

**FOURTEENTH PARLIAMENT OF SINGAPORE**

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**Second Session**

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**THIRD REPORT OF THE ESTIMATES COMMITTEE**

**Parl. 18 of 2023**

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**Presented to Parliament on**

**27 November 2023**

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## **ESTIMATES COMMITTEE**

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## **THIRD REPORT OF THE ESTIMATES COMMITTEE**

### **OVERVIEW**

1 The Estimates Committee, pursuant to Standing Order No. 100 (3), considered the Revenue and Expenditure Estimates for the Financial Year (FY) 2023/2024 (Paper Cmd 20 of 2023).

2 In the consideration of the various matters and initiatives related to the Budget for FY 2023/2024, the Committee decided to focus its enquiry in the following three areas:

- (a) Healthier SG Strategy
- (b) Safeguarding Our Climate Resilience
- (c) Monitoring the Research, Innovation and Enterprise 2025 Plan

3 Over the course of its enquiry, the Committee received three memoranda from the Ministry of Finance (MOF) on 30 June 2023, 31 August 2023 and 31 October 2023. The Committee's queries to MOF and the latter's responses were consolidated in Sections A, B and C of this report.

### **HEALTHIER SG STRATEGY**

4 The Committee noted that in Budget 2023, the Government introduced Healthier SG, as an empowering strategy, so that seniors could take preventive care steps together with their doctors and community partners to improve their health, by remaining physically and mentally active and staying engaged in their communities.

5 Given the Committee's remit of scrutinizing how the Government's annual Budget initiatives are implemented and whether the intended results and outcomes are achieved by the underlying policy instruments, the Committee enquired about the expenditure by the Ministry of Health, whether increases in expenditure are envisaged, and what monitoring systems have been established to ensure prudent spending.

6 The Committee also asked about how operations and services were being transformed to deliver better integrated programmes and services for the healthcare sector, what indicators were used to determine the effectiveness of the Government's healthcare spending under the new capitation funding model, and how the Ministry of Health (MOH) was managing and retaining its talent, among other queries.

### **Summary of MOF's Response to the Committee**

#### *MOH's Healthcare Expenditure*

7 MOF shared that annual spending by MOH averaged \$10.9 billion a year in FY2018 to FY2019. There was an increase in MOH's expenditure across FY2020 to FY2022, to an average of \$16.6 billion per year largely due to funding required for the prevention, containment, and control of COVID-19.

8 The Committee noted that MOH's total expenditure was accounted for by three programmes, namely, the Services Programme, the MOH HQ Programme, and the Health Promotion and Preventive Healthcare Programme. A breakdown of MOH's total expenditure by programme across FY2018 to FY2019 is provided in Table A1 in Section A.

9 It was observed that the Services Programme accounted for 68% of MOH's expenditure across FY2018 to FY2019. The Programme comprised operating subvention provided to healthcare institutions and non-public sector providers, such as Voluntary Welfare Organisations and General Practitioners. MOF shared that the increase in expenditure for the Services Programme from FY2021 to FY2022 was largely due to the categorisation of some grants provided to healthcare institutions under the Services Programme instead of the MOH HQ Programme. The subvention base to healthcare institutions under the Services Programme also increased in FY2022 to enable each public healthcare cluster to scale up initiatives that had demonstrated improvements to health outcomes and facilitated right-siting of care. More details may be found in paragraphs A1(a) and A2(b) of Section A.

10 It was shared that the MOH HQ Programme accounted for 29% of MOH's expenditure across FY2018 to FY2019. MOF conveyed that the Programme funded (i) the formulation of national policies on health and ageing, healthcare manpower planning and development, and the research and corporate functions at MOH HQ (ii) premium support for national insurance schemes (iii) training and education through pre-employment clinical training, residencies, and scholarships (iv) information management and systems development for MOH and its statutory boards (v) regulation of healthcare establishments and (vi) the Health Sciences Authority to support health and non-health regulatory and compliance agencies in safeguarding public health through the regulation of health products and blood supply. Further information is available in paragraphs A1(b) and A2(c) of Section A.

11 The Committee noted that the Health Promotion Programme accounted for 3% of MOH's expenditure across FY2018 to FY2019, which included funding for the Health Promotion Board's (HPB) programmes. MOF explained that from FY2020, the description of the Health Promotion Programme was broadened to go beyond the work of HPB, so as to encompass preventive health holistically. Between FY2020 and FY2022, the spending on preventive care, which included health promotion, subsidies for screenings and vaccinations, as well as other community-based initiatives by public hospitals and community partners, comprised about 5% to 6% of MOH's total expenditure. More information about this Programme in paragraphs A1(c) and A2(a) of Section A.

12 The Committee understood that MOH expected increases in expenditure to be driven by three factors, namely, (a) Singapore's ageing population, (b) higher age-standardised utilisation rates, and (c) higher cost per unit of healthcare. Singapore's population was ageing rapidly, with one in four citizens expected to be 65 and above by 2030, up from nearly one in five as of 2023. This had in turn driven up spending in acute care and long-term care expenditure. Changing lifestyles as well as earlier diagnoses, together with rising incomes and greater accessibility of high-quality healthcare services, had led to higher age-standardised utilisation rates. Finally, medical advancements had made available newer treatments that improve lifespan and quality of life but cost more per treatment. Manpower costs for healthcare staff were expected to increase to ensure appropriate recognition and remuneration for healthcare workers. More details are available in paragraphs A3 and A4 of Section A.

### *Transformation Efforts*

13 It was shared that MOH's healthcare financing policy was grounded on sound principles. MOH insisted on co-payment and curtailed the distortionary effect of insurance through universal risk pooling, co-insurance, and deductibles, and that MOH had put in place a robust Health Technology Assessment system, and driven value-based care throughout the system. The Committee appreciated MOH aiming to achieve better health-adjusted longevity for our seniors by preventing or delaying the onset of ill health. Besides a better quality of life for seniors and more peace of mind for their families, this could also help in moderating future growth in healthcare costs.

14 In this regard, the Committee understood that MOH had undertaken several transformative moves to place a stronger emphasis on preventive care and to anchor care in the community, delivering better healthcare and improving outcomes.

15 The Committee was informed that shifting away from episodic and transactional care model to a holistic, person-centred care model for residents, anchored through a longer-term and stronger doctor-patient relationship would be facilitated by the Healthier SG enrolment programme. Residents would sign up with a regular family doctor who would deliver preventive care and support residents in making lifestyle adjustments to improve their health, on top of delivering chronic care.

16 The Committee further understood that MOH was working to build stronger linkages between healthcare providers and community partners like HPB, Active Ageing Centres, People's Association, and Sport Singapore. These partners played a role in addressing the non-medical determinants of health by offering and enhancing access to programmes and services that help residents keep healthy and well in the community.

17 It was shared that MOH was working with the Agency for Integrated Care's Silver Generation Office to reach out to seniors, in particular those who were lonely and isolated, to identify and refer seniors with needs to Active Ageing Centres. This would allow these seniors to access the relevant support and services such as active ageing programmes and befriending.

18 The Committee was informed that SingHealth, National Healthcare Group, and National University Health System would shift to a capitation-based funding model, taking on the role of regional health managers and looking after the health of their assigned population in their respective regions. Under this funding model, the clusters were paid a pre-determined amount per assigned resident under their charge and were empowered to drive right-siting of patients and preventive care initiatives.

19 The Committee understood that this would align with the intent to reduce the downstream costs of costlier hospital treatment, as compared to workload-based funding, where clusters would receive more funding when there were more patients in hospitals. It was shared that this would also be stronger incentives to better optimise and integrate care across settings, as well as to adopt more cost-efficient practices. Further details may be found in paragraphs A5, A6(a), A6(b) and A6(c) of Section A.

20 It was shared that MOH had put in place a range of initiatives to raise productivity. Under RIE2025, the Population Health Research Grant supported projects including those that

aimed to optimise resource allocation, improve healthcare manpower productivity, and leverage technology to improve health.

21 The Committee was informed that the Community Care Digital Transformation Plan would support community care organisations to adopt a comprehensive suite of digital solutions that help to raise digitalisation levels and improve productivity. The Committee was also informed that Healthcare Industry Transformation Map 2025 would strengthen IT and digital system enablers, as well as regulatory frameworks, to support the transformation of care models and approaches.

22 The Committee was assured that MOH would continue to monitor and outcome indicators in the Revenue and Expenditure Estimates for each Financial Year and the National Population Health Survey report to ensure that efforts to bolster productivity did not compromise the quality of care. It was further shared that the Revenue and Expenditure Estimates for each Financial Year would enable MOH to review the impact of transformation efforts in slowing down the growth of healthcare expenditure. Population Health Survey report tracked health and risk factors and lifestyle practices of Singaporeans.

23 It was shared that MOH would continue to work with public healthcare clusters to monitor the indicators on a cluster-specific basis, identify key cost drivers, and facility cost benchmarking between public healthcare institutions to support optimisation efforts. More information is available in paragraphs A8, A9, A10 and A11 of Section A.

#### *Healthier SG – Building on Past and Existing Efforts*

24 The Committee learned that Healthier SG built on past and existing efforts, including the War on Diabetes (WoD) and the introduction of mandatory nutrition labelling and advertising prohibitions for beverages.

25 It was shared that the WoD was launched in 2016 to spearhead a whole-of-nation initiative to tackle diabetes. MOH had collaborated with multiple stakeholders to create a conducive environment to encourage and sustain healthier behaviours like physical activity and healthy eating. An example was the National Steps Challenge run by HPB, which had encouraged residents to embark on more active lifestyles. The Committee understood that since the inception of the WoD, MOH had spent about \$25.4 million from FY2016 to FY2022 on such efforts.

26 It was understood that MOH was monitoring a set of key performance indicators to measure the effectiveness of the WoD. These indicators included the control of modifiable risk factors, the uptake of chronic disease screening, the management of diabetes and its related complications, as well as diabetes prevalence in the population. More details on the WoD are available in paragraphs A12(a) and A14(a) of Section A.

27 The Committee learned that the mandatory nutrition labelling and advertising prohibitions for beverages, which was rolled out for prepacked beverages in December 2022 and be extended to freshly prepared beverages from end-2023 would (i) help consumers identify beverages that were higher in sugar and saturated fat and make more informed, healthier choices (ii) reduce the influence of advertising on consumer preferences, and (iii) spur industry reformulation.



28 It was shared that MOH was evaluating the success of Nutri-Grade labelling by monitoring whether there was a reduction in the median sugar level across beverages, increased consumer preference for beverages with lower sugar and saturated fat content, and a reduction in Singaporeans' overall sugar consumption from beverages. Further information may be found in paragraphs A12(b) and A14(b) of Section A.

#### *Recruitment and Retention of Healthcare Manpower*

29 The Committee was informed that MOH was taking a multipronged approach to enhance the recruitment and retention of healthcare manpower in order to support the Healthier SG strategy. It was shared that MOH would (i) grow the pool of family physicians (ii) ensure fair and competitive salaries and recognition of healthcare workers (iii) prevent the abuse and harassment of healthcare workers (iv) strengthen the career proposition of support care jobs and (v) enhance foreign manpower recruitment and retention.

30 It was also shared that MOH regularly projected its healthcare manpower demand for doctors, nurses, pharmacists, and allied health professionals to ensure enough supply from (i) local training pipelines and (ii) scholarships and sponsorships for locals in overseas universities to meet the needs of Singapore's healthcare system through a strong, local core of manpower.

31 The Committee learned that from 2013 to 2022, local medical schools had increased their combined annual intake of doctors by around 30%, from around 400 to over 500. About 200 locals who studied or practised medicine overseas had been attracted back to Singapore annually. Overall, between end-2018 and end-2022, the number of doctors registered with the Singapore Medical Council had increased by about 16%, from about 13,800 to 16,000. The proportion of locals had remained above 90%.

32 It was also shared with the Committee that while MOH did not track the number of Singapore Citizens (SCs) who go abroad to study medicine, MOH tracked the number of foreign-trained SCs and Permanent Residents (PRs) who were registered with the Singapore Medical Council, which is provided in Table A5 of Section A. The Committee also learned that the number of doctors per 1,000 population in Singapore had increased from 2.4 in 2018 to 2.8 in 2022.

33 The Committee noted that MOH was on track to meet the target of recruiting 4,000 nurses in 2023 to build up the nursing workforce and cater for expansions of service capacity. In the first half of 2023, the public healthcare clusters had recruited about 2,000 new nurses through intensified local and overseas recruitment and expected to recruit another 1,800 more nurses by the end of the year. It was also shared that the public healthcare clusters had recently enhanced sponsorships for nursing studies in local Institutes of Higher Learning (IHLs). The Committee also learned that fresh nursing graduates from local IHLs who had not taken up sponsorships but entered nursing in the public healthcare clusters or publicly funded residential community care organisations in 2023 would also be eligible for a sign-on bonus of \$15,000.

34 It was further shared that MOH monitored the inflow of new nurses at the national level for both the public and private sectors via the number of new nurses registered with the Singapore Nursing Board (SNB) and measured the attrition rate by the number of nurses who did not renew their practicing certificates with SNB. The number of newly registered nurses at the national level and the number of practicing nurses who did not renew their practicing

certificates for each year in the past five years are provided in Table A7 of Section A. More information may be found in paragraphs A22 to A31 of Section A.

35 It was shared that intakes for family medicine (FM) residency had been increased, and intakes for nursing and allied health programmes would be progressively increased for the coming years. Foreign manpower would augment local pipelines where needed. The Committee was informed that MOH had been working to expand the number of training places for postgraduate FM training to promote continuing professional development. MOH was also growing the pool of family physicians and working towards having at least one family doctor per participating Healthier SG clinic to be accredited as a family physician. See paragraph A17 of Section A for more details.

36 The Committee was informed that MOH regularly reviewed the remuneration of healthcare workers to ensure that their salaries are fair and competitive. In 2020, the salaries of local nurses and support care staff in the community care sector were enhanced. In 2021, the salaries of local and foreign non-medical staff groups in both the acute and community care sectors were boosted. In 2023, the salaries for public healthcare junior doctors and medical officers were improved. It was also shared that MOH had rewarded healthcare workers for their contributions to fight against COVID-19 through the COVID-19 Special Bonus in 2020 and COVID-19 Healthcare Award in 2021. The Nurse Special Payment package was also enhanced in 2022 to recognise the hard work and contributions of nurses. Please refer to paragraph A18 of Section A for more information.

