PRESS RELEASE

7 July 2009

BOOST FOR SINGAPORE R&D WITH $60 MILLION NEW RESEARCH AWARDS FROM NRF

- *Six research projects to receive funding under the Competitive Research Programme (CRP) Funding Scheme's fourth grant call, bringing the total number of CRP awards to twenty.*
- *NRF's CRP grants have spawned a sizeable pool of scientists carrying out internationally competitive high impact science and technology research in Singapore*

1. The National Research Foundation (NRF), on the recommendation of the International Evaluation Panel (IEP) for its Competitive Research Programme (CRP) Funding Scheme (see **ANNEX A** for details), announced today the fourth group of awards.

2. The CRP awards cover a broad range of science and technology research that have high potential economic and societal impact in the future. The current CRP grant call received 70 preliminary proposals (or white papers) submitted by Singapore-based researchers from local universities, public research entities as well as private companies. The proposals span a wide spectrum of science and technology areas. Sixteen white papers were selected for development into full proposals. These full proposals were internationally peer-reviewed before the IEP made the assessment and recommended six for funding.

3. The six research programmes awarded funding by NRF under the CRP scheme are:

- **Interface Science and Technology** (PI: Christos Panagopoulos, Nanyang Technological University)
- **Tailoring Oxide Electronics by Atomic Control** (PI: Thirumalai Venkatesan, National University of Singapore)
- **Nanonets: New Materials, Devices for Integrated Energy Harnessing & Storage** (PI: Subodh Mhaisalkar, Nanyang Technological University)

- **Frontiers in Magnetic Recording Research: Vision for 10 Terabits per square inch** (PI: Charanjit Singh Bhatia, National University of Singapore)
- **Membrane Protein Sciences – Tools for Rational Discovery of Novel Therapeutics and Diagnostics Targeting Integral Membrane Proteins** (PI: JaumeTorres, Nanyang Technological University)
- **Adult and induced pluripotent stem cells for neurological disorders and CNS repair** (PI: George Augustine, Duke-NUS GMS Singapore)

(See **ANNEX B** for more details)

4. Two of the awards, "Interface Science and Technology" at the Nanyang Technological University (NTU) and "Tailoring Oxide Electronics by Atomic Control" at the National University of Singapore (NUS), were assessed by the IEP to be highly complementary and would achieve greater research outcomes if carried out in close collaboration. This is the first time that 2 teams from two separate universities are awarded the funding to bring about cohesive scientific collaboration, to achieve even greater outcome than each of the programme could deliver on its own.

5. IEP Chair Dr Rita Colwell, Distinguished University Professor at the University of Maryland College Park and a member of NRF's Scientific Advisory Board, said: "We are very pleased with the quality of the 6 projects recommended to receive the CRP grant. Research and development are the basis for knowledge creation and are essential in fostering innovative and competitive economies. The international collaborations found in the CRP programmes would undoubtedly lead to synergistic discoveries that benefit participating countries. The CRP grants also have the ability to serve as a magnet to attract overseas researchers to Singapore. I would like to applaud the Singapore government for their efforts in continuing to invest in R&D even during this difficult economic period."

6. IEP member and Nobel Laureate Dr Richard Roberts, Chief Scientific Officer of New England Biolabs added, "The research proposals we recently reviewed are very impressive and demonstrate once again that the Singapore government is far-sighted in its approach to science. The future looks increasingly bright for Singapore."

7. Dr Francis Yeoh, Chief Executive Officer, NRF, said: "Singapore takes a long term holistic approach in our R&D investment. Since its inception, the NRF has put in place a range of programmes and initiatives to advance research, innovation and enterprise in Singapore. The CRP Funding Scheme is one that provides an excellent opportunity for Singapore researchers to compete for substantial funds to undertake research in areas they are passionate about. We hope that this scheme may uncover new strategic research areas for Singapore to develop into new industries for the future."

