

# PRESS RELEASE

---

27 MARCH 2019

## **SINGAPORE HARVESTS FROM INVESTMENTS IN SCIENCE & TECHNOLOGY AND INVESTS IN NEW AREAS FOR FUTURE GROWTH AND RESILIENCE**

1. Prime Minister Lee Hsien Loong chaired the 11<sup>th</sup> Research, Innovation and Enterprise Council (RIEC) Meeting on Wednesday, 27 March 2019, which discussed Singapore's plans to continue harnessing outcomes from our long-term investments in science and technology (S&T) to benefit Singaporeans, our companies and Singapore. The meeting also discussed plans for additional research investments into strategic areas important in enhancing our economic competitiveness, creating new medical therapies for Singaporeans, and strengthening our national resilience.

2. Over the years, Singapore has built up a strong base of S&T capabilities in our universities, research institutes and hospitals from which public sector agencies and companies are harvesting from, to address national challenges, build innovative capacity of our businesses, and improve the lives of Singaporeans.

3. Under the Research, Innovation and Enterprise 2020 (RIE2020) Plan, Singapore has continued to build our strong base of research and development (R&D) capabilities in our universities, research institutes and research hospitals. Innovation and enterprise (I&E) efforts are translating S&T R&D knowledge into new products and services. We are also deepening our international R&D and I&E collaborations to co-create solution to tackle global challenges that countries face today – from health, to sustainable cities and climate change. In the process, we aim to grow new enterprises, that will seize new opportunities and create new markets, and thus create exciting jobs for Singaporeans.

4. Core to our progress, has been our emphasis on talent – both in developing local talent, but also creating a conducive environment that attracts talent from around the world, to come to Singapore to work together with our local talent, as well as collaborate with our partners from around the world. We will continue to create a vibrant ecosystem for S&T and I&E, so that the best minds from Singapore and from around the world will find a home to create the breakthroughs that build a better world tomorrow.

### **BUILDING ON GOOD PROGRESS UNDER RIE2020 PLAN**

5. Building on good progress made under the RIE2020 Plan, we will invest more in strategic ways to a) deepen core capabilities to seize new opportunities, b) synergise existing strengths to build new capabilities, and c) turn constraints into strengths and new opportunities.

6. In particular, we will invest more in three key areas: a) expanding critical digital capabilities, b) developing cell therapy manufacturing capabilities; and c) starting a new chapter in the Singapore Food Story.

## (A) DEEPENING CORE CAPABILITIES TO SEIZE NEW OPPORTUNITIES

7. Singapore is built on the energies and expertise of our people – our key resource. We must thus make the best use of talent in Singapore, including talent from around the world who now call Singapore home, to build core capabilities in our people.

### Expanding Critical Digital Capabilities

8. We live, work and play in a digitally-enabled world. Companies leverage digital technologies to improve productivity, deliver better and new products/services, and transcend our geographical constraints to reach out to a much larger, overseas market. To allow Singapore and Singaporeans to maintain our competitive edge in this digital revolution, **the Government will invest an additional \$500 million into digital technologies under the RIE2020 Plan.**

9. These additional funds will build our core digital technologies, through the expansion of existing programmes, including AI Singapore - the national Artificial Intelligence programme, the National Supercomputing Centre Singapore, and the National Robotics Programme. We will also build new capabilities in strategic technologies such as digital trust, the social science of digital technologies, and computational law. See **Annex A** for details on these initiatives.

## (B) SYNERGISING EXISTING STRENGTHS TO BUILD NEW CAPABILITIES

10. Our investments in S&T R&D have helped our manufacturing sector to become more competitive over the years. These include our latest efforts, in partnership with our Trade Associations and Chambers (TACs), to digitalise our companies, and to apply Industry 4.0 (i4.0) platform technologies across entire sectors, including our small and medium enterprises (SMEs). These will draw on the digital capabilities we are investing more in. We are also using i4.0 technologies to connect our digitalised manufacturing companies with those from our logistics and modern services sectors to maximise synergies and build new capabilities that can then be exported globally through new products and services.

### Developing Cell Therapy Manufacturing Capabilities

11. **Singapore will invest \$80 million to develop core capabilities required for cell therapy manufacturing:** from addressing bottlenecks in manufacturing scale-up, to deepening our understanding of cell quality attributes relating to safety and efficacy, to developing improved technologies to assess the quality of the cells manufactured.

