Republic of the Philippines
Department of Science and Technology
PHILIPPINE COUNCIL FOR INDUSTRY, ENERGY AND EMERGING TECHNOLOGY RESEARCH AND DEVELOPMENT (PCIEERD)

The Call for Proposals of DOST-PCIEERD is aligned with the *AmBisyon Natin 2040*, DOST Harmonized National R&D Agenda (HNRDA) for 2022-2028, and PCIEERD Roadmap and Action Plan (2020-2024) which aims to strengthen and vigorously advance science, technology, and innovation (STI) in the Philippines and ensure responsive, people-centered, and technology-enabled public services and governance.

A. ENERGY SECTOR

Call Rationale

Energy is a fundamental part of human activities, and is an essential need of the industry and services sectors. The government has continuously strived to support these needs, from identifying new energy sources, energy generation, transmission, utilization and conservation. While the country has pushed for rural electrification in the past years, many areas are still unelectrified, including off grid, and unviable areas in parts of Regions IV (MiMaRoPa, 91.53%) V (Bicol, 94%), VI (Western Visayas, 93%) IX (Zamboanga Peninsula, 78.3%) and 12 (SoCCSKSarGen). Different policies have been set up to strengthen our capability to be more energy sufficient and resilient. The present policy under the RA 9513 or the Renewable Energy Act is geared towards harnessing indigenous and renewable energy resource which can offer clean, abundant, and efficient supply of energy. RA 9367 (Biofuels Act) is directed for the use of biofuels while the recent RA 11285 supports the need in conserving and being energy efficient.

The Council have established energy related roadmaps to support the development of new energy resources, efficient energy use, technology development and human capacitating through several stakeholders' consultation, environmental scanning, and emerging technology abroad. This roadmap serves as guidance in detailing R&D activities in specific timeframe to meet the plans, program and projects intended to improve energy development in the next years.

Call Objective

The objective of this call is to provide S&T intervention in the development of clean and effective energy resources through localization, innovative technologies and equipment, supply chain profiling and applications/demonstration to provide energy to unserved and unelectrified communities.

Renewal Energy (RE), Waste to Energy (WTE) and Hydrogen Systems and Technology (*Maximum of 12 projects amounting to Php119M with maximum duration of 2 years*)

a) Green Hydrogen Production and Hydrogen Energy Applications
   - Production of green hydrogen utilizing local resources with actual hydrogen utilization for energy generation/applications

b) Waste to Energy
   - Correlation of MSW and emission via in-situ monitoring with techno-economic assessment in an actual LGU

c) Profiling of RE local supply chain capability and capacity
   - Determine supply chain conditions relative to the utilization of RE technology and determine after-market support is at pace with the demand and utilization. This will lead to an R&D to develop, improve or localize RE technology

d) Policy review on Bioenergy, Profiling of WTE R&D
   - The policy review and profiling should determine the level of readiness of the technologies in relation to its application, from biomass feedstock, pre-process activities and actual utilization for energy generation.

e) Sustainable Island Energy
   - In relation to the UK-NERC's sustainable energy island concept, the project is aimed at developing sustainable energy sources for island communities. Possible research areas include ecological limits, ecosystems services, energy demand and decision-making tools. Partnership with Indonesian counterparts is highly sought in this call

Energy Storage, Energy Efficiency and Conservation (*Maximum of 6 projects under energy management and 4 project for energy storage with a total funding of Php241M with maximum duration of 2 years*)

a) Data analytics applications for energy use, monitoring, and management systems
   - Utilization of data analytics technology to determine, analyze and recommend energy use, demand, monitoring and management

b) Energy profiling and low-carbon technologies applications for MSMEs
   - Energy load profiling of Philippine MSMEs and technology application of low-carbon technologies (DOST SET-UP co-funded)

c) Profiling of local energy efficient low-carbon technologies and smart energy systems supply chain capability and capacity
   - Assessment and profiling of currently available technologies related to energy efficiency, low carbon technologies and smart energy systems in the Philippines. The project would lead to an R&D activity to address the gaps via localization, improvement or innovative technology development and demonstration.

d) Technology applications of local battery energy storage systems for e-vehicles and renewable energy
   - This aims to validate and test the performance of battery related DOST/PCIEERD funded projects

3. Nuclear Energy (*3 projects with maximum funding of Php 110M and duration of 2 years*)
    a) R&D on Nuclear Fuel Cycle
        - In line with DOST's role and responsibilities under the Nuclear Energy Program-Inter Agency Committee (NEP-IAC)[1] Sub-Committee 6 (SC6) which aims to assess the nuclear fuel cycle of the country including siting, environment and emergency plans for nuclear power plant installations, and nuclear radioactive waste management.

The call is in response to the DOST's role under NEP-IAC SC6 to develop front-end and back-end of the nuclear fuel cycle. Specifically, the call aims the following deliverables:

- Nuclear materials and recovery in the Philippines.
- SMR/NPP-Related Studies including siting and assessment, baselining, nuclear reactor design, feasibility/viability, and stakeholder's acceptance.
- Radioactive waste management including siting of storage, pre-disposal, disposal, and borehole disposal facilities.

The call is expected to develop and introduce cost-competitive, innovative and effective energy technologies and policies to address the gaps and deficiencies in the existing supply chain and best available technologies. These technologies should be able to provide solutions and benefits such as improved energy security, resilience, cost effectiveness and social and economic impact. Techno-economic viability studies are required for possible demonstration sites and applications. Output derived from the project must lead to new, or improvement of, existing standards/policies & energy regulations and codes. Differentiate the proposed technology and method/technique by elaborating on cost-competitiveness, productivity enhancement, and efficiency improvement with existing technologies and applications.

Additional Call Document Requirements

The implementing agency and proponent should have a track record and established expertise in implementing projects, specifically in the energy sector.

- Endorsed by the Head of Implementing Agency. Proposals submitted for consortium must also include an endorsement from the Regional Consortium Chair.
- Sound scientific basis for the proposed technology includes:
    - Relevant data and literature to provide situationer for the pressing national problems to be addressed
    - Appropriate experimental design and statistical analyses when applicable
    - Advantages and differentiation over existing similar technologies

[1] NEP-IAC – Created under Malacañan Executive Order 116 titled ""Directing A Study for the Adoption of a National Position on a Nuclear Energy Program, Constituting a Nuclear Energy Program Inter-Agency Committee, and for other Purposes"

- Letter of Commitment from an industry partner or end user. Specific involvement must be identified in the letter (e.g. investor in technology development, adopter of the R&D output) as well as their counterpart support in project implementation (e.g., funding, or in-kind donation – equipment, personnel technical support, provisions for service facility)

The proposal must include the following details:

  - Clearly presented value or opportunity cost of the project outputs/deliverables.
  - Socio-economic impact (projected increase in productivity of risk managers or additional income of industry)
  - Current demand for the proposed technology
  - Environmental impact and waste management plans
  - Initial Feasibility Study (FS)/ Studies that describes the current need/situation of the target community
  - Detailed Risk Management Plan
  - Detailed Sustainability Plan after the Project Completion (institutional, financial, and human resources) for the host institution and partner industry.
  - Counterpart funding from the partner agencies to be involved in the project.
  - Counterpart resources (e.g., facilities, equipment) available in each implementing agency
- For project leaders with on-going or recently completed projects updated reports for their respective projects should be submitted (i.e., technical progress and terminal and audited financial report)

B. UTILITIES SECTOR

I. SMART APPROACH FOR THE CONSTRUCTION INDUSTRY

Call Rationale

The construction industry played a key role in accelerating the Philippine economic recovery in 2022 despite a challenging 2020 and 2021 due to global pandemic. Bases on the data of the Philippine Statistics Authority and Philippine Construction Authority, the Philippine construction industry registered an annual growth of 10.6% in 2021 following an annual decline of 30.3% in 2020, with an expected growth of 21.8% in 2022. This progress was supported by the investment of the government under the Build Build Build Program amounting to P1.2 trillion in 2022. It is expected to register an annual average growth rate of 7.5% from 2023 to 2026, which includes an investment of PHP4.7 trillion ($95.4 billion) on 112 Infrastructure Flagship Projects (IFPs) under the Build Better More Program. 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.

