

What could *long-term sustainable*  
public housing look like?



Knight  
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# 1 Introduction

- A rechargeable electric toothbrush. A simple enough low-tech everyday device. For the typical entry-level range of electric toothbrushes that is carried en masse on the shelves of supermarkets and pharmacies in Singapore, users are not able (and usually not allowed) to change the rechargeable battery themselves when its efficacy runs down after a few years, nor can they easily access the battery compartment to remove and properly recycle the used lithium-ion battery. Therefore, individual users and ordinary households have little option but to throw away these bits of plastic, laced with metal and circuitry (all wrapped up in an unusable electric toothbrush) every few years, adding to the pile in the plastic/electric waste heap.

Now multiply the humble electric toothbrush with mobile devices, smartphones, computers, and so on and so forth, tonnes of plastic and recyclable materials end up in landfills. In the early days of smartphones, batteries were replaceable through removeable casings. However, with big industry needing to continually fill supermarkets, home appliance store shelves and e-commerce platforms with new product, the life cycle of personal devices appears to be shortened such that manufacturers can maintain sustainable (irony intended) consumer pipeline demand for such goods. It is damaging planet Earth and not very environmentally-friendly, but that also does not stop long queues of hopeful consumers from camping out overnight whenever a new version of some prestigious smart device is launched annually.

## WHAT COULD LONG-TERM SUSTAINABLE PUBLIC HOUSING LOOK LIKE?



Do we need new gadgets and appliances every few years at the cost of the environment? If the human race is not able to innovate and provide for the reuse, recycling and prolonging of a humble electric toothbrush's useable lifespan, such that overall waste is reduced, what more when this is applied to the larger physical masses within the ambit of real estate and the built environment?

In 2021, building operations made for 30% of global final energy consumption and 27% of total energy sector emissions (8% being direct emissions in buildings and 19% indirect emissions from the production of electricity and heat used in buildings).<sup>1</sup> Especially in urbanised Singapore where more than 70% of residences take the form of public housing (Housing and Development Board - HDB) blocks, comprising about 10,000 buildings.<sup>2</sup> HDB not only has to house the majority of the population, but also has a contemporary mandate to ensure that public housing supports Singapore's sustainability efforts.<sup>3</sup>

And then there is the added critical challenge of the decaying leases of the 99-year tenures of these blocks. Almost all HDB dwelling units have a 99-year leasehold tenure and according to the HDB Annual Report 2021/2022, it is estimated that around 45% or slightly over 550,000 units were built in the two decades between 1971 to 1990.<sup>4</sup> Therefore, in around 40 to 50 years to come, massed numbers of HDB units will have their tenures drawing down to zero, with each and every five-year period following 2071 chalking up an additional 100,000 more units (or over an estimated 1,000 blocks) with expiring leases.

There are just 50 years to plan and test a sustainable model that would work on such a national/islandwide scale before a substantial number of households might become insecure enough to cause imbalance and instability in the public housing market.

<sup>1</sup>2022 Global Status Report for Buildings and Construction, 2022, International Energy Agency, page 26, <https://globalabc.org/sites/default/files/inline-files/2022%20Global%20Status%20Report%20for%20Buildings%20and%20Construction.pdf>  
<sup>2</sup> HDB, Public Housing - A Singapore Icon, n.d., <https://www.hdb.gov.sg/about-us/our-role/public-housing-a-singapore-icon>  
<sup>3</sup> Ibid  
<sup>4</sup> HDB, Annual Report 2021/2022, 2022, "Key Statistics", <https://assets.hdb.gov.sg/about-us/news-and-publications/annual-report/2022/ebooks.html>

## 2 HDB Initiatives in The Past Decades

HDB has, since independence, pioneered several initiatives to improve the quality of existing residences alongside the development of new homes, blocks and estates. The following sections provide a brief review of some of these key initiatives.

### a) Selective En Bloc Redevelopment Scheme (SERS)

The SERS programme was launched in 1995, where HDB demolished old public housing blocks so that the land can be better-utilised with new higher density developments. Affected residents are provided with compensation and have first right of refusal at newly developed HDB flats in the vicinity.<sup>5</sup> These affected residents are required to surrender their existing homes once the replacement units are ready for occupation.<sup>6</sup>

After more than 27 years of SERS in Singapore over various precincts, HDB flat dwellers have not only become used to the notion of moving out of their homes for an upgraded newer version, but have also registered high levels of satisfaction based on surveys conducted by HDB.<sup>7</sup>

But surely HDB is not going to, nor will it be possible to tear down thousands of blocks of public housing and rebuild from scratch in the years running up to 2071?



