



11 February 2020

**Dear Researchers and Partners:**

The Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) is joining the Call for R&D Proposals of the Department of Science and Technology (DOST). The Call pertaining to PCIEERD priority areas will start on 1 May 2020 until 31 May 2020 in the list of priority areas hereto attached.

More specific details about the topics are attached. This can also be viewed at the PCIEERD website <http://pcieerd.dost.gov.ph>.

For those who are interested to submit proposals, we would like to extend the invitation to a Call Conference being organized by the DOST on the following schedules:

Cluster	Date	Venue
NCR	February 28, 2020	Manila
Visayas	March 10, 2020	Cebu City
Northern Luzon	March 13, 2020	Baguio City

In the said Call Conference, PCIEERD shall present the objectives of the Call and discuss the details pertaining to the priority areas as well as the mechanics for submission together with the M&E process flow. An open forum will follow for clarifications and comments.

Should you need clarification or further information, please do not hesitate to contact PCIEERD at 837 20 71 to 82 local 2107 or email Ms. Grace F. Estillore, Chief SRS, PCMD, at [gfestillore.pcieerd@dost.gov.ph](mailto:gfestillore.pcieerd@dost.gov.ph).

Thank you for your usual support and we hope to collaborate with you through the R&D funding support and other programs being offered by the Council.

Thank you.

Very truly yours,

  
**DR. ENRICO C. PARINGIT**  
 Executive Director

Philippine Council for Industry, Energy and Emerging  
 Technology Research and Development



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READ

# Call for Proposals 2020

## I. Environment Sector

- A. Integrated Program for a Cleaner and Revitalized Environment (I-CARE) Program
  - 1. National Research and Development Program for the Prevention and Control of Air Pollution
  - 2. Innovative Solutions to Solid Waste Management
  - 3. Toxic and Hazardous Waste R&D Agenda – Mercury

## II. Process Sector

- A. Agro-Industrial Program
  - Technological Support for the Upgrading of the Local Cacao and Cocoa Industry
- B. Natural Products Program
  - 1. Improvement of Extraction and Processing, Application and Product Development Studies, Standardization and Performance Assessment Studies of Selected Gums, Resins and Oils
  - 2. Improvement of Natural Dyes Color Stability for Food and Nutraceutical Applications
- C. Textile Program
  - Technical Support to the Philippine Textile and other Allied Industries (smart functionalization, use of alternative fiber sources, recycling, among others)

## III. Advanced Materials, Nanotechnology, and Photonics

- A. Semiconductor and Electronics Industry
  - 1. Aerospace Industry
    - Design and fabrication of materials for aerospace and aircraft that address a specific problem of an existing local company
    - Use of additive manufacturing to improve properties of materials for aerospace and aircraft industries.
  - 2. Energy
    - Fuel cells: single stack, polymer exchange membrane
    - Supercapacitors: non-Platinum alternatives, pseudocapacitors, EDCL
  - 3. Establishment of safety protocols for the use of nanomaterials (occupational and operational)

## IV. Information and Communications Technology (ICT) Sector

- A. Artificial Intelligence (AI) R&D
  - 1. Robotics AI ( predictive mapping, and the power of the crowd; Next-gen robotics and swarm solutions; Aerial drones and immediate aid supply)
  - 2. Data Analytics (Integration and interoperability of big data across different government departments and affiliated organizations; National challenges such as unemployment, terrorism, energy resources exploration, and much more)
  - 3. Gaming development for education (e.g. learning while playing)
  - 4. Virtual Reality (VR) / Artificial Reality (AR) for aerospace, tourism, and human security

## **V. Electronics Sector**

- A. Sensors and Actuators for Intelligent Factories
- B. Wearable Electronics

## **VI. Space Technology Sector**

- A. Global Navigation Satellite Systems (GNSS) Applications
  1. Multi-sensor integration of GNSS applications in surveying and geodesy;
  2. Use of GNSS for aviation, including integration of satellite navigation technology into air traffic management and airport surface navigation and guidance;
  3. Use of navigation and timing systems for road, rail, and engineering applications, including vehicle guidance, geographic information system (GIS) mapping, and precision farming;
  4. Navigation systems operation in marine environment, including waterway navigation, harbour entrance/approach, marine archaeology, fishing, and recreation;

## **VII. Good Governance through Data Science and Decision Support System (GODDESS)**

- Open to Sustainability Program for Data Science Adoption, Reskilling, Training and Adoption (SPARTA) Project – training participants to develop appropriate capabilities, systems and technologies geared towards enabling LGUs and NGAs to adapt data driven governance and evidence-based management such as (1) Urban mobility, (2) Energy management, (3) E-governance and Citizen Services, (4) Waste Management, (5) Water Management, and (6) Others – Incubation/trade facilitation centers, etc.

## **VIII. MSMEs Cost-Competitive Low Carbon Systems**

- A. Low Carbon Technology for MSMEs
- B. Monitoring, detection, analysis and control of energy utilization of MSME
- C. Energy Efficient and Energy conservation technologies for MSMEs

## **IX. Innovative Unmanned and Autonomous Vehicle Systems and Applications**

- A. Development of UAV Materials, Automation and Capabilities Development
- B. Robust UAV Platforms and Cost-Competitive Applications

## **X. Smart Approach for the Construction Industry**

- A. Innovative construction materials maximizing the potential application of indigenous, recycled, and industrial waste materials
- B. Improvement and upgrading of construction techniques/methods
- C. Localization and advancement of equipment/tools for construction, monitoring and testing

## **XI. Mining and Minerals Sector**

- A. Value-adding of Metallic Minerals
  1. Copper - Purification of copper for industrial use
  2. Nickel -Production of engineering castings using laterite nickel pig iron
  3. Iron -Production of iron using low grade magnetite ores

- B. Value-adding of Non-metallic Minerals Marble - Product development for other applications (CaCO<sub>3</sub>, construction materials and decorative items)
  - 1. Clay -Utilization of clay for wastewater treatment and other applications
  - 2. Cement- Process improvement
  - 3. Silica- Utilization of silica for industrial application
  - 4. Limestone- Utilization of lime for paint, rubber, glass, plastic and other applications
- C. Exploration and Extraction of E-tech Elements for Emerging Technologies Applications
  - 1. REE (Scandium, Yttrium and Neodymium) - Exploration and extraction of scandium, yttrium and neodymium from metallic and non-metallic minerals
  - 4. Cobalt (Co)- Exploration and extraction of Cobalt from metallic and non-metallic minerals
  - 5. Tellurium (Te) - Exploration and extraction of Tellurium (Te) from metallic and non-metallic minerals
  - 6. Selenium (Se) - Exploration and extraction of Selenium (Se) from metallic and non-metallic minerals
  - 7. Indium (In) - Exploration and extraction of Indium (In) from metallic and non-metallic minerals
  - 8. Gallium (Ga) -Exploration and extraction of Gallium (Ga) from metallic and non-metallic minerals
- D. Technologies in Support of Environmental Protection, Conservation and Rehabilitation of Mined-out Area
  - 1. Abandoned/Mined-out area
    - Develop technologies that would remediate and rehabilitate abandoned mines and dumped tailings that pose environmental, health and safety problems
    - Control, prevent and treatment of Acid Mine Drainage (AMD)
    - Wastewater treatment technologies
    - Erosion control and slope stabilization technologies
  - 2. Tailings
    - Tailings dam design
    - Utilization of tailings/wastes from mining/processing to valuable products (e.g. carbon sequestration, wastewater treatment, acid mine drainage, etc.)

## **XII. Metals and Engineering Sector**

- A. Machining and Fabrication Sector
  - 1. Development innovative, cost effective and appropriate machines and equipment that will solve the S&T problems and needs of the following industry:
    - a. Cacao industry
    - b. Food Processing industries
    - c. Essential Oils and Fragrances
    - d. Aerospace industries
    - e. Creative and Handicraft industries
    - f. National Defense and Security needs
  - 2. Mechanical and Robotics for industry adoption
  - 3. Production Technologies for select Creative industries (Forest-based; composite and natural materials)
  - 4. National Defense and Security needs of the Philippine Armed Forces
  - 5. Machinery, Parts and Engineered Products (MPEPs) for Design and Dev't.

6. Surface finishing of automotive parts
- B. Tool and Die Sector
  1. Capability Building and services for the die and mold needs of the manufacturing sectors
  2. Tool and Die for Handicraft Industries
- C. Metal casting Sector
  1. R&D on Advanced Metalcasting Technologies and materials Technologies
  2. Metal and composite etching or photo etching, Polishing, Metal Finishing Technologies
  3. Projects and Programs on Materials/Metallurgy Technology

### **XIII. Food Sector**

- A. Food Safety Program
  1. R&D to Support Risk Assessment in Philippine Foods
    - Risk Profiling of Hazards in Philippine Food to Support National Risk Management
    - Prevalence of Mycotoxin in Rice and Corn in the Philippines
    - Prevalence of Heavy Metals and Pesticide Residues in Milled White Rice and White Corn Grits in the Philippines
    - Exposure Assessment of Food Chemical Contamination in Metro Manila: A Pilot Total Diet Study Approach
  2. R & D in Support to Food Industry
    - Development of Food Safety Guidelines for the Food Service Sectors
    - Development of Grading System for Adoption of Food Establishments in the Philippines
- B. Food Innovation
  1. Enhancing Competencies of Food Innovation Centers on Bringing Products to Market, Systems and Process Management, and Mechanisms for Sustainability
  2. Product Development for Ingredients/Intermediate Food
  3. Innovative Food Products Using Local Sources
  4. Utilization of Food Processing By-Products
  5. New Food Processing Technologies for Local Industries
- C. Halal S&T Program
  1. R&D on Halal Tourism and Food Service
  2. Technology Transfer and Policy Advocacy on Halal S&T
  3. Innovation System Support for Halal MSMEs
  4. Establishment of Halal Knowledge Center
- D. Facilities and Laboratories in Support of the Food Sector
  1. Strengthening and Enhancement of Capabilities of the OneLab network
  2. Development of Proficiency Testing Materials for Food Safety and Quality
  3. New Systems and Services in Support of the Local Food Sector

### **XIV. Creative Industry Sector**

- A. Heritage
  1. Arts and Crafts (Furniture, Household Goods, Paper, etc.)
  2. Design
- B. Functional Creations
  1. New Media (Software, Animation, etc.)
  2. Industrial Craft
  3. other creative related technologies



Department of Science and Technology  
Philippine Council for Industry, Energy and Emerging Technology  
Research and Development (PCIEERD)

# Call for Proposals

## I. Environment Sector

### ***A. Integrated Program for a Cleaner and Revitalized Environment (I-CARE) Program***

**Strategic Priority 1:** National Research and Development Program for the Prevention and Control of Air Pollution

#### Call Rationale

The Philippine Clean Air Act of 1999 (Republic Act No. 8749) outlines the government's measures to reduce air pollution and incorporate environmental protection into its development plans. Under the 'Implementing Rules and Regulations for Philippine Clean Air Act, the Air Pollution Research and Development Program, Section 1 states that a "**National Research and Development Program for the Prevention and Control of Air Pollution**, the DENR through its bureau, in coordination with the Department of Science and Technology (DOST), other agencies, the private sector, the academe, NGOs and POs shall, establish a National Research and Development Program for the Prevention and Control of Air Pollution." The government policy relies heavily on the "polluter pays" principle and other market-based instruments to promote self-regulation among the population. It sets emission standards for all motor vehicles and issues on pollutant limitations for industry. The rules and regulations apply to all industrial emissions and other establishments which are potential sources of air pollution. The following are identified as R & D priorities in the IRR:

- Formulation and implementation of **integrated air quality improvement framework for comprehensive air pollution** management and control program;
- Revision of the designation of **air shed utilizing eco-profiling technique** and undertaking scientific studies;
- Studies on **air pollution control techniques**;
- **Establishment of a National Research and Development Program** for the prevention and control of air pollution;
- Setting up of **specifications for all types of fuel and fuel related products**, to improve fuel composition for increased efficiency and reduced emissions.