Despite this investment from the government and private firms, construction is still widely known to be one of the slowest adopters of technology, ranking second from the bottom, ahead of only agriculture. However, for the last two years of pandemic, the industry is recognizing the benefits of construction technology as a means to mitigate challenges of productivity, efficiency, cost, manpower and safety.

Thus, DOST increased its efforts to support the technological needs of the industry in 2020-2022 with 58 research projects amounting to more than 500 million pesos which are implemented by Research and Development Institutions (RDIs) and HEIs nationwide in partnership with private construction firm, DPWH, PPA, NHA and other relevant NGAs/LGUs. To sustain these efforts and to continuously help the industry, DOST initiated collaboration agreement with the DPWH under the Climate Resilient Infrastructure Initiative Program, participated in government-led working group such as NHA AITECH, DTI-CIAP, DOTR Philippine Road Safety TWG, etc, and conducted various stakeholders meetings with DTI Construction Industry Association of the Philippines members, DPWH, NHA, DILG from September to December 2022 resulting to the updating of the Construction S&T Roadmap and re-prioritization of research topics for possible 2025 funding.

The DOST Construction S&T Roadmap with the theme “Smart Approach for the Construction Industry Program” is formulated, aligned with the NEDA Ambisyon 2040 - The Life of All Filipinos: Matatag, Maginhawa at Panatag na Buhay by 2040, the Philippine Construction Industry Roadmap 2020-2030 with the themed "TATAG at TAPAT”, and the DPWH KONKRETO Program. DOST is hoping that the roadmap and its effort to harmonize the various program and initiatives –will aim to provide the necessary technological support in the implementation of the Build Better More program through

providing sustainable construction materials, innovative construction techniques including provision of human resources program and advance testing laboratories.

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 towards a climate-adaptive and resilient infrastructure.

Call Scope

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

A. Construction Material Technologies (40M for 5-7 projects)
    1. Development of climate-adaptive housing and building technologies

        - use of sustainable agro-industrial waste or indigenous materials for green building/housing - ease of construction, cost-effective, improved physical and mechanical properties, and climate-adaptive features

    2. Localization of commonly used chemicals by the construction industry using indigenous or agro-industrial waste (superplasticizer, adhesive, hardener, etc)

B. Improvement of Construction Practices through innovative system with pilot demonstration (90M for 10-12 projects)
    1. Localized and cost-effective construction assessment, monitoring or surveying equipment

        - monitoring or testing equipment used either for pre, during and post construction of roads, bridges or buildings

    1. Innovative and cost-effective design/methods/techniques
    2. Application of new construction technologies contributing to CO2 reduction
    3. Dry construction techniques that utilize innovation with reduce or limited use of water
    4. Value adding and innovative use and application of recycled concrete, debris or any construction demolished materials
    5. Development and demonstration of coastal and mountain engineering infrastructure-related technologies
    6. Utilization of generated science-based data for design and analysis of critical infrastructures (digitalization, actual simulation analysis, etc.)
    7. CRADLE type proposal - Enhancement of current methodologies of relevant NGAs or private adaptor
    8. Foreign Collaboration - Acquisition of knowledge and technologies from in(ternational partners for optimization and application locally, including advance testing laboratories that is needed by the construction industry or in the updating of existing or development of new local testing standard

and code - incorporation in the National Building Code and National Structural Code of the Philippines.

Specific Features Sought in this Call:

The proposed projects should be able to develop and introduce innovative and more efficient construction technologies through the use of indigenous and sustainable **materials**, or 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. The proponent should be ableto 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 must partner and secure a commitment letter with possible technology adoptors, construction companies, relevant government agencies and end-users with provision of counterpart funding support in the project implementation especially for pilot demonstration.

II. SMART AND INNOVATIVE WATER MANAGEMENT AND INFRASTRUCTURE

Call Rationale

The Philippines has an abundant freshwater resource obtained mainly from rainfall, surface water, and groundwater. The average annual rainfall amounts to 2,440 mm, rivers, lakes and reservoirs constitute to 125.4 billion cubic meters with groundwater potential of 20.2 billion cubic meters and reservoir aggregate area of 50,000 sq km. Theoretically, it is expected that the Philippines should have sufficient water supply. However, due to the geographical location, changing environmental conditions, high-economic growth, and water balance (difference between the amount of water resources potential and the water demand), the country is experiencing both flood and drought issues.

Forecast suggests that in 2025, Philippines will not be able to meet the demand for water supply. More so, the World Resources Institute (WRI) predicted a high degree of water shortage that will be experienced in 2040 with agriculture as the most stressed sector, and Mindanao as the most stressed region. In 2015-2016 alone, the country was driven with severe El Nino event ever recorded which caused damage across 16 out of 18 regions – drying nine (9) dams, to where six (6) were critical and ten (10) were below normal levels. Recent typhoons in 2022 once again brought severe flooding

demonstrated current water infrastructures and disaster management systems cannot satisfactorily adopt with extreme climate conditions affecting lives of the Filipino. These phenomena inflict impact on streamflow, dam operation and water allocation, domestic water supply, irrigation, hydro power generation, depth and recharge of aquifers, water quality, and watershed.

In an effort to deliver science-based services towards effective water management of irrigation and in the management of water resources in the Country, DOST partnered with the National Irrigation Administration (NIA) and the National Water resources Board. Consequently, various stakeholders' meetings, water summits were conducted in 2022 with the NIA, NWRB, Department of Interior and Local Government (DILG), the National Economic and Development Authority, and LGU-owned Water Districts that led to the updating of the Water Resources S&T Roadmap with identified new research topics as well as re-prioritization considering the current state of the country in managing its water.

The current roadmap is in accordance with the objectives of the Philippine Development Plan (PDP) 2017-2022, National Climate Change Action Plan (NCCAP) 2011-2028, and aligned with the initiatives of NIA, NWRB, priority of DILG on water management and with the goals of the pending establishment of national framework for water resource management, department of water resources and water regulatory commission.

Call Objective

The objective of this call is to provide S&T interventions that are not yet applied/used locally for effective management of our water resources through the development and introduction of innovative tools, methodologies, and technologies to ensure safe, adequate, and sustainable water supply.