37 It was shared that MOH had formed a Tripartite Workgroup on the prevention of abuse and harassment of healthcare workers, comprising members from the union, public healthcare, private healthcare, and community care organisations. The Committee understood that MOH was developing a zero-tolerance policy against abuse and harassment of healthcare workers to ensure a consistent approach is taken across PHIs. More details are available in paragraph A19 of Section A.

38 The Committee was informed that MOH was working with PHIs and community care organisations to extend the career progression pathways of support care jobs through job redesign efforts, and upskilling of support care staff to take on more complex tasks. See paragraph A20 of Section A for more information.

39 It was shared that due to falling birth cohorts, there was a limit to the extent to which local training pipelines can be expanded. Foreign healthcare workers would have to be brought in to complement our strong local core. The Committee understood that for foreign healthcare workers who became valued members of the healthcare community and demonstrated commitment to Singapore, the Permanent Resident status could be granted to retain manpower to meet growing healthcare needs. More information is available in paragraph A21 of Section A.

## **Observations and Recommendations**

40 The Committee noted the breakdown of MOH's Total Expenditure by Programme across FY2018 to FY2022 and the impact of handling COVID-19 pandemic on MOH's expenditure. The Committee was assured that MOH would continue to monitor healthcare spending and performance and review the impact of transformation efforts in slowing down the growth of healthcare expenditure. Noting that a substantive portion of the MOH's

expenditure include subvention provided to public hospitals and healthcare institutions, community hospitals, general practitioners, and other institutions, including intermediate and long-term care facilities, the Committee took the view that MOH should remind the stakeholders receiving the subventions on the careful management of such resources as part of the effort to slow down growth of healthcare expenditure.

41 It was further observed that the MOH HQ Programme, accounting for 29% of MOH's expenditure across FY2018 to FY2019, funded a wide variety of programmes. The Committee recommended exercising prudence in ensuring cost-effectiveness, administrative efficiency, and the avoidance of wastefulness in such programmes funded by the MOH HQ Programme. This could include reviewing existing programmes, to reduce any duplicate features among the programmes as well as to 'sun-set' programmes should they be found no longer relevant or be incorporated into other programmes to achieve administrative efficiency.

42 The transformation efforts undertaken by MOH to place a stronger emphasis on preventive care and to anchor care in the community were noted. The Committee encouraged the Ministry to continue monitoring progress and outcomes in this front given the expectation that preventive care would grow as Singapore's population ages and the incidence of chronic diseases increases.

43 The Committee also acknowledged the efforts of MOH in putting in place a range of initiatives to bolster productivity such as tapping on the Population Health Research Grant under RIE2025 to leverage technology to improve health and improve healthcare manpower productivity. The Committee was encouraged to note MOH's approach by the push towards digital solutions in the form of Community Care Digital Transformation Plan and the Healthcare Industry Transformation Map 2025 to support the transformation of care models and approaches, and moderate the growth in future resourcing needs.

44 The Committee noted the multipronged approach to enhance the recruitment and retention of healthcare manpower to support the Healthier SG strategy such as growing the pool of family physicians and strengthening career proposition of support care jobs which formed core pillars to the healthcare industry. The Committee was assured that the Government would look into ways to further enhance and strengthen Singapore's healthcare workforce to retain a pool of healthcare manpower critical to Singapore.

45 It was shared that to measure the effectiveness of the WoD in tackling diabetes, MOH had been monitoring a set of key performance indicators comprising intermediate-term, longer-term, and national indicators. These indicators measured desired outcomes under the key thrusts of the WoD, such as the control of modifiable risk factors (e.g. physical inactivity, unhealthy diet, obesity), uptake of chronic disease screening, management of diabetes and its related complications, as well as diabetes prevalence in the population. The Committee encouraged the Ministry to continue monitoring and updating the public on the results of the WoD based on the indicators above.

46 The Committee noted the shift to capitation-based funding for the three public healthcare clusters — SingHealth, National Healthcare Group, and National University Health System — who would take on the role of regional health managers and look after the health of their assigned population in their respective regions. This aligned with the intent to reduce the downstream costs of costlier hospital treatment. There would also be stronger incentives to better optimise and integrate care across settings, as well as to adopt more cost-efficient

practices. The Committee noted that while this shift to capitation-based funding was relatively new, the Committee encouraged the Ministry to monitor the effectiveness of the current efforts and the progress made thus far, in respect of the health promotion and preventive healthcare programme.

47 It was communicated that the number of new doctors registered with the Singapore Medical Council (SMC) had increased in the past five years and that the number of doctors per 1,000 population in Singapore had increased from 2.4 (2018) to 2.8 (2022). The Committee noted that this is important as Singapore became an aged society in 2017 and is set to attain “super-aged” status in 2026. The Committee urged the Ministry to continue increasing the number of new doctors registered with SMC and the number of doctors per 1,000 population in Singapore. The Committee further encouraged the Ministry to continue to attract more foreign-trained doctors who are Singapore Citizens and Permanent Residents to return to Singapore.

## **SAFEGUARDING OUR CLIMATE RESILIENCE**

48 In his Budget 2023 speech, Deputy Prime Minister Lawrence Wong spoke about how the Government has started to prepare Singapore for the existential threat of global warming and climate change. He reiterated that the carbon tax would be raised progressively over the next few years and that the Coastal and Flood Protection Fund had been set up in FY2020 with an initial injection of \$5 billion to support the construction of coastal and drainage infrastructure.

49 Noting these developments, the Committee enquired into how the Coastal and Flood Protection Fund be utilised, including measures in place to ensure prudent and effective spending of the Fund to support the construction of coastal and drainage infrastructure.

50 Additionally, the Committee asked for learnings from the experience of building a polder at Pulau Tekong which was set to finish by end-2024 and experiences from other countries that could be applied to allow Singapore to better protect our coastline against rising sea levels. The Committee also asked for the efforts and measures taken to strengthen Singapore’s community resilience and collective response on dealing with floods.

### **Summary of MOF’s Response to the Committee**

51 In MOF’s first memorandum, it was shared with the Committee that the moneys in Coastal and Flood Protection Fund (CFPF) were ring-fenced for capital and non-recurrent coastal protection and drainage related expenditures by the Public Utilities Board (PUB). Some examples of projects that have been funded under the CFPF include site-specific studies for Singapore’s North-West coast, as well as drainage improvement works to deal with increasing rainfall intensity as a result of climate change. It was shared that the Government would consider tapping on the CFPF for the construction of coastal protection measures, such as sea walls, revetments, seabunds, and dikes, as long as these measures fall within the eligible uses of the CFPF as stipulated by Section 18A of the Public Utilities Act.

52 The Committee was informed that climate adaptation was a long-term endeavour to ensure that Singapore remains resilient to rising sea levels and climate change. As a high-level estimate, the major infrastructural investments needed to protect Singapore against rising sea

levels could cost more than \$100 billion over the next 100 years. An initial injection of \$5 billion was made at the inception of the CFPP in FY2020. Given the long-term nature of the spending that seeks to preserve the value of land, multiple generations of Singaporeans would need to fund this collectively through a combination of methods to finance the various climate adaptation measures from (i) the annual Budget, (ii) borrowing through sovereign green bonds under the Significant Infrastructure Government Loan Act, to spread the costs equitably across the generations that would directly benefit from these measures and (iii) Past Reserves for land reclamation and other eligible costs.

53 It was shared with the Committee that PUB had developed a governance framework to guide the operationalisation of the CFPP. The framework sets out the approving authorities and approval process for coastal protection and drainage projects that were eligible to tap on the CFPP. On top of the governance framework, coastal and drainage infrastructure was subjected to scrutiny through existing processes to ensure cost effectiveness and public accountability, similar to other public sector infrastructure projects.

54 The Committee learnt that continuous improvements and significant investments had been made to Singapore's drainage network and infrastructure over the past few decades where flood-prone areas had been reduced substantially from 3,200 hectares (ha) in the 1970s to less than 30 ha today. In view of the increased risks of inland and coastal flooding due to climate change and rising sea levels, PUB has been working with partners to develop a range of solutions to holistically address such risks.

55 On coastal flooding, the Committee noted that the Government was conducting site-specific studies along the coastal areas progressively, starting with City-East coast, Jurong Island, and the North-West coast. These ongoing studies would examine various coastal protection options, taking into account the impact to existing land use (including maritime life and coastal shipping routes). Where feasible, the coastal protection measures will be multi-functional and co-located with amenities or recreational space and explore the use of hybrid solutions that have nature-based elements.

56 Acknowledging the need to build and strengthen community resilience and collective response to flooding incidents, the Committee learnt of the efforts to do so through (i) early warning systems to provide more timely updates to the public, (ii) PUB's Telegram Channel or the MyENV Mobile App, (iii) PUB and building owners working together to meet design standards for flood prevention and (iv) issuance of PUB's advisories and distribute portable flood devices before the monsoon season.

57 For more details on the questions posed by the Committee and responses received, please refer to paragraphs B1 to B15 in Section B.

## **Observations and Recommendations**

58 The Committee expressed their appreciation for the updates and efforts undertaken by the Government for Singapore's coastal and flood protection due to global warming and climate change. The Committee agreed that the Government could not completely eliminate every single risk with Singapore's finite fiscal resources and supported the efforts taken by PUB to build community resilience and strengthen Singapore's collective response to flooding incidents.

59 Noting the high-level estimate of more than \$100 billion to fund major infrastructural investments to protect Singapore against rising sea levels over the next 100 years, the Committee was supportive of the initial injection of \$5 billion in the form of CFPF and the funding approach through a combination of methods by multiple generations of Singaporeans collectively. As climate adaptation was a long-term endeavour and given Singapore's vulnerability to rising sea levels, the Committee urged the Government to continue monitoring the impact of climate change on Singapore's coastal and flood protection and participate in international efforts to mitigate the impacts of climate change.

60 The Committee took note of the governance framework to guide the operationalisation of the CFPF and ensure the prudent and proper utilisation of the funds.

61 It was shared that continuous improvements and significant investments had been made to Singapore's drainage network and infrastructure over the past few decades. The Committee noted the commendable efforts to reduce flood-prone areas in Singapore substantially from 3,200 hectares (ha) in the 1970s to less than 30 ha this day. The Committee also urged the Government to share the learning and experiences of building the polder.

## **MONITORING THE RESEARCH, INNOVATION AND ENTERPRISE 2025 PLAN**

62 The Budget 2023 statement reiterated that the Government would be investing \$25 billion from 2021 to 2025 to catalyse research, innovation and enterprise, through the Research, Innovation and Enterprise (RIE) 2025 plan, which was launched in 2020.

63 The RIE2020 plan was examined previously by the Committee in 2017 and 2019. Noting the new developments and injection of funds, the Committee sought updates on RIE2020 including how experiences gathered from RIE2020 if any being applied to RIE2025, more information on RIE2025 and the uptake of research and development (R&D) by local enterprises including SMEs.

### **Summary of MOF's Response to the Committee**

#### *Impact of RIEs and Updates on RIE2020*

64 MOF informed the Committee that since the Science & Technology Plan 2010 (S&T2010), Singapore-based businesses had been making greater use of technologies developed by public research performers. The number of licenses to deploy such technologies rose from 270 achieved under S&T2010, to 1,432 under RIE2015, and 3,238 under RIE2020. Local public research performers' collaborations with industry on R&D projects had also increased from 3,618 industry R&D projects in RIE2015 to 9,081 projects in RIE2020.

65 The RIE efforts and investments had also helped to grow Singapore's core of local enterprises that actively leverage R&D and innovation as a source of competitive advantage. Local enterprises' Business Expenditure on R&D increased from \$1.1 billion in 2010 to \$1.4 billion in 2015 and \$1.6 billion in 2020, while the number of local enterprises involved in R&D activities also grew from 477 in 2010 to 491 in 2015 and 594 in 2020 (see [Table 1](#) below). Local startup ecosystem had also seen strong growth, with overall venture capital investments increasing from \$0.4 billion in 2010 to \$1.9 billion in 2015 and \$5.5 billion in 2020. It was also highlighted to the Committee that the Global Startup Ecosystem Index 2023 ranked Singapore's startup scene first in Asia-Pacific and sixth globally.

Table 1: Number of Startups that Benefitted from the RIE Ecosystem<sup>1</sup>

Year	2018	2019	2020	2021	2022
No. of Startups	150	250	400	550	400

66 The Committee learnt that the Government took into consideration the experiences and learning points from past RIE tranches, including RIE2020, to shape RIE2025’s three strategic focus areas to (i) expand RIE mission to tackle a broad spectrum of national needs, (ii) enrich Singapore’s scientific base and (iii) scale up platforms to drive technology translation and strengthen the innovation capabilities of local enterprises. For instance, the Government increased the budget set aside for White Space funding under RIE2025 to 15% from 13% in RIE2020 to provide agility and nimbleness in responding to changes in the global and technological landscape and evolving needs.

67 As an update to RIE2020, it was shared with the Committee that the budget for Research, Innovation and Enterprise (RIE) 2020 was \$19.0 billion, of which up to \$17.4 billion (92%) would be committed as at June 2023. Of the expected total commitment of \$17.4 billion in RIE2020, \$10.1 billion (58.1%) had been spent as of FY2021. There was no rolling over of unutilised funds from RIE2020 into the RIE2025 budget, which was sized to sustain Government spending in research, innovation and enterprise at about 1% of Singapore’s GDP over 2021–2025.

#### *Progress of RIE2025*

68 The Committee noted that progress of RIE2025 should be seen in the broader context of the overall progress achieved since the inception of RIE. Since the RIE journey began in the early 1990s, Singapore had made steady progress to build up a strong research ecosystem. The Institutes of Higher Learning (IHL), A\*STAR Research Institutes, and academic medical centres/hospitals are well-regarded for research excellence. Singapore’s field-weighted citation index rose from 0.71 (29% below global average) in 2000 to 1.51 in 2015 (51% above global average) and 1.78 (78% above global average) in 2020. Similarly, our pool of researchers has grown significantly from 20,000 in 2000 to 43,000 in 2015 and 46,000 in 2020.

69 The RIE investments had also created new value for our economy, and enabled Singapore to address national needs such as making the water supply more secure and resilient through investments in NEWater and desalination technologies. In addition, Singapore’s biomedical R&D capabilities enabled us to respond to the COVID-19 pandemic quickly — Singapore was the third country, outside of China, to successfully culture the virus, and developed several diagnostic test-kits. Significant RIE2025 investments have been allocated to tackle the existential threat of climate change, as science and technology is a key enabler to do so. RIE2025 efforts support all five of the Singapore Green Plan 2030’s pillars.