12. This builds on Singapore's existing strengths as a pharmaceutical manufacturing centre, coupled with our logistics connectivity and global reputation of trust, to develop new capabilities that reposition Singapore as a centre for cell therapy manufacturing.

13. These programmes bring together multi-disciplinary teams across nine publicly-funded research institutions including the Agency of Science, Technology and Research (A\*STAR), Institutes of Higher Learning, hospitals and Singapore-MIT Alliance for Research and Technology (SMART). See **Annex B** for details on the programmes.

## (C) TURNING CONSTRAINTS INTO STRENGTHS AND NEW OPPORTUNITIES

14. Singapore has always met our constraints head on. In the Singapore Water Story – where the government, research institutions and companies had worked together in partnership – we used S&T to turn our water-constrained reality into new technologies that we are then able to export overseas. With climate change, rising sea levels and temperatures could also impact food production, resulting in a global shortage of food.

### Starting a New Chapter for Singapore, in the Singapore Food Story

15. To address these rising challenges, Singapore has set out a vision to achieve “30 by 30” – i.e., to develop the capability and capacity of our agri-food industry to locally produce 30 per cent of Singapore’s nutritional needs by 2030. This was announced during the Committee of Supply 2019 for the Ministry of the Environment and Water Resources. To achieve this vision, our agri-food industry needs to leverage R&D and adopt new climate-resilient and sustainable technologies to raise productivity and overcome resource constraints.

16. The Singapore Food Story also needs to be anchored on a strong foundation of food safety, to ensure that the food we produce are safe for Singaporeans to consume, with potential to be exported to other countries. To support the “30 by 30” goal, **funding of up to \$144 million will be allocated from within the RIE2020 Plan to carry out R&D in Sustainable Urban Food Production, Future Foods and Food Safety Science & Innovation.** See **Annex C** for details on the programme.

17. In line with this, Enterprise Singapore will set up two new Centres of Innovation – the Centre of Innovation in Aquaculture and the Centre of Innovation in Energy – to support technology innovation for Singapore enterprises in the aquaculture and energy sectors. See **Annex D** for details on the two new Centres of Innovation.

## GLOBAL-ASIA NODE OF TECHNOLOGY, INNOVATION & ENTERPRISE

18. Singapore has made significant efforts to move towards an economy driven by technology, innovation and enterprise. We are supporting Singapore-based companies to accelerate the deployment of solutions from the laboratory to the market, and encourage entrepreneurship among Singaporeans. There is also a range of government support, including grants for first-time technology entrepreneurs, co-investment funding with private sector investors, and support for incubators and accelerators. SGInnovate, a government-owned deep-tech venture builder, has also been actively facilitating the growth of deep-tech startup companies in nascent technology sectors.

19. To fuel the growth of our vibrant innovation ecosystem, and build new enterprises that serve the needs of Asia, and even the world, we are deepening our efforts – forging links with other global innovation nodes through our Global Innovation Alliance, and attracting talent from around the world, to work together with talented Singaporeans in Singapore – to form a bridge between Asia and the rest of the world.

20. This year, the Singapore Week of Innovation and TeCHnology (SWITCH) and the Singapore FinTech Festival will also be held together in the week of 11 – 15 November 2019 at the Singapore EXPO Convention and Exhibition Centre. Besides showcasing the vibrant technology and innovation landscape in Asia and in Singapore, this week-long series of events will facilitate the meeting and exchanging of ideas among Asian and global innovators, entrepreneurs, investors, and companies in deep-tech areas such as biotech, manufacturing technologies, fintech, and urban engineering systems.

## **LEVERAGING OUR RESEARCH, INNOVATION & ENTERPRISE EFFORTS TO BUILD THE FUTURE OF SINGAPORE**

21. The future of Singapore lies in our ability to leverage S&T to drive economic growth, overcome our national constraints and improve the lives of Singaporeans. Having built up strengths in S&T that can contribute to Singapore's growth and resilience, these added investments build on the progress to date to fuel our development in the next bound.