In line with this, PCIEERD conducted a series of sessions to formulate the S & T Clean Air Roadmap with collaborative efforts among National Government Agencies (NGAs), academe, non-government organization and other stakeholders. PCIEERD acts to preserve the environment and public health, with the objective of improving air quality and fight against global warming. PCIEERD hopes to provide S & T support for the enforcement of guidelines and standards under Philippine environmental laws; 2) to strengthen the R & D efforts by providing effective air quality and pollution control technologies, treatment options and cleaner efforts to reduce air pollution of various industries and other potential sources of air (i.e. industry, transportation and energy consumption and emissions); 3) to build capacity for good environmental governance. The said Roadmap is aligned to the **DOST Harmonized R & D**

Agenda (HNRDA), Sustainable Development Goals (SDGs), the Philippine Clean Air Act of 1999 and the Philippine Development Plan (PDP) 2017-2022, the first medium-term plan to be anchored on a national long-term vision, or AmBisyon Natin 2040, which represents the collective vision and aspirations of Filipinos for themselves and for the country.

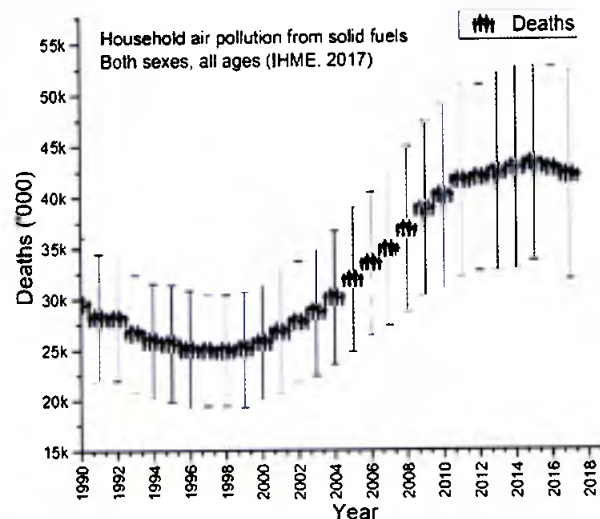
Its mission is to enhance collaboration, minimize/reduce competition, strengthen air quality research leading to influencing policy and society towards cleaner air through science.

The need for the prevention and control of air pollution is backed-up with scientific data gathered by the Department of Health. They have conducted a series of studies related to air pollution and human health. As per the Department of Health's Field Health Service Information System (DOH-FHSIS 2018), Table 1 below shows the top leading causes of morbidity from 2016-2018. It is identified that acute respiratory infection has been consistently the leading cause of morbidity.

Table 1. Leading causes of morbidity from 2016-2018 (Source: DOH-FHSIS 2018).

No.	2016		2017		2018	
	Disease	No. of Cases	Disease	No. of Cases	Disease	No. of Cases
1	Acute Respiratory Tract Infection	3,080,343	Acute Upper Respiratory Infection	2,382,122	Acute Respiratory Tract Infection	1,209,821
2	Hypertension	886,203	Hypertension	904,707	Hypertension	602,811
3	ALRTI & Pneumonia	786,085	ALRTI and Pneumonia	481,561	ALRTI and Pneumonia	503,884
4	Urinary Tract Infection	288,588	Urinary Tract Infection	360,936	Urinary Tract Infection	280,687
5	Influenza	216,074	Bronchitis	170,085	Bronchitis	130,057
6	Bronchitis	200,176	Influenza	154,672	Acute Watery Diarrhea	112,543
7	Acute Watery Diarrhea	139,770	Acute Watery Diarrhea	132,783	Influenza	91,681
8	TB Respiratory	87,422	Asthma All Forms	72,520	Diseases of the Heart	66,688
9	Acute Bloody Diarrhea	57,647	TB Respiratory	59,277	Dengue Fever	51,361
10	Dengue Fever	56,487	Acute Febrile Illness	55,652	TB Respiratory	39,923

In addition, a study from IHME Global Burden of Disease in 2017 determined the relatively cause of death due to household air pollution from solid fuels. In the Philippines, 54.2% of the population rely on fuelwood and 36.4% rely on traditional charcoal as solid fuel for cooking and heating. This translates to **41,552 deaths** and more than 1.5 million disability average life years (DALYs) due to the use of traditional fuels in 2011.



Moreover, there is a need to monitor the effects and impacts of particulate matter, PM<sub>2.5</sub> in terms of health and the environment. Thus, development of real-time PM assessment tool / devices is also a recommendation to help reduce the health impacts of PM. There is an on-

going study being conducted by Cayetano MG., et al, entitled “*Developing the AQI Breakpoint for PM<sub>2.5</sub> in Metro Manila.*” Their study correlates the following data: (1) Daily maximum PM<sub>2.5</sub> readings from DENR AQMS QC station; (2) Daily maximum PM<sub>2.5</sub> from the Lung Center of the Philippines (for those period that are not represented by the DENR data); and (3) Daily cumulative Emergency Room (ER) visits at the Lung Center of the Philippines for a duration of 2 years (Aug 2015 to Aug 2017). The study showed that ER-based morbidity increases as PM<sub>2.5</sub> increases.

### Call Scope

Pursuant to the Department Administrative Order No. 2000-82 (DAO 2000-82), “Integrated Air Quality Improvement Framework-Air Quality Control Action Plan (IAQIF-AQCAP), it states the shared responsibilities of all government agencies to comply, attain and maintain clean and healthy air through the IAQIF-AQCAP. Based on the recent Interagency workshop conducted, the following are the challenges in Air Quality Management:

- Lack of baseline information on air quality per area/airshed
- Insufficient knowledge on the roles of stakeholders
- Insufficient monitoring equipment/devices/stations
- Expensive maintenance of monitoring equipment
- Fragmented roles of different government agencies
- Need for updating of some provisions in the Clean Air Act
- Need for alternative source of energy/fuels
- Need for new technologies for air pollution management

### Call Objective

The Call for Proposal will support new interdisciplinary research and innovation that will tackle SEC. 15. Air Pollution Research and Development Program i.e. establish a National Research and Development Program for the prevention and control of air pollution.

The objectives are to:

1. Give special emphasis to research and development of improved methods and development of innovative technologies having industry-wide application for the prevention and control of air pollution specifically addressing the emissions
  - a. **Baseline data Gathering/Profiling**
    - i. Mapping & Consolidation of Existing/Available Air Quality Data / Studies / Knowledge and Emerging Technologies
    - ii. Baseline data for air quality guideline values and standards in addition to internationally-accepted standards specifically for PM<sub>2.5</sub>.
    - iii. Indoor air pollution related to confined spaces e.g. household fuelwoods (i.e. for cooking and heating); buildings
  - b. **Technology Development**
    - i. To measure air quality by the development and localization of real-time equipment using prescribed methods e.g. prototypes of air samplers and monitoring devices and development of a cost-effective, efficient and improved electrostatic precipitators for vehicles to address its emissions; real-time, high resolution and continuous measurement of relevant air pollutants; instrumentation/sensor development for the detection of dioxins and furans and other related pollutants
    - ii. To model air quality emission using prescribed methods/techniques e.g. use of flux tower and mobile apps for air quality index



- iii. To deploy the developed technologies for air quality e.g. robust optical air quality monitoring device, air filters

The proposals should also incorporate the socio-cultural, political, health and economic implications of air quality management and pollution control. The research should provide scientific data to support/lead to policy formulations and updating of the Philippine Clean Air Act.

## **Strategic Priority 2: Innovative Solutions to Solid Waste Management**

### Call Rationale

Solid waste management remains a major problem in the country, especially in urban areas like megacities (e.g. Metro Manila, Cebu, Davao). Unsurprisingly, the Philippines generates more solid wastes as population increases, infrastructure development, modernization and the like. Based on the DENR report, the Philippines has endeavored to improve its management of solid waste through the passage of RA 9003 also known as the Ecological Solid Waste Management Act that provides for a systematic, comprehensive and ecological waste management program to ensure the protection of the public health and the environment. Recently, the PCIEERD in coordination with other government agencies, provided technological interventions through the deployment of appropriate technologies during the rejuvenation of Boracay. Another workshop was held to identify possible technological solutions to address solid waste problems, particularly in coastal areas on combating marine debris in the ASEAN Region. In this connection, as one of the Member States of the Association of Southeast Asian Nations (ASEAN) signified in joining the ASEAN Community Vision 2025, particularly the ASEAN Socio-Cultural Community (ASCC) Blueprint 2025 on Conservation and Sustainable Management of Biodiversity and Natural Resources which reaffirmed the commitment of strategic measures to “promote cooperation for the protection, restoration and sustainable use of coastal and marine environment, respond and deal with the risk of pollution and threats to marine ecosystem and coastal environment, in particular in respect of ecologically sensitive areas”.

### Call Scope

Aside from the issues of invasive aquatic species (IAS) in ballast water, recent news across the globe focused on plastics, particularly microplastics. These are tiny pieces of plastic material typically smaller than five millimeters. They can be divided into two main categories according to their source: (1) primary - directly released in the environment as small particles and accounts to 15-31% microplastics found in the oceans and (2) secondary - originate from degradation of larger plastic objects such as plastic bags, bottles or fishing nets and accounts to 69-81% microplastics found in the oceans. According to the UN, there are as many as 51 trillion microplastic particles in the sea, 500 times more than stars in the galaxy. Microplastics can be ingested by marine animals, accumulates and can end up in humans through the food chain.

Last year, the DENR called for the rehabilitation of Manila Bay. The campaign in Manila is called the “Battle for Manila Bay” to emphasize how heavily polluted this body of water has become. Plastic pollution covers the bay’s shore, crowds its waves and causes frequent harm to marine creatures, according to Greenpeace.

Noting the United Nations Environment Assembly resolutions 3/7 entitled "Marine litter and microplastics to facilitate establishment and implementation of regional and national action plans to prevent and reduce litter and microplastics in the marine environment and recognising the need and importance of multi-stakeholder cooperation, knowledge sharing, technology transfer, increasing public awareness and innovation dissemination, the PCIEERD calls for the submission of proposals with the following objective:

#### Call Objective

The objective of this call is to support the inter-disciplinary research to understand the risks that plastic pollution poses and provide technological interventions addressing this environmental issue.

1. Baseline data gathering, to include but not limited to, sources and areas of plastic pollution
2. Impact on emission of pollution from plastic wastes
3. New product development from plastic wastes
4. Development of appropriate technologies for the detection, measurement and treatment of microplastics
5. Establishment of a facility for biodegradability testing of plastics

#### **Strategic Priority 3. Toxic and Hazardous Waste R&D Agenda - Mercury**

#### Call Rationale

The Minamata Convention is a cross-cutting concern, global treaty that protects human health and environment from mercury emissions. The member agencies involved and the UNIDO convened for promoting ratification and early implementation of the Minamata Convention on Mercury: Pre-ratification strengthening of capacities for mercury management focused on mercury-added products and wastes containing mercury.