8. Prof Charanjit Singh Bhatia of the Faculty of Engineering at NUS, the Principal Investigator of the awarded CRP project on “Frontiers in Magnetic Recording Research”, said, "This award will enable my colleagues and I to attempt to achieve the goal of 10 terabits per square inch in magnetic storage, which is beyond existing process capabilities today. Doing this would require fundamental research into the basic physics of magnetism of small structures. We are hopeful and confident about creating some breakthroughs in magnetic recording research in Singapore.”

9. The six newly awarded proposals bring the total number of awards to twenty over 2 years. These twenty CRP awards had been selected from 290 White Papers submitted since the CRP scheme was launched in April 2007.

10. Some interesting examples from past awards include research in the following areas:

a) the use of cell therapy and microRNAs (MiRNA), which regulate gene expression, to treat age-related diseases,
b) ultrahigh strength one-atom-thick planar sheet carbon atoms called graphene that could have applications in ultra-capacitors, gas sensors or biodevices,
c) lipodomics, where the study of cellular lipid molecular species and their interactions with other lipids, proteins, and other metabolites could assist in defining the biochemical mechanisms of lipid-related diseases or conditions such as obesity, cardiovascular diseases, diabetes and others.

11. The CRP Funding Scheme offers substantial funding support of up to S$10 million per proposal, over three to five years. The grant funds a broad base of research programmes through a competitive bottom-up (investigator-led) approach, with submissions assessed by international scientific reviews. Through the scheme, NRF aims to identify future strategic research areas for Singapore (see **ANNEX C** for a description of the CRP Funding Scheme).

12. CRP grant calls are announced twice a year. The inaugural CRP grant call was launched on 16 April 2007. The first two CRP calls were general calls which accepted proposals from all fields of science & technology. Ten proposals received the CRP award worth about S$100 million from the first two calls. The third call was a ‘scenario-based’ CRP call, which aimed to focus research proposals to meet major challenges or opportunities arising from a future scenario that Singapore may face. “Ageing” was chosen as the first topic for the scenario-based CRP. Four proposals in the biomedical and life sciences field received ~S$40 million in January 2009 (see **ANNEX D** for a list of all funded CRP). The second scenario-based CRP call, opened on 17 April 2009 for online submission, is on ‘Sustainable Urban Systems’. This call received 68 white papers.

About the National Research Foundation (NRF)

The National Research Foundation (NRF), set up on 1 January 2006, is a department under the Prime Minister's Office.

The NRF sets the national direction for research and development (R&D) by developing policies, plans and strategies for research, innovation and enterprise, funds strategic initiatives, builds up R&D capabilities and capacities through nurturing our own and attracting foreign talent, and coordinates the research agenda of different agencies to transform Singapore into a knowledge-intensive, innovative and entrepreneurial economy. It provides secretariat support to the Research, Innovation and Enterprise Council (RIEC), chaired by the Prime Minister. A five-year budget of S$5 billion has been allocated to the NRF in 2006 to achieve this mission.

The NRF aims to:

- Transform Singapore into a vibrant R&D hub that contributes towards a knowledge-intensive, innovative and entrepreneurial economy; and
- Make Singapore a talent magnet for scientific and innovation excellence.

For more information, please visit www.nrf.gov.sg.