## **RESEARCH, INNOVATION AND ENTERPRISE 2020 (RIE2020) PLAN**

22. The RIE2020 Plan comprise four technology domains, namely – Advanced Manufacturing & Engineering (AME), Health & Biomedical Sciences (HBMS), Services & Digital Economy (SDE) and Urban Solutions & Sustainability (USS); and three supporting horizontals – Academic Research, Innovation & Enterprise, and Manpower.

23. The RIE2020 Plan set out to achieve greater value creation for Singapore from our investment, by pursuing four key thrusts: a) sharper focus on value creation; b) closer integration of strategies; c) stronger dynamic for renewal; and d) better optimised RIE manpower.

24. The five-year plan is for the period of 2016-2020, and we have completed the mid-term review of RIE2020. The adjustments in plans are in response to insights from the review, which was informed by a diverse slate of international experts who know Singapore well.

## **RESEARCH, INNOVATION AND ENTERPRISE COUNCIL (RIEC)**

25. The RIEC, comprising selected Cabinet Ministers and distinguished Singapore and foreign members from the business, science and technology communities, advises Singapore on national research and innovation policies and strategies, and major trends in S&T. The RIEC is chaired by the Prime Minister of Singapore.

---

For media enquiries, please contact:

Ms Charlotte Chen  
Head, Corporate Communications  
National Research Foundation, Prime Minister's Office, Singapore  
DID: +65 6684 2928; HP: +65 9829 9304  
Email: [Charlotte.CHEN@nrf.gov.sg](mailto:Charlotte.CHEN@nrf.gov.sg)

Ms Hoh Suk Mun  
Assistant Head, Corporate Communications  
National Research Foundation, Prime Minister's Office, Singapore  
Tel: +65 6694 5036; Mobile: +65 9150 2036  
Email: [HOH\\_Suk\\_Mun@nrf.gov.sg](mailto:HOH_Suk_Mun@nrf.gov.sg)

## Deepening Our Expertise in Digital Technologies and Automation

1. Singapore is committing more resources to R&D in digital technologies and automation to strengthen Singapore's capabilities. More than \$500 million under the Research, Innovation, Enterprise 2020 (RIE2020) Plan will go towards:

- a) Supporting Growth in the Services & Digital Economy Domain
  - AI Singapore
  - National Cybersecurity R&D Programme
  - Strategic Capability Research Centres (Digital Trust)
  - Emerging Areas of Research (Social Science of Digital Technologies)
  - Computational Law
- b) Boosting Singapore's supercomputing resources
  - National Supercomputing Centre Singapore 2.0
  - SingAREN Lightwave Exchange 2.0
- c) Supporting deployment of robotics and automation

### (A) Supporting Growth in the Services & Digital Economy Domain

#### AI Singapore

2. Singapore's national artificial intelligence (AI) programme, AI Singapore, will receive additional funding to significantly boost research, innovation and industry transformation in Singapore's AI ecosystem. This will be done by developing talent and nurturing scientific excellence, solving national challenges, and supporting industry.

- a) Nurturing scientific excellence and strengthening international partnerships
  - It is critical to ensure that Singapore keeps pace with AI developments worldwide. As such, competitive funding for AI research will be expanded to support more ambitious, game-changing research. A kickstarter fund will also be introduced to support Proof-of-Concepts and the demonstration of preliminary results for promising and potentially game-changing projects.
  - There will be a focus on areas where Singapore has a competitive advantage: Accountable AI, Privacy-aware AI, Resource-efficient AI, Collaborative AI and Lifelong Machine Learning.
  - AI Singapore will be deepening its international partnerships in AI. It is looking to partner leading international institutions and companies keen to collaborate on AI research and innovation. This will help to further augment and enhance our AI capabilities, and provide networks that help us create greater impact from our AI investments. International partners which AI Singapore is currently engaging are:

- Canada: Partnership with AI to accelerate translation of research into scalable products that the government and industry can adopt. Element AI also forged partnerships with GIC to use machine learning on asset management, and with SGIInnovate on talent development;
- UK: Partnership with UK's Alan Turing Institute, to access their cutting edge research and world-class talent in AI;
- France: Partnership with France's PRAIRIE (PaRis Artificial Intelligence Research Institute) on AI for healthcare – this ties in with the recently launched AI in Health Grand Challenge; and
- Switzerland: Partnership with ETH to develop a consortium in AI for design.