<sup>5</sup>Fernandez, W., 2011. Our homes: 50 years of housing a nation, Singapore: Published for the Housing and Development Board by Straits Times Press, pp. 169, 172.  
<sup>6</sup>HDB, Your SERS Journey, n.d., <https://www.hdb.gov.sg/residential/living-in-an-hdb-flat/sers-and-upgrading-programmes/sers/your-sers-journey>  
<sup>7</sup>HDB, SERS Survey, <https://www.hdb.gov.sg/residential/living-in-an-hdb-flat/sers-and-upgrading-programmes/sers/thumbs-up-for-sers/sers-survey>

### b) Upgrading

Before any solution can be found, it is worth mentioning that HDB has a broad and lengthy track record of upgrading existing residential blocks and estates. HDB towns have also evolved across the years from nation building to maturity, from being just purely functional residential neighbourhoods to fully equipped estates with distinct identities, characteristics, and more recently with sustainable features.

The main upgrading programme (MUP) introduced in 1989 aimed to bring older HDB units, entire blocks and whole precincts up to date with newer towns, thereby maintaining its value and utility for a longer duration over the life of the 99-year tenure.<sup>8</sup> Selected flats were fitted out with a space-adding component, while communal facilities and other amenities such as lifts and lift lobbies, carparks, landscapes and recreational facilities were also upgraded or newly constructed.<sup>9</sup> Since then, the MUP has been discontinued, replaced by the Home Improvement Programme (HIP).<sup>10</sup> The upgrading programmes by HDB proved that it is possible to make extensive physical improvements to existing units, blocks and locales, without the need to demolish and restart from scratch in order to provide better homes for residents.

For example, in the earlier blocks of HDB flats in older estates, lifts did not typically access every floor. The lift upgrading programme (LUP) became widespread to provide convenient access to home units to cater to the disabled and elderly individuals, as well as families with young children.<sup>11</sup> However, certain blocks might not have been designed with lift shafts that could access every floor. HDB overcame this challenge by constructing new lift shafts and infrastructure there are external to existing buildings, essentially cladding old designs with new facilities, showing the engineering ingenuity that made it possible to build around and about an existing structure despite the limitations of outdated designs from a previous era.

As a result of the success of HDB's upgrading programmes in the past three decades, HDB now enjoys widespread acceptance of this practice where HDB dwellers are unlikely to object too much to future attempts where their real estate is recovered, reused and recycled for long-term liveable and sustainable objectives.

### c) Sustainable HDB Towns

To-date, HDB's most ambitious drive on the sustainability front is Tengah new town, specifically designed at the start with smart technologies town-wide with a focus on green, sustainable features and community-centric spaces.<sup>12</sup>



<sup>8</sup>Fernandes, pp 160, 168  
<sup>9</sup>Sim, C., Estate Renewal Strategy, Singapore Infopedia, [https://eresources.nlb.gov.sg/infopedia/articles/SIP\\_2014-11-10\\_113032.html](https://eresources.nlb.gov.sg/infopedia/articles/SIP_2014-11-10_113032.html)  
<sup>10</sup>Ibid  
<sup>11</sup>HDB, Lift Upgrading Programme (LUP), n.d., <https://www.hdb.gov.sg/residential/living-in-an-hdb-flat/sers-and-upgrading-programmes/upgrading-programmes/types/lift-upgrading-programme>  
<sup>12</sup>HDB, Tengah, n.d., <https://www.hdb.gov.sg/about-us/history/hdb-towns-your-home/tengah>

### 3 The Future

HDB has come a long way since it was first set up in 1960 to address Singapore's housing crisis in the early days of independence and nation building.<sup>13</sup> HDB has gone on to pioneer upgrading in many forms, improving individual units, whole blocks as well as estates. HDB has also pioneered the limited greening of existing neighbourhoods with HDB Greenprint,<sup>14</sup> and sustainable towns with Punggol Eco-Town and the forward-looking ambitious plans it has for Tengah.

The challenge for the future could now take the shape of combining and consolidating all the above successes that HDB has had, both in the past and present. The challenge would be to continue to house Singapore's population, while upgrading, greening and prolonging the life span of the HDB blocks.

Architect Carl Elefante coined the phrase, "The greenest building is the one that is already built".<sup>15</sup> Rejuvenating old buildings to infuse them with new life would avoid the carbon emissions released by the process of demolishing and rebuilding.<sup>16</sup> After all, buildings already embody huge amounts of investment in energy, material, and finances. Retrofitting and upgrading existing buildings to improved levels of sustainability could be the most sustainable approach to meet Singapore's net zero goals by 2050<sup>17</sup> as HDB blocks comprise a large proportion of the country's built environment.