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ANNEX A

National Research Foundation
Competitive Research Programme Funding Scheme

International Evaluation Panel	
1.	**Dr Rita Colwell (Chairman)** Distinguished University Professor, University of Maryland College Park and Johns Hopkins University Bloomberg School of Public Health, USA Former Director of the US National Research Foundation (concurrently NRF Scientific Advisory Board Member)
2.	**Prof James Foley** Stephen Fleming Chair in Telecommunications and Professor, Interim Dean, College of Computing, Georgia Institute of Technology, USA (concurrently NRF Scientific Advisory Board Member)
3.	**Prof Dr Louis-François Pau** Professor, RSM Erasmus University, Netherlands and Copenhagen Business School, Denmark (concurrently NRF Scientific Advisory Board Member)
4.	**Dr Richard Roberts** Chief Scientific Officer, New England Biolabs, USA Nobel Laureate in Medicine (1993)
5.	**Mr Thomas Stagnaro** President and Chief Executive Officer, Americas Biotech Distributor, USA
6.	**Mr Peter Tan** Founder and General Partner, JP Asia Capital Partners, Singapore
7.	**Dr Richard Yen** Founder and Managing Director, Ednovation Pte Ltd, Singapore
8.	**Dr Hal Broderson** Founder and Managing Director, Rock Hill Ventures, USA

ANNEX B

CRP 4th CALL: RESEARCH PROGRAMMES AWARDED FUNDING

1. Interface Science and Technology (IS-Tech)

Technological advances such as semiconductor-based transistors and giant magneto-resistance read-heads have been serving as pillars for markets of hundreds of billions of dollars a year. These technologies are based on known physical principles and further advancement is subject to this limitation. It is now widely recognized the nation(s) that can make the transition from new basic research into alternative technologies will enjoy substantial intellectual and economic rewards. However, such achievements can only be based on new phenomena and the scientific laws that govern them. These will emerge from novel materials with functionalities beyond the state of today's technology.

This Program is a coordinated effort with Co-PI's Asst Professors Tom Wu and Elbert Chia. Together with our Collaborators, we will engineer and investigate new classes of materials-systems with novel quantum properties and complex electronic phases arising from a collective interaction of electrons in a "caged" nano-device: the *interface*. We will develop, study, control and utilize interfaces between dissimilar materials *e.g*., transition metal oxides, giving rise to phenomena and functionalities not exhibited by the constituent materials alone. This approach opens up new perspectives for the emergence and exploration of interface properties driven by electron interactions in reduced dimensions — a true example of innovative technology, with inventions and applications originating from seminal scientific advances.

Nanyang Associate Professor Christos Panagopoulos
School of Physical & Mathematical Sciences
Nanyang Technological University

Professor Panagopoulos' activities on the specifics of this Program focus on the physics of emergent complex electronic phases. He has published more than sixty articles on this subject and delivered several key note speeches and courses at graduate schools, and over a hundred invited lectures at international meetings and Universities. He has founded and directed two laboratories on complex electronic matter and chaired a number of academic panels. Honors accorded Panagopoulos include the European Marie Curie Excellence Grant (2006), European Young Investigators Award (2006), Invited Professor at the

Venture Business Laboratory, Kyoto (2001), and his election as Research Fellow of Trinity College, Cambridge (1996), National Research Foundation, Singapore (2008) and The Royal Society, UK (2001).

Co-Principal Investigators:

- Assistant Professor Tom Wu (NTU)
- Assistant Professor Elbert Chia (NTU)

Collaborators:

- Assistant Professor Haibin Su (NTU)
- Dr Yong Lim Foo (IMRE)
- Professor Atsushi Fujimori (Tokyo)
- Dr Samuel Bader (Argonne)
- Professor Jenny Hoffman (Harvard)
- Dr Isao Inoue (AIST)
- Dr Jian-Xin Zhu (Los Alamos)
- Dr Wilfrid Prellier (CNRS)
- Dr Ivan Bozovic (Brookhaven)
- Professor Efthymios Kaxiras (Harvard)

2. Tailoring Oxide Electronics by Atomic Control

Imagine a completely transparent electronic circuit integrated on an automobile windshield, providing a variety of guidance functions to the driver. An active window in a building, which can be switched from transparent to dark, or even light-emitting on demand. Or a room temperature superconductor, conducting electricity without energy loss and providing fascinating novel transport possibilities. These are some of the wonderful opportunities, on a variety of time-horizons, in which the area of oxide electronics is perceived to play a dominant role.