70 It was noted that RIE2025 supported a diversified portfolio of foundational and applied research, I&E programmes and talent development. Of the \$25 billion set aside for RIE2025 from FY2021 – 2025, over \$7.6 billion (30.4%) has been committed in FY2021. There were

<sup>1</sup> Startups may receive a wide range of support from RIE-funded programmes to meet various needs, including capital, mentorship, talent and internationalization. Data on the number of unique locally-based startups supported across all programmes is not available. The estimated **non-unique** number of locally-based startups that have benefitted from RIE-funded programmes is provided.

major initial commitments at the beginning of RIE2025 due to the renewal of significant multi-year programmes to continue their R&D activities from RIE2020 to RIE2025. The Government expected that the remaining funds would be sufficient to see through the completion of RIE2025.

71 Additionally, it was shared with the Committee that the Government made sustained investments in core areas of strategic importance across RIE tranches with expectation for findings to be translated into commercial and national outcomes over time. One such example was the investment in R&D to support and strengthen Singapore's pandemic preparedness, including efforts to develop prototype diagnostics, therapeutics, and vaccine candidates, to help strengthen Singapore's capabilities to respond to future infectious disease threats.

72 Noting that RIE2025 had a grant call launched in 2022 to support prenatal and early childhood research, the Committee asked about the progress as well as additional examples of new research areas to optimize Singapore's human potential under RIE2025. It was shared with the Committee that the A\*STAR's Prenatal/Early Childhood grant to support prenatal and early childhood research only began funding projects recently, with the first grant call completed in 2022. Ten projects were awarded in the first grant call with research ongoing and results expected from 2025 onwards, which had the potential to produce findings that improve child health, learning, and well-being and maternal health and well-being. Additional examples of new research that the Government is supporting to optimise Singapore's human potential under RIE2025 include research to better understand the factors that influence adolescent growth and mental health, for example the mechanisms and pathways of child brain and physical development.

#### *Benefits of RIE plans and local enterprises*

73 As part of the Singapore RIE ecosystem, local startups benefit from a range of resources such as technologies, talent, funding, mentorship, infrastructure, and access to international networks. One example is Lucence, which provides ultra-sensitive non-invasive cancer detection technologies. Its flagship tests include LiquidHALLMARK® which helps physicians with personalised treatment selection for their cancer patients, and LucenceINSIGHT™ which helps healthy asymptomatic individuals detect cancer signals earlier when cancer is most treatable. Lucence was founded in 2016 and spun off from A\*STAR in 2017, and it has continued to benefit from its partnership with A\*STAR. Through R&D collaborations supported by RIE funding, Lucence accessed technologies, R&D, manpower, and equipment from A\*STAR and public healthcare institutions (e.g. National University Hospital, National Cancer Centre), and has published findings with these institutions, showcasing how its technology boosts cancer profiling.

74 The Committee was informed that RIE2025 continued to directly support local enterprises to create solutions that leverage science and technology through a spectrum of R&D and Innovation and Enterprise (I&E) activities. There had been greater uptake of R&D and I&E activities by local enterprises thus far under RIE2025, with support for Small and Medium Enterprises (SMEs) more commonly delivered via I&E initiatives such as the Industry Alignment Fund – Industry Collaboration Project (IAF-ICP) scheme, RIE-funded Centres of Innovation (COIs) and Innovation Partner for Impact (IPI).



75 It was shared by MOF that the Government would be building on ongoing efforts to grow the R&D and innovation activities of the local enterprises by:

- (a) Strengthening support for local enterprises to leverage market-oriented R&D and innovation as a source of competitive advantage.
- (b) Supporting a wider base of local enterprises to make use of the capabilities and technologies developed by our public research ecosystem.
- (c) Supporting local enterprises to engage in business and technology collaborations with a wider range of innovation nodes and demand markets around the world, such as through the Global Innovation Alliance (GIA) scheme to support local enterprises' internationalisation efforts, through facilitating access to overseas markets via outbound acceleration programmes.

76 The RIE2025 initiatives were complemented by economic agencies' (such as the Economic Development Board and EnterpriseSG) outreach efforts, to link local enterprises up with these resources and support their applied R&D and innovation efforts. For instance, A\*STAR works with EnterpriseSG to identify and help local enterprises develop Operation & Technology Roadmaps (OTRs) to achieve business growth. A\*STAR had supported the development of OTRs for 873 companies since 2002, and would be expanding its outreach to more local enterprises. The Committee learnt that a SME that benefitted from OTR was ERS Industries, a data centre solutions provider. OTR helped ERS to identify the need to develop R&D capabilities in thermal cooling. This led ERS to collaborate with A\*STAR and develop the ERS E@Rack that reduces the costs of thermal cooling for data server racks. ERS then worked with A\*STAR to develop an energy-efficient system, KoolLogix, that reduced data centre energy consumption by up to 50%. In 2018, ERS spun off KoolLogix to cater dedicated resources for its R&D and business development. OTR helped KoolLogix to identify potential beachhead customers, and supported its expansion to Southeast Asian markets. OTR had also supported Large Local Enterprises (LLEs) like Hyphens Pharma, which provides skin care solutions.

#### *Researchers and Scholars under RIE plans*

77 The Committee learnt that RIE2025 builds on the progress of previous RIE tranches in enriching Singapore's scientific base. This required a robust base of researchers with strong links to the global community. It was shared that the aim was to support more than 9,000 PhD and Master by Research students with tuition subsidies in RIE2025, exceeding the RIE2020 achievement of around 8,500 subsidised students. In addition, the National Research Foundation (NRF) Fellowship (NRFF) and NRF Investigatorship (NRFI) talent schemes supported researchers at the early-career and mid-to-senior-career stages respectively to pursue ground-breaking research in Singapore. The RIE2025 awardees come from a range of fields, from the development of new drug screening and disease diagnostic capabilities to quantum materials for microelectronics applications.

78 Noting this development, the Committee asked for more information about scholarships under the RIEs including the selection process and guidelines for the evaluation and awarding of such scholarships, and the plan to continue to retain the scholars after graduation in their research field for their contribution to Singapore.

79 It was learnt that the Postgraduate by Research (PGR) scholarships were funded in full or in part by RIE funds. Autonomous Universities (AUs) were given the flexibility to supplement RIE funds with other grants to increase the number of scholarships beyond the RIE target. The PGR scholarships funded under RIE expenditures comprised the following:

- (a) MOE-funded PGR Scholarships. MOE provides a Research Scholarship Block to each AU to support tuition fees and stipends of research scholarships for PGR students.
- (b) A\*STAR PGR Scholarships and Singapore International Graduate Award (SINGA).
- (c) Industrial Postgraduate Programme (IPP). IPP awardees pursue full-time postgraduate studies while undertaking an industrial R&D project at participating companies to develop industry-relevant R&D skills.

80 The selection process and guidelines for evaluating and awarding PGR scholarships generally involve the evaluation of candidates' academic and research qualifications, suitability, and aptitude through interviews, academic referees, and relevant proficiency tests. Other attributes assessed include having a goal-oriented mindset, leadership qualities, and analytical writing competencies.

81 The Committee noted for the RIE2020 schemes, about 80% of graduated A\*STAR scholars and 50% of graduated SINGA awardees across the period 2016 to 2020 were currently working in Singapore and actively contributing to the RIE ecosystem primarily in A\*STAR research institutes, AUs, and industry. The strategy to retain scholars after graduation include providing postdoctoral fellowships and awards to resource talented researchers in pursuing impactful research in Singapore. In addition to national-level awards such as the NRF Fellowship for early career researchers and NRF Investigatorship for mid-senior career researchers, the public research institutions have awards such as the NUS Presidential Fellowship, NTU Presidential Postdoctoral Fellowship, A\*STAR Young Achiever Award, and A\*STAR Career Development Fund.

82 On further queries from the Committee on plans to encourage such scholars to anchor in Singapore for the long term, the Committee learnt that beyond various postdoctoral fellowships offered by the universities, targeting their early-stage careers, there were also other schemes and efforts which focus on anchoring them in Singapore over the medium to long term. For instance, A\*STAR encourages early-career scholars to remain in Singapore by offering exposure to the RIE ecosystem beyond A\*STAR. They could take up joint appointments and secondments in the Autonomous Universities, industry and public sector. Scholars with leadership qualities were actively nurtured and provided leadership opportunities within A\*STAR Research Institutes and academia, and as technopreneurs. A\*STAR also continued to stay connected with past scholars who have moved overseas, to secure mindshare of Singapore as an anchoring location.

83 The Committee noted the number and retention rates for A\*STAR PGR scholarship and SINGA scholarship recipients in Tables 2 and 3.

Table 2: Number and retention rates for A\*STAR PGR scholarship recipients

<b>Total number of A*STAR PGR recipients from 2001 to 2022</b>	<b>1255</b>	<b>100%</b>
<b>Total number of recipients employed in Singapore’s RIE ecosystem as of 31 Mar 2022:</b>	<b>1002</b>	<b>80%</b>
<b>Total number of recipients employed overseas as of 31 Mar 2022<sup>2</sup>:</b>	<b>159</b>	<b>13%</b>

Table 3: Number and retention rates for SINGA scholarship recipients

<b>Total number of SINGA recipients from 2008 to 2023 (as of 31 Mar 2023)</b>	<b>269</b>	<b>100%</b>
<b>Total number of recipients who have worked in Singapore after graduation as of 31 Mar 2023<sup>3</sup></b>	<b>156</b>	<b>58%</b>

84 For more details on the questions posed by the Committee and responses received, please refer to paragraphs C1 to C33 in Section C.

### **Observations and Recommendations**

85 The Committee acknowledged the efforts and achievements in stimulating R&D in Singapore through the various RIE plans to support and drive Singapore’s innovation efforts. Noting the support for local enterprises to create solutions that leverage science and technology through a spectrum of activities, the Committee encouraged the Government to have more outreach activities to engage local enterprises to tap on the various initiatives and create or encourage a culture of innovation within these local enterprises. The Committee was pleased to note the efforts to support research on social and health issues to optimise Singapore’s human potential under the RIE plans such as those to better understand the factors that influence adolescent growth and mental health as demonstrated in the grant call launched in 2022 to support prenatal and early childhood research. The Committee urged the Government to do more in this regard.

86 The Committee expressed their appreciation for the updates and efforts undertaken by the Government to catalyse research, innovation and enterprise through the multiple-year and continuous investments through the RIE plans. Nevertheless, due to the complex nature of R&D activities spanning over many years and the sum of public funds involved, the Committee was of the view that it would be important that agencies disbursing RIE funds ensured the accountability and proper usage of such funds, to enable Singapore to reap the most of the RIE investments.

87 The Committee was encouraged to note that the number of startups that benefited from the RIE ecosystem has more than doubled from 2018. This showed that the RIE plans had made headway in catalysing innovation and enterprise to Singapore local business community. The Committee further commended the efforts in supporting SMEs by linking local enterprises up with these resources and supporting their applied R&D and innovation efforts as demonstrated

<sup>2</sup> Data is not available for 94 (7%) of A\*STAR PGR recipients.

<sup>3</sup> Remaining 59 SINGA recipients (22%) did not work in Singapore after graduation. Data not available for 54 (20%) of SINGA recipients.

by the achievement of ERS Industries in developing the ERS E@Rack that reduces the costs of thermal cooling for data server racks.

88 Encouraged by how Singapore had grown a strong core of research manpower, the Committee recommended monitoring developments by identifying and grooming talents in the research manpower sector to ensure that the R&D manpower scene remained viable and robust to support Singapore's R&D ecosystem. The Committee was confident that such initiatives, such as the AI Apprenticeship Programme to train and groom Singaporean AI talents, would be able to play a significant role in positioning Singapore and Singaporeans for future challenges. The Committee noted and agreed that RIE plans should be focused on building up global peaks of research and translational excellence in Singapore, which would be critical in anchoring research talent. Beyond that, the Committee suggested tracking the number and retention rates of the research talents, as well as the relevant scholarship recipients, to ensure the benefits of such programmes to Singapore's RIE plans, and also remained viable in attracting and retaining the talents needed. Noting that 58% of the SINGA scholarship recipients worked in Singapore after their graduation compared to 80% for A\*STAR PGR recipients (who are bonded), the Committee urged the A\*STAR to look into ways to increase the retention rate of SINGA scholars and hoped more can be done to encourage these recipients to continue their contribution to Singapore's research sector.

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**SECTION A**  
**Healthier SG Strategy**

**Committee’s Queries to MOF:**

For a breakdown for the annual spending by the Ministry of Health in terms of the Operating Expenditure and Development Expenditure on (i) Services Programme (ii) Ministry of Health Headquarters Programme and (iii) Health Promotion and Preventive Healthcare Programme.

**Reply from MOF on 30 June 2023:**

A1 Annual spending by the Ministry of Health (MOH) averaged \$10.9 billion a year in FY2018 – 2019, prior to the COVID-19 pandemic. Over the same period, about 87% of MOH’s expenditure was on Operating Expenditure and 13% on Development Expenditure. There was an increase in MOH’s expenditure across FY2020 – 2022, to an average of \$16.6 billion per year, largely due to funding required for the prevention, containment, and control of COVID-19. For MOH’s expenditure across FY2018 – 2019:

- (a) The Services Programme accounted for 68%. This includes funding for subventions to the public hospitals and healthcare institutions, community hospitals, general practitioners, and other institutions, including intermediate and long-term care facilities.
- (b) The MOH Headquarters (HQ) Programme accounted for 29%. This includes funding for existing and new healthcare manpower initiatives, training for the healthcare sector, research, subsidies, and financial assistance for MediShield Life and CareShield Life premiums, as well as other forms of grants and financial assistance.
- (c) The Health Promotion Programme accounted for 3%, which included funding for the Health Promotion Board’s (HPB) programmes.

From FY2020, the description of this Programme was broadened to go beyond the work of HPB, so as to encompass preventive health holistically. Between FY2020 and FY2022, the spending on preventive care, which includes health promotion, subsidies for screenings and vaccinations, as well as other community-based initiatives by public hospitals and community partners, comprised about 5% to 6% of MOH’s total expenditure. Spending on preventive care is expected to grow as our population ages and the incidence of chronic diseases increases.

