

# Singapore Green Bond Report



For the Financial Year 2022



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## 1. Foreword

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### **Indranee Rajah**

Minister in the  
Prime Minister's Office

Second Minister for  
Finance and National  
Development

Chair of the Green Bond  
Steering Committee

Climate change is the defining challenge of our generation. The world needs immediate and deep reductions in emissions across all sectors to have any chance at limiting global warming to 1.5 degrees Celsius. Sustainable finance plays a pivotal role as a catalyst for decarbonisation to tackle this climate crisis.

The Singapore Government has been developing the sustainable finance ecosystem in Singapore, to mobilise financing to catalyse Asia's net zero transition and decarbonisation activities in Singapore and the region. As part of this, we developed the Singapore Green Bond Framework and issued our inaugural sovereign green bond – the Green SGS (Infrastructure) bond – in August 2022. The green bond proceeds will finance projects that are aligned with the Singapore Green Plan 2030, a whole-of-nation movement to advance sustainable development. These projects will facilitate Singapore's transition to a low-carbon economy, and put us in a better position to achieve our climate goals under the Paris Agreement and commitments under the United Nations' Sustainable Development Agenda.

The Government is committed to a credible, high-quality framework for green bond issuance, and reporting is a key part of this endeavour. I am pleased to present this first edition of the Singapore Green Bond Report, which accounts for how the Government allocated the proceeds of the inaugural S\$2.4 billion Green SGS (Infrastructure) bond and the expected environmental impact this will make.

In Financial Year 2022, the green bond proceeds were allocated to the development of electric rail projects, for the construction of the Jurong Region Line and the Cross Island Line. The expansion of our electric rail network is a key enabler to achieve our ambitious goal of significantly reducing land transport emissions in absolute terms, in alignment with Singapore's target to achieve net zero by 2050.

The report also sets out the expected environmental impact arising from green expenditures financed by the Green SGS (Infrastructure) bond. The Ministry of Finance has engaged an independent consultant, Morningstar Sustainalytics, to develop a methodology to compute the avoided greenhouse gas emissions and air pollutants, as a result of investments in the electric rail projects. We have engaged PricewaterhouseCoopers LLP to undertake a limited assurance in respect of the allocation of proceeds as at 31 March 2023 raised through the issuance of the Green SGS (Infrastructure) bond.

I hope that you will find this report insightful. We welcome feedback that can help improve our future green bond issuances and reporting, and further collaborations with like-minded partners towards a more sustainable future.

## 2. Executive Summary

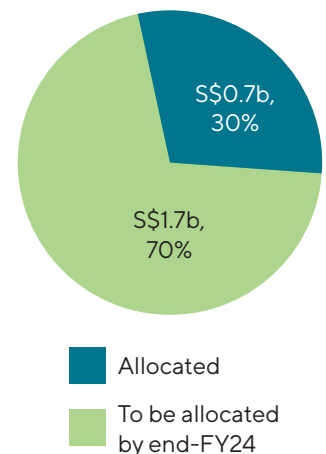
The Singapore Green Bond Report covers the allocation of proceeds from Singapore's inaugural sovereign green bond (i.e. Green Singapore Government Securities ("SGS") (Infrastructure) bond) issued under the Singapore Green Bond Framework. The framework was published in June 2022. This report also provides the expected environmental impact arising from the Eligible Green Expenditures financed by the green bond.

The publication of this report is in line with the Government's commitment under the Singapore Green Bond Framework to provide timely and transparent disclosure on the use of the green bond proceeds. This report covers information for the period ("Reporting Period") between 15 August 2022 (date of bond issuance) and 31 March 2023 (i.e. the close of Financial Year ("FY") 2022)<sup>1</sup>.

### Key milestones of the Singapore Green Bond Programme



The Government issued the inaugural Green SGS (Infrastructure) bond in August 2022, with an issuance size of S\$2.4 billion. This was the only tranche of issuance within FY2022. Part of the green bond proceeds (S\$0.7 billion) were allocated to finance the expansion of the electric rail network in Singapore, namely the Jurong Region Line ("JRL") and Cross Island Line ("CRL"). The unallocated proceeds (S\$1.7 billion) are expected to be fully allocated to the JRL and CRL by the end of FY2024.



Project GHG emissions avoided<sup>2,3</sup>

**100,000 - 120,000 tCO<sub>2</sub>e/year**

Financed GHG emissions avoided<sup>4</sup>

**1,200 - 1,800 tCO<sub>2</sub>e/year**

Relative GHG emissions avoided compared to baseline

**81%**

**1.7 - 2.6 tCO<sub>2</sub>e**

avoided per year per S\$1 million invested

- <sup>1</sup> The Government issued the second tranche of Green SGS (Infrastructure) bond on 4 September 2023. As this falls outside of the Reporting Period, the allocation and impact details will be included in next year's report.
- <sup>2</sup> Figures rounded to two significant figures. Please refer to Section 5, Table 4 for the exact impact figures.
- <sup>3</sup> Project emissions avoided refers to the reduction of greenhouse gas (GHG) emissions between a baseline scenario in which the JRL and CRL do not exist, compared to the project scenario in which the JRL and CRL become fully operational and displace a mix of existing and future transportations along the same travel distance. Please refer to Section 5.1 for more information on the methodology for the impact report.
- <sup>4</sup> Financed emissions avoided is derived by pro-rating the estimated total project emissions avoided based on the share of green bond financing (i.e. green bond allocated as a proportion of the total project costs). Financed emissions avoided would increase correspondingly in future years as the share of green bonds allocated to the projects increase with construction progress.

# 3

# INTRODUCTION

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## 3. Introduction

### 3.1 Singapore's Climate Commitment

As a small, low-lying island city-state, Singapore is especially vulnerable to the adverse effects of climate change, notably the heightened risks of extreme weather events, urban heat stress, and rising sea levels. Although Singapore only accounts for around 0.1% of global emissions, we are deeply committed in contributing to global efforts to address the climate crisis.