b) Talent development

- In AISG's first phase, they had partnered with IMDA to develop three AI talent development programmes to meet industry's needs. These are:
  - **AI Singapore Apprenticeship Programme (AIAP)**, which is a 9-month full-time apprenticeship programme, which aims to train 200 AI engineers (by 2022) who are able to design, develop and deploy AI applications at scale
  - **AI for Industry (AI4I)**, which is a 3-month foundation AI programme, which aims to upskill 2000 working professionals (by 2022) to be able to program basic AI and data applications
  - **AI for Everyone (AI4E)**, which is a 3 hour AI workshop that aims to help 10000 citizens (by 2022) to understand what is AI, and how it can be used to improve the way one lives, works and plays.
- Moving forward, AISG will also work with the Future Economy Council (FEC) clusters to develop dedicated AI manpower training programmes, to enable the workforce in each of these clusters to better leverage AI to transform the industry.

c) Solving national challenges

AI Singapore seeks to create significant social and economic impact through AI research, and thereby raise Singapore's stature in AI efforts globally. The recently concluded AI Singapore Grand Challenge in Health attracted significant interest from the local and international community. See Enclosure for AI Singapore's Press Release on Winners of the Grand Challenge. In the next phase, AI Singapore will:

- Launch 2-3 **Grand Challenges** which aim to address major problems of both national and global relevance, such as in fintech and logistics.

- Design smaller-scale **Tech Challenges** in partnership with interested agencies or companies who have clear demand and receptacles which the research outcomes will be applied to. Possible technology challenges include AI in cyber forensics, AI in cyber defence, and AI in design.
  - Launch **Prize Challenges** to encourage solutions to specific problem statements.
- d) Supporting industry transformation

AI Singapore will augment the broad-based AI Singapore 100 experiments track<sup>1</sup> by:

- Supporting the Future Economy Council's industry transformation effort by partnering Singapore companies in the application of AI to improve business outcomes.
- Continuing to support labs in areas of AI technology, such as speech and Natural Language Processing.
- Boosting innovation among the growing AI community. A Makerspace is envisioned to broaden access to AI tools, computing resources, data-sets and problem statements. The AI Singapore Makerspace will also collaborate with IMDA PiXEL Lab and SGIInnovate to support digital tech startups.

### National Cybersecurity R&D Programme

3. The National Cybersecurity R&D programme (NCR) will grow and expand Singapore's talent and research portfolio in areas such as AI for Cybersecurity, communications security, edge computing, and cloud security. This will ensure that future cybersecurity needs in Government and industry can be met. This is critical given the advent of the Internet of Things, in which more and more devices are connected to the internet.

### Strategic Capability Research Centres (Digital Trust)

4. To build core expertise across the continuum from basic to applied research, capabilities in **digital trust** will be enhanced as it has been identified as a strategic capability for Singapore. Digital trust encompasses the three characteristics of security, privacy and accountability. The next phase of RIE2020 will see an investment in R&D of accountable digital systems and machines, and game-changing integrative projects that seek to create smart systems or machines exhibiting more than one of the aspects of security, privacy, accountability, intelligence, or connectedness. To attract technical experts and projects, Singapore must offer unique opportunities to tackle ambitious problems, meet and work with other top talent, and co-innovate with government agencies. Thus, efforts will be made to:

- Continue support for R&D groups that work closely with industry, or aspire to produce spinouts;

---

<sup>1</sup> The 100 Experiments (100E) track is AI Singapore's flagship programme to solve industries' AI problem statements, and help them build their own AI team. An organisation can propose 100E problem statements where no commercial off-the-shelf AI solution exists, but can potentially be solved by Singapore's ecosystem of researchers and AI Singapore's engineering team within 9 to 18 months.



- Expand the pool of local talent through mechanisms like the NRF Fellowship; and
- Facilitate support for postgraduate students who wish to work with top private and non-profit projects.

5. There will also be support for the ecosystem through a programme office and hacker houses<sup>2</sup>. The programme office will explore and manage co-innovation with government agencies. It will be responsible for other ecosystem building events, such as conferences and hackathons. We will also support hacker houses in Singapore, to create natural landing pads for top digital nomads passing through Singapore. This will foster networks between Singapore’s talent and the global tech elite.

