

To cope with surging populations, city planners are starting to look beneath their feet for space



As the world's population continues to rise, space is becoming scarcer, and cities are looking for new places to host their residents. For Singapore – the world's third most densely populated country and home to nearly six million people – the answer is to head downwards.

Climate change and rising sea levels mean that reclaiming land is no longer a sustainable option for Singapore. Instead, the country is looking to create an underground city. Earlier this year, Singapore's Urban Redevelopment Authority published its draft master plan, setting out what the next 15 years are going to look like.

So far, the equivalent of £10.7m has been invested in the research and development of underground tech. Laws have been changed regarding home ownership, so people only own the land as far down as their basement, to free up space beneath houses for development.

People won't be living underground at first, the authority says. Instead, the city will start by moving storage, utilities, transport and industrial facilities underground, freeing up space above ground for residential and commercial uses.

Currently, Singapore uses underground spaces for transport and cooling systems, which go down to 20m. A deep tunnel sewage system for transporting waste water and sewage is planned for 20m to 50m.

“For deeper space of more than 100m, more heavy-duty functions such as ammunition storage and caverns for petrochemical storage could be created,” says Sing Tien Foo, director of the Institute of Real Estate Studies at the National University of Singapore. One major planned development is the Jurong Rock Caverns, which can hold about 1.5 million cubic metres of crude oil and petroleum.

At the country's airport, Changi, a four-in-one transport hub will host three train depots and one bus depot by 2024, all underground. This will help the country to double its train network by 2030, with all additional railways underground. Moving transport beneath the surface will also help people to escape Singapore's weather, which is seeing rising heat, humidity and rainfall as a result of climate change.

In order to make the most of its subsurface environment, Singapore first needs to understand what's down there at the moment. Currently, Singapore's Building and Construction Authority is developing a 3D geological model using laser scanning, which will be collated into a central database to help map and plan the underground space.

Prof Kevin Curran, a cyber security expert at Ulster University, says that technology is going to be key in allowing this kind of eco-city to develop. For example, air quality will become an important factor that will need constant monitoring, as underground air isn't circulated as easily as air above the surface. “Sensor-enabled devices are already helping monitor the environmental impact of cities around the world, collecting details about sewers, air quality, and garbage,” say Curran.

Underground cities might have smart rubbish bins, for instance, which send an alert when they need to be emptied, and smart lighting,

which only comes on when traffic or pedestrians are approaching.

Although much of Singapore might be underground by 2030, it will be a little longer before people are living there. “Deep underground construction is costly,” says Foo.

Source: [ScienceFocus](#)

“There’s complexity associated with access, ventilation and fire safety.

“The use of the underground space for residential and commercial uses has not been planned yet,” he adds, “but the feasibility could be evaluated in the future, if more land is required.”