In October 2022, Singapore raised our national climate target to achieve net zero emissions by 2050 as part of our updated Long-Term Low-Emissions Development Strategy ("LEDS"). We will also reduce emissions to around 60 million tonnes of CO<sub>2</sub>-equivalent in 2030 after peaking emissions earlier, as part of our revised 2030 Nationally Determined Contribution ("NDC")<sup>5</sup>. These are ambitious targets for Singapore, as a resource-constrained and alternative energy-disadvantaged city-state.

To achieve net zero by 2050, Singapore is accelerating the low-carbon transition for industry, economy and society through four key thrusts:

1. Catalysing business transformation;
2. Investing in low-carbon technologies;
3. Pursuing effective international cooperation; and
4. Adopting low-carbon practices.

In the face of our geographical constraints, Singapore will continue to find innovative ways to reduce emissions whilst remaining competitive. Singapore has limited access to alternative sources of energies like wind or hydro-electric power. Despite these constraints, we have accelerated our deployment of solar power, and forged international and regional partnerships to explore clean energy imports and work on needle-moving low-carbon technology and solutions. Our comprehensive suite of policies and actions to achieve our climate goals are outlined in the Singapore Green Plan 2030 ("Green Plan")<sup>6</sup>.

Our low-carbon transition is supported by a carbon tax, which puts a price signal on the externality cost of carbon. This encourages businesses and individuals to internalise the cost of carbon, and take meaningful actions to reduce their carbon footprint. Singapore implemented a carbon tax in 2019 and this represents the first carbon pricing scheme in Southeast Asia. To help achieve our net zero ambition, the carbon tax will be raised to S\$25 per tonne from 1 January 2024, and progressively to between S\$50 and S\$80 per tonne by 2030.

<sup>5</sup> More information about Singapore's updated LEDS and 2030 NDC can be found at <https://www.nccs.gov.sg/media/publications/singapores-long-term-low-emissions-development-strategy/>.

<sup>6</sup> More information on the Green Plan can be found at <https://www.greenplan.gov.sg>.

## Charting Singapore's Net Zero Future

**Achieve net zero emissions by 2050**  
Long-Term Low-Emissions Development Strategy (LEDS)

**Reduce 2030 emissions to 60 MtCO<sub>2</sub>e**  
after peaking emissions earlier  
2030 Nationally Determined Contribution (NDC)

### Accelerating Low-Carbon Transition in Industry, Economy and Society

#### Catalyse business transformation

- Sustainable energy and chemicals hub in conjunction with industry
- Grants for energy efficiency and emissions reduction

#### Invest in low-carbon technologies

- Carbon Capture Utilisation and Storage
- Low-carbon hydrogen
- Solar and energy storage systems

#### Pursue effective international cooperation

- International carbon markets with high quality carbon credits
- Regional power grids for green energy

#### Adopt low-carbon practices

- Green commutes via public transport, Walk-Cycle-Ride & cleaner energy vehicles

### KEY ENABLER

Right-pricing carbon to shape business decisions and consumer behaviour

Carbon tax  
S\$50-80/tCO<sub>2</sub>e  
by 2030

### EVERYONE CAN PLAY A PART

**Public sector**  
Achieve net zero emissions across public sector around 2045 as part of GreenGov.SG



**Private sector**  
Develop and adopt low-carbon solutions, and pursue green growth opportunities



**Individuals**  
Contribute to climate friendly initiatives



NCCS  
NATIONAL CLIMATE CHANGE SECRETARIAT  
SINGAPORE

STRATEGY GROUP  
PRIME MINISTER'S  
OFFICE

SG GREEN PLAN

## 3.2 Singapore Green Bond Framework

The Singapore Green Bond Framework, together with the Significant Infrastructure Government Loan Act 2021 ("SINGA"), provides the foundation for the issuances of Green SGS (Infrastructure) bonds.

The SINGA authorises the Government to borrow to finance qualifying capital expenditures of approved nationally significant infrastructure projects critical to Singapore's long-term development<sup>7</sup>. Legislative controls are in place to safeguard against the over-accumulation of debt, prevent abuse, and ensure fiscal sustainability<sup>8</sup>. Borrowing to finance such infrastructure spreads the costs across the generations that would benefit from these projects. For any such nationally significant infrastructure that falls within the eight green categories set out in the Singapore Green Bond Framework, the Government can issue Green SGS (Infrastructure) bonds.

The Singapore Green Bond Framework is aligned with internationally-recognised market principles, standards, and best practices. Morningstar Sustainalytics has issued a pre-issuance Second-Party Opinion ("SPO")<sup>9</sup>, which confirmed the framework's alignment with the International Capital Market Association ("ICMA") Green Bond Principles 2021 and the ASEAN Green Bond Standards 2018. As a further step, the Government intends to align the framework with the Singapore-Asia Taxonomy<sup>10</sup> that will be published by end-2023.

<sup>7</sup> To qualify as nationally significant infrastructure, the infrastructure project should be controlled and legally owned by the Government, costs at least S\$4 billion, has a useful life of at least 50 years, and would support or materially improve national productivity or Singapore's economic, environmental, or social sustainability.

<sup>8</sup> The SINGA imposes an (i) overall gross borrowing limit of S\$90 billion based on the expected pipeline of nationally significant infrastructure projects from 2021 to 2036, and (ii) annual effective interest cost threshold of S\$5 billion to prevent excessive interest payments.





<sup>9</sup> The Singapore Green Bond Framework and the SPO can be found at: <https://go.gov.sg/greenbonds>.

<sup>10</sup> More information about the Singapore-Asia Taxonomy can be found at: <https://www.mas.gov.sg/development/sustainable-finance/taxonomy>.

In addition to governing the Singapore sovereign green bonds, the Singapore Green Bond Framework serves as a national benchmark and reference for Statutory Boards<sup>11</sup>. Statutory Boards that issue green bonds are required to align their respective green bond frameworks with the guidelines and standards set out in the national framework.