### Emerging Areas of Research

6. One emerging area of research in the digital space is the **social science of digital technologies**, in which Singapore has the opportunity to cultivate leadership and influence. While we are in a period of pervasive digital technology adoption, policy, governance and implementation around these technologies could be further improved. Singapore has the opportunity to build world-class expertise in the design, implementation, commercialisation and regulation of digital technologies and systems, leveraging our reputation for stable governance.

### Computational Law

7. There will be continued support for innovative R&D projects with high potential to transform industries. One potential research area is in computational law<sup>3</sup>, which aims to codify law in a manner in which computer systems are able to interpret and execute it, so as to enable a higher degree of automation and efficiency. This could bolster existing strength in the legal industry, and related strengths and priorities in the digital economy and smart contracts. Should the vision of computational law be realised, the legal industry stands to be fundamentally disrupted – from fee-based legal services to scalable legal products. It will also be consistent with the demand in the blockchain and related ecosystem for smart legal contracts.

---

<sup>2</sup> Hacker houses are curated community residences, common in major tech hubs – such as San Francisco, Berlin and Paris – that act as global landing pads for technical and creative talent, whether resident or passing by. Hacker houses have been key ecosystem anchors that enrich the networks and experiences of local communities.

<sup>3</sup> Computational law is a branch of legal informatics that focuses on the automation of manual processes in legal work and the integration of legal information with other applications and systems. While the idea of mechanised legal analysis is not new, developments have accelerated in recent years due to progress in computational logic, machine learning, and the proliferation of autonomous systems. While computational law may still be a nascent field, prominent research initiatives are being carried out around the world, such as Computable Contracts at the Stanford CodeX Centre for Legal Informatics, law.mit.edu, the Accord Project, Mattereum and the Commonwealth Scientific and Industrial Research Organisation (CSIRO)’s Data61.

## **(B) Boosting Singapore's Supercomputing Resources**

8. As Singapore embarks on the use of digital technologies on all fronts and realises its Smart Nation vision, its high performance computing (HPC) needs will naturally increase. Under the RIE2020 Plan, funding will be set aside to enhance Singapore's two digital national infrastructure – the **National Supercomputing Centre Singapore** and **SingAREN Lightwave Internet Exchange**. The upgrades will boost Singapore's supercomputing capability and network speed and quality for all Institutes of Higher Learning and research institutions.

## **(C) Supporting Deployment of Robotics and Automation**

9. The National Robotics Programme (NRP), which was established to coordinate government efforts to drive the end-to-end development, test-bedding and deployment of robotics technology, will receive a top-up funding that will go towards supporting the National Environment Agency in the full implementation of the Environmental Robotics programme, where robots will be deployed for the cleaning of public spaces, waste management, and pest and pollution control. The funding will also go towards building up new critical robotics tech enablers, such as soft and hybrid robotics, advanced indoor navigation, human robotics interaction, and wearable robotics.



## **MEDIA FACTSHEET**

### **CELL THERAPY: DRIVING FUTURE GROWTH OF SINGAPORE'S BIOPHARMACEUTICAL MANUFACTURING INDUSTRY**

***Singapore is already an established hub for biopharmaceutical manufacturing. But for continued growth, it needs to position itself as the location of choice to manufacture cell therapies***

Singapore is a globally-leading location for biopharmaceutical manufacturing. While a strong manufacturing base has been established for chemical active pharmaceutical ingredients and biologics, Singapore is repositioning its biopharmaceutical manufacturing sector for future growth through strategic long-term investments in cell therapy manufacturing.

- a) Biopharmaceutical Manufacturing is an important sector for Singapore contributing to our economic growth and providing Singaporeans good jobs.
- b) Over the last two decades, Singapore's biopharmaceutical manufacturing industry has witnessed strong growth<sup>4</sup>.
- c) In 2018, Singapore's biopharma manufacturing sector contributed to 4% of GDP, generating \$15.7 billion in manufacturing output, and S\$9.4 billion value-add. The sector employs more than 7,700 highly skilled workers.

Cell therapy holds great promise in addressing unmet medical needs. Today, with the majority of treatments for chronic and life-threatening diseases designed to deal with symptoms or delay disease progression, cell therapy has the potential to revolutionise this – to cure or significantly change the course of disease.