The DOST is a member of the Inter-Agency Technical Working Group (IATWG) being represented by the DOST-ITDI for the preparation of the National Action Plan (NAP). The following are the member agencies (DENR, DOE, DTI, DOH, DOH-FDA, FPA, DOF-BOC, DILG, DOLE-OSHC, DOST, and Civil Society (Ecowaste Coalition).

Some of the government's upcoming initiatives are the following:

- a. DENR finalizing the revised Chemical Control Order (CCO) for Mercury
- b. DOH finalizing the AO for the phase-out of dental amalgam
- c. DTI-BPS in aligning our existing Philippine standards with the recommendations of the Minamata Convention particularly on lighting products and switches and relays

The IATWG also drafted the National Action Plan (NAP) for the Phase-out of Mercury-added products (MAPs) and the management of the associated mercury-containing wastes.

#### Call Scope

Based on this draft action plan, the DOST as the lead agency was assigned to the: (a) Development of a R&D plan on how to reduce the Hg in products (as trace elements) and for mercury-free alternatives/technologies for products, processes mercury contamination in accordance with DOST harmonized national R&D Agenda. (b) Development of a learning program for eligible graduate students in relation to Mercury Management taking into

consideration the available resources in Minamata City through Minamata Environmental Academia and Kitakyushu City.

### Call Objective

The objective of this Call is to develop a research and development plan on how to address issues in the Minamata Convention in terms of science, technology and innovation focusing on the following:

- a. Development/Updating of mercury standards
- b. Research to address wastes from amalgamation of jewelers
- c. Mercury material flow study (Material balance, LCA)
- d. Alternatives / product development

## **II. Process Sector**

PCIEERD under the **Process Sector** (covers the process industries where the primary production processes are either continuous or occur on a batch of materials that is indistinguishable such as food, beverages, chemicals, pharmaceuticals, petroleum, ceramics, base metals, coal, plastics, rubber, textiles, tobacco, wood and wood products, paper and paper products, etc. as cited by IISE (Institute of Industrial and Systems Engineers, US) invites Research and Development proposals for the following programs to assist specific key industries in the country:

### **A. AGRO-INDUSTRIAL PROGRAM**

The Philippines is an agricultural country. However, despite this widely accepted fact, the country's agriculture is on the decline. Philippine Star reported that as of 2017, only 25% of Filipinos are employed in the agricultural sector. The World Bank also reports that the agriculture sector is one of the poorest performers in 2016, when production declined by 1.3%. Furthermore, the rapid growth of the industrial and service sectors has caused a dwindling in the number of jobs in agriculture. This is where the program comes into the picture.

The Agro-industrial Program is the sub-sector of the economy where farming meets technology. The main focus of this sub-sector is to uplift the lives of the country's farmers by introducing research and development to boost productivity, to improve existing products and create new ones, and to support or change existing policies with science. This program is geared towards the United Nations Sustainable Development Goals number 1: No Poverty.

This sub-sector complements ISPs of PCAARRD, where PCAARRD focuses on upstream industry, which covers genomics, plant cultivation, and up to harvest; while PCIEERD handles the R&D on the downstream processes - product development, by-products processing and/or conversion, and other post-harvest processing.

The R&D programs for Agro-Industrial processing is also anchored to the following:

- Goal 9 of the Sustainable Development Goals, specifically under 9.5 *Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending*

- Philippine Medium-Term Development Plan 2017-2022 under Part 4. Increasing Growth Potential: Vigorously Advancing Science, Technology, and Innovation which states that *by 2022, the efficiency and productivity of agriculture, industry, and services sectors will be improved. New public goods and services (or how services are delivered) will be created and improved. These will be done through maximizing and adopting science, technology and innovation (STI).*
- Harmonized R&D Agenda under Section IV. Industry, Energy and Emerging Technology Research and Development Agenda 2017 – 2022 in B. Countryside Development where more micro, small and medium enterprises (MSMEs) will be developing and producing competitive and world class products and services and C. Competitive Industry where more industries will be enabled by the state-of-the-art R&D, technologies and science-based policies, moving up the value chain and attracting foreign direct investments

### ***Technological Support for the Upgrading of the Local Cacao and Cocoa Industry- Phase II***

#### Call Rationale

The global demand for cocoa is estimated to reach between 4.7 million to 5 million metric tons by 2020, but a cocoa global shortage is also predicted at 1 million MT the same year, as reported by the Department of Agriculture. In the Philippines, the local consumption is at 50,000 MT every year, and the local supply is only around 10,000 MT. To avoid this impending deficit, the Philippines committed to produce 100,000 MT of fermented beans for the export and domestic markets through 40% annual increase in production by 2020 (DTI, 2019). DTI through its 2016-2022 Harmonized National Cacao Industry Road Map crafted by the TWG and led by DTI XI Assistant Regional Director Edwin Banquerigo, is encouraging initiatives that highlights the importance of improving farm productivity, increasing production and access to quality planting materials, continuing research and development, and strengthening, expanding, and promoting the industry.

The Phase II for the Cacao Program is a spin-off of the 2013 Cacao Program. Phase I focused on refining the Philippine tablea. With the success for enhanced production of tablea, the next phase will focus on the production of chocolate, cocoa butter, and cocoa powder and other high-value products from other parts of the cacao tree. In the Focus Group Discussion held by PCIEERD last July 2019 during the National Science Technology Week, cacao processors from Luzon, Visayas and Mindanao expressed their interests for R&D initiatives to boost their downstream capability in order to be competitive on a global scale. The Council is also aligning its R&D priorities with the Cacao Industry Roadmap being led by the Department of Trade and Industry.

#### Call objective

The objective of this call is to develop R&D programs that will provide technologies to uplift the status of the local cacao and cocoa industry particularly on the identified needs during the FGD. The industry needs are different per region, since advancement in technologies are apparent in some areas where majority of the cacao production can be found. The projects to be supported should suit the production and technology level of the areas. From the initial meetings conducted, there is high interest to pursue production of chocolate, chocolate powder and butter and other products.

#### Call scope

The following R&D initiatives are anticipated by the industry players:

1. Technologies to develop processing equipment for chocolate and other intermediate and related products such as conching, tempering, and refining equipment are encouraged since access to equipment is a challenge among small and medium enterprises due to high cost and mostly large-scale capacities.
2. Refining techniques and technologies for various chocolate types (fine, dark, etc.) and other intermediate and related products fit for the company scale of production and addresses internationally acceptable quality parameters for particle size, texture, etc.
3. Improvement or development of technologies that efficiently detects high quality of raw materials from post-harvest process and can contribute to the increased market value of processed products.
4. Processing technologies for deriving high-value products from other parts of the cacao tree (cacao pod husks, leaves, barks, etc) to provide other sources of income to cacao processors

The proposals should demonstrate the following characteristics and should be well-written in the documents:

- a. Counterpart in terms of facility is encouraged for high-maintenance equipment line.
- b. Sustainability of both the supply of raw materials and finished product. An interest from an industry partner to support the marketability of the proposed product. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.

## ***B. NATURAL PRODUCTS PROGRAM***

Natural Product is a compound or substance produced by a living organism such as plants, animals, and microorganisms. Usually it is classified according to primary and secondary metabolites produced naturally. This program will be carried-out by supporting R&D initiatives on but not limited to its wide array of industrial application: food additives and nutraceuticals, flavor and fragrance, dyes, crop, drugs, industrial enzyme catalyst, natural polymers, spalting lignolytic enzymes for wood and paper, colors for food, textile, and paint. It will utilize indigenous resources through provision of relevant technologies that results in increased yield, improved quality, and a more cost-effective process.

This program will be composed of two (2) main research thrusts: the natural colorants and gums, resins, and oils. However, proposals on emerging natural products for food and other industrial applications, such as biological active compounds found in natural products, will also be considered if the local market demand can be established.

Other possible research areas:

1. plant-based proteins
2. plant-based dairy alternatives
3. sea-based proteins
4. enzymes from microbial source
5. natural extracts for cosmetics
6. novel cellulosic functional materials

The R&D programs for the Natural Products Industry is anchored to the following:

- Goal 9 of the Sustainable Development Goals, specifically under 9.5 *Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending*
- Philippine Medium-Term Development Plan 2017-2022 under Part 4. Increasing Growth Potential: Vigorously Advancing Science, Technology, and Innovation which states that *by 2022, the efficiency and productivity of agriculture, industry, and services sectors will be improved. New public goods and services (or how services are delivered) will be created and improved. These will be done through maximizing and adopting science, technology and innovation (STI).*
- Harmonized R&D Agenda under Section IV. Industry, Energy and Emerging Technology Research and Development Agenda 2017 – 2022 in B. Countryside Development where more micro, small and medium enterprises (MSMEs) will be developing and producing competitive and world class products and services and C. Competitive Industry where more industries will be enabled by the state-of-the-art R&D, technologies and science-based policies, moving up the value chain and attracting foreign direct investments

### Call rationale

#### ***Improvement of Extraction, Processing, Application, Standardization Technologies and Performance Assessment of Selected Gums, Resins and Oils***

According to the Market Research Report, the global market size of essential oil is more than US\$6.0 billion in 2015. Per DTI Chamber of Herbal Industries of the Philippines survey shows that manufacturing firms engaged in the production of natural ingredients products are operating at around 50% of their installed operating capacity per year. Natural and organic products estimated total value export (FOB) in 2011 is about US\$153M.

The popularity of aromatherapy, which uses essential oils and other aromatic compounds for their therapeutic effects, has created an important demand for high quality oils. Additionally, the interest in natural perfumes and cosmetics continues to increase, along with the demand of natural essential oils. Increasing applications in aromatherapy coupled with rising demand for fragrances and flavors in food & beverages and personal care is expected to drive market growth over the forecast period.

Growing consumer preference for natural products has led to the development of innovative applications in personal care and beauty products. Rapid industrialization and increasing disposable consumer income are the other major factors driving the market growth, mainly in developing countries such as China, India, Vietnam, and Thailand.

These naturally derived oils have no detrimental side effect unlike most conventional drugs and medicines, which is a major driving factor for the essential oil market. Increasing demand for natural personal care products and pleasant aromatic cleaning agents is expected to foster the industry growth in these applications. Growing need for aromatic flavors and fragrances in cosmetics, perfumes, as well as spa and relaxation applications are expected to fuel demand in upcoming years.

Essential oils are also widely utilized in cleaning & home products owing to their superior antibacterial and antiseptic properties. Customers are keen on specialized products as various applications require specific characteristics and ingredients.

The exorbitant amount of plant matter is required to create a single ounce of oil and increasing concerns regarding resource depletion are likely to hamper the industry over the forecast period. Manufacturers in the market have to overcome numerous challenges such as high capital costs and government certification which hinders to provide high-quality products with value for money to consumers.

#### Call objective

The objective of this call is to develop R&D programs that will innovate technologies to enhance quality and even create new market segments for the use of gums, oils and resins. This is to take advantage of the abundant resources of our country for the important group of non-wood forest products which can be various sources of GRO such as almaciga, elemi and many more. Furthermore, it can possibly support establishment of new industry players for extraction of GRO or provide new materials to industry end-users. Aligning our abundant natural resources with additive needs of the industries for GRO through progressive R&D for its extraction, refinement and purification technologies and even application studies to assess as potential substitution candidates for important additives will be targeted in the program. For the oils, conventional technologies including steam diffusion, hydro-distillation, destructive distillation and cold expression may require time-consuming and resource-intensive processes, therefore highlighting the need for better technologies that are eco-friendlier and more efficient.

