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The use of deep technology and innovation such as AI for cleaner, greener environments is one area where Singapore can excel. BY KAN SIEW NING, THOMAS MENKHOFF AND EUGENE KB TAN

THE prospects look promising for the deployment of artificial intelligence (AI) in the quest for a clean and liveable environment in urban settings. The use of deep technology and innovation such as AI is one area where Singapore can excel while also being the ideal test bed for such experimentation.

One of the salient points in Finance Minister Heng Swee Keat's recent Budget 2019 speech was the emphasis on a smart, green and liveable city. In particular, the Budget makes specific reference to "emissions abatement".

The government expects to collect carbon tax revenues of nearly S$1 billion in the first five years of its implementation. But, and more importantly, it is also prepared to spend an amount more than tax revenue collected "to support worthwhile projects which deliver the necessary abatement in emissions".

This fiscal nudge is timely because reducing emissions intensity and volume will lower particulate air pollution and simultaneously create beneficial health risk reductions.

Particulate matter (PM), many of which are hazardous, refers to the sum of all solid and liquid particles suspended in air. This includes organic and inorganic particles, such as dust, pollen, soot ("black carbon"), smoke and liquid droplets.

PM-induced pollution can result in chronic bronchitis or asthma and premature deaths as a result of cardiovascular problems or a stroke. PM2.5, for example, are inhalable pollutant particles measuring 2.5 microns and smaller in diameter – about a 30th the diameter of a human hair. These ultrafine particles are perilous because they can lead to a variety of health issues such as reduced lung function. Some may even be absorbed into the bloodstream.

The economic cost of particulate air pollution on health in Singapore is substantial. An earlier study conducted by economists Euston Quah and Wai-Mun Chia estimated the total health costs associated with particulate matter in the air at US$3.75 billion or about 2.04 per cent of Singapore's GDP in 2009.

Vehicles represent a major source of particulate matter besides carbon dioxide and other tailpipe pollutants, such as carbon monoxide, hydrocarbons and nitrogen oxides. According to data by the World Health Organisation, 92 per cent of the world's population live in places where air quality levels exceed WHO limits, resulting in millions of deaths every year. In 2012, 6.5 million deaths (or 11.6 per cent of all global deaths) were associated with indoor and outdoor air pollution according to WHO estimates.

While more cities are now vigorously monitoring air pollution, comprehensive and actionable baseline data for monitoring progress in combatting it are not always available. Measurements are often done selectively based on a limited number of measurement stations.

This makes it difficult to get reliable and valid environmental data, for example, about the sources of contaminants that could inform better policy-making for greener cities on the basis of real 24/7 insights. Reducing harmful emissions and clean air predictions require precise, intelligent and actionable measurement systems.

This is a pain point that can be addressed by harnessing the power of sensor technologies, Internet of things (IoT) and artificial intelligence. Through the computation of real-time IoT sensor data (with detailed spatial and temporal pollutant measurements) obtained from various sources such as ground-based sensor units and commercial satellites, user-friendly air quality heat maps and executive dashboards can be created (such as with the help of machine learning algorithms for predictive modelling) to determine the most severe pollution hotspots in order to take proactive steps towards further decarbonising the economy.

A 2016 photo showing Dr Erik Velasco from the Singapore-MIT Alliance for Research and Technology (Smart), with portable scientific air quality sensors he used in a study on air pollution at bus stops. BT FILE PHOTO

Examples of important use cases include tackling specific areas with higher concentrations of pollutants or leveraging (anonymous) crowd-sourced sensor data from cell phones to localise parts of the city which are harmful, with the aim of reducing one's own exposure to PM. Entrepreneurs keen to monetise air pollution data are well advised to do so on the basis of a digitalised business model that uses AI algorithms for creating green(er) and (more) liveable cities with better air quality via real-time assessment and management of outdoor air.

To stay ahead in the smart city race in an era of AI-enabled smart (urban) solutions, civil engineers, planners, regulators and green startups keen to fight against air pollution should possess basic AI know-how and know-why, over and above their expertise and experience in developing land use plans, revitalising urban precincts, making infrastructure services more accessible to disadvantaged segments of the population or creating a scalable business model.

Smart city development programmes will have to be quickly rebooted with an AI advantage in order to leverage new digital technologies, big-data analytics, and cloud computing for cleaner air and better public health. AI is arguably the new frontier of instrumented, environmentally-friendly smart city initiatives.

AI-powered computer vision analytics with facial detection systems, in combination with environmental sensors mounted on smart lamp posts, for example, could enable authorities to identify in real time where exactly air pollution occurs, who is causing it, and where remedial and preventive action is required.

As these systems are able to index faces to determine gender, race and age, as well as perform facial matching against databases, rule violations may become a thing of the past provided the ethics of such surveillance is feasible, guaranteed and accepted.

Current technological advances in the area of AI-enabled smart city systems suggest that intelligent air quality management systems may soon become fully autonomous in making decisions, for example, remotely turning off the (combustion) engine of a self-driving car which is polluting the environment.

The possibilities of smart, AI-enabled "emissions abatements" are indeed endless. Singapore should seek a first-mover advantage through large-scale deployment. The demand for clean, green, and liveable cities is growing in tandem with the deep concern over climate change and how it intimately affects the health of people and the living environment.

Emission abatements will require companies to respond to this massive societal challenge in a purposeful manner. It is also the ethical and socially responsible thing to do with significant benefits beyond the health outcomes and economic well-being. Companies have to reduce their environmental footprint, with governments and consumers requiring they do more to account for the negative externalities their business activities generate.

AI-powered emissions abatement can be a powerful lever towards an empirically-based targeted approach to dealing with environmental pollution and better public health. Singapore can and should exploit this window of opportunity to be a policy- and thought-leader in emissions abatement while spawning technological innovations to power the environmental drive.

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