead to

negative outcomes when assessing the case of St Pancras Station. However, they explore the range of critical issues that need broader consideration and deliberation when nanotechnologies enter the city.

So, when it comes to whether nanotechnology is good or bad for our cities, research responds as usual: it depends. But here is good news: "it depends" means that urban planners, designers and responsible stakeholders can still impact how and what types of nanotechnologies enter our cities. This is a critical time because the pathways are still flexible, and modifications can be made before certain nanotechnologies become too entrenched in the city due to investments, policies and habits.

To successfully shape and navigate the development of "nano-enhanced" cities, we need, however, to adopt new urban practices and take on new responsibilities. First and foremost, the silent encroachment of nanotechnologies into urban environments needs to be replaced by openly deliberating about these technologies. Interest groups and the market do not sufficiently account for public interests that are often jeopardized by the deployment of technologies with ambivalent outcomes. This requires recognizing and considering technology as a key component of urban development. Therefore, urban planners, designers and responsible

stakeholders need to take into account lessons learned from failures in governing technologies such as genetically-modified organisms or nuclear energy. Deliberation, anticipation and a shift toward public interests are the key reference points of responsible nanotechnology innovation.

This calls for more engaged forms of nanotechnology development in cities. A broad range of engagement approaches have been developed with the intent to build nanotechnology literacy and support participatory decision-making throughout the innovation process. More recently, engagement practices that embrace the urban context in nanotechnology development have been added to this pool. With these modern democratic processes on the rise, nanotechnology innovation and governance in cities can become an exemplar for other urban issues that require foresight, mutual learning and collective action across the society.

Arnim Wiek is an Associate Professor in the School of Sustainability with an affiliation to the Center for Nanotechnology in Society at Arizona State University. Rider Foley is a Postdoctoral Researcher in the Center for Nanotechnology in Society at Arizona State University. For more information, please visit: <http://cns.asu.edu/research/trc-2-design>.

Further Reading:

For more information on the rapidly expanding spectrum of nanotechnologies applied in urban areas, the Nanotechnologies in City Environments database (<http://nice.asu.edu>) and the Nanotechnology in Architecture database (<http://nanoarchitecture.net>) are recommended.

For more on the research underpinning the key reference points of responsible nanotechnology innovation and supporting participatory decision-making, see:

Wiek, A., Guston, D.H., van der Leeuw, S., Selin, C., and Shapira, P. (2013). Nanotechnology in the city: Sustainability challenges and anticipatory governance. *Journal of Urban Technology* 20: 45-62.

Wiek, A., Foley, R.W., and Guston, D.H. (2012). Nanotechnology for sustainability - What does nanotechnology offer to address complex sustainability problems? *Journal of Nanoparticle Research* 14: 1093.

Governing Nanotechnology Responsibly in Cities

- Allow deliberation about future risks, benefits, beneficiaries, side effects, alternatives and other issues of nanotechnology development in cities.
- Build citizens' technology literacy, capacity for anticipation and willingness to engage with nanotechnology development in cities.
- Incentivize nanotechnology innovations that create benefits for the majority of citizens, and particularly for vulnerable populations.
- Shift emphasis from commercialization to social entrepreneurship in nanotechnology innovation in cities.
- Create regulations favouring more public, less private interests in nanotechnology innovation.
- Create active networks for exchange, learning and coordination across different sectors and stakeholder groups in nanotechnology innovation.