Singapore has committed to issuing up to S\$35 billion of green bonds by 2030. This will include green bonds issued by the Government as well as Statutory Boards. As of 31 March 2023, the Singapore public sector has issued a total of S\$8.2 billion of green bonds across four green categories (Table 1).

**Table 1: Singapore Public Sector Green Bonds as of 31 March 2023**

Issuer	Issuance (S\$' billion)	Green Category	
Singapore Government/ Monetary Authority of Singapore ("MAS") <sup>[a]</sup>	2.4	Clean Transportation	
National Environment Agency ("NEA") <sup>[b]</sup>	1.7	Waste Management	
Housing & Development Board ("HDB") <sup>[c]</sup>	3.3	Green Building	
Public Utilities Board ("PUB") <sup>[d]</sup>	0.8	Sustainable Water	
<b>Total</b>	<b>8.2</b>		

<sup>[a]</sup> As the agent of the Singapore Government, MAS is empowered by the Government Securities (Debt Market and Investment) Act and the SINGA to undertake the issuance and management of securities on behalf of the Government.

<sup>[b]</sup> NEA's Green Bond Framework can be found at: <https://www.nea.gov.sg/corporate-functions/resources/medium-term-note-programme>.

<sup>[c]</sup> HDB's Green Finance Framework can be found at: <https://www.hdb.gov.sg/about-us/news-and-publications/green-finance-framework-and-reports>.

<sup>[d]</sup> PUB's Green Financing Framework can be found at: <https://www.pub.gov.sg/sustainability/green-financing-framework>.

These public sector green bond issuances will spur the development of a high-quality green bond market in Singapore by serving as reference for the corporate green bond market, deepening market liquidity for green bonds, and attracting green issuers, capital, and investors.

For the avoidance of doubt, the allocation and impact reports in the following sections will only include the Green SGS (Infrastructure) bond issued by the Government, and do not include green bonds issued by the Statutory Boards. The Statutory Boards will publish their green bond reports in accordance with their respective frameworks.

More details about NEA and HDB green bonds can be found in their respective reports<sup>12</sup>. PUB's report will be published later this year.

<sup>11</sup> Statutory Boards will issue their own green bond frameworks to demonstrate how their respective frameworks are aligned with international guidelines and market best practices.

<sup>12</sup> NEA's Green Bond Report (December 2022) can be found at: <https://www.nea.gov.sg/docs/default-source/green-bond-framework/nea-green-bond-report-dec-2022.pdf>.  
HDB's Green Finance Report (August 2023) can be found at: <https://www.hdb.gov.sg/-/media/doc/FIN/Green-Finance/Green-Finance-Report-2023.ashx>.

## 4

## ALLOCATION REPORT



## 4. Allocation Report

The Government issued one tranche of Green SGS (Infrastructure) bond in FY2022 of S\$2.4 billion (Table 2). The issuance saw three ‘firsts’ in the SGS programme: the first sovereign green bond, the first 50-year SGS bond, and the first syndicated<sup>13</sup> SGS issuance. The 50-year bond was also the longest-tenor green bond issued by a sovereign at that time.

The bond received strong demand from institutional investors, with the order book being over-subscribed by 2.3 times for an issuance size of S\$2.35 billion. The remaining S\$50 million was allotted to individual investors under the Public Offer and was fully subscribed.

The Ministry of Finance (“MOF”) has set up a Green Bond Steering Committee (“GBSC”), chaired by the Second Minister for Finance, to oversee and approve key decisions related to the green bonds issued under the Singapore Green Bond Framework. The GBSC currently comprises the following senior government representatives:

- Permanent Secretary, MOF
- Deputy Managing Director, MAS
- Accountant-General, Accountant-General’s Department (“AGD”)
- Deputy Secretary, Ministry of Sustainability and the Environment (“MSE”)
- Deputy Secretary, Ministry of Transport (“MOT”)

The GBSC is supported by the Green Bonds Programme Office under MOF.

Each SINGA project is individually screened and verified by MOF and the relevant Ministries to determine its eligibility as Eligible Green Expenditures. On an ongoing basis, MOF will maintain central oversight of all Eligible Green Expenditures and work with other relevant Ministries to ensure that the expenditures (i) comply with the green eligibility criteria specified in the framework, and (ii) do not fall into the pre-defined list of excluded expenditures such as fossil fuel electric power generation projects<sup>14</sup>.

In FY2022, GBSC approved the capital expenditures of the JRL and CRL projects as Eligible Green Expenditures under the “Clean Transportation” Use of Proceeds category. These electric rail lines have zero direct/tailpipe emission (Scope 1), and hence meet the eligibility criteria set out in the framework (i.e. low and zero emission passenger mobility solutions). Indirect emissions from powering the electric rails (Scope 2) are expected to decrease over time as we progressively decarbonise our national power grid. The JRL and CRL also qualify as nationally significant infrastructure under the SINGA<sup>15</sup>.

Table 2: Details of Green SGS (Infrastructure) Bond Issued

<b>ISIN</b>	SGXF47639806
<b>Issue Date</b>	15 August 2022
<b>Maturity Date</b>	1 August 2072
<b>Tenor</b>	50 years
<b>Principal Amount</b>	S\$2,400,000,000
<b>Coupon</b>	3.00%

<sup>13</sup> Syndication involves the appointment of a group of banks to jointly market and distribute a bond. Syndication provides MAS added flexibility to determine the timing and size of an issuance based on market conditions.

<sup>14</sup> Full exclusion list can be found in Section 2.1.1 of the Singapore Green Bond Framework.

<sup>15</sup> Pursuant to Section 11 of SINGA, the Minister for Finance must approve an infrastructure project before borrowing for that project may commence.