Table A1. Breakdown of MOH’s Total Expenditure by Programme across FY2018 – 2022

<b>\$’ Billion</b>	<b>FY2018 Actual</b>	<b>FY2019 Actual</b>	<b>FY2020 Actual</b>	<b>FY2021 Actual</b>	<b>FY2022 Revised</b>	<b>Share of Total Expenditure (FY2018 – 2019)</b>
<b>Services Programme</b>	7.1	7.8	8.2	8.8	11.5	68%

<b>MOH HQ Programme</b>	3.1	3.2	6.2	7.4	4.9	29%
<b>Health Promotion and Preventive Healthcare Programme<sup>#</sup></b>	0.3	0.3	0.8	1.1	0.8	3%
<b>Total Expenditure</b>	10.4	11.3	15.3	17.3	17.2	-
<b>Operating</b>	8.9	9.9	14.3	16.3	16.1	87%
<b>Development</b>	1.5	1.4	0.9	1.0	1.1	13%

Note: Figures may not add up due to rounding.

<sup>#</sup> MOH had amended the programme title and description from “Health Promotion Programme” to “Health Promotion and Preventive Healthcare Programme” in the Revenue and Expenditure Estimates from FY2020 onwards to account for non-HPB preventive healthcare initiatives.

**Committee’s Further Queries to MOF:**

For further clarification on MOH’s total expenditure, the reasons for the increase in expenditure in Services Programme, and whether some examples can be given.

**Reply from MOF on 31 August 2023:**

A2 MOH’s budget is allocated to the Services Programme, MOH Headquarters (HQ) Programme, and the Health Promotion and Preventive Healthcare Programme.

- (a) A breakdown of the Health Promotion and Preventive Healthcare Programme is provided below:

Table A2. Key Contributors to Revised Expenditure Estimates for the Health Promotion and Preventive Healthcare Programmes Across MOH’s FY2020 – FY2022 Revised Expenditure Estimates

<b>Item</b>	<b>Average Share of the Programme Across MOH’s FY2020 – FY2022 Revised Estimates</b>
Prevention and Control Efforts for Infectious Diseases <sup>A1</sup>	2%
Health Promotion Efforts	2%
Outreach and Prevention Efforts for Seniors	1%
Others	~1%

Preventive health efforts are today largely driven by the Health Promotion Board through the provision of nationally recommended immunisations and subsidised screenings, as well as school and workplace programmes. However, the public healthcare clusters and community providers are increasingly taking on a larger role in preventive health to meet regional

<sup>A1</sup> This includes funding for COVID-19 related expenditure.

health needs for various population segments, through outreach and community-based programmes to support residents in adopting a healthier lifestyle. MOH anticipates that preventive health expenditure will continue to increase with Healthier SG.

- (b) The Services Programme comprises operating subvention provided to healthcare institutions and non-public sector providers, such as Voluntary Welfare Organisations and General Practitioners. The increase in expenditure for the Services Programme from FY2021 to FY2022 was largely attributed to the categorisation of some grants provided to healthcare institutions under the Services Programme instead of the MOH HQ Programme, with effect from FY2022. These reclassified grants include the Home Caregiving Grant and manpower expenditure by public healthcare institutions (including for salary enhancements). Besides the above reclassification, the subvention base to healthcare institutions under this programme also increased in FY2022 to enable each public healthcare cluster to scale up initiatives that had demonstrated improvements to health outcomes and facilitated right-siting of care.
- (c) The MOH HQ Programme funds:
- i. The formulation of national policies on health and ageing, healthcare manpower planning and development, and the research and corporate functions at MOH HQ.
  - ii. Premium support for national insurance schemes (i.e. MediShield Life and CareShield Life).
  - iii. Training and education through pre-employment clinical training, residencies, and scholarships.
  - iv. Information management and systems development for MOH and its statutory boards, such as the Next Generation Medical Record.
  - v. Regulation of healthcare establishments, including the implementation of the Healthcare Services Act, monitoring of clinical quality and standards, etc.
  - vi. The Health Sciences Authority to support health and non-health regulatory and compliance agencies in safeguarding public health through the regulation of health products and blood supply.

**Committee's Further Queries to MOF:**

Whether and what increases in expenditure are envisaged for each programme.

**Reply from MOF on 30 June 2023:**

A3 MOH expects increases in expenditure on these programmes to be driven by three factors:

- (a) Ageing population. Singapore's population is ageing rapidly, with one in four citizens expected to be 65 and above by 2030, up from nearly one in five today. This in turn drives up spending in acute care, which is the most expensive part of the system. Older people are more susceptible to falling sick or suffering from disabilities, and require more medical attention and longer hospital stays. Further, long-term care expenditure is also rising as more seniors become frail or cannot live independently and families live apart. Between 2013 and 2018, MOH's expenditure on the long-term care sector under the Services Programme increased from \$296 million to \$723 million — a Compound Annual Growth Rate of 20%.
- (b) Higher age-standardised utilisation rates. These represent healthcare utilisation rates after normalising for the impact of ageing. Changing lifestyles as well as earlier diagnoses have contributed to rising age-standardised prevalence of chronic diseases<sup>A2</sup>, which have increased healthcare demand. Further, rising incomes and greater accessibility of high-quality healthcare services have also led to higher utilisation rates<sup>A3</sup>.
- (c) Higher cost per unit of healthcare. First, medical advancements have made available newer treatments that improve lifespan and quality of life, but cost more per treatment. In medical oncology, public sector spending on cancer drugs has more than doubled from \$110 million in 2016 to \$275 million in 2021. Second, manpower costs of healthcare staff are expected to continue increasing, to ensure that healthcare workers are appropriately recognised and remunerated<sup>A4</sup>.

**Reply from MOF on 31 August 2023:**

A4 Projected spending by MOH for the next three fiscal years is likely to follow a long-term upward trajectory due to a combination of our ageing population, rising utilisation of healthcare, and medical inflation. However, actual specific expenditure will be subject to short-term fluctuations. The latest expenditure requirements will be published in the Revenue and Expenditure Estimates for the relevant Financial Year.

**Committee's Further Queries to MOF:**

For an update on how operations and services are transformed to deliver integrated programmes, services and more comprehensive solutions.

**Reply from MOF on 30 June 2023:**

A5 MOH's healthcare financing policy is grounded on sound principles. MOH insists on co-payment, and curtails the distortionary effect of insurance through universal risk pooling, co-insurance, and deductibles. Moreover, MOH has put in place a robust Health Technology Assessment system, and driven value-based care throughout the system. This is however

<sup>A2</sup> The age-standardised prevalence of Singapore residents living with hypertension and hyperlipidemia have risen from 20% and 26% in 2010 to 32% and 37% in 2019 – 2020 respectively.

<sup>A3</sup> The number of Total Knee Replacement surgeries has risen from 187 patients for every 100,000 people aged 65 and above in 1999 to 499 patients in 2019 — a multiple of 2.7 times in the prevalence rate.

<sup>A4</sup> In 2021, MOH announced base salary increases of between 5% and 14% for public healthcare nurses to further enhance the competitiveness of the nursing profession.



insufficient. MOH aims to achieve better health-adjusted longevity for our seniors by preventing or delaying the onset of ill health. Besides a better quality of life for our seniors (and more peace of mind for their families), this could also help in moderating future growth in healthcare costs.

A6 In this regard, MOH has undertaken a fundamental transformation of our healthcare system to place a stronger emphasis on preventive care and to anchor care in the community. Healthier SG was developed after consultations with more than 6,000 residents, including employers and healthcare professionals. It involves several transformative moves to better deliver healthcare and improve outcomes:

- (a) Shifting away from episodic and transactional care model to a holistic, person-centred care model for residents, anchored through a longer-term and stronger doctor-patient relationship. This will be facilitated by the Healthier SG enrolment programme where residents will sign up with a regular family doctor who will deliver preventive care and support residents in making lifestyle adjustments to improve their health, on top of delivering chronic care.
- (b) Building stronger linkages between healthcare providers and community partners (e.g. HPB, Active Ageing Centres, People's Association (PA), Sport Singapore). These partners play an important role in addressing the non-medical determinants of health by offering and enhancing access to programmes and services that help residents keep healthy and well in the community. For example, MOH is working with the Agency for Integrated Care's Silver Generation Office to reach out to seniors, in particular those who are lonely and isolated, to identify and refer seniors with needs to Active Ageing Centres. This will allow these seniors to access the relevant support and services such as active ageing programmes and befriending. MOH, the Ministry of National Development, and the Housing Development Board (HDB) have also been working together to bring care and social support closer to seniors. Stronger linkages between healthcare providers and community partners would also facilitate referrals of residents who require additional help in managing their social and lifestyle interventions.
- (c) Shift to capitation-based funding for the three public healthcare clusters — SingHealth, National Healthcare Group, and National University Health System — who will take on the role of regional health managers and look after the health of their assigned population in their respective regions. Under this funding model, the clusters are paid a pre-determined amount per assigned resident under their charge, and are empowered to drive right-siting of patients and preventive care initiatives. This aligns with the intent to reduce the downstream costs of costlier hospital treatment (compared to workload-based funding, where clusters receive more funding when there are more patients in hospitals). There will also be stronger incentives to better optimise and integrate care across settings, as well as to adopt more cost-efficient practices.

A7 In addition, MOH will strengthen partnerships with businesses and unions to promote health at workplaces. MOH has worked with the Singapore National Employers Federation

and National Trades Union Congress to encourage employers to enhance employee health and well-being. This includes getting more panel General Practitioners (GPs) to join Healthier SG, and encouraging Healthier SG participation amongst employees. By doing so, employees can continue to see the same GP clinic and enjoy Healthier SG benefits even after they retire or change jobs, while employers will have a healthier and more productive workforce.

**Reply from MOF on 31 August 2023:**

A8 MOH has put in place a range of initiatives to raise productivity. Under RIE2025, the Population Health Research Grant supports projects including those that aim to optimise resource allocation, improve healthcare manpower productivity, and leverage technology to improve health. The Community Care Digital Transformation Plan will support community care organisations to adopt a comprehensive suite of digital solutions that help to raise digitalisation levels and improve productivity. Building on past efforts, the recently launched Healthcare Industry Transformation Map 2025 will strengthen IT and digital system enablers, as well as regulatory frameworks, to support the transformation of care models and approaches. MOH expects these initiatives to moderate the growth in our future resourcing needs.

A9 To ensure that efforts to bolster productivity do not compromise the quality of care, MOH will continue to monitor and publish outcome indicators in the Revenue and Expenditure Estimates for each Financial Year and the National Population Health Survey report, as well as work with our public healthcare clusters to monitor outcomes on a cluster-specific basis.

**Committee's Further Queries to MOF:**

On the monitoring systems established to ensure prudent spending and to avoid further increases within each programme.

**Reply from MOF on 30 June 2023:**

A10 MOH will monitor and evaluate the progress and impact of the reforms through short-, medium-, and long-term indicators covering a range of focus areas, such as preventive care and anchoring of care in the primary care and community setting. MOH will also continue to track and publish expenditure and outcome indicators in the Revenue and Expenditure Estimates for each Financial Year and review the impact of transformation efforts in slowing down the growth of healthcare expenditure. MOH also publishes the outcomes of the National Population Health Survey to track health and risk factors and lifestyle practices of Singaporeans. MOH will continue to work with our public healthcare clusters to monitor the indicators on a cluster-specific basis, identify key cost drivers, and facilitate cost benchmarking between public healthcare institutions (PHIs) to support their optimisation efforts. Healthcare financing policies such as bundled payments and capitation will continue to provide clusters with the incentive to prioritise the delivery of value-based care.

A11 Progress of MOH's efforts will be reviewed regularly, bearing in mind that the transformation is a dynamic and multi-year effort where results may not be immediate. In addition to these indicators, MOH will regularly consult and engage key stakeholders (e.g. healthcare clusters, primary care leaders) to align efforts and priorities, and to address any gaps.

**Committee's Further Queries to MOF:**

For examples of how integrated programmes and solutions have translated into concrete healthcare benefits for Singaporeans.

For the metrics of success on the effectiveness of such programmes.

**Reply from MOF on 30 June 2023:**

A12 Furthermore, Healthier SG builds on past and existing efforts:

- (a) One example is the War on Diabetes (WoD), which was launched in 2016 to spearhead a whole-of-nation initiative to tackle diabetes. As part of WoD, MOH has collaborated with multiple stakeholders to create a conducive environment to encourage and sustain healthier behaviours, such as through specific initiatives that promote physical activity and healthy eating. For example, HPB runs a variety of programmes to support residents in leading healthier lifestyles, such as the National Steps Challenge™. To galvanise the community to participate in the Challenge, HPB collaborated with corporate and community partners (e.g. PA, Silver Generation Office, Mendaki, HomeTeamNS, SAFRA). The Challenge has been successfully encouraging residents to embark on more active lifestyles.
- (b) Another example is the introduction of mandatory nutrition labelling and advertising prohibitions for beverages. This will (1) help consumers identify beverages that are higher in sugar and saturated fat and make more informed, healthier choices, (2) reduce the influence of advertising on consumer preferences, and (3) spur industry reformulation. These Nutri-Grade measures have been rolled out for prepacked beverages from 30 Dec 2022 and will be extended to freshly prepared beverages from end-2023.

A13 In support of Healthier SG, these efforts will be scaled up and MOH will continue working with other community partners to ensure robust support for residents. As the impact of Healthier SG reforms on residents' health and healthcare expenditure may only be discernible in the long run, MOH has put in place mechanisms to monitor progress and outcomes.

**Reply from MOF on 31 August 2023:**

A14 MOH monitors and evaluates the progress of programmes, including the War on Diabetes (WoD) and the mandatory nutrition labelling and advertising prohibition measures for beverages.

- (a) Since the inception of the WoD in 2016, MOH has spent about \$25.4 million from FY2016 to FY2022 on such efforts. This amount was tabulated based on key items, such as the Let's BEAT Diabetes marketing campaign to increase public awareness of diabetes and various initiatives implemented in

support of the WoD<sup>A5</sup>. It is not possible to isolate all spending items as programmes like Healthier SG will contribute towards better management of chronic conditions, including diabetes.

- (b) To measure the effectiveness of the WoD in tackling diabetes, MOH has been monitoring a set of key performance indicators comprising intermediate-term, longer-term, and national indicators. These indicators measure desired outcomes under the key thrusts of the WoD, such as the control of modifiable risk factors (e.g. physical inactivity, unhealthy diet, obesity), uptake of chronic disease screening, management of diabetes and its related complications, as well as diabetes prevalence in the population.

A15 Similarly, MOH evaluates the success of Nutri-Grade labelling, such as by monitoring whether there is a reduction in the median sugar level across beverages, increased consumer preference for beverages with lower sugar and saturated fat content, and a reduction in Singaporeans' overall sugar consumption from beverages.