<sup>13</sup>HDB, HDB History and Towns, n.d., <https://www.hdb.gov.sg/cs/infoweb/about-us/history>

<sup>14</sup>HDB, HDB Greenprint, n.d., <https://www.hdb.gov.sg/cs/infoweb/about-us/our-role/smart-and-sustainable-living/hdb-greenprint>

<sup>15</sup>Elefante, C., n.d., The greenest building, <https://carlelefante.com/insights/the-greenest-building-is/>

<sup>16</sup>Teh, S.N., 2021, "Green buildings: Why the benefits of retrofitting outweigh the costs", The Straits Times, 15 August

<sup>17</sup>Elefante, The greenest building



## 4 What if...?

### *A Few Humble Suggestions*

#### **The Modernisation**

What if, instead of upgrading or designating a precinct for SERS, HDB decants these blocks of existing occupiers, strips the non-structural material for re-use and adds a full suite of sustainable features? While this goes beyond just upgrading work, it would not be a total redevelopment of a precinct marked for retrofit. The foundations and structures can be recovered for reuse – in effect, a modernisation of obsolete HDB blocks and precincts. An example from the private sector would be the redevelopment of the former AXA Tower in the Downtown Core, where the entire existing foundation will be reused, and the new tower will be built with sustainable materials to minimise material use and environmental impact.<sup>18</sup>

A possible way to bring this idea to life is to develop a precinct of residences that would serve only as temporary housing for the number of months to possibly more than a year that it would take for the modernisation to complete, housing the displaced residents. This temporary housing precinct can then be used to cycle through different subsequent batches of affected residents each time any old precinct undergoes modernisation.

Another option would be to offer the affected residents new Build-To-Order (BTO) or Sale of Balance Flats (SBF) units. Once all residents have vacated the precinct, HDB can start the modernisation, and after completion, sell the units in the modernised precinct as new BTO units to Singaporeans and Permanent Residents (PRs) without incurring the carbon cost of demolition and “build-from-scratch” redevelopment.



<sup>18</sup>Soh, R.M., Perennial-led consortium secures S\$3b real estate green loan, 2022, The Business Times, 17 November

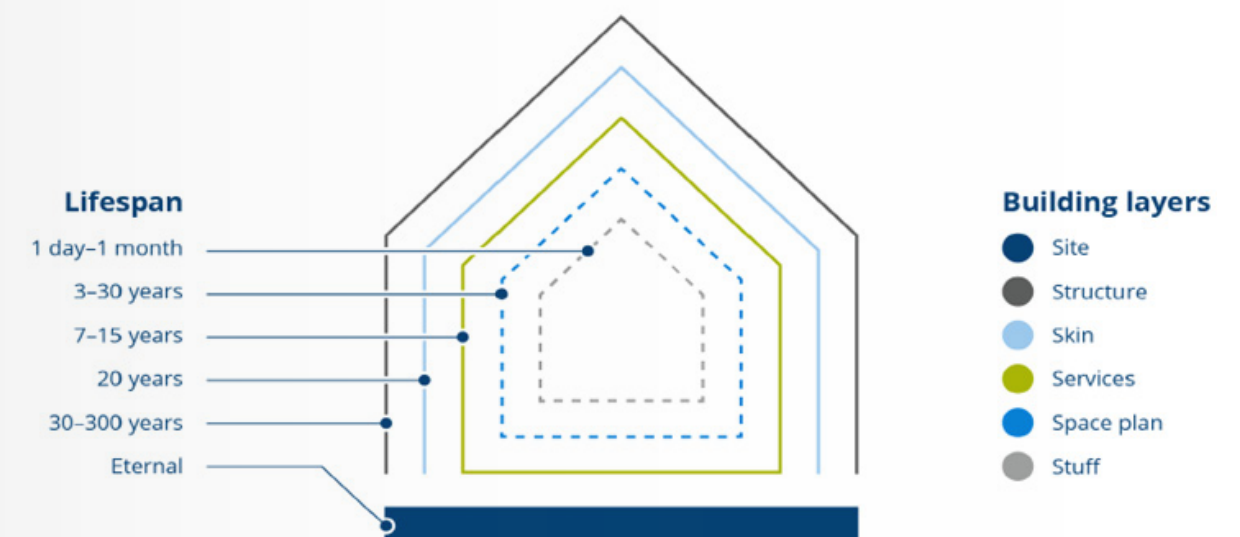
Work can then start on the emptied flats and the entire precinct in a comprehensive manner that can include, but is not limited to, the innovations that HDB has already planned for Tengah and other HDB towns such as:<sup>19</sup>