The land transport sector today accounts for about 15% of carbon emissions in Singapore. One key strategy to reduce carbon footprint in this sector is encouraging greener commutes, among other initiatives such as vehicle electrification and greening infrastructure and operations. Expanding our public transport infrastructure and electric rail network is a core element of this strategy, and these projects are aligned with the Land Transport Master Plan 2040.

The development of JRL and CRL will support the “Sustainable Living” pillar of the Green Plan<sup>16</sup>, which targets to expand our rail network to 360 kilometres (“km”), and achieve 75% mass public transport modal share, up from the current share of 64%. The development of JRL and CRL is a key enabler to achieve the ambitious goal of significantly reducing land transport emissions in absolute terms, in line with Singapore’s net zero target by 2050.

Capital expenditures on the JRL and CRL projects are expected to continue to meet the green eligibility criteria for the transport sector, even after we align the Singapore Green Bond Framework with the Singapore-Asia Taxonomy.

100% of the first tranche of green bond proceeds (S\$2.4 billion) are earmarked for the JRL and CRL. As of 31 March 2023, 30% of green bond proceeds (or S\$0.7 billion) have been allocated to current Eligible Green Expenditures (Table 3).

**Table 3: Allocation of Green SGS (Infrastructure) Bond**

Green Category	Environmental Objective	Green Plan Pillar	Eligible Green Expenditures	Allocation (S\$)
Clean Transportation	Climate Change Mitigation	Sustainable Living	Passenger Electric Rail	708,656,367

The unallocated green bond proceeds of S\$1.7 billion as at 31 March 2023, were either (i) temporarily held in a separate cash account maintained with MAS which is ring-fenced for Eligible Green Expenditures, or (ii) invested by AGD in short-term liquidity instruments (i.e. fixed deposits) in accordance with the framework. These unallocated green bond proceeds are expected to be fully allocated to the JRL and CRL by the end of FY2024.

MOT and the Land Transport Authority (“LTA”) are responsible for the implementation and monitoring of the JRL and CRL projects, and informing the GBSC of any potential non-compliance with the eligibility criteria and Environmental, Social, and Governance (“ESG”) controversies. There were no non-compliance and ESG controversies noted during the Reporting Period.

<sup>16</sup> The “Sustainable Living” pillar of the Green Plan seeks to make reducing carbon emissions, keeping our environment clean, and saving resources and energy a way of life in Singapore. The expansion of electric rail network comes under the sub-pillar “Green Commutes”.

## Jurong Region Line

The JRL is Singapore's seventh mass rapid transit ("MRT") line, serving both existing and future development in the western part of Singapore. The JRL will be a 24-km long elevated MRT line with 24 stations. It will significantly improve connectivity of the region and support development of the Jurong area, which is set to be the largest commercial hub outside the Central Business District. Commuters can expect to be connected to key activity nodes in Jurong, such as the Jurong Industrial Estate, Jurong Innovation District, and the Nanyang Technological University ("NTU").

The JRL will put 60,000 more households in Jurong within a 10-minute walk from a train station. The JRL's ridership is expected to reach 200,000 daily in the initial years and rise to more than 500,000 a day when the Jurong Innovation District, Tengah Town and Jurong Lake District are fully developed. With three interchange stations, the JRL will bring more connectivity to the existing rail network and enable commuters to enjoy more alternative routes of travel.

Commuters can expect substantial time savings when travelling to the Western part of Singapore with the JRL. For example, a trip from Choa Chu Kang MRT station to NTU will be shortened from 60 minutes to 35 minutes, while commuting from Woodlands MRT station to Jurong Island Checkpoint will take 45 minutes instead of around 80 minutes today.

The LTA has awarded a contract for the supply of 62 fully-automated and driverless car trains for the JRL, and the first train is expected to arrive in Singapore around mid-2024. The JRL is expected to open in three stages from 2027 to 2029.

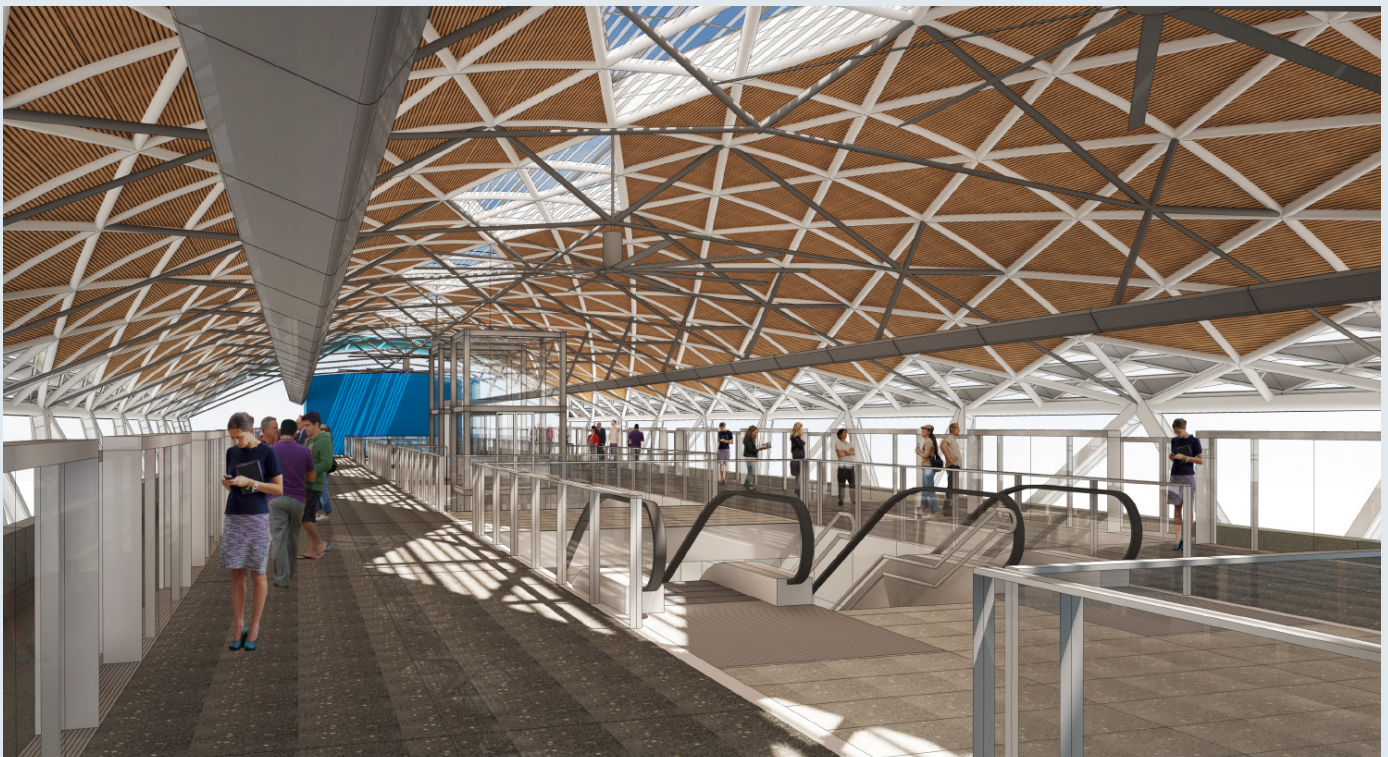
Sustainability is a key consideration in designing the JRL. Sustainability features of the JRL include:

- All JRL stations will be fitted with photovoltaic solar panels to generate renewable energy for station operations. The solar panels will reduce carbon footprint of JRL operations by providing a constant source of power with little to no GHG emissions.
- Stations are designed to allow crossflow natural ventilation to reduce mechanical energy usage from fans and air-conditioning.
- JRL trains will also be equipped with sensors to automatically dim lights during the day.
- JRL trains will adopt a regenerative braking system, which uses energy produced by trains during braking to power nearby trains or stations.



Constructing the JRL through a mature and densely developed corridor is challenging as works are carried out along an alignment with curves and limited space over busy roads, major expressways, and canals. As the JRL is designed to navigate through existing developments, minimising noise disturbance is a key design consideration. Hence, permanent noise barriers will be installed along viaducts that are near residential areas.

LTA engineers have also undertaken extensive planning and rolled out a number of mitigating measures to minimise disruptions to traffic and the environment. To ensure that construction is carried out safely, technologies such as Virtual Design and Construction are being used to support detailed planning. In addition, drones and automated instruments, such as 3D scanners, are being deployed for real time monitoring of progress for key segments of construction.



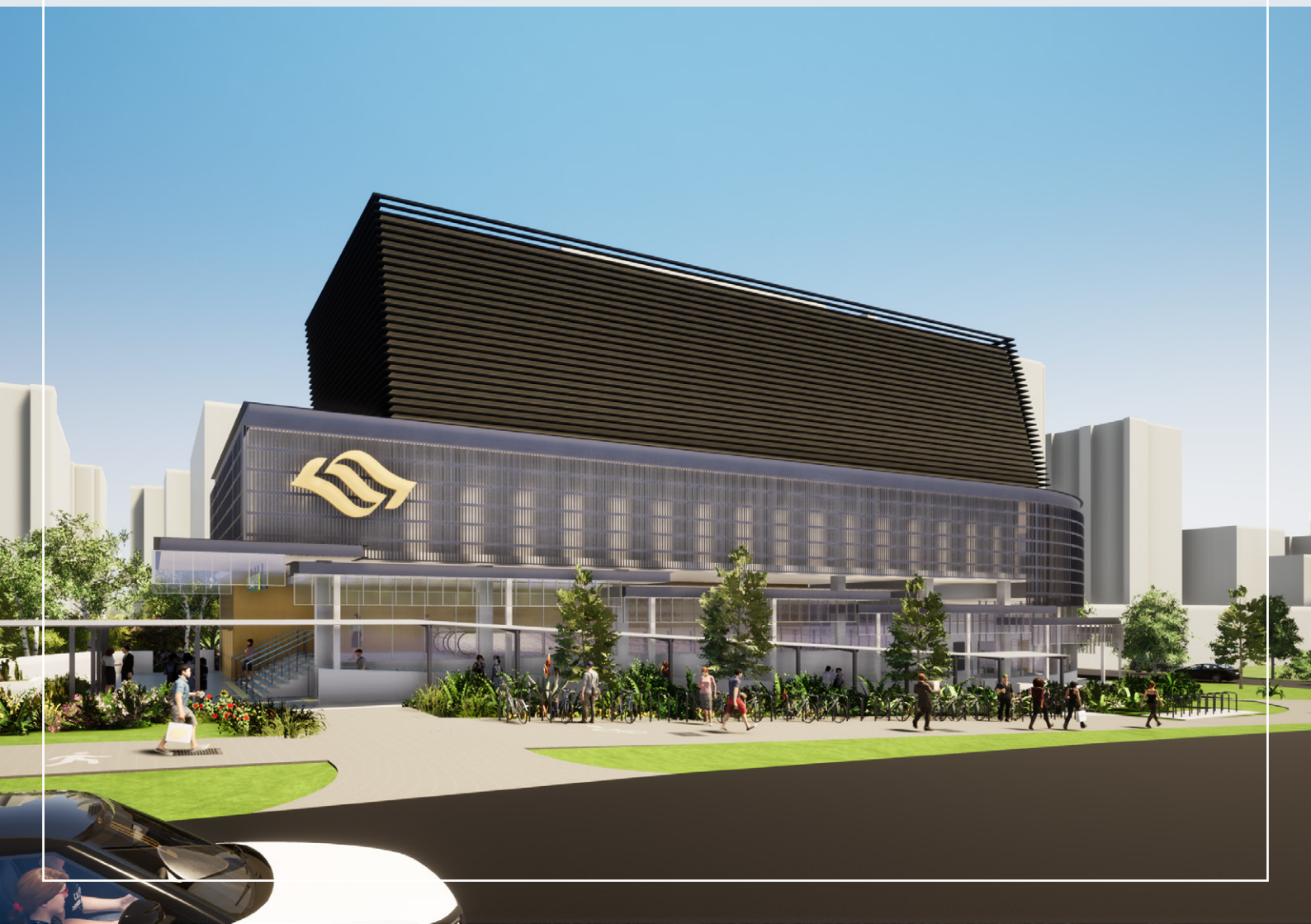
## Cross Island Line

The CRL is Singapore's eighth MRT line, and it will be our longest fully underground line at more than 20 stations and 50 km long. It will serve existing and future developments in the eastern, western, and north-eastern corridors, connecting major hubs such as Jurong Lake District, Punggol Digital District and Changi region.