#### Call scope

The R&D initiatives may include the following potential study areas:

1. Improvement technologies in all aspects of the industry such as processing, grading and classification for increased yield and improved quality control
2. Application and product development studies for utilization of natural gums and resins to broaden its usage and increase market position
3. Enhanced oil extraction technologies of high value oils in the market such as supercritical fluid, microwave, etc. by improving yield, purity and cost of production (except expeller and enzymatic process for locally commercial oils produced)
4. Development of extraction technologies for new GRO sources with comparable properties with existing in-demand GRO

The proposals should demonstrate the following characteristics and should be well-written in the documents:

1. Results of industry roadmaps
2. Technology Readiness Level between 2-4. It should encompass Technology Formulation, Validation of the Technology, Small Scale Prototype, Large Scale Prototype (if applicable)
1. Sustainability of both the supply of raw materials and finished product. An interest from an industry partner to support the marketability of the proposed product. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.
2. Has a potential for commercialization

### Call Rationale

#### **Natural Dyes Color Stability Improvement Technologies for Food and Nutraceutical Applications**

Natural dye is a potential market growth driver in both local and global trade, with high demands for application in different industries such as textile, food, and cosmetics, brought about by the shift in consumer preference to natural products, food safety issues, and environmental awareness. According to statistics, the global demand for natural dyes is expected to show an increasing trend of 5.7% annually until 2023 that can amount to \$5.12 Billion.

### Call objective

The objective of the call is to further enhance extraction and application technologies for natural colorants, specifically identifying compatibilities with the wide range of classifications for food and cosmetics to fit the technical requirements of the industries. The program is a complementation from the initiatives started focusing on use of natural colorants as additives in food products and ingredients to cosmetics. These were project components under the Natural Dyes and Colorants R&D Program funded in 2017 which addressed the challenge to diversify applications from textile. The natural dyes for textiles have been the subject of over a decade R&D program of the Philippine Textile Research Institute (PTRI).

### Call scope

The R&D initiatives may include the following potential study areas:

1. Upscaling of Extraction, Characterization and Application of Natural Colorants in Food and Cosmetic Application
2. Technologies for improvement:
  - a. stability and sensory quality at all stages of the production chain (i.e., production, transportation and marketing)
  - b. efficiency in extraction process (reduction of solvent used, reduction of extraction time, reduction in energy used)
  - c. improved cost of production

The proposals should demonstrate the following characteristics and should be well-written in the documents:

1. Results of industry roadmaps
2. Technology Readiness Level between 2-4. It should encompass Technology Formulation, Validation of the Technology, Small Scale Prototype, Large Scale Prototype (if applicable)
3. Sustainability of both the supply of raw materials and finished product. An interest from an industry partner to support the marketability of the proposed product. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.
4. Has a potential for commercialization

### **TEXTILE PROGRAM**

The Textile sub-sector covers products that develops and makes use of fibers, yarn intermediates, yarns, fabrics, and end-user products that retain all the strength, flexibility, and



other typical properties of the original fiber or filaments. This is based from the Standard Terminology Relating to Textiles, ASTM D123 – 19.

The R&D programs for textile is anchored to the following:

- Goal 9 of the Sustainable Development Goals, specifically under 9.5 *Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending*
- Philippine Medium Term Development Plan 2017-2022 under Part 4. Increasing Growth Potential: Vigorously Advancing Science, Technology, and Innovation which states that *by 2022, the efficiency and productivity of agriculture, industry, and services sectors will be improved. New public goods and services (or how services are delivered) will be created and improved. These will be done through maximizing and adopting science, technology and innovation (STI).*
- Harmonized R&D Agenda under Section IV. Industry, Energy and Emerging Technology Research and Development Agenda 2017 – 2022 in B. Countryside Development where more micro, small and medium enterprises (MSMEs) will be developing and producing competitive and world class products and services

#### Call rationale

##### **Technical Support to the Philippine Textile and other Allied Industries**

Over the years, the industry was challenged due to the decreasing survival of big industry players. In an effort to support the industry, the Process Sector together with key stakeholders from private and government institutions initiated the Roadmapping for the Textile Sector and came up with the following outputs:

- S&T Textile Roadmap
- Economic Development Agenda
- Handwoven Textile Agenda from the Cultural Development Group

With the continuous support to the textile industry yearning for Philippine-sourced fibers and other materials to be used in production of textiles for garments, and even extending to other marketable products such as bags, shoes, etc., the provision of S&T support is essential to the industry's revitalization and sustainability.

#### Call objective

The objective of this call is to support R&D programs that will improve technologies to enhance textile production using natural fibers and other low-cost, sustainable and comparable sources and create new materials for textiles with improved properties. To contribute in the economic status of the Philippine Textile industry, the market value of the target products should be highlighted to esteem endorsement for R&D support.

#### Call scope

The R&D initiatives may include the following potential study areas:

1. Latest trends on textile including but not limited to smart functionalization, use of alternative fiber sources, recycling, etc.

2. Development of cost-effective technologies using natural fibers resulting to highly acceptable wearability for consumers covering all aspects of production such as fiber treatment, spinning, finishing, etc.
3. Strengthening technologies for fiber sources for textile applications
4. Improved body measuring technologies for textile and other high industry applications compatible with garments/textiles developed from natural fiber sources

The proposals should demonstrate the following characteristics and should be well-written in the documents:

1. Results of industry roadmaps
2. Technology Readiness Level between 2-4. It should encompass Technology Formulation, Validation of the Technology, Small Scale Prototype, Large Scale Prototype (if applicable)
3. Sustainability of both the supply of raw materials and finished product. An interest from an industry partner to support the marketability of the proposed product. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.
4. Has a potential for commercialization

### **III. Advanced Materials, Nanotechnology, and Photonics**

#### ***A. Semiconductor and Electronics Industry***

##### *Call Rationale*

The semiconductor and electronics industry in the Philippines is a significant driver of the economy and considered as the largest contributor in the manufacturing sector. Most businesses operate in CALABARZON, Cebu, Metro Manila, and Northern to Central Luzon, employing 3.2M workers in 2018. The industry accounted for 56% of the total exports of the country. (Source: <https://www.seipi.org.ph/>)

The DOST has provided support to the industry by establishing the Advanced Device and Materials Testing Laboratory (ADMATEL) and the Electronic Product Development Center (EPDC) to support its failure analysis and R&D needs. With the unveiling of the third hub – the Advanced Manufacturing Center (AMCEN), it is expected that additive printing technologies will further strengthen the capabilities of the local semiconductor and electronics industry to keep up with the increasing global demand.

##### *Call Objectives*

The call aims to support the local semiconductors and electronics, and optics and photonics industries. Topics should address the following:

- Design and fabrication of semiconductor materials (*i.e.* lightweight and have high temperature stability/resistance; better fuel efficiency; molecular dynamics, density functional theory, and other computational modeling, among others) that address a specific problem of an existing S&E company (preferably local).

- Use of additive manufacturing to improve thermal and physical properties of semiconductors and electronics devices.

### Call Scope

To ensure that the research output will be utilized by the target industry, a letter of commitment must be secured.

### **1. Aerospace Industry**

#### Call Rationale

Aerospace manufacturing is a high-technology industry that produces aircraft, guided missiles, space vehicles, aircraft engines, propulsion units, and related parts. The industry in the Philippines is comprised of government and private industries that perform the institutional roles of end-users, suppliers and manufacturers. The value chain consists of the government and airline companies as primary customers; OEM companies, a tiered chain of suppliers and manufacturers; companies that perform MRO of equipment and parts; and the consuming public as aircraft passengers.

Currently, the domestic aerospace industry has an estimated 15% share of 2013 GDP, and a projected 0.57% share of 2022 GDP projection given a positive program intervention spearheaded by the government.

For the Philippines to be a major hub for manufacturing of OEM parts and allied services (MRO) for the global commercial aircraft industry.

March 23, 2016 made a special mark in Philippine history when its first microsatellite was launched to the International Space Station (ISS). The endeavor to design, fabricate, and launch Filipino-made satellites will continue especially that the Philippine Space Agency is already established. This will enable the local aerospace industry to accelerate towards contributing to the country's economy. Given the intervention of the local government, a 0.57% GDP share is projected in 2022.

#### Call Objective

The call aims to support the R&D needs of the aerospace industry. Specific topics are the following:

- Design and fabrication of materials for aerospace and aircraft (*i.e.* lightweight and have high temperature stability/resistance; better fuel efficiency; molecular dynamics, density functional theory, and other computational modeling, among others) that address a specific problem.
- Use of additive manufacturing to improve properties of materials for aerospace and aircraft industries.

#### Call Scope

To ensure that the research output will be utilized by the target industry, a letter of commitment for co-support / counterpart funding must be secured.

## 2. Energy

### Call Rationale

In the Philippines and in its neighboring countries, diverse power generation sources are being utilized. However, the country relies mostly on coal, followed by natural gas, oil and renewable energy (e.g. geothermal and hydrothermal). The reliance on fossil fuels is one of the most challenging problems that need to be dealt with vigorously in recent times. Since it is not sustainable and its continuous use leads to serious environmental issues, such as air pollution and global warming- consequently affecting economic security and development. An alternative to fossil fuel is highly possible which will be more environmentally friendly, sustainable and efficient as well. Among all the different technologies associated with renewable energy, fuel cell technologies represent one of the most promising technological advancements to curb the situation.

### Call Objectives

The study should be able to produce a market-ready material that will result in a spinoff company or IP licensure. Topic should fall under any of the following:

- Fuel cells: single stack, polymer exchange membrane
- Supercapacitors: non-Platinum alternatives, pseudo-capacitors, EDCL

The proposed priority action could be classified as follows:

- R&D Focused: The design and development studies would utilize and harness locally available raw materials as components of fuel cells
- Capacity or Institution Building: Researchers and industry partners would be trained for stack development and testing, fuel cell development for various applications, and robust research infrastructure

### Call Scope

Industry Collaboration, wherein the fuel cell modules and systems would be deployed for transportation or grid integration is required. To ensure that the research output will be utilized by the target industry, a letter of commitment must be secured.

## 3. Establishment of safety protocols for the use of nanomaterial safety (occupational and operational) Phase II

### Call Rationale

Nanotechnologies pose new opportunities and challenges to both the industry and the regulatory bodies alike. Benefits of nanotechnologies include helping address societal and environmental challenges, (e.g. in providing renewable energy and clean water, and in improving health and longevity, as well as the environment). As the technology progresses, however, unlocking this potential will require responsible and co-coordinated approach to ensure that potential challenges will be addressed concurrently. The general approach

towards safe handling and control of nanomaterials works the same as other types on materials. The UK's Control of Substances Hazardous to Health Regulation (COSHH) outlines a framework that can be applied also to the control of nanomaterials:

- identify the hazards and assess the risks;
- decide what precautions are needed;
- prevent or adequately control exposure;
- ensure that control measures are used and maintained;
- monitor the exposure;
- carry out appropriate health surveillance;
- prepare plans and procedures to deal with accidents, incidents and emergencies; and
- ensure employees are properly informed, trained and supervised.

These hazard levels are determined based on a risk assessment. This is dependent on a) hazardous properties of the nanomaterial and b) exposure level. From risk assessment, occupational safety measures can be derived following the priority list of the STOP principle: Substitution, Technical measures, Organizational measures and Personal protection measures. The appropriate occupational safety measures can be determined using evaluation criteria and the recommendations should be adapted to the respective national legislation of the respective member state. The decision criteria can support the risk assessment of activities with nanomaterials and lead to an appropriate safety strategy. The occupational safety measures are influenced by the quantity, the release potential, as well as the exposure level of the respective nanomaterial. A wide range of guidelines published from different institutions can additionally provide support in deriving the appropriate occupational safety measures. These refer either specifically to handling nanomaterials or more generally to handling chemicals of the respective hazard groups and can additionally provide support in deriving the appropriate occupational safety measures.