Call Scope

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

1. Innovative drought mitigation technologies and systems
2. Integrated community-based water management system
    a. Artificial groundwater recharge, natural recharge
    b. Rainwater Harvesting Facility
1. Use of innovative approach in generating artificial rainfall (cloud zapping) including raw materials development
2. Innovative flood defense/control system/infrastructure
3. Integrated water saving/recycling systems (i.e., filtration and water re-use_
4. Water desalination (non-membrane, non-solar powered) and saltwater intrusion mitigation technologies

5. Dams/watershed management and monitoring strategies including development/establishment of in-situ equipment
6. Monitoring system and decision support tool for high turbidity in water during extreme weather events
7. Automated irrigation operation and management
8. Smart IoT-Based water supply and demand management and monitoring (water accounting and duty)

Specific Features Sought in this Call:

DOST is looking for proposals on the development of cost-effective, advanced, and localized tools, methodologies and technologies in managing our water sources: surface water, & groundwater, and in addressing water-related hazards: flooding & drought. Through this intervention, the program will provide solution to limited water resources, water efficiency and conservation, water demand management, aquifer depletion, mitigation of water related hazards and climate change adaptation strategies. The projects should be able to differentiate the proposed interventions by elaborating the cost-comparative assessment, monitoring and management improvement, efficiency, and sustainability.

Further, the output of the project should contribute to the development and/or improvement of new and existing water policy and management decisions, codes, benchmarks, sanitary, irrigation, flood control, assessment and allocation tools and operating rules of all existing and future water infrastructure. Proponents must partner and secure commitment letter with possible technology adaptors, water companies, relevant government agencies and end-users with provision of counterpart funding support in the project implementation.

C. TRANSPORTATION SECTOR

Call Rationale

Transport and logistics have been recognized by several development plans as critical for the Philippines' economic and social transformation and competitiveness. AmBisyon Natin 2040, for example, identifies "connectivity" through roads, bridges, ports, vehicles, and transport systems as a "priority sector". The recently published Philippine Development Plan (PDP) 2023-2028 acknowledges transport and logistics as key in linking markets to each other and in facilitating the movement of people and goods (Figure 1). Towards this end, national government agencies, such as the Department of Trade and Industry (DTI), the Department of Transportation (DoTr), and the Department of Public Works and Highways (DPWH), have formed a collaboration to launch initiatives that aim to facilitate the seamless movement of goods. The Pagtanaw 2050 by the Department of Science and Technology has also foregrounded the role of transportation, especially considering the country's maritime and archipelagic environment. For its part, the Council has also formulated transportation roadmaps in support of these thrusts.

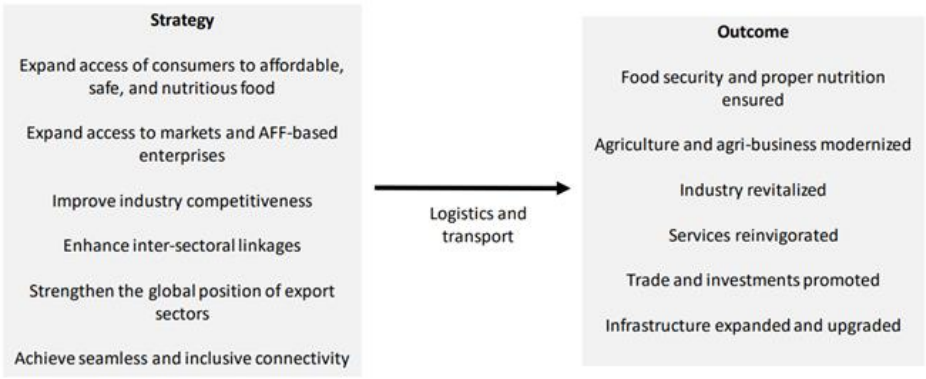


Figure 1: Logistics and transport as a key component of the strategy to achieve national outcomes (Adapted from PDP 2023-2028)

In a series of consultations conducted by the Council in 2022, the theme of "digital transformation of the transport sector" emerged as a prominent area suggested by the stakeholders (see, for example, Sunio et al, 2022). Digitalization has for many years been supported by the Council, as can be seen in its Transport S&T Roadmaps (2020-2024). Moving forward, we aim to further support the digital transformation of the transport sector in the following areas: (a) human element and training, (b) cargo and logistics, (c) maritime safety, and (d) vessel management. The need for digitalization was in no small part catalyzed by the COVID pandemic, which fueled rapid digitalization across the globe.

Further, with the passage of EVIDA law, transitioning of public utility vehicle to cleaner mode of transportation like electric vehicle is being planned that in the near future only electric vehicle will be allowed for new vehicle registration. Hence, S&T intervention from the local transportation manufacturers would need assistance to conform with the EVIDA law.

Call Objective

The objective of this call is to provide science and technology intervention to accelerate the digital transformation of the transport and logistics sector. Digital transformation may result in greater efficiency in the delivery of services and in increased industry competitiveness. We are interested specifically in the digital transformation of the following:

- Logistics sector through the adoption of the physical internet paradigm
- Education and training of human resources in the maritime sector
- Maritime safety
- Scheduling of the dry-docking of the Philippine-flagged vessels
- Electric Public Utility Bus

Call Scope

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

1. The Digital Transformation of the Logistics Sector

    A. Development of proof-of-concept in support of the implementation of the physical internet for urban and maritime logistics *(Maximum of 2 projects with a maximum total funding of PHP 10,750,000)*

    Since the physical internet is a new paradigm in the Philippines, there is a need first to persuade potential stakeholders from the logistics sector of the viability of implementing the physical internet in the Philippines. In this regard, proofs of concept (POC) are needed. They can be simulation- or field-based proofs of concept, which aim to gradually implement and test key functions of PI-enabled interconnected logistics. The POCs must demonstrate how the industry may look like in comparison to the status quo and the potential gains that may be expected when partially and fully transitioning to the Physical Internet.

    B. Use of ICT based technology for cargo and traffic management in and outside the ports and corresponding cities *(Maximum of 1 project with a maximum total funding of PHP 10,750,000.00)*

Mentioned in the national logistics master plan of the Department of Trade and Industry (DTI) as a key action area where DOST can contribute to, this project aims to utilize information and communication technologies to facilitate the seamless movement of cargo from ports to urban areas. Such emerging ICT may enable the integration of ports and cities for efficient freight movement and logistics.

2. Development of online course platforms and learning management systems for superintendents, seafarers, cadets, and other workers *(Maximum of 2 projects with a maximum total funding of PHP 21,500,000)*

Due to the pandemic, there is a growing recognition of the need to deliver high-quality maritime education and training for human resources through online courses and e-learning platforms. This project aims to digitalize human element and training for the maritime industry by developing simulation tools and online courses for the Philippines' manpower resources (seafarers, cadets, superintendents, etc.). Potential collaborators can be MARINA, Marine and Technical Superintendent Association of the Philippines, and National Maritime Polytechnic.

3. Development of real-time monitoring system of vessels for the purposes of maritime incident investigation *(Maximum of 1 project with a maximum total funding of PHP 10,750,000)*

Different from AIS-based applications for the purposes of rescue by the Philippine Coast Guard, the proposed system aims to develop a monitoring system for vessels in real-time for maritime incident investigation. This requires cross-agency collaboration and sharing of data, such as weather information, including sea conditions (PAGASA), tidal and underwater current information (NAMRIA), vessel information from AIS (PCG), vessel inventory (DOSIS-MARINA), port inventory (PPA), vessel traffic reports (PPA), and maritime accident/incident report (ES-MARINA). This can support Program 6 of MARINA's Maritime Industry Development Plan (MIDP) on the Enhancement of Maritime Safety in the Philippines.