- Smart-enabled homes for energy monitoring and savings,
- Centralised cooling system,
- Vertical and horizontal solar photovoltaic panels,
- Pneumatic waste conveyance system,
- Electric vehicle charging,
- Natural wastewater treatment using bioswales and bioretention basins to collect and cleanse rainwater before storage or re-direction to reservoirs,
- Biophilic features incorporating a nature-centric neighbourhood,
- Car-free living environment,
- Clustering of residential with ancillary retail and recreational facilities, reducing motorised transport, and increasing green infrastructure with walking and cycling paths that run through parks and green connectors.

At the same time, the following improvements should also be incorporated:

- Non-structural portions of the building to be hollowed out and the materials reused as recycled building material as part of the process of modernisation,
- Use of replacement materials that are low carbon,
- New electrical, water, sewage and communications services to be installed,
- Risers and vertical shafts needed to house new infrastructure (such as centralised cooling systems) to be added to existing ones, just as lift shafts were created to house new lifts systems under LUP,
- The layout of the individual units to be updated, as well as entrances to units being adjusted,
- The internal space of units to be made flexible such that end-users have some prerogative to layout rooms on their own,
- Senior-friendly features such as grab bars and ramps to be installed,
- Identifying elements of a building with shorter lifespans and access to these elements for maintenance or replacement purposes to be included in the modernised design of the building (Exhibit 1).<sup>20</sup>

#### **Exhibit 1: Shearing Layers Model**



Source: Adapted from Brand, 1994

<sup>19</sup>HDB, Live Green, n.d., <https://www.hdb.gov.sg/cs/infoweb/about-us/history/hdb-towns-your-home/tengah/live-green-at-tengah>  
<sup>20</sup>Brand, S., 1994, How buildings learn: what happens after they're built. New York, NY: Viking

Where possible, salvaged materials or those with recycled or renewable bio-based content such as timber, bamboo, straw and mycelium with lower carbon compositions can be considered instead of the modern construction materials such as steel, concrete, aluminium and glass which have high embodied carbon.<sup>21</sup>

**Exhibit 2: Cradle to Gate Embodied Carbon of Various Building Materials<sup>22</sup>**

| Material Type          | Carbon Dioxide Emission kg per M <sup>2</sup> | Range of Carbon Dioxide Emission kg per M <sup>2</sup> |
|------------------------|-----------------------------------------------|--------------------------------------------------------|
| Rammed earth           | 48                                            | 40-170                                                 |
| Softwood timber        | 110                                           | 1-480                                                  |
| Cross laminated timber | 219                                           | 160-320                                                |
| Stone (in general)     | 237                                           | 60-2,100                                               |
| Reinforced concrete    | 635                                           | 120-1,370                                              |
| Glass (in general)     | 3,600                                         | 2,300-5,100                                            |
| Steel section          | 12,090                                        | 7,600-28,000                                           |
| Aluminium              | 18,009                                        | 2,400-58,000                                           |

Source: Circular Ecology, Embodied carbon footprint database

Any retrofitting exercise of such scope to modernise buildings will be challenging with many complicated technical considerations. In addition, the immediate economic cost of such a venture might very well be higher than demolishing obsolete buildings and redeveloping due to the complexity. However, more important considerations such as the total useable and sustainable life of the building and living spaces over generations of human users should have greater priority as opposed to traditional financial austerity – especially if greater ESG (Environmental, Social and Governance) ideals are to be achieved.

Despite the expected higher cost, the success of such a nationwide programme would make pioneering inroads that foster a circular economy<sup>23</sup> in the housing sector and the built-environment. This would contribute significantly to the Singapore Green Plan 2030 as the country endeavours to be a zero-waste nation.<sup>24</sup>

<sup>21</sup>Circular Ecology, n.d., Embodied carbon footprint database, <https://circularecology.com/embodied-carbon-footprint-database.html>  
<sup>22</sup>Ibid  
<sup>23</sup>What is a circular economy?, Ellen MacArthur Foundation, n.d., <https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview> - In the current linear economy, materials are taken and used from the planet, while in a circular economy, economic activity is detached from the consumption of finite resources with the use of renewable energy and materials. A circular economy is driven by the three design principles of waste elimination, circulation of material and regeneration of nature.  
<sup>24</sup>Singapore Green Plan 2030, n.d., <https://www.greenplan.gov.sg/key-focus-areas/sustainable-living/>