#### Call Objective

The call aims to support specific R&D needs of the industry in terms of occupational and operational safety in the use of nanomaterials and the eventual adoption of risk assessment protocols by the industry and local regulatory agency.

#### Call Scope

To ensure that the research output will be utilized by the target industry or local regulatory agency, a letter of commitment must be secured.

## IV. Information and Communications Technology (ICT) Sector

### **A. Artificial Intelligence (AI) R&D**

#### Call Rationale

Artificial intelligence is becoming more and more prevalent in everyday life. Coupled with the expanded possibilities given by AI technologies, Filipino engineers, researchers, and practitioners have the opportunity to tackle previously insurmountable problems, especially those deeply relevant to the Filipino community. Equipping select individuals that have the potential to make use of the technologies and spread the knowledge to relevant peers is a great first step in DOST's artificial intelligence education agenda.

The mismatch between the supply of and demand for digital skills has been widely acknowledged. Education systems would need to boost their STEM (science, technology, engineering, and mathematics) to meet the required digital skills of today. However, there is also a current need to differentiate people's' capability apart from activities that are hard to automate or codify. Skills such as creativity, teamwork, and problem solving will be essential in complementing artificial intelligence.

- AI will lead to a society that is very different from today's world
- Automation and machine learning for basic tasks
- Readiness for automation and connectivity
- Matching of graduates and employment

#### Call Objective

Proposed projects must develop technologies on:

- Education
  - To construct a program or computer capable of identifying what a student does and doesn't know through diagnostic testing and then developing personalized curricula based on each student's specific needs.
- Security (cyber & physical, national, industry, individual)
  - Network Intrusion Detection and Prevention
  - Hacking Incident Forecasting
- Human-Machine and Machine-Assisted Human-to-Human communication
  - To construct a program or computer capable of generating/transcribing rich notes for meetings, interviews, lectures, and other important voice conversations in Filipino language.
  - To develop applications for conversational agents as front-end customer service and information-dissemination "agents" of government agencies – and again use the data collected from such deployment in enriching the datasets for Filipino speech understanding, speech synthesis and text applications (natural language processing).
- Traffic Administration
  - Resolving control and optimization problems by prediction and detection of traffic accidents and conditions

- Convergence of AI and Humanities
  - To construct a program or computer capable of human-level creativity.
  - To better understand human creativity and to formulate an algorithmic perspective on creative behavior in humans.
  - To design programs that can enhance human creativity without necessarily being creative themselves.

### Call Scope

- direct industry co-support/ counterpart funding
- multi-institution collaboration where researchers from universities can collaborate through a program with multicomponent projects,
- involve young or new researchers to encourage new R&D professionals

## **A. Robotics AI**

### Call Rationale

Artificial intelligence (AI) and robotics are a powerful combination for automating tasks inside and outside of the factory setting. In recent years, AI has become an increasingly common presence in robotic solutions, introducing flexibility and learning capabilities in previously rigid applications.

During the past 50 years, the frequency of recorded natural disasters has surged nearly five-fold.

Converging exponential technologies (AI, robotics, drones, sensors, networks) are transforming the future of disaster relief—how we can prevent them in the first place and get help to victims during that first golden hour wherein immediate relief can save lives.

Here are the three areas of greatest impact:

- AI, predictive mapping, and the power of the crowd
- Next-gen robotics and swarm solutions
- Aerial drones and immediate aid supply

### Call Objectives

Proposed projects must develop technologies on:

- Sensors and robot vision systems as well as the planning and control of robot actions including the design of control systems and their implementation
- Advanced sensors and multisensor systems
- Explicit robot programming
- Implicit (task-orientated) robot programming
- Interaction between programming and control systems
- Simulation as a programming aid
- AI techniques for advanced robot systems and autonomous robots.

### Call Scope

- direct industry co-support/ counterpart funding
- multi-institution collaboration where researchers from universities can collaborate through a program with multicomponent projects,

- involve young or new researchers to encourage new R&D professionals

## **B. Data Analytics**

### Call Rationale

Data science is a field that focuses on improving and informing decisions through the analysis of data.

For all the concern on possible infringement on the right to privacy of personal information, there is the counterbalancing fact that services by government can be vastly improved if differentiated services are offered to targeted clients or customers (citizens) based on their actual needs, capacity to pay, health profile, geographic location, and distribution, etc. In addition, services can be better delivered if an entire suite of government services are packaged in logical bundles, given a prior study of data coming from different government units.

Data-driven decisions are not yet the norm in the Philippine government, and delivery of government services, in general, does not truly benefit from prior detailed analysis of information that either have not been pre-collected or have been collected in some form but have not been digitized and transformed in a manner that is amenable to data analytics. And assuming there is such information that has been digitized (and there will probably be more and more of such collected data), there is no general technical capability nor infrastructure that is already in place to use the power of AI to study these data and contribute to better public service.

### Call Objectives

Proposed projects must develop technologies on:

- Integration and interoperability of big data across different government departments and affiliated organizations.
- National challenges such as unemployment, terrorism, energy resources exploration, and much more.

### Call Scope

To ensure that the research output will be utilized by the target government agency, a letter of commitment for co-support and counterpart funding must be secured.

## **C. Gaming development for education (e.g. learning while playing)**

### Call Rationale

Video games have become an increasingly ubiquitous part of society due to the proliferation and use of mobile devices. Video games and creativity explores research on the relationship between video games and creativity with regard to play, learning, and game design. While video games can be sources of entertainment, the role of video games in the classroom has emerged as an important component of improving the education system.



### Call Objectives

The proposed project should design and develop game-based learning to effectively promote the acquisition of knowledge and skills in an exciting medium. Below are the specific objectives:

- A creative design and content should be integrated to spur interest and zeal for the users.
- Identify specific indicators to measure requisite skills and learnings acquired through game-based learning.
- Deploy and evaluate the impact and effectiveness of game-based learning in comparison to traditional learning.

### Call Scope

- Proposed project should focus on primary to secondary education subjects.
- Possible adoption by the Department of Education should be explored.

## **D. Virtual Reality (VR) / Artificial Reality (AR) for aerospace, tourism, and human security**

### Call Rationale

VR and AR are among the latest technology trends sweeping across many industries, like gaming, education and tourism. Virtual Reality is fast evolving and there is a need to explore its applications, and the many issues that arise in application design and implementation, including hardware requirements, system integration, interaction techniques and usability preferably for aerospace, manufacturing, tourism and human security through the proposed project.

### Call Objectives

The proposed project should explore the possible use of VR and AR to develop aerospace solutions, promotion of local tourism, and advancement in human security.

Proposals may include the following:

- Satellite assembly and development.
- Proposed projects for aerospace solutions should be usable for the Philippine Space Agency.
- Department of National Defense training and field monitoring.

### Specific Requirements

To ensure that the research output will be utilized by the target industry or local regulatory agency, a letter of commitment must be secured.

## V. Electronics Sector

### A. Sensors and Actuators for Intelligent Factories

#### Call Rationale

Sensors and actuators are key building blocks of an intelligent industry – particularly in the manufacturing sector or so-called “Smart Factory”. In modern industries, IoT applications, distributed sensors gather information about a system, which is then processed to form the basis for issuing commands to actuators that in turn, drive the system and processes. With faster computers, smarter machines, smaller sensors, cheaper data storage and transmission could make production segments and products smarter to communicate with and learn from each other through use internet-of-things (IoT) devices, Artificial Intelligence (AI) and Data Analytics techniques. Sensors and actuators technology, therefore have complementary roles in enabling manufacturing industries to attain efficiency, reduce errors and increase productivity. These innovations will transition traditional manufacturing processes founded on hierarchical automation systems, to self-organizing cyber-physical production system to allow flexible mass custom production and flexibility in production quantity.

#### Call Scope

PCIEERD, in line with its thrust to propel the Philippines to achieve its Industry 4.0 aspirations, is calling for research proposals to develop integrated sensor-actuator systems and technologies for sensor and actuator with decentralized controls and connectivity, sensor/actuator networks, streaming data analytics for optimal and adaptive manufacturing. The proposed project should be able to set up an *intelligent, agile or reconfigurable and fully networked production line* or subline that integrates physical input objects, machines, smart sensors, and demonstrate the application of manufacturing data analytics across the boundaries of organization.

This call intends to solicit proposals on the integration of intelligent sensor networks, coupled with AI, to improve existing systems and/or develop new services and breakthroughs in science as applied to **Intelligent Factories**.

Proposed projects must develop technologies on:

1. Sensors (biosensing, biophotonic, chemical, optoelectronics, mechanical, thermal, micromechanics, magnetics. Sensor and sensor-array chemometrics, microarray)
2. Nano- or micromechanics and microcontrols; actuators, structures, integrated sensors-actuators, microsystems, and other devices or subdevices ranging in size from millimeter to sub-micron- levels, nanomotors, microfluidic components) nanomotors.
3. Systems and controls: Interface electronics, chip-based detection devices i.e. biochips, lab-on-a-chip.
4. Machine vision  
Acting as the ‘eyes’ of the factory, image processing systems based on industrial cameras can compute information that was previously gathered and analysed by humans. It aids in the intelligent exchange of information among sensors, devices and machines.

## 5. Industrial Internet of Things, AI and Data Analytics

Basis for issuing commands to actuators that in turn, drive the system. With faster computers, smarter machines, smaller sensors, cheaper data storage and transmission could make production segments and products smarter to communicate and learn from each other through the use of internet-of-things (IoT) devices, Artificial Intelligence (AI) and Data Analytics techniques.

### Specific Requirements

Partnership with an industry is required.

## **B. Wearable Electronics**

### Call Rationale

Wearable electronics refers to an integrated computing device or product, which help the person or the user wearing it to enhance day-to-day activities. The market for wearable electronics was largely dominated by North America, followed by the European Union and Asia Pacific.

Wearable electronics are electronic devices constantly worn by a person as unobstructively as clothing to provide intelligent assistance that augments memory, intellect, creativity, communication and physical senses.

### Call Scope

Proposed projects must develop technologies on wearable electronics products and components such as, but not limited to:

- PCBs
- Memory
- Battery
- Sensor
- Connectivity
- Audio
- Display
- Camera
- Others

## **VI. Space Technology Applications Sector**

### Call Rationale

Global Navigation Satellite Systems (GNSS) include constellations of Earth-orbiting satellites that broadcast their locations in space and time, of networks of ground control stations, and of receivers that calculate ground positions by trilateration. GNSS are used in all forms of transportation: space stations, aviation, maritime, rail, road and mass transit. (<https://www.unoosa.org/oosa/en/ourwork/psa/gnss/gnss.html>) With significant growth observed in recent years, the global GNSS market will continue to expand in the next decade –both in terms of devices and services. The growth will be stimulated by global macrotrends such as digitalisation, big data, sharing economy and artificial intelligence that use GNSS for

Position, Navigation and Timing. In combination with other technologies, GNSS can also contribute towards tackling challenges such as climate change by supporting environmentally friendly transport solutions, sustainable agriculture and meteorological monitoring (GNSS Market report issue 6, 2019). GNSS is also a new enabling innovation to global ICT society.

#### Call Objectives

The objective of the call is to harness the full potential of space technology such as GNSS for the development of new applications by creating niche for new services, user benefits and business potentials.