Cell therapy is a therapy in which intact living cells are injected into a patient to derive a therapeutic effect such as restoring tissue or organ function, or fighting cancer. Led by the recent launches of cell therapy products, the industry has seen accelerated growth over the past few years. Therefore, cell therapy manufacturing presents high-value opportunities for Singapore.

In spite of this breakthrough, manufacturing of cell therapy remains challenging due to the complex manufacturing process and lack of suitable manufacturing technologies.

---

<sup>4</sup> Between the years 2000-2017, manufacturing output, value-add to the economy, and employment numbers in Singapore's biopharmaceutical manufacturing industry have more than tripled.

The key challenges are:

- a) **Scalability**: how to generate sufficient quantities of cells for therapy;
- b) **Characterisation and quality control of cell-based products**: how to identify and measure the attributes of safety and efficacy;
- c) **Improve process efficiencies**: to reduce manual processes and increase reproducibility.

While cell therapies could have significant public health and economic benefits, it would require the cost-effective, scalable, and reproducible manufacturing of high-quality cells to realise their potential. Enabling industrial-scale cell manufacturing requires advanced technologies and techniques that can increase cell production scale and speed while improving quality assurance, reducing manufacturing costs, enhancing manufacturing reproducibility and consistency, and increasing treatment efficacy and safety.

Over the past decade, the public-sector research performers have developed extensive knowledge and research capabilities ranging from stem cell biology and immunology, to cell culturing and bioprocessing, and manufacturing systems and process analytical technologies. In addition, at the healthcare cluster, we have key opinion leaders driving clinical translation and clinical trials in different diseases.

Harnessing these capabilities, three cell therapy manufacturing R&D programmes have been established to address the different aspects hampering cell therapy manufacturing. These unique programmes bring together multi-disciplinary teams across nine public-sector research performers including A\*STAR, Institutes of Higher Learning, Singapore-MIT Alliance for Research and Technology (SMART), and hospitals.

Singapore will be investing a total of \$80 million across these cell therapy manufacturing programmes that aim to address the bottlenecks in manufacturing scale-up, deepen our understanding of cell attributes relating to safety and efficacy, and develop analytical technologies to assess the quality of products during manufacturing. The three cell therapy manufacturing R&D programmes are:

- a) **Scalable Autologous Clinical Cell Manufacturing Platform**: Aims to develop a commercially scalable platform for autologous cell therapy across healthcare clusters in Singapore by identifying and addressing bottlenecks in the entire autologous cell therapy manufacturing process.
- b) **Biological Quality Determinants for Allogeneic Mesenchymal Stem Cells Manufacturing**: Aims to transform allogeneic cellular therapy and establish therapeutically-potent mesenchymal stem cells for clinical translation by integrating new manufacturing technology within Singapore to address donor selection and optimal culture conditions.
- c) **Critical Analytics for Manufacturing of Personalised Medicine Programme (“CAMP”)**: Aims to develop technology that will enable safe, effective and cost-

efficient manufacturing of biological cells for use in personalised medicine for human health impact.

Singapore's strategic investments in research and innovation in cell therapy manufacturing will foster a vibrant cell therapy ecosystem by attracting investments from multi-national companies as well as enabling the growth of local biotechs. In recent years, there has been an exponential growth of local cell therapy biotechs<sup>5</sup> (with half of these companies exploring the establishment of cGMP manufacturing facilities in Singapore).

The cell therapy manufacturing R&D programmes will support the growing number of local biotechnology companies and multi-national companies in (1) cell therapy asset development, and (2) cell manufacturing related processes, with the ultimate goal of anchoring R&D and manufacturing activities from these companies in Singapore. Through such partnerships, these programmes hope to help these companies develop robust and efficient manufacturing processes, and address their industrial-scale manufacturing challenges while ensuring products of high quality and safety for patients.

Given Singapore's track record in biopharmaceutical manufacturing, intellectual property protection policies, compliance with international regulatory standards, excellent science and knowledge base, it is well-poised to capture the growth opportunities in cell therapy and be the regional hub for cell therapy manufacturing.