When operational, it will have the highest number of interchange stations, with almost half the stations on the line being linked to existing rail stations. This means more alternative travel routes for commuters to get to their destinations. The CRL is expected to have a daily ridership of at least 600,000 in the initial years, growing to one million in the longer term.

The CRL will be constructed in three phases.

- Construction for CRL Phases 1 and 2 has commenced and is expected to be completed by 2030 and 2032 respectively.
- Engineering studies for CRL Phase 3, which will serve the Jurong Industrial Estate, are currently ongoing. LTA will publish more details after these studies are completed.



To allow an informed decision on the alignment for the stretch of the CRL in the vicinity of the Central Catchment Nature Reserve (“CCNR”) to be made by the Government, LTA had appointed a consultant to conduct a comprehensive two-phased environmental impact assessment (“EIA”)<sup>17</sup> and involved multiple stakeholders including the nature groups, heritage groups, residents and grassroots leaders.

Based on the EIA, both underground alignments (direct and skirting) are feasible, with direct being the eventual decision. The residual impacts for the factors studied are largely moderate or below with appropriate mitigation measures. LTA is committed to implementing all necessary mitigation measures outlined in the EIA.

For example, during construction, LTA will be adopting measures such as tunnelling underground as deep as 70 metres below average ground level for the stretch of the direct alignment under the CCNR. Doing this ensures that tunnelling is fully carried out through hard granite rock and far away from surface flora and fauna with no surface works within the CCNR. LTA will also be locating worksites outside the nature reserve to reduce any disturbance to nearby flora and fauna. A robust Environmental Monitoring and Management Plan has also been put in place and this will be reviewed and strengthened as necessary, as the project progresses.



<sup>17</sup> More information about the EIA can be found at: [https://www.lta.gov.sg/content/ltagov/en/upcoming\\_projects/rail\\_expansion/cross\\_island\\_line.html](https://www.lta.gov.sg/content/ltagov/en/upcoming_projects/rail_expansion/cross_island_line.html).

## 5

## IMPACT REPORT




## 5. Impact Report

To assess the impact of Eligible Green Expenditures, we have taken reference from ICMA's Harmonised Framework for Impact Reporting (June 2023) handbook. As the JRL and CRL projects are still being constructed as of the end of the Reporting Period, this report includes the ex-ante (expected) impact figures of these Eligible Green Expenditures on a portfolio basis (Table 4).

We have focused on the environmental impact (i.e. avoidance of GHG emissions and air pollutants), as well as other performance indicators relating to the JRL and CRL projects. Updates on ex-post (actual) impact figures will be provided when the JRL and CRL become operational in future years.

While it is not possible to attribute the number of jobs created to specific rail lines, the upcoming expansion of the rail network is expected to create about 800 jobs. MOT and LTA will use the Rail Manpower Development Package ("RMDP")<sup>18</sup> to equip and prepare workers for the future rail network that will be larger and more complex.

Table 4: Impact indicators

Portfolio		Clean Transportation
Allocated Amount	S\$	708,656,367
Project lifetime	years	99
Project Emissions Avoided	tCO <sub>2</sub> e/year	99,906 - 122,107
Financed Emissions Avoided	tCO <sub>2</sub> e/year	1,232 - 1,841
Emissions Avoided per S\$ Million Allocated	tCO <sub>2</sub> e/year/ S\$'million	1.7 - 2.6
Relative Emissions Avoided	%	81
Project Air Pollutants Reduced	kg/year	SO <sub>x</sub> : 20,494 - 25,049 NO <sub>x</sub> : 26,132 - 31,939 PM <sub>10</sub> : 1,311 - 1,602 PM <sub>2.5</sub> : 940 - 1,149
Financed Air Pollutants Reduced	kg/year	SO <sub>x</sub> : 253 - 378 NO <sub>x</sub> : 322 - 482 PM <sub>10</sub> : 16 - 24 PM <sub>2.5</sub> : 12 - 17
Passenger-kilometers Travelled	million pkm/ year	2,207 - 2,697
Length of Rail	km	74
Contribution to SDG		 11 SUSTAINABLE CITIES AND COMMUNITIES

<sup>18</sup> The S\$100 million RMDP was launched in 2019 to support and accelerate rail workforce transformation. More information about the RMDP can be found at: [https://www.lta.gov.sg/content/ltagov/en/industry\\_innovations/industry\\_transformation\\_map/rail\\_manpower\\_development\\_package.html](https://www.lta.gov.sg/content/ltagov/en/industry_innovations/industry_transformation_map/rail_manpower_development_package.html).

## 5.1 Impact Methodology

For MOF's inaugural impact report, we commissioned Morningstar Sustainalytics, an ESG research, ratings and analytics firm, to independently develop a methodology to quantify the green bond impact<sup>19</sup>. The methodology was developed by leveraging best-in-class methodologies, protocols, and frameworks<sup>20</sup>.