#### Scope of the Call

Projects must focus on GNSS-based applications, but not limited to:

- Multi-sensor integration of GNSS applications in surveying and geodesy;
- Use of GNSS for aviation, including integration of satellite navigation technology into air traffic management and airport surface navigation and guidance;
- Use of navigation and timing systems for road, rail, and engineering applications, including vehicle guidance, geographic information system (GIS) mapping, and precision farming;
- Navigation systems operation in marine environment, including waterway navigation, harbour entrance/approach, marine archaeology, fishing, and recreation;
- The use of GNSS signals for navigation and positioning of in-orbit space operations, particularly from low-Earth orbit to cis-Lunar

## **VII. Good Governance through Data Science and Decision Support System (GODDESS)**

#### Call Rationale

To create a critical mass of experts on data science and analytics, the DOST embarked, in 2018, on a massive training through an online learning management platform. Funded under the DOST Grants-in-Aid Program, the project, titled “Learning at Scale Volume 1: Data Science Track”, offered one thousand slots covering various course modules from the Coursera Data Science and Computer Science specializations. Following the success of this project and taking into consideration the lessons learned during its implementation, the successor project titled, “Sustainability Program for Data Science Adoption, Reskilling, Training and Adoption (SPARTA)”, was approved in 2019. The SPARTA project aims to address, at a massive level, a data-literate population able to collect and process big data for research, which will be provided through an on-line learning platform (registration via [sparta.dap.edu.ph](http://sparta.dap.edu.ph)). Part of the learners’ output is a data-driven project, policy, process or system addressing the needs of a local government unit (LGU) or a national government unit that will benefit the local population or address a national issue and contribute to Smart Governance.

#### Call Objective

This Call for Proposal is open to **SPARTA Project training participants** to develop appropriate capabilities, systems and technologies geared towards enabling LGUs and NGAs to adapt data driven governance and evidence-based management.

### Call Scope

The program area should present a novel concept or mechanism and should have an immediate application. The proposal should show the local/national government agency's (LGU/NGA) current status/demand for the project/service/system/policy and the specific need to be addressed. Researchers should also collaborate with the LGU or NGA, who will be the eventual adaptor of the technology/system developed. A letter of commitment from the LGU/NGA project partner is required.

Proposed projects must be able to develop technologies or systems that will be identified under the SPARTA project such as but not limited to:

1. Urban mobility (smart parking, intelligent traffic management, integrated multimode transport)
2. Energy management (smart meters and management, renewable sources of energy, energy efficiency and green buildings)
3. E-governance and Citizen Services (public information, electronic service delivery, citizen management, video crime monitoring)
4. Waste management (waste to energy & fuel, waste to compost, treatment of C&D waste)
5. Water Management (smart meters & management, leakage identification & preventive maintenance, water quality monitoring)
6. Others – Incubation/trade facilitation centers, etc.

## **VIII. MSMEs Cost-Competitive Low Carbon Systems**

### Call Rationale

Medium, Small and Micro Enterprises (MSME)s play a vital role in driving the Philippine economy. They help reduce poverty through job creation in line with the country's growing workforce and stimulate economic development in rural community areas. MSMEs also provide support services on large enterprises and serve as breeding ground for new entrepreneurs and large corporations<sup>[1]</sup>

According to the Philippine Statistics Authority 2018 Report, the total number of establishments operating in the country is recorded around 1,003,111 business enterprises where 99.52% are MSMEs. Micro, Small and Medium enterprises constitute 88.45%, 10.58% and 0.49%, respectively<sup>[2]</sup>. The top five (5) industry sectors constituting 83.62% of the total number of MSME establishments are: (1) Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles; (2) Accommodation and Food Service Activities; (3) Manufacturing; (4) Other Service Activities; and (5) Financial and Insurance Activities.

Most common challenges faced by MSMEs are accessing low carbon and energy efficient technologies due to high upfront cost and investment. Financial support for low carbon technology is not common since MSMEs are too small for financial backing that leads them to implement energy intensive traditional processes. In addition, there are lack of awareness in energy management and energy efficient practices are not prioritized.

To address these issues, the call aims to locally develop and demonstrate cost-effective technologies applicable to MSMEs such as smart energy systems, energy sensors, peak power detection, and energy management system and validate its performance.

### Call Objective

The program aims to provide S&T intervention support to MSME through low carbon technology adoption, energy consumption reduction and increased energy management awareness. The project should directly benefit the MSME eventually by being cost competitive, reduce electricity dependence and lower carbon emission. Interested proponents must provide a partner MSME which will utilize, adapt and sustain the technologies to be developed herein. The proponent should present the actual energy load profile of the MSMEs collaborating company and highlight the advantages of the low carbon technology intervention. Determining the MSME's product/s carbon footprint shall likewise be included in the project deliverables.

### Call Scope

#### *Low Carbon Technology for MSMEs*

The project should design, develop or utilize low-carbon technology in order to reduce energy utilization of MSMEs. The low-carbon technology should be incorporated into the existing production/processing facility, and should showcase low-emission, clean technologies, which significantly reduce the MSME's greenhouse gas emission, enhance productive use of energy and reduce electricity consumption.

#### *Monitoring, detection, analysis and control of energy utilization of MSME*

The project should utilize existing technologies or develop new technologies that can monitor energy utilization of a facility from its branch circuit. The system should be capable of detecting anomalies on power utilization and must be able to present relative actions to control improper use of energy. The energy monitoring system should have an integrated control mechanism to regulate energy consumption (i.e. fan speed reduction vs cooling requirements, lighting control for tasks/non-tasks area, motor speed regulation, etc) based on the recorded energy data and set parameters.

#### *Energy Efficient and Energy conservation technologies*

The project should focus on developing energy recovery technologies i.e. waste-heat recovery integrated with software, sensors, etc. that will increase the energy efficiency and conservation of an MSME. Software may include monitoring and planning of energy use and attached activities. Sensors will be used to detect forms of energy leakage, and waste energy recovery technologies will be used to utilize waste energy (heat, mechanical, chemical) form which the MSME has in its production/processing facility.

[1] [The MSME Sector at a Glance, 2012, Senate Philippines](#)

[2] [Department of Trade and Industry, www.dti.gov.ph, 2018](#)

## **IX. Innovative Unmanned and Autonomous Vehicle Systems and Applications**

### **Call Rationale**

In highly developed countries, UAVs had been extensively applied in different aspects of life. Currently, there are UAV applications providers in the country (DronesPH, Unmanned Systems Consulting, SkyEye). However, the services offered focus mainly on UAV assembly and control training, aerial mapping and surveillance alone. The Philippines, being an archipelago in the tropical region, is highly vulnerable to disasters. Hence, it is important for the Philippines to focus on enhancing its capabilities for disaster mitigation and response. The country will benefit a lot if this recently-evolving technology is fully adopted.

### **Program Description**

Development of innovative unmanned and autonomous vehicles (UAVs), cost-effective designs, as well as UAV technology intended for higher end applications (e.g. imaging, intelligence, and monitoring capabilities).

### **Call Objective**

The objective of the call is to multiply the capacity and efficiency of doing work with the use of UAVs and to provide a technology that could help enhance the country's capabilities for disaster response, rescue operations, and climate change adaptation in order to minimize the loss in property and human lives, especially to those located in geographically challenged and isolated parts of the Philippines.

### **Call Scope**

#### **1. Development of UAV Materials, Automation and Capabilities**

Further advancement of the technical capabilities of UAV such as increased range and endurance. The need for automated UAV applications and use of novel local materials are also areas that should be further developed, such as:

- a. UAV capable of delivering supply (heavy payload) to remote locations (VTOL capabilities)
- b. Utilization of local fibers and smart materials as structural components for UAV platforms
- c. Automated capabilities for swarm and cooperative UAV missions
- d. High-resolution imaging, LIDAR and radar capable UAV

#### **2. Robust UAV Platforms and Cost-Competitive Applications**

- a. Environmental (e.g. land, air, sea, coastal) monitoring
- b. Delivery of supplies and materials, and possibly unmanned transport
- c. Amphibious applications and for volcanic monitoring and various meteorological and geographical scenarios
- d. High-resolution imaging, remote sensing and radar capable UAVs
- e. Cost-effective cooperative mission and/or swarm applications
- f. Industrial and infrastructure inspection, maintenance and repair, asset management

3. The proposal should be able to differentiate with existing practices/applications and exhibit the cost-competitiveness of the proposed UAV applications. Proponents should partner with UAV commercial service providers and end-users as well as obligate them with counterpart support in the project implementation. Further, proposal should highlight pre-feasible business models for the innovative commercial application.

4. In order to maintain the long-term sustainability of the UAV S&T intervention program, it is crucial that the local industry is capacitated and developed. This includes not just the manufacturing of UAV or UAV components, but also the provision of local services for maintenance and repairs as well as local parts replacement. Specifically encouraging S&T collaboration among the academe, service providers and end-users to develop UAV hardware, software and applications.

## X. Smart Approach for the Construction Industry

### Call Rationale

The Philippine construction industry registered a growth of 15.1% in real terms in 2018. The government total spending on infrastructure grew by 49.7% in the first eleven months of 2018, compared to the same period in 2017. It increased from PHP486.5 billion in January-November 2017 to PHP728.1 billion in January-November 2018. The industry's output value is expected to continue to expand in real terms over the forecast period (2019-2023), driven by the government's plans to upgrade the country's transport infrastructure. In addition, public and private sector investments in residential, commercial and educational infrastructure construction projects are expected to support growth in the industry over the forecast period.

The industry's output value is expected to continue to expand in real terms over the forecast period (2019-2023), driven by the government's plans to upgrade the country's transport infrastructure. The industry's output value in real terms is expected to rise at a compound annual growth rate (CAGR) of 8.60% over the forecast period. The industry is consequently expected to rise from a value of US\$44.3 billion in 2018 to US\$66.9 billion in 2023, measured at constant 2017 US dollar exchange rates.

The total construction project pipeline in the Philippines including all mega projects with a value stands at PHP19.1 trillion. The pipeline, which includes all projects from pre-planning to execution, is skewed towards early-stage projects, with 55.0% of the pipeline value being in projects in the pre-planning and planning stages as of April 2019.

Accounting for 33.3% of the industry's total value in 2018, residential construction was the largest market in the Philippine construction industry during the review period. The market is expected to retain its position over the forecast period, and account for 34.7% of the industry's total value in 2023. Infrastructure construction accounted for 21.5% of the industry's total output in 2018, followed by commercial construction with 17.5%, energy and utilities construction with 15.6%, institutional construction with 7.0% and industrial construction with 5.2%. (source: GII)

### Program Description

The project involves the development and introduction of innovative and more efficient construction technologies through indigenous and sustainable **materials**, and innovative and cost-effective concepts/**techniques**. These technologies should be able to provide solutions and benefits such as reduced costs, improved processes (testing and monitoring), green construction, recycling decommissioned materials, multifunctional and environment-friendly materials, quality and longevity of buildings, and improved quality of life for users. Differentiate the proposed technology and method/technique by elaborating on cost-competitiveness, productivity enhancement, and efficiency and materials performance improvement with existing technologies and applications.

Output derived from the project must lead to new, or improvement of, existing standards/policies & building regulations and codes. Proponents should partner with possible



technology adoptors, construction companies, relevant government agencies and end-users as well as solicit counterpart support in the project implementation.

#### Call objective

The objective of this call is to develop and deploy indigenous construction materials and innovative techniques/tools in support of the construction industry program and for a resilient infrastructure.

