Towards a greener future, the use of public transport, particularly the public transit system, is regarded as a highly sustainable means to go out and about the city-state of Singapore, compared to using private vehicles. Still, operating the Singapore Rapid Transit System (RTS) which comprises stations and trains involves high energy requirements and contributes to the total carbon footprint.

Under the Land Transport Masterplan 2013, the rapid transit rail network is set to double from 178km today to about 360km by 2030, pointing to likely increases in energy use and related greenhouse gases emissions!

To minimise the environmental impact of the RTS and to reduce energy demand in the operations, the Land Transport Authority (LTA) has invested in a range of strategies and design features to maximise energy efficiency across the RTS infrastructure.
A paper by LTA published in May 2012 *Energy Efficiency in Singapore’s Rapid Transit System* describes the major energy efficient characteristics of the RTS – from station and train design to railway lines to operational strategies, including how the trains are being driven.

### Electrical Systems & Energy Regeneration

1. Did you know that up to 5% of total energy used by the RTS is the excess regenerative energy recovered from the braking of trains as they come to a stop at stations? Inverters installed in the RTS recover the regenerated energy which is then channelled back for use within the station premises.

### Lighting System

2. The design of station lighting is aligned with the Singapore Standard SS530 or Energy Efficiency Standard for Building Services. Strict lighting power budgets are stipulated for different functional areas. For station entrances, leveraging on natural lighting is the first option as a means to reduce lighting energy consumption. In general, where lighting is required, energy efficient lighting such as T5 fluorescent or LED lighting is always considered.

### Air Conditioning System

3. Given the prevailing hot humid weather conditions and the need to offer commuters with a certain degree of thermal comfort, the underground stations are equipped with air-conditioning. There is no doubt this is a major energy consumer. Hence, to reduce energy use from the need to draw fresh air supply in to the stations, carbon dioxide (CO2) sensors are installed that monitor air quality and to automatically adjust fresh air supply only when needed.

4. In addition to having CO2 sensors, chiller plant efficiency for the air-conditioning system in each station is also improved by specifying a standard higher than stipulated in the SS530 for the RTS. Variable speed drives for the chilled water pumps and cooling towers act to cut energy use by up to 0.4 per cent in station power consumption.

### Control of Escalators

5. During extended periods outside peak travel time, when the escalator is operating at low load or no load, it is able to reduce speed or even come to a stop. Through an energy saving device, such as an inverter system, the escalator can slow down from 0.75m/s to 0.2 m/s. The feature is estimated to save up to 30 per cent in energy use.

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**Figure 3:** An auto-speed reduction system during low load or no load by the escalator saves up to 30 per cent in energy use

*Photo of Bras Basah Station by RaphaelChen on Flickr*
**Weight Management**

6. Less weight means less energy used. Managing the weight of the passenger vehicle or train carbody through the choice of the material plays a vital role in determining the energy consumption of the vehicle. The adoption of an aluminium alloy which is light, yet strong, has reduced carbody weight significantly. For trains of the newer Circle Line, even more weight has been saved by using less glass, skeletal cable trays, and lighter seat designs.

![Photo of train interior by Scintt on Flickr](https://scintt.com)

**Energy Efficient Driving**

7. Trains in the RTS are driven in an energy efficient manner. To minimize propulsion energy requirements, the highest possible acceleration and deceleration rates are required. As coasting saves a significant amount of energy, it follows that the energy efficient regime has the trains start at a high acceleration rate extending over a short period, followed by a longer coasting period and then a braking period at a high deceleration rate. This minimises power consumption for any given speed.

8. The energy efficient driving practice is complemented by the use of hump profile in the alignment and design of the RTS tracks. The use of the hump profile reduces energy requirements for braking and accelerating by slowing the trains as they enter the station on the upgrade, and facilitate acceleration when departing on the down-grade.

![Figure 5: The hump profile - used to reduce energy used by trains for braking and accelerating - is achieved by raising the station above the inter-station alignment.](https://example.com)
**Green Mark for RTS**

9. In recent years, LTA has been working with train manufacturers and suppliers to improve energy efficiency of the RTS. The Green Mark for Rail Transit System framework has been developed with the Building and Construction Authority (BCA) and provides a benchmark for energy efficient design that meets the performance and operational requirements of RTS networks.

With an extensive and expanding rail transit network to keep up with Singapore’s transport demands and needs, making the rail transit system more energy efficient is a very important component to managing the environmental impact as well operations costs for the long-term.

![Figure 6: The Green Mark for Rail Transit System framework provides a benchmark for energy efficient design of the RTS networks](Image)

*Photo of rail network by Scint on Flickr*

The paper *Energy Efficiency in Singapore’s Rapid Transit System* authored by Land Transport Authority engineers Messrs Melvyn Thong and Adrian Cheong, from which this article has been adapted, is available for download at


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