With new techniques developed in the last few years, the control in the synthesis of these complex multi-element materials has reached an unprecedented level of perfection on the atomic scale. This enables us to exploit the enhanced possibilities arising e.g., from combining different oxide materials, or from highly precise electronic doping. Such tailoring of oxide electronics by atomic control creates the possibilities to provide new or improved functionality to the oxide compounds. These highly remarkable developments have attracted great attention, as is best illustrated by the fact that Science Magazine placed it rank 5 in the Science Top 10 Breakthroughs of the Year 2007. Moreover, it was very prominently advocated as one of the key new research areas in a recent report by the Basic Energy Sciences Advisory Committee of the U.S. Department of Energy, outlining 'Five Grand Challenges for Science and the Imagination'.

This CRP has attracted a team of some of the leading researchers in this field from within NUS and globally to set up a series of research activities around the theme of tailoring oxide electronics by atomic control, with an impact in such areas as next generation electronics; novel sensors; optics and lighting; and the development of new materials with exceptional properties with future potential in strategic areas such as energy. The CRP will enable us to lead at the cutting edge of this scientific field, publish in world class journals whilst developing technology for the future, leading to patents and spin off companies.

Professor Thirumalai Venkatesan
NanoCore, ECE/Phy
National University of Singapore

Professor Venkatesan's research focuses on nanostructured materials, oxide films and heterostructures, helium ion microscope for nanoscale imaging and

patterning. He has published over 500 papers and is an ISI highly cited Physicist (ranked 66 globally) with over 19,000 citations and an H factor of 73. He was at Bell for 17 years, University of Maryland for another 17 and is currently the Director of NanoCore, a multidisciplinary research program at NUS involving researchers from Physical and life Sciences and Engineering and Medical School. He is a Fellow of the American Physical Society and is the Vice Chairman and Chairman elect of the Forum on Industry and applications of Physics of the APS. He has helped found two companies and 10 of his former researchers are entrepreneurs or Corporate CXOs.

Co-Principal Investigators:

- Hans Hilgenkamp (Phy/ECE NUS & U. Twente)
- Ariando (Phy, NUS)
- Andrivo Rusydi (Phy, NUS)
- Qing-Hua Xu (Chem, NUS)

Collaborators:

- Chua Soo Jin (ECE, NUS)
- Hyunsoo Yang (ECE, NUS)
- Andrew Wee (Phy, NUS)
- Yuan Ping Feng (Phy, NUS)
- Dan Pickard (ECE, NUS)
- Herbert Moser (SSLS/Phy, NUS)
- Ding Jun (MSE, NUS)
- Wang Shijie (IMRE)
- T. White (NTU)

Overseas Collaborators:

- R. Greene (Maryland)
- R Ramesh (UC Berkeley)
- D. Blank (U.Twente)
- D. Schlom (Cornell U)
- G. Sawatzky (U. British Columbia)
- M. Blamire (Cambridge)
- S. B. Ogale (NCL)
- G. Baskaran (IMSC)
- J. Preston (McMaster U)
- G. Botton (McMaster U)
- M. Ruebhausen (U. of Hamburg)

3. Nanonets: New Materials, Devices for Integrated Energy Harnessing & Storage

The compelling need for clean energy harnessing and storage devices has become increasing evident against the backdrop of uncertainties in energy supplies and their impact on local and global environment. This project will focus on new materials and devices for sustainable energy applications by exploiting two key emerging technologies, namely solution processable electronic devices and nanotechnology.

The emergence of inorganic nano-scale materials as viable electronics enablers and our ability to fabricate nano-scale wires from practically any material leads to a toolbox of “ready-made” elements, which will be assembled to form novel material architectures, with properties that will bring new functionalities to applications in green energy systems such as solar cells for energy generation and supercapacitors/ batteries for energy storage.

“Nanonets” constructed from nanostructured elements will enable high surface areas, enhanced electrochemical activities and efficient charge transport, thus offering significant enhancements to a new generation solar cells and batteries.