#### Call Scope

The R&D initiatives should address/cover the following identified research areas:

1. Innovative construction materials maximizing the potential application of indigenous, recycled, and industrial waste materials.
2. Improvement and upgrading of construction techniques/methods.
3. Localization and advancement of equipment/tools for construction, monitoring and testing.

## **XI. Mining and Minerals Sector**

#### Call Rationale

The Philippines ranks as the 5<sup>th</sup> highly mineralized countries in the world. It is among the world's most richly endowed with gold, copper, nickel, iron and chromite. It is also rich in other minerals like coal, cobalt, gypsum, silver and sulfur. Thus, making the mining and minerals industry a potential driver of the country's economy.

Based on the Mines and Geosciences Bureau (MGB) data, from the 30 million hectares total land area of the Philippines, 9 million hectares has high mineral potential where 702,715.39 hectares are covered by mining tenements (January 2019). As of 2018, the country has 48 metallic operating mines (8 gold mines, 3 copper mines, 30 nickel mines, 3 chromite mines and 4 iron mines), 61 non-metallic mines (35 limestone/shale quarries, 5 silica quarries, 15 aggregate quarries, 1 dolomite quarry and 3 clay quarries, 2 sand & gravel), 5 processing plants (2 gold processing plants, 2 nickel processing plants and 1 copper smelter plant) and 3,389 small quarries and sand & gravel operations. From these operating mines and quarries, the country was able to export metallic and non-metallic minerals such as copper, gold, and nickel to Japan, Australia, Canada and China with estimated mineral exports amounting to US\$ 4.26 Billion in 2018. The total estimated production value for metallic minerals is PhP121.94 Billion where PhP 44.81 Billion accounts for gold, PhP 55.18 Billion for Nickel & Nickel Products and PhP20.68 Billion for copper.

#### Call Objective

To further revitalize the mining industry and accelerate its economic development without comprising the environment and the health of the people, the country has to continue conducting researches on metallic and non-metallic minerals, rehabilitation of mined-area, e-tech elements for current and future green emerging technologies, capacitate researchers on mining and metals related researches and enhance competitiveness of SUCs and RDIs laboratories and facilities to conduct the researches.

#### Call Scope

To harness the industry growth thru science, the DOST thru the PCIEERD, will prioritize the following areas for research:

1. Value-adding of Metallic Minerals for gold, copper, nickel, iron and chromite
2. Value-adding of Non-metallic Minerals for marble, clay, silica, cement and lime.
3. Extraction and Value-addition of E-tech Elements for Emerging Technology Applications such as REE (Scandium, Yttrium, Neodymium), Cobalt, Tellurium, Selenium, Indium and Gallium.
4. Technologies in Support of Environmental Protection, Conservation and Rehabilitation of Mined-out Area such as treatment/prevention of acid mine drainage, wastewater treatment, phytoremediation, remediation of mercury contaminated area, etc)

Call for Proposals

**1. Value-adding of Metallic Minerals (CY: 2021-2023)**

The country is richly endowed with metallic resources such as gold, copper, nickel, iron and chromite. However, majority of the companies are operating via Direct Shipping Ore (DSO) scheme. With such scheme, the government is not benefiting that much due to the lower price offered for the ores. Moreover, Executive Order 79 mandates the development of value-adding activities and downstream industries for strategic metallic ores.

To support EO 79 and for our local minerals to be given additional value, the PCIEERD will be calling for proposals covering the following:

**A. Copper**

- Purification of copper for industrial use

**B. Nickel**

- Production of engineering castings using laterite nickel pig iron

**C. Iron**

- Production of iron using low grade magnetite ores

**2. Value-adding of Non-metallic Minerals (CY:2021-2023)**

Non-metallic minerals refer to minerals with no metallic luster. They are a special group of elements from which no new product can be generated if they are melted. They could be industrial minerals such as sulfur, gypsum, coal, barite, salt, clay, feldspar, borax, lime, marble, magnesite, potash, phosphate, silica fluorite, asbestos, abrasives and mica; precious stones such as gem minerals and construction minerals such as stone, sand, gravel and limestone.

Nonmetallic minerals may be used directly and/or processed before their application. Because of its various industrial use, our local nonmetallic minerals should be utilized and be given additional value.

As such, the PCIEERD would like to call for proposals particularly on the following:

**A. Marble**

- Product development for other applications (CaCO<sub>3</sub>, construction materials and decorative items)

**B. Clay**

- Utilization of clay for wastewater treatment and other applications

**C. Cement**

- Process improvement
- D. Silica**
  - Utilization of silica for industrial application
- E. Lime**
  - Utilization of lime for paint, rubber, glass, plastic and other applications

Health of the community residing within or near the mining site should also be a priority. Some of the non-metallic minerals contain technologically enhanced NORM (potassium, uranium, thorium) and mercury which leach into the soil and water, affecting cropland and, in turn, enters the food chain. Hence, **nationwide inventory of naturally occurring radioactive materials (NORM) and mercury present in the mining area will also be included in the call for proposals.**

### **3. Exploration and Extraction of E-tech Elements for Emerging Technologies Applications (CY 2021-2024)**

E-tech elements are elements that are of high demand globally because of its significant use to the development of advance and emerging green technologies. E-tech elements are composed of Rare Earth Elements (REE) and some elements such as Cobalt (Co), Tellurium (Te), Selenium (Se), Indium (In) and Gallium (Ga). Rare Earth Elements (REE) are a set of seventeen (17) metallic elements which includes Scandium, Yttrium and the fifteen (15) Lanthanides on the Periodic Table of the Elements.

E-tech elements are used for a growing number of industrial applications. To name a few are for **Electronics** (e.g. television screens, computers, cell phones, etc.); **Manufacturing** (e.g. High strength magnets, metal alloys, stress gauges, automotive catalytic converters, etc.); **Medical Science** (e.g. Portable x-ray machines, x-ray tubes, magnetic resonance imagery (MRI) contrast agents, nuclear medicine imaging, cancer treatment applications, etc.); **Technology** (e.g. Lasers, optical glass, radar detection devices, highly reflective glass, computer memory, nuclear batteries, high temperature superconductors, etc.) and **Renewable Energy** (e.g. Hybrid automobiles, wind turbines, next generation rechargeable batteries, biofuel catalysts).

With the increasing demand of e-tech elements globally, the PCIEERD would like to explore local sources and the viable extraction of these elements. As such, the PCIEERD would like to call for proposals for the following:

- A. REE (Scandium, Yttrium and Neodymium)**
  - Exploration and extraction of scandium, yttrium and neodymium from metallic and non-metallic minerals
- B. Cobalt (Co)**
  - Exploration and extraction of Cobalt from metallic and non-metallic minerals
- C. Tellurium (Te)**
  - Exploration and extraction of Tellurium (Te) from metallic and non-metallic minerals
- D. Selenium (Se)**
  - Exploration and extraction of Selenium (Se) from metallic and non-metallic minerals
- E. Indium (In)**
  - Exploration and extraction of Indium (In) from metallic and non-metallic minerals
- F. Gallium (Ga)**

- Exploration and extraction of Gallium (Ga) from metallic and non-metallic minerals

#### **4. Technologies in Support of Environmental Protection, Conservation and Rehabilitation of Mined-out Area (CY: 2021-2024)**

Mining if irresponsibly done, contribute to serious environmental and social problems. Long-term damage to soil and groundwater can pose health risks not only to the ecosystem but also to the community. With proper remediation and rehabilitation of the area, this would restore the conditions of the area as closely as possible to its original state, convert the area to a safe and stable condition and make the land suitable to productive uses to support sustainability of the site.

As such, the PCIEERD would like to call for proposals covering the following:

##### **A. Abandoned/Mined-out area**

- Develop technologies that would remediate and rehabilitate abandoned mines and dumped tailings that pose environmental, health and safety problems
- Control, prevent and treatment of Acid Mine Drainage (AMD)
- Wastewater treatment technologies
- Erosion control and slope stabilization technologies

##### **B. Tailings**

- Tailings dam design
- Utilization of tailings/wastes from mining/processing to valuable products (e.g. carbon sequestration, wastewater treatment, acid mine drainage, etc.)

## **XII. Metals and Engineering Sector**

### *Call Rationale*

The Metals and Engineering Sector is one of the priority sectors of the **PCIEERD** (Philippine Council for Industry, Energy and Emerging Technology Research and Development). It plays a significant role towards the competitiveness of Philippines manufacturing industries. It principally impacts across the other sectoral priorities of the **PCIEERD** such food, mining, textile, process agri-processing as well on the environment sector and advanced technology sectors.

The Metals and Engineering (M&E) industries plays a vital role in the country's economic growth and development. The Philippine economic sectors manufacturing, agricultural and service sectors-are heavily dependent on the M&E industry especially in terms of their requirements for tools, implements, machines and equipment, parts and assemblies, among others.

Through this **Call for Proposal**, the Metals and Engineering Sector through the **PCIEERD**'s Grant-In-Aid for programs and projects will support infrastructure development of metals-related S&T services, the research programs directed towards the development of improved and advanced metal-related technologies. The **PCIEERD** also considers grant support for

capacity building and institutional technology development proposals directed to the Metal and Engineering sectoral priorities.

The Metals and Engineering sector is calling for proposals for 2020-2022 from qualified local institutions that will address the needs, gaps and problems of the local industry.

#### Call Objectives

1. To invite submission of S&T and R&D program/projects that will enhance and or develop the M&E Sector.
2. To enjoin qualified local institutions, engineers and scientists and individuals to foster linkages with DOST and PCIEERD in the field of science and technological activities directed to the M&E Sector
3. To develop and provide technologies towards improving the productivity of M&E sector and its allied sectors
4. To partner with public and private research institutions in developing innovative technologies that will contribute to the nation's productivity and competitiveness

The Metal and Engineering sector comprises three major groups, namely: Machining and Fabrication Sector, Tool and Die Sector, and the Metalcasting Sector

#### **A. Machining and Fabrication Sector:**

- Mission:
1. To enhance the manpower needs of the sector
  2. To support the equipment upgrading requirements of the sector
  3. To develop new technologies.

Vision: A machining and fabrication industry providing globally competitive products, machineries and services.

#### **Priority Program Agenda:**

- Development innovative, cost effective and appropriate machines and equipment that will solve the S&T problems and needs of the following industry
  - a. Cacao industry
  - b. Food Processing industries
  - c. Essential Oils and Fragrances
  - d. Aerospace industries
  - e. Creative and Handicraft industries
  - f. National Defense and Security needs
- Mechanical and Robotics for industry adoption
- Production Technologies for select Creative industries (Forest-based; composite and natural materials)
- National Defense and Security needs of the Philippine Armed Forces
- Machinery, Parts and Engineered Products (MPEPs) for Design and Dev't.
- Surface finishing of automotive parts

#### **B. Tool and Die Sector:**

- Mission: 1. To support the manpower development needs of the Tool and Die sector

2. To support the equipment upgrading requirements of the Tool and Die sector
3. To establish common service facilities that will cater to various sectoral industries

Vision: A viable and competitive industry providing the tool and die requirements of the local markets.

**Priority Program Agenda:**

- Capability Building and services for the die and mold needs of the manufacturing sectors
- Tool and Die for Handicraft Industries

**C. Metal casting Sector:**

- Mission:
1. To support the manpower development needs of the metalcasting sector
  2. To support the capability building initiatives of the metalcasting sector
  3. To make the metalcasting industry export-capable on selected products

Vision: Export capable and competitive metalcasting industry providing quality products and services.