---

5

- Companies developing immune cells therapies (e.g. Tessa Therapeutics, Lion TCR, MediSix Therapeutics)
- Companies developing stem cells and derived products as therapies (e.g. CellResearch Corp, Paracrine Therapeutics, Celligenics)
- Contract development and manufacturing organisations (e.g. CellVec, Esco Aster)

## The Singapore Food Story R&D Programme

1. Singapore faces space and resource constraints, and is vulnerable to global trends that impact food supply and safety. These include the growing complexity of food systems, climate change, urbanisation, and new business models and food products. The Singapore Food Story R&D Programme, jointly developed by the Singapore Food Agency (SFA) and A\*STAR, seeks to turn our food challenges into advantages by focussing on the three R&D themes of:

- a) Sustainable Urban Food Production;
- b) Future Foods: Advanced Biotech-based Protein Production; and
- c) Food Safety Science and Innovation.

2. The Singapore Food Story R&D Programme will contribute to the national “30 by 30” goal<sup>6</sup> for local production, to reduce our reliance on imports and buffer against the impact of overseas supply disruptions. It also aims to transform our agri-food industry by growing enterprises and creating jobs. By building a strong base of R&D capabilities in our research institutions in partnership with industry, and undertaking cross-domain research in emerging areas in the agri-food industry, we will help to strengthen our food security, contribute to our economy, and develop a future-ready food safety system.

### **(A) Sustainable Urban Food Production**

3. Research under this theme will focus on tropical aquaculture and urban agriculture. The development of technology in these areas can help to strengthen food security by raising productivity and improving sustainability, as well as capture economic opportunities.

- a) Tropical aquaculture: Aquaculture will be increasingly important for food production as global fisheries decline and demand for fish increases. The tropical aquaculture sector has high potential growth, particularly through the use of technology for intensive farming.
- b) Urban agriculture: Urban agriculture technologies such as climate control and multi-tier farming systems can increase our capacity to grow locally. For example, these technologies can allow us to grow seasonal crops not typically found in the tropics.

---

<sup>6</sup> The goal is to develop the capability and capacity of our agri-food industry to locally produce 30% of Singapore’s nutrition needs by 2030.

4. The key targets and potential research areas include:

- a) Increase the productivity of local food producers, beyond what is achievable by current best-in-class technologies. For example, this could be achieved through the use of vegetable and fish species bred with desirable traits.
- b) Lower resources and operation costs, by optimising indoor vegetable species with lower energy needs or fish feed, to make indoor farming and tropical aquaculture more commercially viable.
- c) Improve disease and health management of indoor farming and tropical aquaculture, such as through the development of smart sensors for real-time detection of plant stress.
- d) Improve nutritional quality of produce through nutrient loss reduction and shelf-life extension.

#### **(B) Future Foods: Advanced Biotech-based Protein Production**

5. The global demand for proteins will grow significantly in the coming decades as the world population grows and income levels rise. This rising demand will put a heavy strain on the environment if we rely on traditional methods of animal agriculture and fishing to supply proteins. Fuelled by advances in biotechnology, discoveries of novel protein functionalities, new processing methods, as well as greater consumer awareness and acceptance, Alternative Proteins is an emerging industry with innovative new food products starting to come onto the market.

6. In addition to contributing to local production, the growth of the Alternative Proteins industry presents an economic opportunity for Singapore. R&D is needed to mature the technologies to produce them at scale, with good safety and cost efficiency. We will focus on plant and microbial-based proteins, as well as cell-based cultured meat. Targeted investments to build on and integrate Singapore's existing research capabilities in bioengineering, nutrition, bioprocessing and agri-food science can help to grow this industry segment in Singapore.

7. This R&D theme seeks to enhance food security and achieve economic outcomes using advanced biotechnology and industry 4.0 manufacturing. Key objectives and potential research areas include:

- a) Development of novel biotech-based methods for high-value, sustainable and nutritious protein production. Such methods include fermentation and extraction of microbial protein, improvement of the functionality, formulation and flavour of plant-based protein food products, as well as developing scaffolding techniques with sustainable, cost-effective cell culture media for cell-based cultured meat.

- b) Discovery, process development and scale-up of alternative proteins, to position Singapore as a leading alternative protein R&D hub. The JTC Food Hub @ Senoko, which houses commonly used processing equipment and tools, is a shared facility that could be used by companies to conduct such scale-up trials in alternative proteins.
- c) Development of technologies that enable circular bio-economy and improve sustainability of natural resources through the use of under-utilised crops, as well as agricultural and food waste side streams.

