



URBAN SUSTAINABILITY THE SINGAPORE EXPERIENCE

The importance of green buildings, the circular economy, and zero waste.

Lee Chuan Seng, Chairman of the National Environment Agency (NEA) and the founding President of the Singapore Green Building Council (SGBC), speaks on urban sustainability, including his thoughts on ways to promote reduction and reusing of various components from the built environment.

Where do you believe Singapore's green building strategy has surpassed global benchmarks, and in which areas can the country continue to improve?

We can always improve, but where Singapore has done it differently is right at the beginning. In the early 2000s, we realised that developing green buildings is one way in which Singapore can lower its carbon footprint and achieve net savings from energy savings. In other words, you can save energy and water by making buildings green, and by doing so, you can also save on maintenance and running costs. So we embarked on the green building journey with a much broader national objective than many other countries. Why is there such a difference? Partly because in Singapore, the green building system was set up by a government agency—the Building and Construction Authority (BCA)—and it was looking to achieve national objectives, whereas in most other countries or economies, their green building journey was put forth by an NGO (non-government organisation), a green building committee, or a research organisation vested with a sustainability agenda.

A lesser-known aspect of our green building story is that Singapore at that time had just emerged from the Asian Financial Crisis in the late 1990s, and the real estate and construction sectors were still grappling with excess capacity. The industry was looking

for help. The authorities at that time assessed that the best way to help the industry was not in the form of giving handouts, but rather in giving it a leg up to climb the sustainability ladder, so as to acquire better technology and deliver better value. And so the Green Mark certification scheme was set up with this in mind. It was designed to be a calibrated system; we would initially go green with minimum energy efficiency standards for new buildings set to achieve a 30-percent improvement over the 2005 baseline. Every few years, this standard would be further raised. In this way, we help the industry to improve itself.

We then looked at what would be a better way of moving the needle for the whole market. If you look at many green building rating systems in other countries, they are after the development of iconic buildings. After all, when you say that “this building is super energy-efficient”, it grabs headlines. Whereas we were setting up our system as a regulatory process to not only help the industry climb the technology ladder, but also for Singapore as a whole to achieve its national target and manage its carbon emission goals. When

we aim to green 80 percent of our buildings, we are not just looking at the number of buildings. Instead, we are looking at the total GFA (gross floor area)—we aim to green 80 percent of that by 2030, and that is really the litmus test for energy consumption. Today, we have achieved close to 60 percent.

By focusing on performance, we zero in on efficiency—if you can reduce your energy consumption by a certain percentage, you can possibly save millions of dollars a year from reduced operating costs. This translates to a message that developers can understand because it hits their bottom line. In fact, you can save money by going green. For instance, if we are able to design large parts of a building by carefully shaping the openings on its façade, the airflow velocity should be comfortable enough to the extent that people can go without air conditioning. To achieve that, we do a lot of airflow simulation and work with architects to make sure that the sun shading and other design features are suitable. In this manner, one way in which I would say that we have surpassed benchmarks is that we are the ones setting some of the benchmarks now!

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Which recent innovations in green building technologies have caught your attention, especially if you have found them to be promising for Singapore's built environment in the near future?

The aim is to work towards higher energy efficiency using methods that don't contribute more to our carbon footprint and require greater usage of materials.

I find four key areas promising.

The first is to do with photovoltaics (i.e., solar PV panels), which in most of our buildings have only about 16 percent efficiency. In the last five years or so, the efficiency of PV panels has gone up to about 25 percent. One of the most common business models to generate solar power is under a solar leasing model—as the solar panel efficiencies go up, the solar leasing companies could swop their panels for higher

efficiency panels or even part ways through their lifespan. Almost doubling the energy generation will really move the greening needle. Having solar PV will also support buildings that are looking to be Super Low Energy/Zero Energy/Positive Energy.

The second one is smart building controls, which is the ability to put sensors and controls within individual equipment in buildings. The Internet of Things (IoT) is finally coming to the implementation stage. So given the availability of affordable sensors today, smart building controls can integrate many more sensors, providing enhanced personalised control. That means, for instance, individual workstations can sense and even set their own target temperature. There are also lower lighting levels in general and more task lighting. These kinds of controls will give us much better outcomes than what we had been able to achieve about three to five years ago.





The third area is hybrid air conditioning. There has been research done at Singapore's CREATE (Campus for Research Excellence and Technological Enterprise) in collaboration with leading global universities and research institutions. In one of the studies by the Berkeley Education Alliance for Research in Singapore (BEARS), it was found that if a workspace has air movement by virtue of a desk or ceiling fan, then the air conditioning thermostat can be set higher at 26°C or even 27°C (instead of the customary practice of setting it at 24°C) while maintaining or even improving occupants' thermal comfort. Simultaneously, for every 1°C increase in aircon temperature, we can expect about five percent in energy savings and five percent reduction in carbon emissions.

The last area is smart facilities management (FM). In the last five years, there has been a tremendous effort to send FM staff for training on maintaining and monitoring buildings with smart

controls. This would mean that instead of conducting routine scheduled maintenance, one can use sensors to monitor, say, lighting level or chiller performance, and conduct predictive and preventive maintenance instead. We are seeing increased adoption of robotics in FM operations, especially cleaning and security, as well as tapping of smart FM to meet corporates' ESG (environmental, social, and governance) reporting and net-zero ambitions.

What areas does Singapore need to work on when it comes to promoting the circular economy and moving to zero waste?