**Priority Program Agenda**

- R&D on Advanced Metalcasting Technologies and materials Technologies
- Metal and composite etching or photo etching, Polishing, Metal Finishing Technologies
- Projects and Programs on Materials/Metallurgy Technology

**Other Priority Program Agenda:**

- Surface Engineering
- Heat Treatment
- Additive and Subtractive Manufacturing
- Surgical implements and implants
- 3D Printing

### **XIII. Food Sector**

Food processing is a main growth driver of the Philippine manufacturing sector. It comprises 39% of the manufacturing industries and consistently contributes more than 35% to the country's Gross Domestic Product (GDP) from the 1990s until 2014 (Philippine Statistics Authority). Processing refers to any action that substantially alters the initial raw materials or product or ingredients to produce food. Processing is separate from primary production, which is the rearing, or growing of produce for harvest, and postharvest stages, which involves minimal transformation of food such as sorting and milling of grains, and slaughter of animal for food (Food Safety Act of 2013). Most of the food processing industries are classified as Micro, Small, and Medium Enterprises (MSMEs) located all over the islands of the country. This leads to employment of over 800,000 with an annual growth rate of 2.4% and remains as the sub-sector with the biggest average contribution to total manufacturing employment at 20% from 2001 to 2010 and 25% from 2011 to 2013 (Philippine Statistics Authority).

Despite its continuous growth, the food processing sector is hindered by several challenges that need to be addressed. Investments in research and development, technology transfer and upgrading — the widely accepted measures of innovation, have been historically low for food manufacturing industries in the Philippines (PIDS 2017). These challenges were identified relative to the ASEAN integration in 2015 and still remain as the main challenges affecting the local industries. These are, (1) continued dependence on imported raw materials, (2) need for improvement or innovation in technology, (3) ability to consistently deliver the required level of quality and food safety.

#### **Call Objectives**

To address these challenges, effective programs and strategies should be developed for (1) use of indigenous products rather than importing raw materials, (2) developing technologies that will cover not only the processing part but also the conversion of "waste-materials" into something more useful, as well as (3) development of human resources and support to upgrading of facilities, (4) continued support and technical assistance to MSMEs for product safety and quality, and (5) conduct of joint research on new technologies in response to global trends.

Thus, the Food Sector remains a priority for PCIEERD and shall continue to accept proposals line with its priority programs for 2021-2023 in line with the Harmonized National R&D Agenda under Food and Nutrition Security, Countryside Development, and Competitive Industries.

#### **A. Food Safety Program**

##### **Call Rationale**

Assurance of food safety from farm-to-fork is a shared responsibility of all the stakeholders in the food chain – from production, postharvest, processing, distribution, to consumption. It is imperative that appropriate R&D and S&T programs be in place to ensure the safety of the local food supply. The Integrated Food Safety program is DOST's support for the implementation of Republic Act 10611 or the Food Safety Act of 2013 in coordination with the Food Safety Regulatory Agencies (FSRAs) of the Department of Health (DOH), Department of Agriculture (DA), Department of the Interior and Local Government (DILG), and the Local Government Units (LGUs). The Food Safety Law provides the legal framework and basis for all food safety related programs, projects and activities of government agencies. Article IV, Section 7 of the Food Safety Act lays the foundation for the use of science-based risk analysis for the development of standards, regulations and programs.

Experts from the FSRAs, academe, and DOST Agencies, including Research and Development Institutes, Regional Offices, and Sectoral Councils were involved in the planning of the food safety program of DOST. With the series of consultation meetings and workshops, the Integrated Food Safety Program was developed with the following objectives:

- To provide food safety related services to meet customer satisfaction;
- To develop and implement effective systems, processes and protocols on food safety;
- To develop and enhance human resource on food safety; and
- To develop and institute strategies and mechanisms to sustain the food safety program.

As action plan to the strategies, the developed DOST Food Safety Program has four (4) major components: Research and Development, Enhancement of Testing Capabilities on Food Safety, Human Resource Development, and Technology Transfer and Policy Advocacy Program, with the overall vision towards safe food for everyone, by everyone, through science, technology, and innovation. Current projects implemented are on the following R&D aspects and Human Resource Development:

*R&D to Support Risk Assessment in Philippine Foods*

- Risk Profiling of Hazards in Philippine Food to Support National Risk Management
- Prevalence of Mycotoxin in Rice and Corn in the Philippines
- Prevalence of Heavy Metals and Pesticide Residues in Milled White Rice and White Corn Grits in the Philippines
- Exposure Assessment of Food Chemical Contamination in Metro Manila: A Pilot Total Diet Study Approach

*R & D in Support to Food Industry*

- Development of Food Safety Guidelines for the Food Service Sectors
- Development of Grading System for Adoption of Food Establishments in the Philippines

Call Scope

For 2021-2023, priority is given for proposals on the following:

- *R&D in Support to Food Industry (Informal Sectors, Food Manufacturers, Food Service)*
- *R&D to Support Food Testing of Microbiological and Chemical Hazards*
- *Development of testing kits for food safety and quality (rapid, on-site tests)*
- *Development of new testing methods on food safety related parameters*
- *Knowledge/Technology Transfer and Policy Advocacy on Food Safety*
- *Establishment of Food Safety R&D Hubs*

**B. Food Innovation**

Call Rationale

Innovation covers a wide range of activities that aim to translate ideas into useful new products, processes, and services. For the Food Sector, an array of possibilities exists for



innovation - from the sourcing of raw materials, processing, packaging, including marketing and distribution systems. In the Philippines, while there are large corporations operating in the country, majority of food manufacturers are still MSMEs. Thus, the challenge of introducing innovations by generating concepts and creating new products entail a level of risk that are usually too high to bear especially for micro and small entrepreneurs, particularly on access to processing technologies and facilities.

For 2017 – 2019, the projects handled by PCIEERD on Food Innovation focused on two (2) general areas: (1) *Enabling Systems for Food Innovation*, and (2) *Product Innovation – specifically for Innovative Food Products from Local Sources, Ingredients and Intermediate Products, and Emergency Food*. A total of 23 projects were supported for a total budget of over 201M, with 5.8M allocated until 2020.

A major accomplishment under *Enabling Systems for Food Innovation* is the establishment of Food Innovation Centers (FICs) in partnership with Higher Education Institutes (HEIs) to serve as centralized facilities for turning concepts into products. There are eighteen (18) FICs all over the country, one (1) in each of the seventeen (17) regions and one (1) Main FIC at the Industrial Technology Development Institute (ITDI). The FICs are equipped with rolled out DOST-developed food processing equipment: water retort, spray dryer, vacuum fryer, freeze dryer, and other auxiliary equipment. The network of FICs makes it possible to maximize value addition to diverse food resources in the regions and contribute to the sustainable development of the Philippine food industry.

#### Call Scope

For 2021-2023, proposals are open for the following themes:

1. *Enhancing Competencies of Food Innovation Centers on Bringing Products to Market, Systems and Process Management, and Mechanisms for Sustainability*
2. *Product Development for Ingredients/Intermediate Food*
3. *Innovative Food Products Using Local Sources*
4. *Utilization of Food Processing By-Products*
5. *New Food Processing Technologies for Local Industries*

### **C. Halal S&T Program**

#### Call Rationale

The global Halal market is estimated to be about 2.3 trillion US dollars. In order to penetrate this huge market, Philippine products must comply with Halal certification requirements of importing countries. Unlike other Halal exporting countries in the ASEAN like Thailand, the Philippines, a non-Muslim country, still must realize the potential of its Halal industry. While we work for the enhancement of the competitiveness of our Halal products for export, we also need to ensure compliance of imported products to protect consumers and products in the domestic market.

Republic Act No. 10817 or the Act Instituting the Philippine Halal Export Development and Promotion Program, creating for the Purpose the Halal Export Development and Promotion Board, and for Other Purposes seeks to enhance the competitiveness of the Halal export industry in the Philippines. The law provides for the establishment and implementation of institutional and human resources development program for Halal industry development. It also mandates the formulation and implementation of a national research, development and extension program to develop, propagate or commercialize products and technologies and to

improve and expand the number of Halal products, processes and services for both local and export markets.

In pursuit of its mandate as a member of the Halal Export Development and Promotion Board, DOST formulated the DOST Halal Policy which seeks to ensure the smooth execution of the role of DOST as provider of scientific and technical knowledge in support to the development of the Halal industry. This program lays down plans and programs for research and development, technology transfer, human resource development and Halal verification through laboratory testing. These initiatives hope to strengthen the Halal industry specifically in meeting world standards, promoting competitiveness of entrepreneurs, increasing capability in Halal accreditation and formulating standards, and upgrading research and development.

The DOST Halal S&T Program involves all the regional offices, advisory councils, and research and development institutions of DOST, and HEIs. DOST Halal Advisory Committee provides overall direction and develop policies governing the management and operation of the program, with the following objectives:

- To provide Halal compliant products and services to meet customer satisfaction;
- To develop and implement Halal-compliant and effective systems, processes and protocols; and
- To develop and enhance human resources on Halal science, technology and innovation; and
- To develop and institute strategies and mechanisms to sustain the Halal S&T program.

#### Call Scope

For 2021-2023, proposals are open under the following priorities:

1. *R&D on Halal Tourism and Food Service*
2. *Technology Transfer and Policy Advocacy on Halal S&T*
3. *Innovation System Support for Halal MSMEs*
4. *Establishment of Halal Knowledge Center*

#### **D. Facilities and Laboratories in Support of the Food Sector**

##### Call Rationale

Appropriate facilities and laboratories are necessary for the food sector and its related industries to thrive. Thus, support for the establishment and maintenance of facilities and laboratories for the sector remain a priority in keeping the products and services compliant and competitive.

For the previous years, the sector handled projects on the upgrading of laboratories of DOST Research and Development Institutes (RDIs) and Regional Offices (ROs), catering to the needs of clients and industries. This translated to the establishment of the OneLab network which is a one-stop service provider for the laboratory testing services needed by the industry. This means virtual access to all testing services at a single touchpoint and makes it easier for clients as it offers a system of referral of samples from one laboratory to another. This also includes support for new specialized services such as the Simulation Packaging Research and Testing Laboratory and Green Packaging Laboratory of the Industrial Technology Development Institute (ITDI), and systems such as food banking which is currently being established in the country.

### Call Scope

For 2021-2023, the following priorities are identified:

1. *Strengthening and Enhancement of Capabilities of the OneLab network*
2. *Development of Proficiency Testing Materials for Food Safety and Quality*
3. *New Systems and Services in Support of the Local Food Sector*

## **XIV. Creative Industry Sector**

### Call Rationale

Creative Industries are considered as one of the fastest growing sectors in the global economy and contribute significantly to Gross Domestic Product (GDP) of developed countries by capitalizing on their creative industries. The Philippines is among those countries with rich cultural heritage and pool of creative talents that can potentially boost the economy through its Creative goods. Creative Industries will provide support and strengthen different fields to be globally competitive and to promote locally-made products and designs. According to a PDIS report (Prado), the Philippines supplies and exports a wide range of creative services that includes R&D services and Design and Architecture. The GDP contribution of Creative Industries are the following: 13.8% (2006); 4.25% (2008); 5.44% (2009). The Philippine Creative Industry has the potential to be a sector, particularly on export trade area, that will provide support and/or drive the country's economic development.

### Call Scope

To support the development of creative industries in the country, effective programs and strategies should be developed for the following areas:

- 1. Heritage**
  - a. Arts and Crafts (Furniture, Household Goods, Paper, etc.)
  - b. Design
- 2. Functional Creations**
  - a. New Media (Software, Animation, etc.)
  - b. Industrial Craft
  - c. and other creative related technologies