### **(C) Food Safety Science & Innovation**

8. This R&D theme seeks to build local food safety scientific capabilities to support innovation in food production and manufacturing, and to develop new food safety standards.

9. To drive food safety research, SFA, A\*STAR and Institutes of Higher Learning will set up a new platform for public-private partnership called the Future REady Food Safety Hub (FRESH), which will foster tripartite collaboration among industry, researchers and regulators. By consolidating food safety capabilities within the local ecosystem, there is an opportunity for Singapore to address emerging challenges in food safety and quality through science, and develop new food standards, such as risk assessment protocols and technical specifications for foods, which will be recognised and adopted by the international community.

10. Potential research areas to be studied under this theme include:

- a) Ascertaining emerging safety risks of novel foods, including toxicity, allergenicity and other risks.
- b) Developing an early warning and predictive modelling system that uses artificial intelligence to integrate and analyse data on emerging pathogens, food fraud, and other food safety risks.
- c) Understanding consumer perceptions and social considerations of food innovations to facilitate effective public communication and educational efforts, and improve acceptability of food innovations.





## **New Centres of Innovation in Energy and Aquaculture**

1. Enterprise Singapore will be establishing two new Centres of Innovation (COIs) with partners to support technology innovation for Singapore enterprises in the growing sectors of energy and aquaculture.
2. This will bring the total number of COIs in Institutes of Higher Learning (IHLs) and public Research Institutes (RIs)<sup>7</sup> to ten. The COIs were set up to support SMEs with technology innovation for growth. Each COI specialises in a different industry, providing SMEs with assistance to develop technology projects through access to technical facilities, consultancy services and training.

### **(A) Energy Centre of Innovation**

3. The COI for the energy sector will be established in the Nanyang Technological University, Singapore (NTU Singapore) to increase technology commercialisation of cutting-edge innovative solutions by Singapore enterprises.
4. It will collaborate with the Sustainable Energy Association of Singapore (SEAS) to identify problem statements and drive industry-led innovation. The COI will provide technical expertise to Singapore enterprises, translate energy research into commercial technologies and solutions, as well as work with corporates to provide private-sector testbeds for these enterprises to test and implement the solutions. It will also groom startups in the energy sector.
5. The COI will focus on the following technology areas:
  - Renewable Energy
  - Energy Efficiency
  - Electric Mobility
  - Smart Grids (including Battery Storage)
  - Smart Cities
  - Energy IoT, Big Data and Artificial Intelligence
  - Circular Economy
  - Carbon Reduction

---

<sup>7</sup> The eight COIs are (i) Food Innovation & Resource Centre with Singapore Polytechnic, (ii) Environment & Water Technology with Ngee Ann Polytechnic, (iii) Supply Chain Management with Republic Polytechnic, (iv) Electronics and Internet-of-Things (IoT) with Nanyang Polytechnic, (v) Complementary Health Products with Temasek Polytechnic, (vi) Materials with A\*STAR's Institute of Materials Research and Engineering, (vii) Marine and Offshore Technology with Ngee Ann Polytechnic and (viii) Precision Engineering with A\*STAR's SIMTech.

## **Aquaculture Centre of Innovation**

6. This COI for the aquaculture sector will be established in Temasek Polytechnic to strengthen Singapore's aquaculture sector. It will support the sector's growth by developing innovative solutions in sustainable urban and smart aquaculture with a focus on areas including nutrition feeds, additives, and feeding management; health and disease management; genetics, breeding, and seed production; and farm husbandry and sustainable production. It will also raise industry standards through product testing, certification, quality standards development, and employee training for standards and technology adoption. Lastly, the COI will also promote open sharing of knowledge and networks through platforms such as conferences, workshops and joint R&D collaborations.

7. The aquaculture COI is formed in collaboration with Ngee Ann Polytechnic, Republic Polytechnic, National University of Singapore, NTU Singapore, James Cook University, Agency for Science, Technology and Research (A\*STAR) and Agri-food and Veterinary Authority (AVA)<sup>8</sup>, and is the first COI that involves collaboration across IHLs, RIs and government agencies. It will facilitate access for SMEs and startups to applied research capabilities and services through co-sharing of resources, intellectual property, infrastructure and pooled expertise.

---

<sup>8</sup> To be referred as Singapore Food Agency with effect from 1 April 2019.