**Committee's Further Queries to MOF:**

On how the Ministry is prioritising resources on talent management and retention to support the Healthier SG strategy.

**Reply from MOF on 30 June 2023:**

A16 To support the Healthier SG strategy, MOH is taking a multipronged approach to enhance the recruitment and retention of healthcare manpower.

A17 Growing the pool of family physicians. There are ongoing efforts to recruit staff in the primary care and community sectors to meet the demand for healthcare services and support healthcare transformation efforts. To do so, intakes for family medicine (FM) residency have been increased, and intakes for nursing and allied health programmes will be progressively increased for the coming years. Local pipelines are being augmented with foreign manpower where needed. Additionally, MOH has been working with the various committees and organisations involved in FM education (e.g. Family Medicine Training Advisory Committee, College of Family Physicians Singapore) to expand the number of training places for postgraduate FM training. MOH is actively growing the pool of family physicians and is working towards having at least one family doctor per participating Healthier SG clinic to be accredited as a family physician. To support primary and community care professionals in implementing Healthier SG, MOH has also been working with family doctors to promote continuing professional development.

A18 Fair and competitive salaries and recognition of healthcare workers. MOH regularly reviews the remuneration of healthcare workers to ensure that their salaries are fair and competitive.

- (a) In 2020, we enhanced the salaries of local nurses and support care staff in the community care sector.

<sup>A5</sup> These initiatives include the cluster-led, community-based diabetes prevention and management pilot programmes, WoD engagements and publicity, Tier 1 National Diabetes Reference Materials, Care Team Education framework, and Cluster Patient Empowerment programmes.

- (b) In 2021, we enhanced the salaries of local and foreign non-medical staff groups in both the acute and community care sectors.
- (c) In 2023, we enhanced the salaries for public healthcare junior doctors and medical officers.
- (d) We rewarded healthcare workers for their contributions to fight against COVID-19 through the COVID-19 Special Bonus in 2020 and COVID-19 Healthcare Award in 2021.
- (e) We enhanced the Nurse Special Payment package in 2022 to recognise the hard work and contributions of our nurses.

A19 Prevention of abuse and harassment of healthcare workers. MOH formed a Tripartite Workgroup on the prevention of abuse and harassment of healthcare workers, comprising members from the union, public healthcare, private healthcare, and community care organisations. MOH is developing a zero-tolerance policy against abuse and harassment of healthcare workers to ensure a consistent approach is taken across PHIs. Private healthcare and community care organisations may adapt the zero-tolerance policy to suit their operating context. In the second half of 2023, MOH Holdings will also launch a national public education campaign to promote trust and respect between healthcare workers, patients, and their caregivers.

A20 Strengthening career proposition of support care jobs. To improve the attraction and retention of support care staff, we are working with PHIs and community care organisations to extend the career progression pathways of support care jobs through job redesign efforts, and upskilling of support care staff to take on more complex tasks. By empowering the support care workforce, this would also free up bandwidth for our nurses and other healthcare professionals to practise at the top of their licence.

A21 Enhancing foreign manpower recruitment and retention. Due to falling birth cohorts, there is a limit to the extent to which we can expand local training pipelines, and we will have to continue to bring in foreign healthcare workers to complement our strong local core. In particular, we are ramping up recruitment of foreign nurses, amidst heightened global competition for healthcare manpower which has resulted in higher attrition in recent years. For foreign healthcare workers who become valued members of the healthcare community and demonstrate commitment to Singapore, we are prepared to grant them Permanent Resident status to retain manpower to meet our growing healthcare needs.

**Reply from MOF on 31 August 2023:**

A22 MOH regularly projects its healthcare manpower demand for doctors, nurses, pharmacists, and allied health professionals to ensure that we have enough supply from (1) local training pipelines and/or (2) scholarships and sponsorships for locals in overseas universities to meet the needs of Singapore's healthcare system through a strong, local core of manpower.

A23 For doctors, from 2013 to 2022, our medical schools increased their combined annual intake by around 30%, from around 400 to over 500. While our main source of doctors will

continue to be our local medical schools, we are also attracting about 200 locals who studied or practised medicine overseas back to Singapore annually. In addition, we supplement recruitment with a small proportion of qualified doctors from recognised universities in other countries to ease the workload in specific departments and hospitals. Overall, between end-2018 and end-2022, the number of doctors registered with the Singapore Medical Council had increased by about 16%, from about 13,800 to 16,000. The proportion of locals has remained above 90%.

**Further Data Provided by MOF on 31 October 2023:**

The number of new doctors registered with the Singapore Medical Council (SMC) has increased in the past five years (see [Table A3](#) below).

**Table A3: Number of new doctor registrations between 2018 and 2022**

<b>Year</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
No. of new doctor registrations	678	763	745	776	799

**Source:** Singapore Medical Council (SMC)'s Annual Report (2018 – 2022)

A24 For nurses, MOH had earlier announced that the healthcare sector targeted to bring on board 4,000 nurses this year — 40% more than pre-pandemic annual levels — to build up our nursing workforce and cater for expansions of service capacity. In the first half of 2023, the public healthcare clusters have recruited about 2,000 new nurses through intensified local and overseas recruitment, and expect to recruit another 1,800 more nurses by the end of the year. Including nurses recruited in the private healthcare sector, MOH is on track to meet the target of 4,000.

**Further Data Provided by MOF on 31 October 2023:**

The number of new nurses registered with the Singapore Nursing Board (SNB) has increased in the past five years (see [Table A4](#) below).

**Table A4: Number of new nurse registrations between 2018 and 2022**

<b>Year</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
No. of new nurse registrations	2,763	2,804	3,017	3,324	3,458

**Source:** Singapore Nursing Board (SNB)'s Annual Report (2018 – 2022)

A25 MOH will continue to work with the public healthcare clusters and community care organisations to strengthen nursing recruitment. The clusters recently enhanced their sponsorships for nursing studies in local Institutes of Higher Learning (IHLs) to encourage more students to take up nursing jobs in the clusters upon graduation.

A26 Fresh nursing graduates from local IHLs who have not taken up sponsorships but enter nursing in the public healthcare clusters or publicly-funded residential community care organisations such as nursing homes in 2023 will be eligible for a sign-on bonus of \$15,000, paid out in three tranches of \$5,000. The first tranche will be paid out at the start of employment, with the second and third tranches at the end of the first and second years of service respectively. The bonus will apply to fresh graduates who join between 1 January and 31 December 2023. MOH is also looking into a long-term retention scheme for nurses in our public healthcare clusters, and will share more details when ready.

A27 MOH will continue to work with healthcare employers to review the salary package of the healthcare workforce on a regular basis, and look into ways to further enhance and strengthen our healthcare workforce, through a strong local core augmented with skilled foreign manpower. Overall, these efforts are meant to retain a pool of healthcare manpower critical to Singapore.

#### Reply from MOF on 31 November 2023:

A28 MOH does not track the number of Singapore Citizens (SCs) who go abroad to study medicine. Instead, MOH tracks the number of foreign-trained SCs and Permanent Residents (PRs) who are registered with the Singapore Medical Council (SMC) (see [Table A5](#)).

**Table A5: Number of new doctor registrations, from foreign-trained SCs and PRs**

	2018	2019	2020	2021	2022
<b>Number of New Doctor Registrations, from Foreign-trained SCs &amp; PRs</b>	190	203	209	217	195

Source: SMC's Annual Report (2018 – 2022)

A29 Overall, the number of doctors per 1,000 population in Singapore increased from 2.4 (2018) to 2.8 (2022) (see [Table A6](#)).

**Table A6: Number of doctors per capita in Singapore**

	2018	2019	2020	2021	2022
<b>Number of Doctors per 1,000 population</b>	2.4	2.5	2.6	2.8	2.8

Source: SMC's Annual Report (2018 – 2022)

A30 MOH monitors the inflow of new nurses at the national level for both the public and private sectors via the number of new nurses registered with the Singapore Nursing Board (SNB), and measures attrition by the number of nurses who do not renew their practising certificates with SNB (see [Table A7](#)).

**Table A7: Number of newly registered nurses at the national level and practising nurses who did not renew their practising certificates**

	2018	2019	2020	2021	2022
<b>Number of newly registered nurses at the national level</b>	2,763	2,804	3,017	3,324	3,458
<b>Number of practising<sup>1</sup> nurses who did not renew<sup>2</sup> their practising certificates</b>	1,213	1,267	1,237	1,505	1,474

**Source:** SNB's data

<sup>1</sup>Defined as working part-time and full-time in Singapore.

<sup>2</sup>Defined as registered with SNB in the previous year but dropped out of the register in the prevailing year.

A31 Over the past five years, around 700 foreign nurses were granted PR status on average each year. Family members can be assessed for PR status as well. Foreign healthcare workers are encouraged to include their spouses and minor children in their PR application.



## **SECTION B**

### **Safeguarding Our Climate Resilience**

#### **Committee's Queries to MOF:**

For how the Coastal and Flood Protection Fund would be utilized and what other expenses besides the Fund that the Government would expect to incur or provide for in safeguarding Singapore's climate resilience.

#### **Reply from MOF on 30 June 2023:**

B1 The Coastal and Flood Protection Fund (CFPF) was established as a statutory fund under the Public Utilities Board (PUB) in 2020, pursuant to Section 18 of the Public Utilities Act (PUA). Moneys in the CFPF are ring-fenced for capital and non-recurrent coastal protection and drainage related expenditures by PUB, with allowable purposes prescribed under Section 18A of the PUA (refer to *Annex*). Some examples of projects that have been funded under the CFPF include site-specific studies for Singapore's North-West coast, as well as drainage improvement works to deal with increasing rainfall intensity as a result of climate change.

B2 Climate adaptation is a long-term endeavour to ensure that Singapore remains resilient to rising sea levels and climate change. As a high-level estimate, the major infrastructural investments needed to protect Singapore against rising sea levels could cost more than \$100 billion over the next 100 years. An initial injection of \$5 billion was made at the inception of the CFPF. Given the long-term nature of the spending that seeks to preserve the value of land, multiple generations of Singaporeans will need to fund this collectively. Therefore, the Government will employ a combination of methods to finance the various climate adaptation measures. In addition to the CFPF, expenses for climate adaptation measures will be met from:

- (a) The annual Budget.
- (b) Borrowing through sovereign green bonds under the Significant Infrastructure Government Loan Act, to spread the costs equitably across the generations that will directly benefit from these measures.
- (c) Past Reserves for land reclamation and other eligible costs.

#### **Committee's Further Queries to MOF:**

For other flooding prevention technologies such as sea wall construction are being actively considered for funding with the Coastal and Flood Protection Fund.

#### **Reply from MOF on 31 August 2023:**

B3 We will consider tapping on the CFPF for the construction of coastal protection measures, such as sea walls, revetments, seabunds, and dikes, as long as these measures fall within the eligible uses of the CFPF as stipulated by Section 18A of the Public Utilities Act (see *Annex*).

**Committee's Queries to MOF:**

For measures in place to ensure prudent and effective spending of the Fund to support the construction of coastal and drainage infrastructure, and some examples of such infrastructure.

**Reply from MOF on 30 June 2023 and 31 August 2023:**

B4 PUB has developed a governance framework to guide the operationalisation of the CFPP. The framework sets out the approving authorities and approval process for coastal protection and drainage projects that are eligible to tap on the CFPP.

B5 On top of the governance framework, coastal and drainage infrastructure is subject to scrutiny through existing processes to ensure cost effectiveness and public accountability, similar to other public sector infrastructure projects.

(a) Projects above \$120m are subject to scrutiny by the Ministry overseeing the project and MOF. The Centre for Public Project Management (CP2M) in MOF, comprising a multi-disciplinary team of architects, engineers, and quantity surveyors, reviews the scope, design, and cost reasonableness of the proposals to optimise the project design. For the project to proceed, approval from the Development Planning Committee (DPC), comprising three Cabinet Ministers, must be obtained.

(b) Projects above \$600m are put through a rigorous Gateway Process, which involves several stages of reviews by the Development Project Advisory Panel (DPAP), supported by CP2M, before submission to DPC. DPAP comprises senior public officers, academics, and industry practitioners with deep technical expertise and experience in major infrastructure developments, allowing the Government to draw on the knowledge and best practices in both the public and private sectors.

B6 Some examples of coastal and drainage infrastructure projects include drainage improvements to the Bukit Timah Canal, PA Camp Outlet Drain, Parbury Outlet Drain, Sungei Selarang, and Benoi Road Outlet Drain.

**Committee's Further Queries to MOF:**

For projects that have been approved or managed by the Centre for Public Project Management (CP2M) and about the three Cabinet Ministers in the Development Planning Committee (DPC).

**Reply from MOF on 31 August 2023:**

B7 CP2M in MOF reviews the scope, design, and cost reasonableness of the proposals to optimise the project design. Approval is then obtained from the DPC for the project to proceed.

B8 PUB has obtained DPC's approval for ten projects that tap on the Coastal and Flood Protection Fund (CFPP), such as projects for drainage improvement.

B9 The DPC comprises a Minister each from the Ministry of Finance and the Ministry submitting the proposal, plus a third Minister.

**Committee's Queries to MOF:**

For learnings from the experience of building a polder at Pulau Tekong which would be set to finish by end-2024 and experiences from other countries that could be applied to allow Singapore to better protect our coastline against rising sea levels.

**Reply from MOF on 30 June 2023:**

B10 Empoldering is an alternative method that uses less reclamation fill material compared to traditional land reclamation, by putting in place additional measures to protect the low-lying polder land from coastal and inland flooding. This includes the polder dike which serves as the primary sea defence against wave overtopping and sea level rise, and a comprehensive water management system to cater to both wet and dry weather conditions. The polder dike and water management systems of the polder would need proper operations and maintenance in order to protect the low-lying polder land.

B11 In designing and building the polder at Pulau Tekong, HDB had learnt from the experiences of the Netherlands, which has a long history of tackling the challenges of coastal inundation. HDB had also worked with technical agencies and local consultants to adapt it to cater to Singapore's local climate and coastal conditions.

B12 PUB has also established a Coastal Protection Expert Panel to tap on relevant experience overseas and to incorporate international best practices in PUB's coastal protection plans. Agencies will continue to learn from our experience in building and operating/maintaining the polder, and conduct research and development (R&D) to better optimise and improve the polder system, particularly to cater to our local conditions, such as our high rainfall intensity and extent of sea level rise that might be faced by Singapore.

**Committee's Queries to MOF:**

For the efforts and measures taken to strengthen our community resilience and collective response to how we deal with floods, including the impact on maritime life and coastal shipping routes.