Associate Professor Subodh Mhaisalkar

Head-Materials Technology Division, School of Materials Science & Engineering

Professor Subodh Mhaisalkar is an Associate Professor in the School of Materials Science & Engineering at the Nanyang Technological University, Singapore. At NTU, he also holds the posts of co-Director, Energy Research Institute at NTU and Head, Materials Technology Division.

Prior to joining NTU in 2001, Professor Subodh has over 10 years of research and engineering experience in the microelectronics industry where he held senior managerial positions in STATS Singapore, National Semiconductor, and SIMTech.

Professor Subodh's expertise includes microelectronics materials & processes and his main areas of research comprise printed electronics, sensors, organic

photovoltaics, and printed charge storage solutions including supercapacitors and batteries. Common to all these projects are methods of solution processing of semiconductors (organic, carbon nanotubes, or inorganic nanowires), fundamental device physics studies, and device integration. Professor Subodh received his Bachelors' degree from IIT-Bombay and his MS/Ph.D. degrees from The Ohio State University.

Major Collaborators:

- Seeram Ramakrishna (NUS/Mechanical Eng)
- Chorng-Haur Sow (NUS/Physics)
- Madhavi Srinivasan (NTU/Materials)
- Ting Yu (NTU/ Physics)
- Haibin Su (NTU/Materials)
- Yeng Ming Lam (NTU/Materials)
- Qing Wang (NUS/Materials)
- Lydia Wong (NTU/Materials)
- BVR Chowdari (NUS/Physics)
- Wee Shong Chin (NUS/Chemistry)
- Zexiang Shen (NTU/Physics)

Overseas Collaborators:

- George Gruner (Physics, University of California Los Angeles)
- Michael Graetzel (Ecole Polytechnique Federale de Lausanne, Switzerland)
- Dr Ladislav Mares (Elmarco)

4. Frontiers In Magnetic Recording Research: Vision for 10 Terabits/inch^2

The data storage industry keeps moving ahead at blistering pace of 40% compound annual growth rate. Information Storage Industry Consortium (INSIC) has recently moved their research target to 10 Terabit/in^2. PI, Prof C S Bhatia, was involved in defining many research projects for this ambitious goal of magnetic data storage industry which is one of the pillars for Singapore economy. This new goal of 10 terabits per square inch puts this technology roadmap beyond the solid state memory which will likely "run out of gas" by 2017. This will require an interdisciplinary, high level of scientific and engineering approaches to accomplish key tasks. If the key scientific challenges can be worked out as proposed in this CRP proposal then one can argue that hard disk drive industry can be a viable & growth industry and continue to contribute to Singapore's economy. Prof Bhatia was recognized by the US based Magnetic Data Storage Consortium for his pioneering efforts in defining research projects for 10 terabits per square inch.

Professor Bhatia Charanjit Singh
Department of Electrical and Computer Engineering
National University of Singapore

The lead PI worked on the magnetic hard disks and devices at IBM/HitachiGST for ~30 years and many ideas developed in the lab were commercialized under his management. This year, the INSIC Staff was pleased to present the 2008 Distinguished Contribution Award to Dr. C. Singh Bhatia in recognition of his dedicated, long-term leadership and outstanding level of contribution to the INSIC EHDR Research Program in advanced hard disk storage technology. Dr. Bhatia is the only individual to have twice been awarded the INSIC Leadership Achievement Award (in 1998 and 2003). He was honored for his recent efforts in leading a working group to define approaches to the head-disk interface for 10 terabit per square inch recording, and for his pioneering efforts in INSIC's research programmes.