4. Design and Development of a Digital Tracking and Scheduling System for the Dry Docking of Philippine-flagged Vessels *(Maximum of 1 project with a maximum total funding of PHP 5,375,000.00)*

The absence of a digital tracking and scheduling system causes the ship owners to have difficulties in overseeing their vessel's drydocking calendar. Since shipyards have a limited drydocking capacity, urgent drydocking appointments may pose scheduling problems. A digital tracking and scheduling system for the drydocking of Philippine-flagged vessels is thus needed. Conceptualized by the University of Science and Technology of Southern Philippines (USTP) during the Maritime Conference held in

Cagayan De Oro City, this technology innovation is intended to help vessels and drydocking facilities be compliant with the requirements of the Convention for the Safety of Life at Sea (SOLAS).

5. Urban Electric Public Utility Bus Conversion and Development (maximum of PhP25,000,000)

Reducing GHG emission in urbanized areas is one of the priorities in the climate change mitigation program and the transportation sector is one of the major GHG contributors. Likewise, addressing the local transportation manufacturers need to conform with the EVIDA law, a low bed electric public utility bus is prioritized to be locally developed and viability assessment for electric conversion of existing PUB if economically proven with policy intervention and standard development is also being prioritized in collaboration with the local bus manufacturers.

Further Reading:

The following materials are suggested for further reading. These are write-ups prepared after the stakeholders' consultations:

Sunio, V., Santos, E., Baleta, F. and Tabañag, I (2022). "Research and Development Agenda for the Philippine Maritime Sector: Results from Stakeholder Consultations". https://ncts.upd.edu.ph/tssp/wp-content/uploads/2023/01/TSSP2022_02.pdf

Special Issue on the Digital Transformation of Transportation.

https://innovatus-pub.github.io/abstractpublications_archive/abstractpublications_2022b.html

D. FOOD SECTOR

Call Rationale

The agri-food sector in the Philippines is a primary driver of the economy. Valued at USD 127B, the sector contributes 30% of the country's total GDP and employs 43% of the country's workforce, with food and beverage manufacturing as the largest component supporting 4.0 million jobs in 2019 (Oxford Economics, 2021). However, the COVID-19 pandemic in 2020 led to limited movement and transport restrictions that magnified the vulnerabilities in the sector as availability and access to food affected the population regardless of socioeconomic status. As a result, the national government reaffirms the need to boost the improvement of the sector amidst imminent risks on the agri-food sector brought by the prevailing effects of the pandemic, emerging market tensions and global trends, and the impacts of climate change.

The *Pagtanaw 2050* Philippine Foresight on Science, Technology, and Innovation recognizes the shift towards a science-based food system paradigm to achieve the desired transformation into a more sustainable future with sufficient, safe, accessible, and affordable nutritious food supply that have positive or neutral impact on the environment. In line with this, PCIEERD continuously supports R&D and S&T initiatives for the food sector as specified in the Harmonized National R&D Agenda 2022-2028 for Industry, Energy, and Emerging Technologies, and in support of the UN Sustainable Development Goals No. 2 on Zero Hunger and No. 12 on Responsible Production and Consumption. This is also aligned with efforts towards food security and nutrition outcomes identified in Chapter 3 of the Philippine Development Plan 2023-2028.

Call Objectives

To address challenges in the sector, this Call aims to support effective programs and strategies for (1) ensuring product safety and quality, (2) utilizing local products rather than importing raw materials for food processing, (3) developing technologies for the conversion of "waste-materials" into value-added products, (3) development of human resources for the food sector, and (5) conduct of joint research on new technologies and systems in response to global trends.

Call Scope

This Call covers the four (4) programs of the Food Sector with specific priorities presented in the next sections and as validated with the program stakeholders:

1. Food Safety Program
2. DOST Halal S&T Program
3. Food Innovation Program
4. DOST Smart Food Value Chain Program for the New Normal

I. *Food Safety Program*

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 Republic Act 10611 or the Food Safety Act of 2013 was enacted to ensure the safety and quality of foods and to serve as the framework for the implementation of the farm to fork food safety regulatory system in the country. The Department of Science and Technology (DOST) supports the implementation of this law through the provision of appropriate science, technology, and innovative programs through our DOST Integrated Food Safety Program.

In 2021, the DOST Food Safety Policy (DOST Memorandum Circular no. 3 s. 2021) was signed which defined the role and scope of the DOST on the implementation of RA 10611. It is also through this policy that the DOST Integrated Food Safety Program Committee was formed in which the DOST Undersecretary for Research and Development and DOST Undersecretary for Regional Operations were assigned as Chair and Co-Chair of the Committee, respectively. With the gaps/challenges identified during the review and assessment of the program roadmap covering the period 2017 to 2022, a new program roadmap was crafted to cover the period 2022 to 2028. Roadmaps for the following program components were developed: (1) Research and Development on Food Safety, (2) S&T Services on Food Safety, (3) Human Resource Development on Food Safety, and (4) Knowledge and Technology Transfer and Policy Advocacy on Food Safety. The roadmaps were also presented to stakeholders in a virtual presser in the last quarter of 2021.

In 2022, the DOST Food Safety Program Committee reviewed the priorities and validated the topics for inclusion in the next Call. The identified priorities per component are as follows:

Priorities

Under *Food Safety R&D*:

- Development of guidance manual on safety aspects of food processing equipment
- R&D to support food industry in the time of pandemic and beyond for guidelines, training, and policy measures for safe production and distribution of food products including specialty food manufacturers and online food sellers
- Food packaging hazard migration studies for scientific data on level of food packaging contaminants
- Development of MSMEs' traceability systems
- Center on food safety risk profiling for chemical and microbiological hazards

Under *Food Safety S&T Services*:

- Application of globally accepted DOST standard chemical and microbiological methods for food safety testing parameters, and harmonization of tests methods into international reference methods.

- Provision of analytical testing services for quality assessment of local products (quality of Virgin Coconut Oil, safe methanol level of lambanog, and histamine testing for local and export food products)
- Establishment of the National Food Safety Reference Laboratory in the Philippines with proficiency testing, food reference materials, and quality control material and proficiency test scheme for food microbiological laboratories.
- Strengthening food safety and traceability through nuclear and isotope-based technology

Under *Food Safety Human Resource Development*

- Food safety guidelines and training for disaster management and model kitchen/facility for disaster relief operations
- Competency-based training program for DOST Food Safety Teams
- Development of massive open-online course on Food Safety

Under *Food Safety Knowledge and Tech Transfer and Policy Advocacy*

- DOST Food Safety fora and summit

Target Number of Projects: 11
Total Budget: 239M

II. ***DOST Halal S&T Program***

RA 10817 or the Philippine Halal Export Development and Promotion Act was enacted in 2016 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 response to RA 10817, the DOST issued Memorandum Circular No. 010, series of 2016 *"DOST Policy on Science and Technology (S&T) Support to Halal Industry Development"* 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 in the country. With this, the DOST implemented the DOST Halal S&T Program which lays down the plans and programs for four (4) areas, namely: (1) Research and Development (R&D), (2) Human Resource Development (HRD), (3) Knowledge Transfer and Advocacy, and (4) Halal Verification Laboratory (HVL) Testing. These initiatives hope to strengthen the local Halal industry in meeting technical standards for global competitiveness, enhancing capability in Halal verification, and transfer the knowledge from the R&D to help promote Halal awareness.