A key output of the impact methodology is "emissions avoided", which refers to the reduction of GHG emissions over the operational lifetime of the JRL and CRL between a baseline (i.e. counterfactual) scenario in which the projects do not exist, compared to the project scenario in which the JRL and CRL become operational and displace a mix of existing and future transportations (including private vehicles, trains, taxis, buses, and active mobility) along the same travel distance. The calculations account for predicted shifts in grid emission factors and local transportation fuel mixes<sup>21</sup>.

The expected baseline and project scenarios have been determined based on Singapore's unique national context. In particular, the predominant transport mode in Singapore today (64% of motorised journeys during daily peak hours) is mass public transport (i.e. trains and buses), which are less emissions-intensive compared to private cars. Hence, the reduction in emissions arising from the green bond-financed expansion of our electric rail network is comparatively lower than if we had a less developed public transportation system.

In order to measure impact across the entire value chain, the calculations adopt a 'well-to-wheel' emissions approach. This approach accounts for both direct<sup>22</sup> and indirect<sup>23</sup> emissions by applying an additional, indirect emissions factor to the emissions directly emitted by the project and baseline vehicles.

Financed emissions avoided is derived by pro-rating the estimated total project emissions avoided based on the share of green bond financing (i.e. green bond allocated as a proportion of the total project costs<sup>24</sup>). Hence, the amount of financed emissions avoided would increase correspondingly in future years as the share of green bonds allocated to the projects increase over time with construction progress.

<sup>19</sup> Morningstar Sustainalytics' Impact Report for Singapore Sovereign Green Bond issuance can be found at: [https://www.sustainalytics.com/corporate-solutions/sustainable-finance-and-lending/published-projects/project/ministry-of-finance-singapore/singapore-ministry-of-finance-green-bond-impact-report-\(2023\)/singapore-ministry-of-finance-green-bond-impact-report-\(2023\)](https://www.sustainalytics.com/corporate-solutions/sustainable-finance-and-lending/published-projects/project/ministry-of-finance-singapore/singapore-ministry-of-finance-green-bond-impact-report-(2023)/singapore-ministry-of-finance-green-bond-impact-report-(2023)).

<sup>20</sup> These include the GHG Protocol, International Financial Institutions Guideline for a Harmonised Approach to GHG Accounting, Partnership for Carbon Accounting Financials' Global GHG Accounting Standard, and the United Nation's Clean Development Mechanism.

<sup>21</sup> The calculations for "air pollutants reduced" follow a similar approach.

<sup>22</sup> Associated with the fuel consumption of transportation vehicles (i.e. 'tank-to-wheel' emissions).

<sup>23</sup> Associated with upstream activities (i.e. 'well-to-tank' emissions), such as electricity transmission losses and the extraction and refining of primary fuels.

<sup>24</sup> The JRL and CRL projects are financed using a mix of Green SGS (Infrastructure) bond proceeds and development grants provided by the Singapore Government. Total project costs for JRL and CRL are not disclosed as at the publication date of this report so as not to prejudice future tenders.

The midpoint of the bond's term to maturity is assumed to be the representative year for which the annual emissions avoided is calculated. For the tranche of Green SGS (Infrastructure) bond issued in FY2022 with a tenor of 50 years, the representative year is assumed to be 2047. We consider this approach to be reasonable as it provides an accurate representation of the expected average annual impact over the bond tenor, given that (i) the JRL and CRL projects will be completed and operating at normal capacity by the year 2047, and (ii) the projected reduction in grid emission factors<sup>25</sup> in future years is taken into account within the calculations.

We have chosen to disclose a range of impact figures instead of point estimates where applicable, to account for potential variations<sup>26</sup> in project parameters. A sensitivity analysis on the estimated impacts was conducted by varying two key input variables, namely passenger-kilometres ("p-km") travelled per year<sup>27</sup> (directly correlated to project impacts) and project costs (inversely correlated to financed impacts). The range of impact figures encompasses various scenarios arising from the sensitivity analysis, including (i) an upside scenario whereby the projects deliver higher than expected p-km travelled and enjoy cost savings, and (ii) a downside scenario whereby the projects deliver lower than expected p-km travelled and suffer cost overruns. MOF will update and publish the impact projections if there are any material changes.

The JRL and CRL projects are estimated to result in total carbon savings of more than 100,000 tonnes of CO<sub>2</sub>-equivalent annually, which is equivalent to taking at least 22,000 cars off Singapore's roads<sup>28</sup>. This represents an estimated emissions reduction of 81% compared to the baseline scenario.

Financed GHG emissions avoided for the green bond portfolio is then calculated to be between 1,200 and 1,800 tonnes of CO<sub>2</sub>-equivalent annually. The financed emissions avoided figures are divided by the amount of green bonds allocated (i.e. S\$0.7 billion as at 31 March 2023) to derive the avoided emissions intensity of between 1.7 and 2.6 tonnes of CO<sub>2</sub>-equivalent avoided annually, per million Singapore dollar allocated.

MOF will provide annual updates on the estimated impact in our future green bond reports. As part of this endeavour, we will continually refine our impact methodology, in line with international standards and best practices.

25 The use of a lower projected grid emission factor in the impact calculations causes the estimated amount of emissions avoided arising from the JRL and CRL to be more conservative (i.e. emissions in the baseline scenario decrease to a larger extent compared to the decrease in emissions in the project scenario).

26 We recognise the uncertainties inherent in projecting ex-ante estimations of environmental impact. We have worked with Morningstar Sustainalytics to account for foreseeable policy changes (e.g. changes to our national energy strategy that will affect the grid emission factor) as far as possible - the data sources and assumptions are detailed in Morningstar Sustainalytics' impact report.

27 A p-km represents the transport of one passenger over one kilometre. This is a dynamic value influenced by actual ridership and service frequency, and the range of p-km accounts for uncertainties over this input variable.

28 MOF's estimate based on the United States Environmental Protection Agency (EPA)'s assumption that an average passenger car emits about 4.6 tonnes of CO<sub>2</sub>-equivalent per year. EPA's figure is likely to be slightly higher compared to the emission factor in Singapore's context.