Major Collaborators:

Collaborators:

- Hongyu Chen (SPMS, NTU)
- Marc Armand (ECE, NUS)
- Hyunsoo Yang (ECE, NUS)
- Abdullah A Mamun (ECE, NUS)
- Aaron Danner (ECE/NUS)
- Sujit Kumar Sinha (ME, NUS)
- Thirumalai Venkatesan (ECE, NUS)
- Xu Qing-hua (Chemistry, NUS)
- Daniel Pickard (ECE, NUS)
- MSM Saifullah (IMRE)
- Kui Yao (IMRE)

International Collaborators:

- Mark Kryder (Professor at CMU, Chairman of SAB of DSI, Former CTO of Seagate)
- Stuart Parkin (IBM, Almaden)
- Vladimir Esalov (P-SUD France)
- Jack Judy (Univ of Minnesota)
- K. Komvopoulos (UC Berkeley)
- Thomas Schrefl (St. Pölten Univ of Appl. Sci., Austria)
- Sadamichi Maekawa (Tohoku Univ)
- James Harris (Stanford Univ)
- Bodh Mehta (IIT, Delhi)
- Information Storage Industry Consortium (INSIC)

5. Membrane Protein Sciences – Tools for Rational Discovery of Novel Therapeutics and Diagnostics Targeting Integral Membrane Proteins

Integral membrane proteins (IMPs) constitute a third of prokaryotic and eukaryotic proteomes and are involved in almost every cellular process. IMP malfunction results in a range of diseases, and activity modulation of IMPs is one of the main therapeutic strategies available. The importance of IMPs in drug discovery and diagnostic applications is immense, but the knowledge of IMPs structure and mechanism is rudimentary, and technologies for in vitro studies of IMPs, which can accelerate drug design programs, are highly underdeveloped.

The present proposal addresses these problems by establishing a core facility for IMP production and stabilisation of IMPs, for which new library technologies combined with parallel platforms for screening expression parameters will be developed. The latter will be coupled to mechanistic studies of IMP families of high therapeutic and diagnostic importance. Structure-function studies of IMPs will be facilitated by new crystallisation and NMR methods of structure determination. Generic strategies for in vitro selection of IMP-directed ligands or binding proteins for diagnostic and therapeutic use wil be developed and novel ligand-binding paradigms will be investigated by NMR and other biophysical approaches. The identification of proteins that bind IMPs and the generation of specific antibodies, to be used in diagnostics or therapeutics, will be facilitated with the availability of purified protein.

Associate Professor Jaume Torres
School of Biological Sciences
Nanyang Technological University

Associate Professor Jaume Torres is one of the first faculty to arrive at the School of Biological Sciences at NTU. He has published nearly 60 peer-reviewed articles that have attracted more than 1000 citations. In the Department of Biochemistry at the University of Cambridge (UK), he developed infrared linear dichroism techniques and isotope labeling of transmembrane domains of ion channels and membrane proteins involved in signal transduction. During his career, he has worked with several ‘classic’ integral and ‘facultative’ membrane proteins such as bacteriorhodopsin, cytochrome c oxidase, insecticidal toxins, integrins and viral ion channels. His current work focuses on ion channel structure and function in coronaviruses and new approaches to synthesis and

expression of difficult viral membrane proteins and transmembrane signal transduction mechanisms.

Major Collaborators (co-PIs):

- Associate Professor Konstantin Pervushin
- Associate Professor Julien Lescar
- Professor Par Nordlund
- Assistant Professor Tobias Cornvik
- Associate Professor Said Eshaghi

Collaborators:

- Associate Professor Susana Geifman-Shochat
- Associate Professor Nam Trung Nguyen
- Assistant Professor Mu Yuguang
- Assistant Professor Sze Siu Kwan, Newman
- Professor Eva Sinner

6. Adult and Induced Pluripotent Stem Cells for Neurological Disorders and CNS Repair

Many neurological disorders arise from damage to nerve cells (neurons). Such damage impairs brain function because the adult brain is unable to regenerate or replace the damaged neurons. Some hope for ameliorating such conditions comes from recent studies showing that new neurons in fact can be generated in the adult brain. In principle, therapeutic approaches to these neurological disorders could be developed by transplanting exogenous progenitor cells or by coaxing endogenous progenitor cells to migrate to damaged areas. However, it is not yet known whether newly generated neurons can functionally integrate into the brain to replace dead neurons, which is necessary for newborn nerve cells to repair damaged brain tissue.