From 2018 to 2022, there are 18 projects implemented, with the majority on R&D (11 projects), followed by HRD (5 projects), and Laboratory Testing (2 projects). The remaining unsubscribed component is on Knowledge Transfer and Advocacy in which the establishment of a Halal Knowledge Center and conduct of Halal S&T Summit are targeted. These targets were also confirmed in the consultation meeting with representatives of the DOST Halal S&T Committee in 2022.

To continue its holistic intervention in strengthening the Halal ecosystem of the country, the Council is now on its final leg of providing support by focusing the call on Technology Transfer and Policy Advocacy.

Priorities

- Establishment of Halal Knowledge Center as central repository with online database of R&D output and Halal-related activities
- Organized Halal S&T Summit in collaboration with stakeholders

Target Number of Projects: 2
Total Budget: Php 25,000,000.00

III. ***Food Innovation Program***

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). The following challenges identified relative to the ASEAN integration in 2015 continue to affect the local industries:

- Continued dependence on imported raw materials
- Need for improvement or innovation in local technology
- Ability to consistently deliver the required level of quality and food safety

To address these concerns, an array of possibilities exists for innovation - from the sourcing of raw materials, processing, packaging, including marketing and distribution systems. For the period 2018-2022, the food innovation priorities supported by the Council fall under three (3) general themes:

- Enabling Systems for Food Innovation – these include projects on establishment or upgrading of processing centers and other facilities, building capabilities, and enhancing systems that impact the food sector as a whole
- Innovative Food Products – these include projects on new product development for ingredients or intermediate food, emergency food, and other novel food products
- Specific Industry or Regional Concerns – these include projects conceptualized to address a particular problem or challenge of a company or an industry group. Projects handled under the Collaborative Research and Development to Leverage Philippine Economy (CRADLE) fall under this theme.

The overall roadmap was crafted starting with the 2017-2022 strategic map of the DOST Food Innovation Centers and the priorities supported by the council on food innovation. With these priorities, the Food Innovation Program was developed with the vision to make local industries more sustainable and at the same time, geared towards innovative food products with better quality and improved safety that responds to the population's nutritional and health requirements.

Industry concerns and challenges were validated in February 2021 during the S&T consultation with the food industry conducted in partnership with the Board of Investments of the Department of Trade and Industry (DTI-BOI). For 2022, there were two (2) consultation meetings conducted to review the priorities under the program together with stakeholders from the academe, industry, and government.

For the 2025 call for proposals, the priorities will continue for the three general themes, with specific topics and corresponding output identified.

Priorities

Under *Enabling Systems for Food Innovation*

- New Processing and Packaging Technologies for Local Food Industries
    - Nutrition-sensitive food processing technologies:
        - Freeze Concentration Technology (for calamansi & other juices, coconut water) Membrane Technologies (for coconut water)
        - High Pressure Processing
        - Pulsed Electric Fields
    - Smart Packaging Solutions:
        - Self-heating mechanism for ready-to-eat food
        - Freshness indicators for local commodities

Under *Innovative Food Products*

- Utilization of Food Processing Industry By- Products for Food Applications
    - Shrimp production by-products (extracts, chitosan)
    - Monolaurin and Medium Chain Triglycerides (MCTs) from Virgin Coconut Oil (VCO) processing
    - Banana flour and Coconut flour from industry by-products as food ingredient with technical functionality
    - Lycopene from tomato processing by-products

Under *Specific Industry or Regional Concerns*

- Center for Revitalization of the Philippine Salt Industry
    - Technologies for improved production efficiency and salt quality
    - Standardized salterns based using best practices
    - Integrated salt production system for local communities considering geographical location and climate conditions
    - Scientific data on the effect of salt iodization on food processing and product characteristics

Target Number of Projects: 8
Total Budget: Php 75,000,000.00

IV. *DOST Smart Food Value Chain Program*

The DOST Smart Food Value Chain Program was conceptualized in 2020 in response to the need to ensure local food sufficiency for the new normal as a result of the severe disruption in the food value chain. This program integrates the initiatives of the DOST agencies: PCAARRD, PCIEERD, ITDI, FNRI, the Regional Offices, and our partner institutions to further develop and utilize smart and innovative technologies throughout the food value chain. Through the program, interventions are introduced along the different nodes of value chain from production, processing including packaging, distribution, to consumption. Under Production, PCAARRD handles Enhancing the Agri-Aqua Food Value Chain through Smart Technologies and Partnerships and Upgrading of Agricultural TBIs. Meanwhile, PCIEERD handles projects under Processing, Distribution, and Consumption.

Beyond the food value chain is the concept of a larger food system that interacts with and has corresponding impacts on the environment, economy, and the society. Thus, this program is a jumpstart in recognizing the current dysfunction in Philippine food systems, with the increasing demand to provide adequate food for the growing population as it is expected to reach almost 145 million in 2050 (UN World Population Prospects, 2022). This is further affected by climate change, malnutrition, depletion of resources, inequality, and poverty. In 2021, the Philippines participated in the UN Food Systems Summit by conducting a series of dialogues that highlighted the need for food systems transformation with the following outcomes:

- Improved access to safe and nutritious food
- Shift to healthy and sustainable consumption patterns
- Boosted nature-positive production at scale
- Advanced equitable livelihood and value distribution
- Built resilience to vulnerabilities, shocks, and stresses

For this Call, proposals are sought on the remaining topics identified under the program as validated with stakeholders from the academe, government, and industry in 2022. In addition, a scoping study on the current level of knowledge to determine priority R&D and S&T interventions for Philippine food systems transformation is included.

Priorities

- Development of IT-based platform for traceability and effective management of resources within the food supply chain
- Processing technology on food waste management and recovery
- Establishment of smart/innovative technologies in the food value chain that allows direct retail from farmers to consumers

- Scoping study on food systems transformation for the Philippines

Target Number of Projects: 4
Total Budget: Php 35,000,000.00

Specific Features Sought in this Call

For all programs

- The implementing agency and proponent should have a track record and established expertise on the proposed project.
- A collaborative undertaking among institutions is encouraged. Institutions from other region/s which are working on similar or related research areas may also be engaged given their capability and commitment.
- The proposal must include the following details:
    a. Detailed Review of Literature by including previous works and/or relevant studies where the proposal will take off.
    b. Sound scientific basis including:
        i. Relevant data and literature to provide situationer for the pressing national problems to be addressed
        ii. Appropriate experimental design and statistical analyses
        iii. Advantages and differentiation over existing similar technologies/studies
    c. Information on potential socio-economic impact and marketability:
        i. Projected employment generation after the completion of the project. Identify the possible specific jobs to be involved and estimated number of personnel needed.
        ii. Estimated income/productivity rate once the project's outputs are established.
        iii. Current demand and potential market expansion due to the project.
        iv. Advantages of the proposed studies and its target cost over the existing/commercially available/similar studies
        v. Potential impacts to the identified industry partner or partner institution.
    d. Data on how the project can contribute to the improvement of environmental conditions by including any possible environmental impact from the proposal and waste management plan
    e. Adequate counterpart funding from the implementing, collaborating, and cooperating agencies.
    f. Counterpart resources (e.g., facilities, equipment) available in each implementing agency.
    g. Letter of commitment from identified cooperating agencies willing to test and/or adopt the project output.
    h. Risk Management Plan. Identify the risks on the implementation of the project. Develop and submit an action/contingency plan for identified risks and prepare alternative activities to avoid delays in the conduct of the activities of the project and its implementation.

i. Technology Roadmap. A clear roadmap of project activities and outputs

- Clear plans for utilization of project results:
    a. Specify mechanisms for the sustainability of operations
    b. Strategies for wider adoption by indicating how the project results can be scaled up to be widely used or available.
    c. Provide the details on how the target beneficiaries will participate or benefit from the project
    d. Detailed plans for promotion and transfer of technology to end-users
    e. Sustainability plan includes established mechanisms in terms of institutional, financial, and human resources capability. The sustainability plan refers to the continuity of the project after its completion.