## 6

## EXTERNAL REVIEW





## **INDEPENDENT PRACTITIONER'S LIMITED ASSURANCE REPORT ON THE ALLOCATION OF PROCEEDS AS AT 31 MARCH 2023 RAISED THROUGH THE ISSUANCE OF THE GREEN SINGAPORE GOVERNMENT SECURITIES (INFRASTRUCTURE) BOND AS SET OUT IN THE SINGAPORE GREEN BOND REPORT**

### **To the Ministry of Finance-Ministry Headquarter**

We have been engaged by Ministry of Finance-Ministry Headquarter ("MOF") to undertake a limited assurance engagement in respect of the allocation of proceeds as at 31 March 2023 raised through the issuance of the Green Singapore Government Securities (Infrastructure) bond as set out on page 11 of the Singapore Green Bond Report ("the Selected Information").

Our assurance engagement was with respect to the Selected Information as at 31 March 2023. We have not performed any procedures with respect to (i) earlier periods and (ii) any other elements included in the Singapore Green Bond Report, and in the website and other publications, and therefore do not express any conclusion thereon.

#### *Reporting Criteria*

The Selected Information has been assessed against the Singapore Green Bond Framework<sup>1</sup> ("the Framework").

#### *Management's Responsibility*

Management of MOF is responsible for the preparation of the Selected Information in accordance with the Framework. The responsibility includes designing, implementing and maintaining internal controls relevant to the preparation of the Selected Information that is free from material misstatement, whether due to fraud or error.

#### *Practitioner's Independence and Quality Management*

We have complied with the independence and other ethical requirements of the Accounting and Corporate Regulatory Authority (ACRA) Code of Professional Conduct and Ethics for Public Accountants and Accounting Entities (ACRA Code), which is founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour.

Our firm applies Singapore Standard on Quality Management 1 which requires the firm to design, implement and operate a system of quality management including policies or procedures regarding compliance with ethical requirements, professional standards and applicable legal and regulatory requirements.

#### *Practitioner's Responsibility*

Our responsibility is to express a limited assurance conclusion on the Selected Information based on the procedures we have performed and the evidence we have obtained. We performed our limited assurance engagement in accordance with Singapore Standard on Assurance Engagements 3000 (Revised) – Assurance Engagements other than Audits or Reviews of Historical Financial Information ("Standard"). This Standard requires that we plan and perform our work to form the conclusion about whether the Selected Information is free from material misstatement. The extent of our procedures depends on our professional judgment and our assessment of the engagement risk.

A limited assurance engagement involves assessing the suitability in the circumstances of MOF's use of the Framework as the basis for the preparation of the Selected Information, assessing the risks of material misstatement of the Selected Information whether due to fraud or error, responding to the assessed risks as necessary in the circumstances, and evaluating the overall presentation of the Selected Information. A limited

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<sup>1</sup> The Singapore Green Bond Framework (June 2022) can be found on the MOF website at: <https://www.mof.gov.sg/policies/fiscal/greenbonds>



assurance engagement is substantially less in scope than a reasonable assurance engagement in relation to both the risk assessment procedures, including an understanding of internal control, and the procedures performed in response to the assessed risks.

The procedures selected included inquiries, observation of processes performed, inspection of documents and agreeing or reconciling with underlying records. Given the circumstances of the engagement, we also performed the following:

- interviewed management and personnel in relation to the Selected Information;
- obtained an understanding of how the Selected Information is gathered, collated and aggregated internally;
- performed limited substantive testing, on a selective basis, of the Selected Information to check that data had been appropriately measured, recorded, collated and reported, to the extent we considered necessary and appropriate to provide sufficient evidence for our conclusion; and
- considered the disclosure and presentation of the Selected Information.

The procedures performed in a limited assurance engagement vary in nature and timing from, and are less in extent than for, a reasonable assurance engagement. Consequently, the level of assurance obtained in a limited assurance engagement is substantially lower than the assurance that would have been obtained had a reasonable assurance engagement been performed. Accordingly, we do not express a reasonable assurance opinion about whether the Selected Information has been prepared, in all material respects, in accordance with the Framework.

#### *Inherent Limitations*

In designing these procedures, we considered the system of internal controls in relation to the Selected Information and reliance has been placed on internal controls where appropriate. Because of the inherent limitations in any accounting and internal control system, errors and irregularities may nevertheless occur and not be detected.

#### *Conclusion*

Based on the procedures we have performed and the evidence we have obtained, nothing has come to our attention that causes us to believe that the Selected Information as at 31 March 2023 is not prepared, in all material respects, in accordance with the Framework.

#### *Purpose and Restriction on Distribution and Use*

Without modifying our conclusion, we draw attention to the fact that the Selected Information was prepared for inclusion in the Singapore Green Bond Report by the management of MOF as required by the Framework ("Purpose"). As a result, the Selected Information may not be suitable for another purpose.

Our report is intended solely for the Purpose set forth in the paragraph above and should not be used for any other purpose. Save for the disclosure of our report in the Singapore Green Bond Report and on MOF's website, neither this report nor its contents or any part thereof may be distributed to, discussed with or otherwise disclosed to any third party without our prior written consent. MOF is responsible for all other information other than our report, in the Singapore Green Bond Report and our report does not cover this other information, and we do not express any form of assurance conclusion thereon. To the fullest extent permitted by law, we do not accept any liability or assume any responsibility to anyone else other than MOF for our work or this report. Any reliance placed on this report by any third party is entirely at its own risk. MOF is responsible for its website and that we do not accept responsibility for any changes that may have occurred to the Selected Information or Framework since the publication of our report in the Singapore Green Bond Report.

Yours faithfully

*PricewaterhouseCoopers LLP*

PricewaterhouseCoopers LLP  
Public Accountants and Chartered Accountants  
Singapore  
21 September 2023

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