**Reply from MOF on 30 June 2023:**

B13 Continuous improvements and significant investments have been made to our drainage network and infrastructure over the past few decades. Flood-prone areas in Singapore have reduced substantially from 3,200 hectares (ha) in the 1970s to less than 30 ha today. In view of the increased risks of inland and coastal flooding due to climate change and rising sea levels, PUB has been working with partners to develop a range of solutions to holistically address such risks.

B14 On coastal flooding, the Government is conducting site-specific studies along our coastal areas progressively, starting with City-East coast, Jurong Island, and the North-West coast. These ongoing studies will examine various coastal protection options, taking into account the impact to existing land use (including maritime life and coastal shipping routes). Where feasible, the coastal protection measures will be multi-functional and co-located with

amenities or recreational space<sup>9</sup> and explore the use of hybrid solutions that have nature-based elements<sup>10</sup>.

B15 It is not possible to cater to every extreme rainfall event, due to Singapore's space constraints. In addition, with our finite fiscal resources, the Government cannot completely eliminate every single risk. We also need to build community resilience and strengthen our collective response to flooding incidents:

- (a) PUB has been enhancing its early warning systems to provide more timely updates to the public, and has leveraged technology such as X-Band Radars for more accurate rainfall forecasting, CCTVs, and Water Level Sensors to enhance flood monitoring. Coupled with the expansion of PUB's fleet of flood response vehicles in 2021, PUB officers are better equipped to respond quickly to flooding incidents and provide timely assistance to the public.
- (b) Members of the public and motorists are encouraged to subscribe to PUB's Telegram Channel or the MyENV Mobile App to receive timely updates on heavy rain, potential flood risk locations, and flash floods areas on-the-go.
- (c) PUB works with building owners to meet design standards for flood prevention and, where necessary, install flood protection measures such as humps and flood barriers.
- (d) Ahead of the monsoon season, PUB issues advisories and distribute portable flood devices that can be readily deployed to keep out flood water to residents and business owners who are located at flood prone areas.

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<sup>9</sup> Multifunctional solutions include the Marina Barrage.

<sup>10</sup> Nature-based elements include mangrove swamps.

## **Annex: Sections 18 and 18A of the Public Utilities Act**

### **Coastal and Flood Protection Fund**

**18.**—(1) The Coastal and Flood Protection Fund is established consisting of —

- (a) all moneys from time to time appropriated from the Consolidated Fund or Development Fund and authorised to be paid into the Coastal and Flood Protection Fund by Supply law;
- (b) all moneys authorised by or under any other written law to be paid into the Coastal and Flood Protection Fund;
- (c) any gifts or donations made by any person for the purposes of the Coastal and Flood Protection Fund; and
- (d) all investments out of moneys in the Coastal and Flood Protection Fund authorised to be made by this Act and the proceeds of any such investment, including the net income from such investments.

*[13/2020]*

(2) On 1 April 2020, the Government must pay into the Coastal and Flood Protection Fund such sum as the Minister for Finance may determine out of moneys to be provided by Parliament for the Coastal and Flood Protection Fund.

*[13/2020]*

(3) For the purposes of subsection (1)(d), the net income from investments is the amount ascertained by adding to, or deducting from, the income received from investments of moneys in the Coastal and Flood Protection Fund, any gain derived or loss sustained, realised or unrealised (as the case may be) from those investments.

*[13/2020]*

(4) Upon the dissolution of the Coastal and Flood Protection Fund during any term of office of the Government (within the meaning of the Constitution), the balance then remaining in that Fund must be transferred to the Consolidated Fund and added to the reserves of the Government not accumulated by it during that term of office.

*[13/2020]*

### **Purposes of Coastal and Flood Protection Fund**

**18A.**—(1) The moneys in the Coastal and Flood Protection Fund may be withdrawn by the Board only for the following purposes:

- (a) for the Board to carry on any coastal management activity consisting of —
  - (i) the construction, improvement or extension, or any demolition and replacement, of any structure or installation within the coastal zone —
    - (A) to stop or reduce the impact of coastal hazards on land adjacent to tidal waters, including (but not limited to) a seawall, revetment, groyne, weir or dyke, and drains or other channels for the interaction of tidal waters with catchment floodwaters; or

- (B) to mitigate current and future risks from coastal hazards, taking into account the effects of climate change; or
    - (ii) the restoration or planting within the coastal zone of mangroves, littoral forest or other vegetation that is necessary or expedient for coastal management;
- (b) for the Board to carry on any construction, improvement or extension, or any demolition and replacement, of any structure or installation that is part of the stormwater drainage systems, drains and drainage reserves within the meaning of the Sewerage and Drainage Act 1999;
- (c) for the acquisition by the Board of capital machinery or equipment required for or in connection with —
  - (i) the start of operations of any structure or installation the construction, improvement or extension, or demolition and replacement, of which (as the case may be) was paid for with money from the Coastal and Flood Protection Fund; or
  - (ii) the operations of any structure or installation that is part of the stormwater drainage systems, drains and drainage reserves within the meaning of the Sewerage and Drainage Act 1999, the construction, improvement or extension, or demolition and replacement, of which was completed before, on or after 1 April 2020;
- (d) for the Board to carry on any associated design, investigative and engineering studies or survey preparatory to the undertaking of any activity, work or acquisition mentioned in paragraph (a), (b) or (c);
- (e) to pay any of the following which is incurred or payable (as the case may be) for the purposes of any activity or work in paragraph (a) or (b):
  - (i) the costs incurred by the Collector of Land Revenue in the acquisition of any land under the Land Acquisition Act 1966;
  - (ii) the compensation payable for the acquisition of any land under the Land Acquisition Act 1966;
- (f) to pay insurance premiums on capital equipment or other investments acquired, and land (including structures and installations) acquired and constructed, replaced, improved or extended using moneys of the Coastal and Flood Protection Fund;
- (g) for the Board to undertake (solely or in collaboration with other persons) scientific, engineering or other studies to develop plans or strategies to improve the resilience of the coastal zone to the impact of an uncertain climate future, including the impact of extreme weather events;
- (h) to pay all amounts relating to the sale, disposal or write-off of any investments paid for with money from the Coastal and Flood Protection Fund;

- (i) to invest in accordance with section 16;
- (j) to pay any expenses properly attributable to the setting up of the Coastal and Flood Protection Fund and the administration, management and investment of moneys in that Fund.

*[13/2020]*

(2) However, no investment paid for with money from the Coastal and Flood Protection Fund may be written-off by the Board without the prior approval of the Minister.

*[13/2020]*

(3) To avoid doubt, no money may be withdrawn from the Coastal and Flood Protection Fund for the purposes of land reclamation by or on behalf of the Government.

*[13/2020]*

## SECTION C

### Monitoring the Research, Innovation and Enterprise 2025 Plan

#### Committee's Queries to MOF:

For the amount spent for RIE2020 and whether the learning points/experience learnt from RIE2020, if any, are applied to RIE2025.

#### Reply from MOF on 30 June 2023:

C1 The budget for Research, Innovation and Enterprise (RIE) 2020 was \$19.0 billion, of which up to \$17.4 billion (92%) will be committed<sup>11</sup>.

C2 The Government took into consideration the experiences and learning points from past RIE tranches, including RIE2020, to shape RIE2025's three strategic focus areas:

- (a) Expand RIE mission to tackle a broader spectrum of national needs. In RIE2025, the Government refreshed the scope of the four vertical domains<sup>12</sup> to include new research areas of strategic importance, such as the trade and connectivity sectors (under Manufacturing, Trade and Connectivity), and human potential (under Human Health and Potential). In addition, given the RIE 2020 experience where White Space funding provided agility and nimbleness in responding to changes in the global and technological landscape and emerging priorities<sup>13</sup>, the Government also increased the budget set aside for White Space funding in RIE2025 (\$3.75 billion; 15% of total budget), compared to RIE2020 (\$2.50 billion; 13% of total budget) to better support evolving needs.
- (b) Enrich our scientific base. Our universities and research performers have built up foundational research capabilities over previous RIE tranches, which are essential to spur future breakthroughs and for downstream value creation. For example, our earlier investments in biomedical sciences and infectious diseases laid the foundation for Singapore to respond quickly to the COVID-19 pandemic, such as through the development of cPass — the world's first serology test for neutralising antibodies to be given emergency use authorisation by the US Food and Drug Administration. Hence, RIE2025 continues to maintain strong support for basic research, with one-third of the overall funding committed to continue growing our base of research capabilities.
- (c) Scale up platforms to drive technology translation and strengthen the innovation capabilities of local enterprises. RIE2025 builds on the progress of RIE2020 by scaling up the Innovation & Enterprise (I&E) platforms established in RIE2020. For example, RIE2025 is supporting the Diagnostics Development Hub and National Additive Manufacturing Innovation Cluster led by the Agency for Science,

<sup>11</sup> Some RIE2020 funds have not been committed as they received programme-specific commitment extensions, for example to allow RIE2020 White Space funds allocated for new programmes in 2019/2020 to have sufficient time for grant calls to be launched and awarded by implementing agencies.

<sup>12</sup> RIE2020 was organised around four domains: (1) Advanced Manufacturing and Engineering, (2) Health and Biomedical Sciences, (3) Urban Solutions and Sustainability, and (4) Services and Digital Economy. RIE2025 domains are: (1) Manufacturing, Trade and Connectivity, (2) Human Health and Potential, (3) Urban Solutions and Sustainability, (4) Smart Nation and Digital Economy.

<sup>13</sup> Examples of new/expanded areas supported by White Space funding under RIE2020 were PhD training for top Artificial Intelligence research talent, R&D in sustainable urban food production and future foods, and the growth of maritime R&D capabilities.



Technology and Research (A\*STAR) — which were successful platforms established in RIE2020 — to move into adjacent areas with high growth potential.

**Committee’s Queries to MOF:**

For the allocation of RIE2025 funds by sector.

**Reply from MOF on 30 June 2023:**

C3 RIE2025 supports a diversified portfolio of foundational and applied research, I&E programmes and talent development (see breakdown in *Table C1*).

Table C1 - Portfolio of RIE2025 budget allocation

Area	Budget allocation (\$' Billion)	% of RIE2025 Investment
Core capabilities in universities and A*STAR Research Institutes	7.3	29%
Mission-oriented research to support RIE domains’ objectives	6.5	26%
Dedicated I&E activities to establish new I&E platforms, strengthen enterprise innovation capabilities, etc	5.2	21%
Talent development	2.2	9%
White Space funding for new programmes to respond to future needs and emerging opportunities	3.75	15%
<b>Total Allocation</b>	<b>25</b>	<b>100%</b>

**Committee’s Further Queries to MOF:**

Whether the remaining \$1.6 billion will be rolled over to RIE2025 budget, and of the \$17.4 billion that has been committed, how much has been spent thus far and for how the RIE2020 funds were allocated across the four domains.

**Reply from MOF on 31 August 2023:**

C4 There was no rolling over of unutilised funds from RIE2020 into the RIE2025 budget, which was sized to sustain Government spending in research, innovation and enterprise at about 1% of Singapore’s GDP over 2021–2025.

C5 Of the expected total commitment of \$17.4 billion in RIE2020, \$10.1 billion (58.1%) had been spent as of FY2021.

C6 The distribution of RIE2020 and RIE2025 funds, as allocated at the beginning of each tranche, is in Table C2. The broad allocations for the different areas stayed at similar proportions between RIE2020 and RIE2025, with White Space funding specifically increased (as a proportion of the total RIE budget) to better support evolving needs. It is important to note that RIE projects (and hence funding) are often cross-cutting, such that domains’ topic areas may be supported from other funds beyond the specific domain’s allocated funds. For example, digital RIE investments are not purely funded from the Smart

Nation and Digital Economy domain, and can be funded from related projects under other domains and non-domains.

**Table C2 - Portfolio of budget allocation in RIE2020 and RIE2025  
(as at beginning of tranche)<sup>14</sup>**

Area	Budget Allocation [\$' billion (% of RIE Tranche Budget)]	
	RIE2020	RIE2025
<b>Domain allocations</b>		
RIE2025: Manufacturing, Trade and Connectivity <i>RIE2020: Advanced Manufacturing and Engineering</i>	1.0 (5%)	1.5 (6%)
RIE2025: Human Health and Potential <i>RIE2020: Health and Biomedical Sciences</i>	2.4 (13%)	3.2 (13%)
RIE2025 and RIE2020: Urban Solutions and Sustainability	0.9 (5%)	1.2 (5%)
RIE2025: Smart Nation & Digital Economy <i>RIE2020: Services and Digital Economy</i>	0.3 (2%)	0.6 (3%)
<b>Non-Domain allocations</b>		
Core capabilities in universities and A*STAR Research Institutes	6.1 (32%)	7.3 (29%)
Innovation and Enterprise	3.9 (21%)	5.2 (21%)
Talent Development	1.9 (10%)	2.2 (9%)
White Space	2.5 (13%)	3.8 (15%)
<b>Total Allocation</b>	<b>19</b>	<b>25</b>

*Note: Numbers and percentages may not sum due to rounding.*

**Committee's Queries to MOF:**

For the amount of the \$25 billion earmarked for RIE2025 committed to date and whether the remaining funds are sufficient to see the plan through to its completion.

**Reply from MOF on 30 June 2023:**

C7 Of the \$25 billion set aside for RIE2025 from FY2021 – 2025, over \$7.6 billion (30.4%) has been committed in FY2021. There were major initial commitments at the beginning of RIE2025 due to the renewal of significant multi-year programmes to continue their R&D activities from RIE2020 to RIE2025. We expect the remaining funds to be sufficient to see through the completion of RIE2025.

<sup>14</sup> For comparability, the figures presented for RIE2020 have been reclassified to adopt RIE2025's organising frame for allocations (for example, core capabilities in A\*STAR research institutes are now accounted under the same category as core capabilities in universities, rather than under specific domain allocations). These RIE2020 figures thus differ from the original RIE2020 domain allocations published publicly at the beginning of RIE2020.

**Committee's Queries to MOF:**

For an update on the progress and achievements of the RIE2025 Plan.