For the Food Safety Program

1. Clearly presented values or the corresponding opportunity cost for the proposed interventions. This can include details on potential socio-economic impact in terms of the projected increase in productivity of risk managers or additional income of industry, as well as potential benefits in terms of public health.
2. Defined partnerships or collaborations with food safety regulatory agencies and other relevant institutions for the project implementation and sustainability of operations
3. **Food Safety Risk Profiling Center**
    - Multi-year project (maximum of 3 years) with a clear roadmap of R&D activities and outputs
    - Have at least three (3) R&D project proposals which may have different implementing agencies
    - Submit endorsement of the Regional Development Council (RDC) or its equivalent and by the Head of the Implementing Agency.
    - Organizational and operational structure of the proposed Food Safety Risk Profiling Center.

For Halal Knowledge Center

- Endorsement by the DOST Halal S&T Program Leader.
- Strategic location in establishing the center and provide the capacity and how the operationalization will take place after the project completion.

For Smart Food Value Chain Program

- The proponent should have established partnership with DOST Regional Offices, private institutions, local government units, and other government agencies that would contribute data on the different stages of the value chain.
- The proposed system must integrate existing developed systems/platforms of other agencies on value chain and resource management.
- Identified strategies for deployment and transfer of the proposed system to the end users

E. 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 chemicals, pharmaceuticals, petroleum, plastics, rubber, textiles, tobacco, food, beverages, etc. as cited by IISE (Institute of Industrial and Systems Engineers, US).

The Process Sector of PCIEERD invites Research and Development proposals for the following programs to assist specific key industries in the country:

- ***Natural Products Program*** (Regular Call)
- ***Chemical and Biological Manufacturing and Allied Industries Program*** for (a)Metrology Program; (b) Vaccine Manufacturing and its Allied Pharmaceutical Industries Program; and (c) Controlled-Chemicals for Industrial Use (Regular Call)
- ***Textiles Program*** (Regular Call)
- ***Green Polymers Research*** (Regular Call)

With CFP 2025, the Process Sector aims to:

- Assist the identified sub-sectors in their S&T needs through R&D Programs and interventions resulting to increased competitiveness of the industry
- Engage the R&D Institutes and Academe in collaboration with the industry in developing R&D programs for the identified research calls
- Contribute to the development of the industries by enabling R&D programs that are anchored/aligned to the following:
    a. Existing PCIEERD Roadmaps or its corresponding industry roadmap from government agencies (eg. DTI and DA)
    b. 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*
    c. Harmonized R&D Agenda under Section IV. Industry, Energy and Emerging Technology Research and Development Agenda 2022 – 2028 in II.V. Process

- **NATURAL PRODUCTS PROGRAM**

Call Rationale

The Natural Products subsector is the program focused on products from extraction and downstream processing from agricultural and marine sources that would serve the needs of the community for industries, such as personal care, cosmetics, food, household products, and non-active components of pharmaceuticals. Natural Products industries have been a fast-growing economic cluster owing to their products' associated health benefits and functionality.

According to GlobalData, the Philippine skin care industry is expected to increase at 7.7% CAGR valued at Php74.8B by 2026. The opportunity in natural products is expected to increase as consumer preference increases toward sustainable and natural ingredients. This is also true for other industries which showed a positive impact on natural products such as the textile and food sector.

In November 2022, a Stakeholder Consultation meeting was conducted to review the midterm action plan for 2025-2027 of the roadmap. This meeting was participated by key stakeholders from the industry (SECURA INTERNATIONAL CORP., Herbanext Laboratories, Inc., PHILEXPORT, Natural Products Society of the Philippines), academe (UP Baguio, UP Los Baños, UP Manila, UP Diliman, ADMU), research institutions (FPRDI, FNRI, ITDI, PTRI), and relevant government agencies (PCHRD, DTI-BOI, FDA). The output of this meeting is reflected in the call scope.

Call objective

The objective of this call is to develop innovative technologies to enhance quality and even create new market segments for the use natural products. This is to take advantage of the strong market demand gains momentum on natural product with wide array of industrial application: food additives and nutraceuticals, flavor and fragrance, dyes, crop, drugs, industrial enzyme catalyst, natural polymers, 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.

Call scope

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

1. Valorization of various wastes for extraction of natural compounds for various industry applications
    a. development of plant-derived excipient for industrial application (except pharmaceutical products)
    b. seed nut and seed cake pongamia, bitaog, and malunggay for cosmetic application
    c. commercial-scale production of natural products from banana, pineapple, coconut, molasses, and calamansi
2. Development of Natural Products from abundant raw material source for personal care products application (e.g. Rubber seed oil, mussel, and microorganisms)

3. Comparison of Ultrasound and Conventional Extraction Methods on the Yield of Anthocyanin Pigments from Roselle, Cooked Ubi Peels, and other sources
4. Comparative GC-MS Profiling of wild and propagated seed-bearing plants and essential oil products

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

- Results of industry roadmaps (if available)
- Intensive Review of Literature showing no duplication in proposal concept with local researches conducted
- Technology Readiness Level between 2-6. It should encompass Technology Formulation, Validation of the Technology, Small Scale Prototype, Large Scale Prototype (if applicable).
- Sustainability of both the supply of raw materials and finished product.
- Has a potential for commercialization. Commitment letter/s from industry partner/s to support the marketability of the proposed product to demonstrate interest is required. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.

PCIEERD will fund/endorse maximum of 4 projects not to exceed Php60M budget covering all projects. The maximum duration for each project is 2 years.

- **CHEMICAL AND BIOLOGICAL MANUFACTURING AND ALLIED INDUSTRIES PROGRAM**

The primary program of the Chemistry and Biology Roadmap is the Metrology Program. However, the roadmap has expanded its coverage in 2022 to include industry-driven R&D needs such as the virology program and the PNP-controlled chemicals.

Call Rationale

B.1. Metrology Program

Metrology, the science of measurement, is vital for fair trade, consumer protection, health, safety, product quality, R&D, and environmental protection of a country. The importance of measurement can be seen practically everywhere, for example, when buying commodities by weight, getting blood pressure for diagnosis, measuring diameter for proper fit, time of day, duration of metered call, speed, and for R&D, among other things. For the Philippines, metrology is led by and practically centered at the National Metrology Laboratory (NML) of the Industrial Technology Development Institute. The program, " Enhancement of the Competence and Capability of the National Metrology Laboratory of the Philippines" implemented by ITDI from 2017 to 2022 has substantially upgraded the competency and capability of the national metrology laboratory by expanding

its services relevant to the testing requirement of the food industry as well as the manufacturing industry.

