HONG KONG

Few cities provide a more ideal setting to study the phenomenon of the urban heat island than Hong Kong. First of all, it is one of the most densely populated places on Earth, and also one of the richest. So Hong Kong's towering skyscrapers and extensive road network offer a true test of how modern urban development will shape local climates.

Second, and just as important, Hong Kong has historical climate data dating back more than 130 years, thanks to the Hong Kong Observatory. Nearly continuous temperature records have been kept since 1884 (save for during World War II), and several analyses of those records attribute much of the roughly 2° C (3.6° F) increase in average temperature to the heat generated through infrastructure development.

The trend is continuing, and may be accelerating. Indeed, a 2007 study by scientists at the Observatory predicted that by 2100, there will be less than one cold day a year (12° C or below), meaning that for some winters, there will not be any cold days at all, and winter could disappear in Hong Kong.

The island's location and topography play a role in how development is shaping the climate. Located at the entrance of the Pearl River Delta, Hong Kong is humid and subtropical. Its steep hillsides concentrate development onto the relatively few areas flat enough for high-rise buildings.

The tall, densely packed buildings are stifling street-level airflow, according to Observatory data.

Average wind speeds at a weather station on the mainland portion of Hong Kong (the area once called Kowloon) dropped from 3.5 meters per second in 1968 to two meters per second in 2014. The urban calm contrasts with the Observatory's remote Waglan Island weather station, southeast of the city, where wind speeds have been stable over the last 50 years.

The stagnant air is unable to disperse heat and pollutants, warns Professor Li Yuguo, who heads the mechanical engineering department at the University of Hong Kong. The combination of warmer air and lower winds is leading to what Li calls an "urban dome." His team found that, in the absence of winds, convective heat from individual buildings rose and formed a dome-shaped accumulation of warm air and pollutants above the city.

Some urban redesign may help alleviate the problem. Li, for example, suggests keeping secondary streets along northern Hong Kong Island wide and short to facilitate downslope windflow from the hills. Another option would be to keep the ground floors of tall buildings open, to promote air circulation at street level, though this would mean foregoing the valuable commercial real estate that now occupies much of downtown Hong Kong.

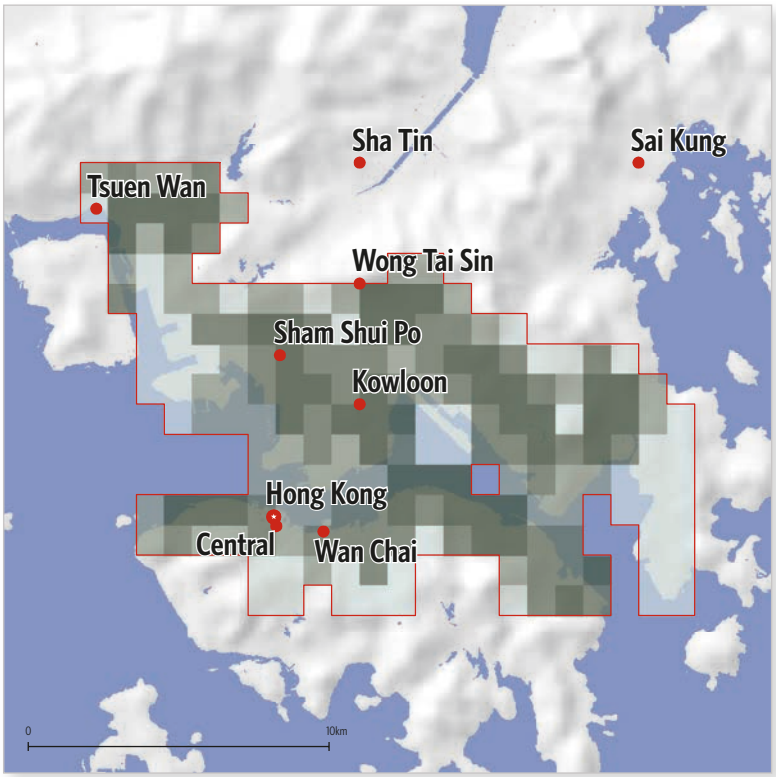
Government incentives could help prompt developers to provide better ventilation and make land pricing policies more flexible. They could also promote better use of Hong Kong's waterfront. In New York, another densely populated island city, all the streets run toward water and bring in cooler air. But Hong Kong's main thoroughfares run parallel to Victoria Harbor, so tall building close off the sea breeze from one direction, while the steep hills close off the other.

The news is not all bad for Hong Kong. Despite the dense population and the growing demand for buildable land, the city still boasts ample green space. Just 7 percent of Hong Kong is zoned for residential use. Parks, hiking trails, and beaches ring the city. Hong Kong's country parks cover about 40 percent of the territory's roughly 1,108 square kilometers of land.

While the parks are off-limits to development, at least for now, other green spaces may be more vulnerable. Hong Kong has set aside other greenbelt areas to act as a buffer against urban sprawl, but with land values skyrocketing the pressure to expand into those areas is intense. In 2015, the city's Development Bureau said the greenbelt areas were "suitable for urban expansion and thus have good potential to be rezoned for housing purposes."

As a high-density city, Hong Kong has a relatively high ROI of tree planting. Hong Kong is a fairly compact city, so the minimum mapping unit of our analysis (1 square kilometer) gives us relatively little detail into which neighborhoods in Hong Kong have the highest ROI. The compact size of Hong Kong also means that a small additional investment in street tree planting could have significant benefits.

Results from the Hong Kong study



Map 17. Neighborhood-level ROI for Hong Kong (temperature reduction).

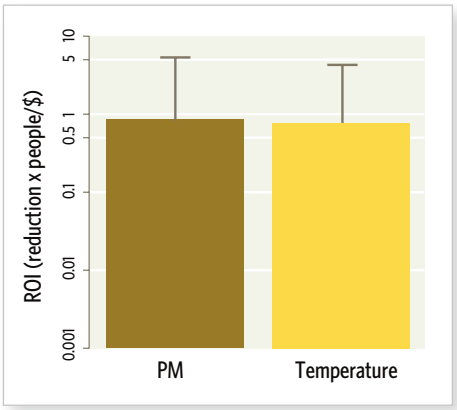


Figure 22. ROI for tree planting for Hong Kong.

Investment	Annual Cost ($)	> 1 ug/m² $PM_{2.5}$*	1.5 deg C
10% of sites	152,000	290,000	324,000
20% of sites	294,000	503,000	531,000
Full Investment	1,280,000	1,010,000	1,010,000

*Note: Most people will receive a reduction of > 10 ug/m² $PM_{2.5}$ in this city

Table 10. Temperature and PM reduction benefits under three investment scenarios for Hong Kong.

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