**Reply from MOF on 30 June 2023:**

C8 The progress of RIE2025 should be seen in the broader context of the overall progress achieved since the inception of RIE. Since our RIE journey began in the early 1990s, we have made steady progress to build up a strong research ecosystem. Our Institutes of Higher Learning, A\*STAR Research Institutes, and academic medical centres/hospitals are well-regarded for research excellence. Singapore's field-weighted citation index rose from 0.71 (29% below global average) in 2000 to 1.51 in 2015 (51% above global average) and 1.78 (78% above global average) in 2020. Similarly, our pool of researchers has grown significantly from 20,000 in 2000 to 43,000 in 2015 and 46,000 in 2020. Our RIE investments have also created new value for our economy, as elaborated in the responses C11-C14 below, and enabled us to address national needs such as making our water supply more secure and resilient through investments in NEWater and desalination technologies. In addition, Singapore's biomedical R&D capabilities enabled us to respond to the COVID-19 pandemic quickly — we were the third country, outside of China, to successfully culture the virus, and developed several diagnostic test-kits. In addition to cPass, this included the Fortitude test kit developed by A\*STAR and Tan Tock Seng Hospital, which was exported to more than 45 countries worldwide.

C9 As mentioned in para C2, RIE2025 builds on the progress of previous RIE tranches in enriching our scientific base. This requires a robust base of researchers with strong links to the global community. We aim to support more than 9,000 PhD and Master by Research students with tuition subsidies in RIE2025, exceeding our RIE2020 achievement of around 8,500 subsidised students. In addition, the National Research Foundation (NRF) Fellowship (NRFF) and NRF Investigatorship (NRFI) talent schemes support researchers at the early-career and mid-to-senior-career stages respectively to pursue ground-breaking research in Singapore. Since the start of RIE2025, NRF has granted 22 NRFF and 23 NRFI awards across two annual calls, and is on track to match or exceed the RIE2020 average of 10 NRFF and eight NRFI awardees per call. The RIE2025 awardees come from a range of fields, from the development of new drug screening and disease diagnostic capabilities to quantum materials for microelectronics applications.

C10 The Government makes sustained investments in core areas of strategic importance across RIE tranches, and we expect them to continue bearing fruit over time as findings are translated into commercial and national outcomes. For example, we are continuing to invest in R&D to support and strengthen Singapore's pandemic preparedness, including efforts to develop prototype diagnostics, therapeutics, and vaccine candidates, which can help strengthen our capabilities to respond to future infectious disease threats. Examples of progress made under RIE 2025, in terms of specific programmes that were extended or launched are below.

- (a) [Extended under RIE 2025] Under RIE2020, the Experimental Drug Development Centre (EDDC) was established as a national platform for integrated drug discovery and development. RIE2025 provides EDDC with an additional \$100 million to strengthen its focus on commercial outcomes for greater value capture. EDDC has been closing significant industry licensing deals between companies and local

Research Institutions in areas such as antibodies for targeted cancer therapies and therapeutics to treat multidrug-resistant tuberculosis.

- (b) [Extended under RIE 2025] RIE2025 has invested an additional \$250 million for Artificial Intelligence (AI) R&D, on top of the \$500 million committed under RIE2020. These investments support fundamental and translational research, as well as industry-research collaborations. For example, two ongoing Grand Challenges were launched in December 2022: “Robust AI” and “AI for Materials Discovery”. The Government has also been identifying, training, and grooming Singaporean AI talents through the AI Apprenticeship Programme.
- (c) [New under RIE 2025] The Technology Centre for Offshore and Marine, Singapore (TCOMS), Singapore’s first ocean basin facility, was launched in July 2022. This facility is equipped with state-of-the-art wave and current generation systems, and can simulate challenging real-world scenarios for offshore and coastal environments. In partnership with industry, TCOMS can co-create, stress-test, and validate solutions as well as novel concepts of future ocean infrastructure. With these capabilities, TCOMS will support the transformation of the marine and offshore industries, including through diversification into the green economy and lower-carbon solutions. It will also support national priorities such as maritime security and coastal adaptation to climate change.
- (d) [New under RIE 2025] We have been actively funding new research areas to optimise Singapore’s human potential. In 2022, we launched a grant call to support prenatal and early childhood research, which has the potential to produce findings that strengthen maternal health and well-being, child nutrition, and cognitive development. We have also been providing seed funding to catalyse transformative ideas and innovation to advance healthy longevity.

The responses in C11 to C15 contain details on the progress made in other RIE2025 areas.

**Committee’s Queries to MOF:**

Whether there has been greater uptake of research and development (R&D) by local enterprises including SMEs since the launch of RIE2025 and what has been the outreach to local enterprises including SMEs on the R&D support.

**Reply from MOF on 30 June 2023:**

C11 Since the Science & Technology Plan 2010 (S&T2010), Singapore-based businesses have been making greater use of technologies developed by public research performers. The number of licenses to deploy such technologies rose from 270 achieved under S&T2010, to 1,432 under RIE2015, and 3,238 under RIE2020. Licensing revenue similarly rose from \$27.3 million in RIE2015, to \$46.5 million in RIE2020. Our public research performers’ collaborations with industry on R&D projects have also increased from 3,618 industry R&D projects in RIE2015 to 9,081 projects in RIE2020.

C12 RIE efforts and investments have also helped to grow our core of local enterprises that actively leverage R&D and innovation as a source of competitive advantage. Local enterprises’ Business Expenditure on R&D increased from \$1.1 billion in 2010 to \$1.4 billion in 2015 and \$1.6 billion in 2020, while the number of local enterprises involved in

R&D activities also grew from 477 in 2010 to 491 in 2015 and 594 in 2020. Our startup ecosystem has also seen strong growth, with overall venture capital investments increasing from \$0.4 billion in 2010 to \$1.9 billion in 2015 and \$5.5 billion in 2020. Most recently, the Global Startup Ecosystem Index 2023 ranked Singapore's startup scene first in Asia-Pacific and sixth globally.

C13 RIE2025 continues to directly support local enterprises to create solutions that leverage science and technology through a spectrum of R&D and I&E activities. There has been greater uptake of R&D and I&E activities by local enterprises thus far under RIE2025, with support for Small and Medium Enterprises (SMEs) more commonly delivered via I&E initiatives.

- (a) The Industry Alignment Fund – Industry Collaboration Project (IAF-ICP) scheme encourages local enterprises to collaborate with Institutes of Higher Learning and A\*STAR Research Institutes. Thus far, midway through RIE2025, local enterprises participate in 63% of IAF-ICP projects compared to 54% of ICP projects for RIE2020.
- (b) RIE-funded Centres of Innovation (COIs) support SMEs by providing technical expertise and facilities to build their innovation capabilities. Since the start of RIE2025, COIs have facilitated close to twice as many innovation projects with local enterprises in 2021 – 2022 compared to 2019 – 2020.
- (c) Innovation Partner for Impact (IPI), a subsidiary of Enterprise Singapore (EnterpriseSG), accelerates the innovation process for local enterprises by providing access to IPI's global innovation ecosystem as well as advisory services by industry veterans. IPI facilitated one and a half times as many innovation projects with local enterprises in 2021 – 2022 compared to 2019 – 2020.

C14 The RIE2025 initiatives are complemented by economic agencies' (such as the Economic Development Board and EnterpriseSG) outreach efforts, to link local enterprises up with these resources and support their applied R&D and innovation efforts.

- (a) COIs conduct outreach to SMEs through seminars and workshops by tapping on partners such as EnterpriseSG, Trade Associations and Chambers, and other corporate collaborators. RIE2025 funding is supporting EnterpriseSG's plans to engage more than 10,000 unique local SMEs and facilitate close to 2,000 innovation projects across five pilot sectors: Agri-Tech, Construction, Food Manufacturing, Precision Engineering, and Retail. Three new Polytechnic-based COIs established in 2022 will expand support to SMEs in the Built Environment, Beauty and Personal Care, and Urban Agriculture sectors.
- (b) A\*STAR works with EnterpriseSG to identify and help local enterprises develop Operation & Technology Roadmaps (OTRs) to achieve business growth. A\*STAR has supported the development of OTRs for 873 companies since 2002, and intends to expand its outreach to more local enterprises.

**Committee's Queries to MOF:**

For how the RIE2025 align or support the Singapore Green Plan 2030.

**Reply from MOF on 30 June 2023:**

C15 Significant RIE2025 investments have been allocated to tackle the existential threat of climate change, as science and technology is a key enabler to do so. RIE2025 efforts support all five of the Singapore Green Plan 2030's pillars.

- (a) Energy Reset pillar. Under RIE2025, the Government has set aside an additional \$129 million for the ongoing Low Carbon Energy Research initiative (e.g. for the import, handling and utilisation of hydrogen and carbon capture, usage and storage).
- (b) Sustainable Living and City in Nature pillars. RIE2025 is financing a new Closing the Resource Loop Funding Initiative to support R&D on sustainable resource recovery solutions for key waste streams such as e-waste, plastics, and food. The Cities of Tomorrow R&D programme has also been enhanced in RIE2025 to support conservation and urban greenery management.
- (c) Resilient Future pillar. RIE2025 will strengthen climate adaptation R&D efforts. PUB launched the \$125 million Coastal Protection and Flood Management Research Programme in March 2023. An additional \$165 million has also been allocated under RIE2025 to support the ongoing Singapore Food Story R&D programme and strengthen our food security.
- (d) Green Economy pillar. RIE2025 supports the development and commercialisation of innovative sustainability solutions, which will help establish Singapore as a leading regional centre for developing and test-bedding new sustainability solutions. This will support Singapore's green growth, create green jobs, and groom local talent and enterprises to capture sustainability opportunities.

**Committee's Further Queries to MOF:**

For more about scholarships under the RIEs including the selection process and guidelines for the evaluation and awarding of such scholarships, and what is the plan to continue to retain the scholars after graduation in their research field for their contribution to Singapore.

**Reply from MOF on 31 August 2023:**

C16 The target number of Postgraduate by Research (PGR) scholarships, where awardees have monthly stipends and full tuition coverage, is ~5,000 PGR scholarships for RIE2025, compared to ~4,600 target for RIE2020. For the period 2016 to 2020 corresponding to RIE2020, the actual achievement was ~5,400 PGR scholarships that were funded in full or in part by RIE funds. Autonomous Universities (AUs) are given the flexibility to supplement RIE funds with other grants to increase the number of scholarships beyond the RIE target.

C17 The PGR scholarships funded under RIE expenditures comprise the following:

- (a) MOE-funded PGR Scholarships. MOE provides a Research Scholarship Block to each AU to support tuition fees and stipends of research scholarships for PGR

students. These PGR scholars serve as an important source of manpower to support the research activities undertaken by faculty in the AUs. Upon graduation, they contribute to a robust research manpower base for the wider RIE ecosystem across the AUs, A\*STAR research institutes, and industry.

- (b) A\*STAR PGR Scholarships for Singapore Citizens and Singapore International Graduate Award (SINGA) for Foreign Citizens. A\*STAR scholars and SINGA awardees conduct research that create new scientific discovery and contribute to economic growth and jobs for Singapore, playing a pivotal role in bridging the academia-industry research and development (R&D) gap. These individuals add to the capabilities in A\*STAR's research institutes and collaborate with the wider research community, industry, and public sector agencies towards meaningful and impactful scientific outcomes.
- (c) Industrial Postgraduate Programme (IPP). IPP awardees pursue full-time postgraduate studies while undertaking an industrial R&D project at participating companies to develop industry-relevant R&D skills. Based on a survey conducted in 2020, around 90% of company respondents indicated that the IPP was a useful platform to support expansion of their R&D activities in Singapore, allowing them to explore more upstream research and build capabilities in new areas that they may have otherwise deprioritised in the short term.

C18 Based on the Postgraduate by Research Graduate Employment Survey, the proportion of RIE-funded PGR scholars across all the aforementioned schemes who worked in Singapore within one year of graduation averaged 64% for the graduated cohorts in 2019–2021. It is not uncommon for local PhD graduates to pursue overseas post-doctoral stints to gain international research experience, even if their intent is to be based in Singapore eventually. We have also been tracking statistics on the retention of graduated scholars for the A\*STAR Scholarships and SINGA. For the RIE2020 schemes, about 80% of graduated A\*STAR scholars and 50% of graduated SINGA awardees across the period 2016 to 2020 are currently working in Singapore and actively contributing to the RIE ecosystem primarily in A\*STAR research institutes, AUs, and industry.

C19 The selection process and guidelines for evaluating and awarding PGR scholarships generally involve the evaluation of candidates' academic and research qualifications, suitability, and aptitude through interviews, academic referees, and relevant proficiency tests. Other attributes assessed include having a goal-oriented mindset, leadership qualities, and analytical writing competencies.

C20 Our strategy to retain scholars after graduation include providing postdoctoral fellowships and awards to resource talented researchers in pursuing impactful research in Singapore. In addition to national-level awards such as the NRF Fellowship for early career researchers and NRF Investigatorship for mid-senior career researchers, the public research institutions have awards such as the NUS Presidential Fellowship, NTU Presidential Postdoctoral Fellowship, A\*STAR Young Achiever Award, and A\*STAR Career Development Fund. A\*STAR also integrates their scholars and SINGA awardees into A\*STAR's research community from the start through regular dialogues with research leaders within and outside A\*STAR, development programmes at critical junctures of their scholarship journeys, and mentorship by senior researchers.

**Committee's Further Queries to MOF:**

Noting the strategy to retain scholars by providing postdoctoral fellowships and awards to resource talented researchers in pursuing impactful research in Singapore, what are the plans to encourage such scholars to anchor in Singapore for the long term.

**Reply from MOF on 31 October 2023:**

C21 We refer to our earlier response in C20 on the various initiatives to anchor research talent, including scholars, here in the immediate to medium- and long-term. Beyond various postdoctoral fellowships offered by the universities, targeting their early stage careers, there are also other schemes which focus on anchoring them in Singapore over the medium to long term:

- (a) Early-career: After the completion of their postdoctoral stints, scholars can apply for schemes for early-career researchers offered by the Autonomous Universities (AUs) (e.g. NUS Presidential Young Professorship, NTU Nanyang Assistant Professor) or national schemes like the NRF Fellowship (5 years of support). Awardees are placed on the respective AUs' tenure-track and are also eligible to apply for other research grants to strengthen their research portfolio (e.g. MOE's Academic Research Fund).
- (b) Mid-career: The NRF Investigatorship provides funding support for mid-career researchers and may be awarded up to twice to each researcher (5 years of support each, total 10 years), to pursue groundbreaking research.

C22 A\*STAR also encourages early-career scholars to remain in Singapore by offering exposure to the RIE ecosystem beyond A\*STAR. They can take up joint appointments and secondments in the Autonomous Universities, industry and public sector. Scholars with leadership qualities are actively nurtured and provided leadership opportunities within A\*STAR Research Institutes and academia, and as technopreneurs. A\*STAR also continues to stay connected with past scholars who have moved overseas, to secure mindshare of Singapore as an anchoring location.