In March 2021, a Stakeholders Consultation meeting attended by more than 100 participants from the academe, government testing laboratories, and private laboratories prioritized Proficiency Testing needs of the testing laboratories based on industry demand. To sustain and further stabilize the Chemical and Biological metrology, the development of technologies for the next priority list of analytes/microorganisms should be done. This is to also support the industries heavily reliable on dependable testing results such as food, beverage, chemical and other related industries. Moreover, the programs will continuously upgrade the capability of the physical metrology laboratories to be at par with international standards and sustain traceability through its accreditation, continued competitiveness of its personnel and completeness of its facility.

Consequently, the Metrology Act of 2003 or RA 9236 is one of the legislative priorities of DOST. This act aims to create a National Institute of Metrology to accelerate the measurement capabilities of the country in various technical measurement areas and enables computation confidence to facilitate fair trade.

As a primary institute and champion of metrology in the country, it is highly encouraged for the NML to produce output such as publications and enable participation of Calibration and Measurement Capabilities (CMCs) in key comparisons within the framework of the International Committee for Weights and Measure Mutual Recognition Agreement (CIPM MRA).

B.2. Controlled Chemicals for Industrial Use

In August 2022, PCIEERD spearheaded a Policy Dialogue on the IRR of PNP-Controlled Chemicals to elaborate the industry, researcher, and academe perspective on the IRR. From this dialogue, ways forward through PCIEERD interventions were identified:

1. Capacity Building (e. g. local training, benchmarking, Upgrading and Establishment of Laboratories, BSP and S&T Fellows)
2. Review of list of chemicals including concentration and volume, explosive potential (4 chemicals) for exemption to regulation and testing
3. Development of mobile applications- GODDESS Program to automate processing permits and improvement of the existing chemical logistics
4. Method development to address the lack of standard method for determining the explosive potential
5. Expanded science communication on Chemical, Biological, Nuclear Explosives Initiatives; and
6. Policy Analysis of IRR (Impact Assessment, Effectivity of Control) as an initial step towards amendment of the IRR of PNP Controlled Chemicals

In Dec 2022, as a response to the Directed Call for Proposal under the PNP-Controlled Chemicals Program, the project "Basic Training Course for PNP Personnel on the Fundamentals of Chemical Safety and the Safety Data Sheet (SDS)**"** was approved and funded. This aims to provide basic chemical training to PNP personnel in nine (9) regions in the country to understand the Safety Data Sheet (SDS) that are submitted together with chemical purchases. The Basic Training Course will cover the information contained in the SDS so that the PNP personnel can properly regulate chemicals. The concerns for health and environment also require a basic understanding of toxicology and environmental science the Safety Data Sheet (SDS), also known as Material Safety Data Sheet (MSDS), is a document that is prepared by the chemical manufacturer or dealer that contains information on the basic physico-chemical properties of a chemical product, its potential hazards (including flammability, reactivity, health hazards, environmental hazards) and how to safely handle the chemical product.

Following the model of training of trainers, the PCIEERD Management Team (PMT) recommended to consider this an initial strategy to apply in the pyrotechnics industry. There is also an opportunity for researchers to develop materials and processes that would raise the quality fireworks in the country to conform with industry standards. The access to testing requirements to ensure safety at toxicity of these products should also be made available to the MSMEs.

Call objective

This call aims to support R&D programs that will improve and develop technologies to enhance chemical and biological manufacturing and allied industries with economic, trade, human security, and health relevance. This is to also position the Philippines in a competitive advantage through a scientific-enabled research framework.

Call scope

1. Metrology in Chemistry and Biology
2. Modular Pilot Vaccine Manufacturing Plant to Fill Parenteral Products for Clinical Trials
3. Method development on explosive potential determination of controlled-chemicals and pyrotechnics
4. Localization of Manufacturing of Chemicals in the PNP-controlled List (eg. Nitric Acid)

Specific Features Sought in this Call

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

1. Data demonstrating the importance of developing RMs/conducting PTs for the target analytes/microorganisms in the identified matrices, such as detention cases

for exports, product recalls for detected health hazards, poisoning cases related to products, etc.
2. List of target participants for the provision of PT/use of RMs and letter/s indicating participation (if available, highly encouraged)
3. Sustainability plans and roadmap

PCIEERD will fund/endorse maximum of 4 projects not to exceed Php1.065 B budget covering all projects. The maximum duration for each project is 2 years. The breakdown is as follows:

	Call Theme	**Call Scope**	**Budget**
1	Metrology R&D Program	Metrology in Chemistry and Biology	35,000,000
2	Vaccine Manufacturing and its Allied Pharmaceutical Industries	Modular pilot vaccine manufacturing plant to fill parenteral products for clinical trial	1,000,000,000
3	Controlled-Chemicals for Industrial Use	3.1. Method development on explosive potential determination of controlled-chemicals and pyrotechnics 3.2. Localization of manufacturing of chemicals in the PNP-controlled list	30,000,000
		TOTAL	1,065,000,000

- **<u>TEXTILE PROGRAM</u>**

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.

Call Rationale

According to the Philippine Statistics Authority, the textile industry contributes 0.99% to the gross value added in the Philippine Manufacturing sector. The exports of textile industry have an average annual growth rate of 1.7% from 2016 to 2019. However, this industry has been negatively affected by the pandemic with the exports dropping by 8% in 2020. It further decreased by 3.2% when comparing the exports in the first three quarters between 2020 and 2021. Meanwhile, for the domestic market, there is limited to no available data to assess the current industry situation for the textile sector. Government support through research and development is necessary to help the sector recover from the challenges posed by the pandemic.

In November 2022, a stakeholder consultation meeting was conducted to review the mid-term action plan for 2025 to 2027 period of the roadmap. The following are the key agreements during the said mid-term action plan review:

1. Upcycling Technologies for Textiles
2. Treatment of fibers using recycled water and effluents for cost-reduction
3. New sources of natural textile fiber (eg. bakong plant or spider lily)

Call objective

The objective of this call is to support R&D programs that will improve and develop 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 to 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. Upcycling Technologies for Textiles
2. Treatment of fibers using recycled water and effluents for cost-reduction
3. New sources of natural textile fiber (eg. bakong plant or spider lily)

Specific Features Sought in this Call

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

1. Results of industry roadmaps (if available)
2. Intensive Review of Literature showing no duplication in proposal concept with local researches conducted
3. Technology Readiness Level between 2-6. It should encompass Technology Formulation, Validation of the Technology, Small Scale Prototype, Large Scale Prototype (if applicable).
4. Sustainability of both the supply of raw materials and finished product.
5. Has a potential for commercialization. Commitment letter/s from industry partner/s to support the marketability of the proposed product/facility to demonstrate interest is required. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.

PCIEERD will fund/endorse maximum of 3 projects not to exceed Php50M budget covering all projects. The maximum duration for each project is 2 years.