### The Methods

HDB could embark on such a groundbreaking undertaking, so as to set an example that the private sector can model after. After all, HDB has always recorded net deficits year after year before government grant, for the good of the nation. The most recent was in 2021, where the deficit doubled to a record S\$4.4 billion due to the increase in development projects as well as rising construction costs.<sup>25</sup> The financial outlay of the first few projects that would be the testbeds of this new housing and sustainability initiative would likely be substantial. Nevertheless, there are possibilities that with lessons learnt, processes streamlined and technologies researched, studied, applied and improved upon, savings and efficiency will increase with each subsequent project to green old precincts.

With this modernisation and greening of precincts, HDB would have within its arsenal the following broad programmes to keep Singapore housing up-to-date:

- SERS – where the enbloc redevelopment of certain precincts can be assessed as the best course for rejuvenation given that it might be technically prohibitive to reuse existing buildings, or else, overarching land use plans and national vision require a change of use or an enhancement in development intensity that using the structures of old buildings is deemed totally untenable,
- BTO – the development of new HDB estates in areas such as Paya Lebar Airbase once the land is released by the military and freed up for development, and the Great Southern Waterfront,
- Modernisation and greening of existing precincts.



<sup>25</sup>Lim, R., 2022, "HDB posts record deficit of S\$4.4b in FY2021", The Business Times, 31 October

**The Tenure and the Financing**

The subject of the decaying leases in 99-year HDB flat tenures is a sensitive and complicated one. If a generation is defined as all the people born and living at about the same time, regarded collectively, this would reflect an average period of between 20 to 30 years where children are born and grow up to become adults and begin to have children.<sup>26</sup> If a 30-year average is taken as one generation, then the useable life of a 99-year leasehold tenure would roughly consist of three generations.

Perhaps the HDB blocks that are fast approaching a remaining balance of one generation should be among the first to undergo modernisation and greening. And the earlier the better... for practical reasons of finance.

HDB has a Lease Buyback Scheme (LBS) where HDB owners are able to monetise their flat to receive a stream of income during their retirement years, while continuing to live in it. This is by selling part of the flat's lease to HDB and choosing to retain the length of lease based on the age of the youngest owner.<sup>27</sup> Using the same method of assessing the remaining value of the flat based on the remaining years of lease as measured by market value, HDB could use this remaining value of an existing flat to offset against the cost of a new BTO unit, a new SERS unit or a modernised and greened unit. In the case of modernisation and greening, this amount might need to be augmented with other forms of government assistance as well as the flat owner's own financial resources to purchase the retrofitted unit from HDB. A mix of compensation (similar to SERS) as well as subsidies might have to be included to fund the new flat and also the topping up of the lease to a fresh 99-year lease. The faster HDB is able to implement such a plan, the higher the number of remaining years left in existing flats that can be harnessed to assist in financing the modernised and greened replacement unit.



**5 Concluding Remarks**

HDB's role is changing. It is now different after having housed the entire nation which was its primary objective in the first 50 years since independence. The new imperative going forward should be to re-house a nation with new and sustainable housing. And at its core, lies the original soul of Singapore – the foundations and structures that brought the nation from a housing crisis to a model that other countries look to emulate. HDB now has another chance to make a mark on how old homes can not only be made new, but also sustainable.

Although a very challenging undertaking, when broken down into individual parts, the greening and modernising of existing precincts is not something entirely new to HDB. It is more a matter of HDB combining the best of everything that it has done in the past and in the present (developing new flats, upgrading old flats, developing sustainable towns, etc), into something that would be game-changing for the future... for the future of Singapore residents.

It might not be feasible for all or even the majority of current HDB homes to undergo sustainable modernisation. However, if a substantial minority of HDB blocks were able to successfully make the transition, it would go some way towards achieving Singapore's national sustainability goals and net-zero targets, creating a circular economy within the public housing sphere and providing a meaningful model that would redefine “redevelopment” in the ESG era to preserve Mother Earth.

<sup>26</sup>Generational Insights and the Speed of Change, American Marketing Association, 2022, <https://www.ama.org/marketing-news/generational-insights-and-the-speed-of-change/>  
<sup>27</sup>HDB, Lease Buyback Scheme, <https://www.hdb.gov.sg/residential/living-in-an-hdb-flat/for-our-seniors/monetising-your-flat-for-retirement/lease-buyback-scheme>



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