I think the way to go for circularity is not to prescribe how we are going to get the whole economy to be circular. Rather, we should drill down to the details and work layer by layer, industry

by industry to get it done. Take the construction industry as an example. Some waste types such as ferrous/non-ferrous metals, and construction & demolition debris are 99-percent recycled. The construction industry also uses the spent slag used by the marine industry for sandblasting, thereby recycling 99 percent of it.

We have stopped the dumping of construction waste in a landfill. When you want to demolish a building, you not only get an engineer to give you a plan on how to demolish the structures safely, but the contractor would also need to have a materials management plan on how to reuse or recycle the demolished materials. For instance, the steel bars that are in the concrete are extracted, smelted, and made into new steel bars. Aluminium frames and copper wires are collected, and mostly exported for processing as we do not have smelters for these in Singapore. All these are wonderful, and this part is circular.

But I believe we need to focus more on plastics, since only five percent of them are recycled. The recycling rate for food and textiles/leather too is low at 18 percent and two percent respectively. As for paper/cardboard, its usage has increased tremendously, especially after the COVID-19 pandemic because of the packaging used for deliveries and e-commerce, and only 31 percent of that is recycled.

One of the most serious problems we have with our recycling, especially from the point of collection at residential sites, is that the collected materials are

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typically mixed. But this is not the crux of the challenge, as we can sort them out at one point. The issue is that about half of the recyclables are contaminated by food waste. That makes it very hard for our workers to process everything else due to the smell and hygiene issues. We are nonetheless encouraged to see some improvement in household recycling—according to a recent survey conducted by NEA, 72 percent of households carried out recycling in 2023 compared to 64 percent in 2021. In addition, a higher proportion of survey respondents are aware of common items that can be deposited into recycling bins and chutes. NEA will continue with its outreach

programmes to work with members of the public to not only recycle more but also recycle right.

We also realise that asking the public to sort their waste into different types of recycling bins, just like what is being done in societies such as Japan, Taiwan, and Korea may not be efficient. We would have to send five trucks to collect five different types of materials and likely on different days. So back in 2019 when we launched our slogan of working towards a zero-waste and circular economy, we were actually working towards getting people not to contaminate the recyclables awaiting collection. We are also educating the people across different sectors who are generating waste.

Once we empty out Semakau Landfill, there would be space left there that can be converted into a transit storage and processing hub. We will segregate all the materials that come in based on the stage they may leave the landfill, which would depend on the demand for them. Hence these are very granular, multifaceted solutions that we will have to look at.

We are also still finalising the testing of the treated mixed material that had been dumped in Semakau Landfill. What we have been doing is sending the residues from burning our rubbish to this landfill. If we are able to treat the residues further and convert them to artificial rock for land reclamation, then there will be no more waste left. Perhaps we should call it NEARock! If we succeed, then Singapore can become a truly zero-waste nation.

As an aside, we are really happy with what fellow Singaporeans have accomplished with food tray returns at the hawker centres! The initiative to encourage diners to clear their used trays and crockery began in September 2021, and by April 2024, the average tray and crockery return rate had gone up from 65 percent to 93 per cent. We did not enact new regulations and used only the existing anti-littering ones, and it has been such a success story. We have been so successful on that front that you even hear stories of Singaporeans being spotted returning trays when they travel to other countries!

How does a leader build his or her policy thinking on sustainability? Could you share with us some of the things you have done in developing your strategic mind around this matter?

There is no choice but to read very widely and have a lot of interactions with people to know what is possible and what is not. You need to really pay attention to details, because it is no longer possible for leaders today to set out ideas in broad brush strokes. You need to know your material, your area, the solutions, and be able to see the linkages among different things that could create value and the incentives for people to go that way, since that's what you're trying to lead them towards.

This is especially true in sustainability because it is an area where many have strong counter-

arguments and contrarian views. So you need to be well-informed such that if the counter-arguments presented are false or misleading, you can explain and convince the other person of your thinking. If the counter-argument actually has substance, you should be able to evaluate it so that after you are persuaded by it, you can move to a higher plane of understanding. Do not be afraid of a discussion or a debate.

Besides paying attention to details, you also have to make sure that the commercial model works. You may have the science and the research, but in the end, what drives adoption is the commercial value. There are also a host of social and behavioural factors involved. Hence, the technology may work well, but if it doesn't gel with how people feel about it, it may fail.

At the same time, it helps to involve agencies that are able to move the market. For instance, back in the early 2000s in the private sector, we tried for years to get people to change from using the older fluorescent tubes to the more efficient new fluorescent ones which are thinner. But we couldn't shift the market because Singapore's private residences made up a minority of the total residential market. But when the Housing & Development Board (HDB), which is responsible for public housing in Singapore, said that it was going to use these more efficient lights for all the HDB block corridors, that finally moved the market. Suppliers started importing competing brands, and the price

premium dropped from around 50 percent to about 20 percent. Eventually, nobody bought the old larger diameter fluorescent tubes and new thinner fluorescent tubes became the norm. It is now happening with LED lights too. The same thing happened when HDB decided to adopt solar panels and allowed the market to go into a leasing mode. Immediately, the scale expands dramatically, and projects become very bankable. So if you want to be a business leader, you must think through your processes to ensure they are commercially feasible.

A leader needs to think out of the box by looking at the different aspects of not just technology, but also business models, and have the ability to reorganise and reject potential solutions based on the different marginal costs. To get people to buy into sustainability solutions and green mark buildings and the like, we need to introduce the solutions in steps. If we do so, it challenges the better designers and contractors to design and construct them. And then the leading companies must share their learnings. At the same time, the authorities must ensure that they revise regulations very carefully, so that there is a level playing field. It cannot be just a few who are doing it. Only when everyone is doing it can the market be sustained. [LMM](#)