C23 More broadly, RIE plans are focused on building up global peaks of research and translational excellence in Singapore, which is ultimately critical in anchoring research talent.

**Committee's Further Queries to MOF:**

Whether A\*STAR Postgraduate by Research (PGR) and SINGA scholarship recipients are expected to work in Singapore for a specified period of time at some point after their graduation.

**Reply from MOF on 31 October 2023:**

C24 The A\*STAR PGR scholarships comprise six different types of scholarships<sup>15</sup>. In general, A\*STAR PGR scholars are expected to work in Singapore via serving a bond, upon the completion of their studies. The bond period ranges from two to six years depending on the level of qualification, country of study, and length of study.

<sup>15</sup> These are the National Science Scholarship Bachelor Science-PhD (NSS BS-PhD); National Science Scholarship PhD (NSS PhD); National Science Scholarship Masters (NSS Masters); A\*STAR Graduate Scholarship (AGS); A\*STAR Computing & Information Science Scholarship (ACIS); and A\*STAR International Fellowship (AIF).



C25 Two types of scholarships – the AGS and ACIS – have no bond obligations for Singaporeans and SPRs. The absence of bond obligations for Singaporeans and SPRs would make the scholarship with A\*STAR Research Institutes (RI) more attractive, enabling the growth of a local pool of PhDs at A\*STAR’s RI who contribute to local research during their training. For non-Singaporeans and non-SPRs, there is a three-year bond for them to work in any Singapore based company.

C26 The Singapore International Graduate Award (SINGA), which is targeted at international students, has no bond obligations to be more effective in attracting international talent to attain their PhDs in Singapore and increase international diversity within our R&D ecosystem. Around 60% of SINGA recipients subsequently stayed on as post-doctoral researchers or worked in Singapore. Scholars who return to their home countries continue to be part of Singapore’s research networks around the world, strengthening the capabilities and capacity of our R&D ecosystem through joint publications, collaborations, and providing expertise<sup>16</sup> to our local researchers.

**Committee’s Further Queries to MOF:**

For the number of A\*STAR PGR and SINGA scholarships awarded in each of the past five years, and the value of the scholarship in each category in each of the past five years.

**Reply from MOF on 31 October 2023:**

C27 Table C3 shows the number of A\*STAR PGR and SINGA scholarships awarded for the past five years.

Table C3: Number of A\*STAR PGR and SINGA Scholarships Awarded from 2018 to 2022

Scholarship scheme	2018	2019	2020	2021	2022
A*STAR PGR	81	75	59	67	82
SINGA	37	59	14	30	46

C28 The value of each scholarship, depending on factors such as the level of qualification, country of study, and length of study, ranges from about \$300,000 for A\*STAR International Fellowship (AIF) to about \$500,000 for Bachelor studies and \$1.0m for PhD studies.

**Committee’s Further Queries to MOF:**

For the progress of the prenatal and early childhood research outlined in paragraph C10(d), and the additional examples of new research areas to optimize Singapore’s human potential under RIE2025.

**Reply from MOF on 31 August 2023:**

C29 A\*STAR’s Prenatal/Early Childhood grant to support prenatal and early childhood research only began funding projects recently, with the first grant call completed in 2022.

<sup>16</sup> For example, inputs on emerging technologies for acquisition, as well as technology benchmarking against industry/sector practices.

Ten projects were awarded in the first grant call. Research is currently ongoing, with results expected from 2025 onwards. These projects are conducting research in one or more of the following areas:

- (a) Improving child health, learning, and well-being. Under this thrust, proposals aim to address the following problem statements: (i) healthy children through the reduction of childhood obesity and other conditions such as myopia, (ii) reduction in children requiring learning support, and (iii) emotionally stable, resilient children with self-regulation.
- (b) Improving maternal health and well-being, through a deeper understanding of (i) healthy mothers during and after pregnancy, and healthy babies through improved maternal physical health, as well as (ii) healthy babies through improved family mental wellness and emotionally stable and resilient mothers.

C30 Additional examples of new research that the Government is supporting to optimise Singapore's human potential under RIE2025 include research to better understand the factors that influence adolescent growth and mental health, for example the mechanisms and pathways of child brain and physical development. A\*STAR is also currently running a grant call which invites proposals to promote child socio-emotional development, explore the relative impact of home and preschool factors on early childhood development, and investigate the effects of adverse childhood experiences and how they can be mitigated systematically.

**Committee's Further Queries to MOF:**

For examples of local startups or enterprises that have benefitted from RIE efforts and investments.

**Reply from MOF on 31 August 2023:**

C31 As part of the Singapore RIE ecosystem, local startups benefit from a range of resources such as technologies, talent, funding, mentorship, infrastructure, and access to international networks.

- (a) One example is Lucence, which provides ultra-sensitive non-invasive cancer detection technologies. Its flagship tests include LiquidHALLMARK® which helps physicians with personalised treatment selection for their cancer patients, and LucenceINSIGHT™ which helps healthy asymptomatic individuals detect cancer signals earlier when cancer is most treatable. Lucence was founded in 2016 and spun off from A\*STAR in 2017, and it has continued to benefit from its partnership with A\*STAR. Through R&D collaborations supported by RIE funding, Lucence accessed technologies, R&D, manpower, and equipment from A\*STAR and public healthcare institutions (e.g. National University Hospital, National Cancer Centre), and has published findings with these institutions, showcasing how its technology boosts cancer profiling. Lucence also benefitted from Enterprise Singapore's (EnterpriseSG) support for its expansion into the US market, which included the development of a commercialisation roadmap and sending of experienced Singaporeans to kick start Lucence's US operations. Lucence has since rapidly scaled its US-based testing capacity for its flagship LiquidHALLMARK® test, and secured US Medicare approval for it in early 2023, marking the first time an Asian

healthcare services provider has secured approval from the US national insurer. Lucence's US\$20 million Series A funding round in 2019 also drew investment support from SGInnovate, a Government-owned deep tech investor and a fund manager under EnterpriseSG's Startup SG Equity co-investment scheme.

- (b) Another example is VFlowTech, which aims to improve the efficiency and lifespan of energy storage solutions through commercialising vanadium redox flow batteries (RFB). Compared to lithium batteries, VFlowTech's RFBs have a longer lifespan, are lower maintenance, and result in negligible energy storage degradation over time and use, making them a promising, environmentally-friendly energy storage solution that has found significant market traction. Founded in 2018, VFlowTech is a spin-off from NTU and was incubated at the Energy Research Institute at NTU, benefitting from unique Intellectual Property arising from years of intensive research at NTU. VFlowTech also benefitted from EnterpriseSG's support for its internationalisation efforts. EnterpriseSG helped to connect the company to potential business partners, customers, and consultancy services firms in Germany, and supported VFlowTech for a product development project with research partners in Germany through a joint German-Singapore Call for R&D Proposals in 2020. VFlowTech's most recent US\$10 million Series A fundraising round in 2023 also drew investment support from SEEDS Capital, the investment arm of EnterpriseSG.

**Committee's Further Queries to MOF:**

For how RIE2025 can encourage local enterprises to increase their R&D expenditure at a faster rate than they have between 2010 and 2020 and how much funds were allocated for the Industry Alignment Fund – Industry Collaboration Project (IAF-ICP), RIE-funded Centres of Innovation (COIs) and Innovation Partner for Impact (IPI) to support the local enterprises.

**Reply from MOF on 31 August 2023:**

C32 In RIE2025, we are building on ongoing efforts to grow the R&D and innovation activities of our local enterprises.

- (a) We are strengthening support for local enterprises to leverage market-oriented R&D and innovation as a source of competitive advantage. For instance, as part of the Singapore Global Enterprises Initiative, promising local growth enterprises may receive customised support to build sustained R&D and innovation capabilities that enhance their long-term global competitiveness. This includes co-funding to establish in-house R&D and innovation centres. Local enterprises can also benefit from Centres of Innovation and other technology commercialisation infrastructure, innovation intermediaries such as Innovation Partner for Impact, and collaborations with public research performers supported by the Industry Alignment Fund – Industry Collaboration Project, schemes to which \$940 million had been collectively allocated at the start of the RIE2025 tranche<sup>17</sup>.

<sup>17</sup> While Centres of Innovation and Innovation Partner for Impact primarily support local enterprises, the Industry Alignment Fund – Industry Collaboration Project scheme supports public research performers to collaborate with both local and foreign enterprises.

- (b) We are supporting a wider base of local enterprises to make use of the capabilities and technologies developed by our public research ecosystem. For instance, new Centres of Innovation for Built Environment – Advanced Materials, Beauty and Personal Care, and Urban Agriculture were launched in 2022 to support local enterprises across a wider range of key industry sectors to access technical expertise in our IHLs, and to transform from technology adopters to product builders.
- (c) We are supporting local enterprises to engage in business and technology collaborations with a wider range of innovation nodes and demand markets around the world. The Global Innovation Alliance (GIA) is a scheme that supports local enterprises’ internationalisation efforts, through facilitating access to overseas markets via outbound acceleration programmes. The number of GIA innovation nodes has grown from nine in 2019 to 17 in 2022, and includes cities such as Jakarta, Seoul, Bangalore, Shanghai, and San Francisco.

**Committee’s Further Queries to MOF:**

For examples of local startups or enterprises that have benefitted from the development of Operation & Technology Roadmaps (OTRs).

**Reply from MOF on 31 August 2023:**

C33 Operation & Technology Roadmaps (OTRs) help local companies across a range of enterprise segments to develop long-term strategies that build their R&D and market expansion capabilities.

- (a) One Small & Medium Enterprise that benefitted from OTR is ERS Industries, a data centre solutions provider. OTR helped ERS to identify the need to develop R&D capabilities in thermal cooling. This led ERS to collaborate with A\*STAR and develop the ERS E@Rack that reduces the costs of thermal cooling for data server racks. With a proprietary product offering, ERS moved from being a data centre solution distributor to becoming an Original Equipment Manufacturer. ERS then worked with A\*STAR to develop an energy-efficient system, KoolLogix, that reduced data centre energy consumption by up to 50%. In 2018, ERS spun off KoolLogix to cater dedicated resources for its R&D and business development. OTR helped KoolLogix to identify potential beachhead customers, and supported its expansion to Southeast Asian markets.
- (b) OTR has also supported Large Local Enterprises (LLEs) like Hyphens Pharma, which provides skin care solutions. Through OTR, Hyphens Pharma identified the need to build R&D capabilities and partnered A\*STAR to develop the Ceradan product range for eczema. This transformed Hyphens Pharma from being a distributor to a manufacturer of its own skin care products. The OTR also facilitated Hyphens Pharma’s partnership with Nanyang Polytechnic to enhance customers’ monitoring of their eczema severity using a mobile application. Hyphens Pharma has since launched a corporate HQ with an integrated R&D facility, and has expanded overseas to Oman and Bangladesh.
- (c) LLEs have seen the commercial benefits of OTR, and expanded OTR for wider use in their firms. Since undergoing OTR in 2011, Akribis (a local precision engineering LLE) witnessed a twentyfold increase in revenue (from about S\$5 million to over

S\$100 million) and a tenfold increase in its manpower size (from 200 to 2,000). Akribis staff have been trained as internal OTR facilitators, so that Akribis can do OTR across all its subsidiaries.

## APPENDIX

### MINUTES OF PROCEEDINGS

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#### 10th Meeting

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Thursday, 11 May 2023

10.00 am

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#### PRESENT

Mr Ang Wei Neng (*in the Chair*)  
Mr Lim Biow Chuan  
Assoc Prof Jamus Jerome Lim  
Mr Sitoh Yih Pin  
Mr Vikram Nair  
Mr Yip Hon Weng  
Mr Zhulkarnain Abdul Rahim

#### ABSENT

Miss Rachel Ong

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1. The Committee deliberated.

Adjourned to a date to be fixed.

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## 11th Meeting

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Thursday, 20 July 2023

10.00 am

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PRESENT

Mr Ang Wei Neng (*in the Chair*)  
Mr Lim Biow Chuan  
Assoc Prof Jamus Jerome Lim  
Miss Rachel Ong  
Mr Sitoh Yih Pin  
Mr Vikram Nair  
Mr Yip Hon Weng  
Mr Zhulkarnain Abdul Rahim

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1. The Committee deliberated.
2. The Committee considered a memorandum submitted by the Ministry of Finance (MOF) in respect of (a) Healthier SG; (b) Safeguarding Our Climate Resilience; and (c) Monitoring the Research, Innovation and Enterprise 2025 Plan.
3. The Committee further deliberated.

Adjourned to a date to be fixed.

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## 12th Meeting

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Thursday, 28 September 2023

10.00 am

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### PRESENT

Mr Ang Wei Neng (*in the Chair*)  
Assoc Prof Jamus Jerome Lim  
Miss Rachel Ong  
Mr Sitoh Yih Pin  
Mr Vikram Nair  
Mr Yip Hon Weng  
Mr Zhulkarnain Abdul Rahim

### ABSENT

Mr Lim Biow Chuan

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1. The Committee deliberated.
2. The Committee considered a second memorandum submitted by the Ministry of Finance (MOF) in respect of (a) Healthier SG; (b) Safeguarding Our Climate Resilience; and (c) Monitoring the Research, Innovation and Enterprise 2025 Plan.
3. The Committee further deliberated.

Adjourned to a date to be fixed.

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## 13th Meeting

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Thursday, 16 November 2023

10.00 am

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### PRESENT

Mr Ang Wei Neng (*in the Chair*)  
Mr Lim Biow Chuan  
Assoc Prof Jamus Jerome Lim  
Miss Rachel Ong  
Mr Vikram Nair  
Mr Yip Hon Weng

### ABSENT

Mr Sitoh Yih Pin  
Mr Zhulkarnain Abdul Rahim

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1. The Committee deliberated.
2. The Committee considered a third memorandum submitted by the Ministry of Finance (MOF) in respect of (a) Healthier SG; (b) Safeguarding Our Climate Resilience; and (c) Monitoring the Research, Innovation and Enterprise 2025 Plan.
3. The Committee further deliberated.

### Report

1. The Chairman's report brought up and read the first time.
2. Resolved, "That the Chairman's report be read a second time paragraph by paragraph."  
Paragraphs 1 to 88 and Sections A to C inclusive read and agreed to.
3. Resolved, "That this report be the report to the Committee to Parliament."
4. Agreed that the Chairman do present the Report to Parliament when copies are available for distribution to Members of Parliament.

*Adjourned sine die.*

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