The goal of this programme is to apply powerful new techniques for tagging, identifying and activating nerve cells to study the proliferation of endogenous and transplanted stem cells and neural precursors, and the migration, integration and functional activity of individual newborn neurons within the brain. For this purpose, we have assembled a team of scientists with broad expertise in neural stem cells, synaptic circuitry, brain anatomy, neurological disorders, and bioengineering. The ultimate objective is to optimize the potential for treating degenerative neurological disorders, such as Parkinson's Disease, via cellular transplantation or by efficient deployment of endogenous neurogenesis.

Professor George J. Augustine
Programme in Neuroscience and Behavioural Disorders
Duke-NUS Graduate Medical School

Professor Augustine studies synaptic transmission between nerve cells and has developed several novel technologies for analyzing synaptic function. He has published more than 150 scientific articles and is co-author of *Neuroscience*, a leading textbook for medical students. Professor Augustine was the Founding Editor of *Brain Cell Biology* and has served on the editorial boards of many other

scientific journals, including *Neuron*, the *Journal of Neuroscience*, and the *Journal of Physiology.*

Major Collaborators:

- Assistant Professor Eyleen Goh (Duke-NUS)
- Assistant Professor Beiping He (NUS)
- Associate Professor Kah Leong Lim (NNI, Duke-NUS)
- Assistant Professor Evelyn Yim (NUS)

ANNEX C

NRF's Competitive Research Programme Funding Scheme

The National Research Foundation's Competitive Research Programme (CRP) Funding Scheme complements NRF's Strategic Research Programmes that have been identified top-down, by funding a broad base of research ideas, through a competitive bottom-up approach. This will help to identify new potential strategic research areas in which Singapore can invest to develop core capabilities for new industries of the future.

The CRP Funding Scheme will support a large R&D project or a programme, comprising multiple related projects under a unifying theme. Each award is for up to S$10 million over three to five years. Two grant calls will be made each year.

While the CRP Funding Scheme is open to all areas of science and technology, preference will be given to areas that fall outside of existing NRF Strategic Research Programmes, such as the Biomedical Sciences Translational and Clinical Research (BMS TCR), Environmental and Water Technologies (EWT) and Interactive and Digital Media (IDM).

Open to both public and private sector participants, the CRP Funding Scheme aims to encourage collaboration and partnerships between academia and industry. By funding at the programme level, a more coordinated and integrated support of high-impact inter-disciplinary research is possible as a larger budget can be allocated to fund a number of related projects to address a given problem.

The CRP Funding Scheme involves two types of calls: General and Scenario-based calls.

Overview of General and Scenario-based CRP

General CRP

The General CRP allows the Principal Investigators (PIs) to surface any new area of research with potential economic and societal benefits for Singapore through a bottom-up approach. Calls for the General CRP will be held annually. Each proposal should be submitted by a Lead PI, who is expected to be actively involved in the overall management of the programme and who will be accountable for the research and its deliverables.

CRP proposals are expected to have the following:

i. High quality cutting-edge science;

ii. High likelihood of building up research infrastructure and capabilities in Singapore;
iii. Competent team consisting of members with credible track records;
iv. Excellent execution of individual projects within the supported programme; and
v. High potential to generate economic and societal benefits to Singapore by creating new industries or advancing existing industries.

Scenario-based CRP

The Scenario-based approach to identifying research programmes complements the General CRP scheme. The Scenario-based CRP aims to support R&D programmes that are use-inspired and able to produce technical breakthroughs to address big challenges and opportunities for Singapore.

In each Scenario-based call, NRF will articulate a future scenario that offers a major challenge or opportunity for Singapore. The research community will be invited to submit proposals for research programmes that will address key scientific and technological challenges presented by the given scenario.

In addition to the basic criteria for General CRP proposals, Scenario-based CRP proposals will also be evaluated on the following:

i. Extent to which the proposed R&D programme address the challenges or opportunities posed by the given scenario;
ii. Relevance and importance of the proposed R&D programme in terms of the economic, technological, social and environmental impact on Singapore; and
iii. Quality of the proposed R&D programme, compared to similar international efforts elsewhere.

Eligibility

Principal Investigators from all Singapore-based institutions of higher learning (IHLs), public sector agencies and research institutions, not-for-profit hospitals and research laboratories as well as companies and company-affiliated research laboratories, are eligible to apply. Support for private sector organisations which are based in Singapore would be provided on a co-funding basis.

Only research conducted in Singapore may be funded under the CRP.

R&D proposals already funded by other Singapore agencies would not be considered under the CRP.

Evaluation of Proposals

Both the General CRP and Scenario-based CRP involve a two-stage proposal submission process. Proposals submitted will be evaluated and shortlisted by a Local Evaluation Panel in the first stage. Shortlisted submissions will be asked to be developed into full proposals and sent for international peer review. The final evaluation and selection of projects to be awarded will be made by NRF on the recommendation of the CRP International Evaluation Panel (IEP).

Applications

Calls for both the General CRP and the Scenario-based CRP are publicised on NRF's Research, Innovation and Technology Administration (RITA) system. Interested applicants may find out more about the specific CRP calls that are open and submit their applications through the system.

For more information, please visit https://rita.nrf.gov.sg.

ANNEX D

List of all funded CRP from the 1st to the 3rd call

S/N	Awarded Programmes	PI	Host Institution
1	Artificial mesoscopic structures for next generation electronic and photonic technology	Assoc. Prof. Ting Mei	Nanyang Technological University
2	Combined-cycle solar energy self-sustaining membrane distillation (MD) and membrane distillation bioreactor (MDBR) water production and recycling system	Assoc. Prof. Choo Fook Hoong	Nanyang Technological University
3	Graphene related materials and devices	Assoc. Prof. Loh Kian Ping	National University of Singapore
4	Lipidomics: Novel tools and applications	Assoc. Prof. Marcus Wenk	National University of Singapore
5	Multi-functional spintronic materials and devices	Assoc. Prof. Ding Jun	National University of Singapore
6	Molecular engineering of membrane materials research and technology for energy development: Hydrogen, natural gas and syngas	Prof. Chung Tai Shung, Neal	National University of Singapore
7	Biodegradable Cardiovascular Implants	Prof Freddy Boey	Nanyang Technological University
8	Biologically-Inspired Design, Nano-Fabrication and Nano-Lubrication of MEMS, NEMS, and Micro-Mechanical Devices	Asst Prof Sujeet Sinha	National University of Singapore
9	Theory and Practice of Coding and Cryptography	Prof. Ling San	Nanyang Technological University
10	Towards Manufacturability of Carbon Nanotube-Based Printed Electronics	Prof. Chan Bee Eng, Mary	Nanyang Technological University

S/N	Awarded Programmes	PI	Host Institution
11	Age-Related Neurodegenerative Disease – The Roles of microRNAs and Their Targets	Dr Stephen Cohen	Temasek Life Sciences Laboratory
12	An Integrated Approach to Overcome Sarcopenia and Frailty in Ageing Humans	Assoc. Prof. Ravi Kambadur	Nanyang Technological University
13	Autologous Cell Therapy for the Ageing Heart Using Reprogrammed Cells	Dr Winston Shim	National Heart Centre
14	Ischemic Stroke with a Focus on Intracranial Stenosis	Prof. Peter Wong	National University Health System, Yong Loo Lin School of Medicine

CRP 1 awardees: 1-6
CRP 2 awardees: 7-10
CRP 3 awardees: 11-14