- **<u>GREEN POLYMERS RESEARCH</u>**

The Philippines has continuously contributed to the solid waste crisis which is projected to increase by 165% by 2025. In October 2022, key stakeholders convened in a national forum organized by the United Nations Development Programme (UNDP) together with the government of Japan and DENR to discuss the position of the Philippines in the Circular Economy and revisit the plans to avert pressing climate crisis through the commitment of the Philippines in the Paris Agreement of 75% greenhouse gas emission reduction by 2023.

In line with this, The Extended Producer Responsibility Act of 2022 (EPR Law) was enacted in July 2022 requiring large companies to recover a certain percentage of their annual use of plastic in packaging materials.

In November 2022, a Stakeholders Consultative Workshop for the Crafting of Circular Economy R&D Roadmap was conducted to identify research areas under the following thematic areas:

1. **Think Green** *Understanding and Planning for a Circular Economy*
1. **Make Green** *Green Processes and Technologies*
1. **Turn Green** *Getting Value for Wastes*
1. **Keep Gree**n *Waste Treatment Technologies*

In support to this initiative spearheaded by the Environment Sector and its Solid Waste Management Roadmap, the Process Sector will contribute by enabling the Make Green and Turn Green research areas through development of bio-based polymers from locally sourced raw materials and innovative technologies for pilot-scale production of bioplastics. materials

Call objective

The objective of this call is to foster technological advancement fit for green polymer research as a response to existing policy environment on circular economy and solid waste management.

Call scope

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

1. Bio-based polymers from locally-sourced raw materials
2. Cost reduction innovations for pilot-scale production of bioplastics

Specific Features Sought in this Call

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

- Results of industry roadmaps (if available)
- Intensive Review of Literature showing no duplication in proposal concept with local researches conducted

- Technology Readiness Level between 2-6. It should encompass Technology Formulation, Validation of the Technology, Small Scale Prototype, Large Scale Prototype (if applicable).
- Sustainability of both the supply of raw materials and finished product. The mode of collection of target raw materials should be demonstrated to support logistics viability.
- Has a potential for commercialization. Commitment letter/s from industry partner/s to support the marketability of the proposed product to demonstrate interest is required. Ideally, the industry partner will use the resulting technology in its formulation during the validation phase.

PCIEERD will fund/endorse maximum of 2 projects not to exceed Php40M budget covering all projects. The maximum duration for each project is 2 years.

F. MINING AND MINERALS SECTOR

Call Rationale

The Philippines is one of the world's most well-endowed country in terms of mineral resources – with rich and vast amounts of metallic and non-metallic mineral deposits. This immense untapped potential makes the mining and mineral industry an important contributing factor in the catalyzation of the country's economic recovery and development.

Mining provides the essential components for virtually everything we use on the daily – from building roads and infrastructures to generating electricity and producing goods that improve the consumers' standard of living as well as supplying the world with the mineral commodities it needs. The mining industry also provides employment opportunities and livelihood programs and is a direct contributor to the country's economic success. However, concerns have been raised about the mining industry's long-term viability and sustainability as the minerals are extracted from nonrenewable resources and the industry generates complex environmental and socio-economic issues.

To address these challenges, ongoing research and innovative solutions are being developed in the mining and minerals sector to help the country in its pursuit towards a more economically, environmentally, and socially responsible and sustainable way of providing for the modern society's growing need for minerals and metals.

Call Objectives

The call aims to further revitalize the country's mining industry and accelerate its economic development without compromising the environment and the health of the people. Specifically, it aims to provide support on the country's scientific research on metallic and non-metallic minerals and technologies that engage in the treatment and utilization of mine tailings. This will also enhance the competitiveness of Higher Education Institutes (HEIs) and Research and Development Institutes (RDIs) laboratories and facilities that conduct researches as well as capacitate researchers in mining-related studies.

Call Scope:

For the 2025 Call for Proposals (CFP), the Mining and Minerals Sector priorities are the following:

1. Iron and Iron-rich minerals for Ironmaking
2. Value-addition of Silica for industry application
3. Extraction of Critical Minerals from Metallic and Non-metallic Minerals
4. Phosphogypsum Tailings Treatment and Utilization to Valuable Products
5. Ex-ante Assessment of Offshore Mining

The above priorities are aligned with the Mining and Minerals Sector R&D Roadmaps and were validated as priorities for the 2025 CFP by the Mining Stakeholders and other concerned agencies during the PCIEERD Consultation Meetings and Focused Group Discussions (FGDs) in 2022.

DETAILS OF THE RESEARCH PRIORITIES:

Program 1: Iron and Iron-rich Minerals for Ironmaking

Call Rationale

The Philippines is richly-endowed with iron and iron-rich minerals, with an estimated reserve of lump magnetite of almost 56 million MT, magnetite sand of less than 2 billion MT, and laterite ores of less than 2 billion MT. Iron is an important component in the production of iron and steel and other metallurgical products which are used in a wide range of industries including energy infrastructure, civil construction, and transportation.

To support *EO 79, Institutionalizing and Implementing Reforms in the Philippine Mining Sector, Providing Policies and Guidelines to Ensure Environmental Protection and Responsible Mining in the Utilization of Mineral Resources*, particularly Section 8 *Value-Adding Activities and the Development of Downstream Industries for the Mineral Sector,* the Mining and Minerals Sector research priority for the Metallic Program for the 2025 CFP is Iron. Iron is aligned with the R&D Roadmap for Metallic Minerals (2022-2040) and was validated as priority research during the consultation with the Mining Stakeholders.

Study on iron and iron rich minerals for iron and steel making at bench scale level as well as metallurgical testing laboratory following internationally accepted standard procedures are none existent in the Philippines. The laboratory facility would be the first in the country, not only catering to mining industry's needs, but would also serve as training Center to develop competent metallurgists. As such, this endeavor will not only help mining companies for their needed services but would also support State College and

Universities (SUCs) offering higher degree programs related to metallurgical engineering to produce competent metallurgical engineers.

Call Objective

The call aims to develop ferrous laboratory R&D facility for iron and iron-rich minerals for iron and steel making

Call Scope:

Establishment of a ferrous metallurgical R&D facility for iron and iron-rich mineral ores for iron and steelmaking with the following components:

- Production of green and indurated/fired pellets for iron and steel making from different iron rich minerals
- Development of products specific for industrial applications
- Metallurgical testing laboratory following internationally accepted standard procedures
- Training Center to develop competent metallurgical engineers

The maximum budget allotted for the research is Php 80,000,00.00 for a duration of three (3) years covering CY: 2025-2027

Program 2. Value-adding of Silica

Call Rationale

Silica is a common mineral found in the earth's crust. It is also called silica sand or quarts which is easy to mine and process. Silica is used in many industrial applications. To name a few, as food additive**,** as abrasives and polishes; in glass manufacturing, in specialty coatings, electronics optics, in solar cells and for metal casting.

In the Philippines, silica is mined in Abra, Pangasinan, Bulacan, Rizal and Davao Oriental (*http://databaseportal.mgb.gov.ph/#/public/directory-operating-nonmetallic-mines*).
Because of the abundance of silica in the country, the Mining and Minerals Sector in consultation with the Mining Stakeholders has agreed to investigate our local silica to develop products that could support the industry needs particularly of the Energy and Metal Industries. As such, the PCIEERD will be calling for proposals on the value-addition of silica for the following: (1) Silicon for solar cells as silicon is the primary material that is cost-efficient and offers good energy efficiency in solar cells and (2) silica for metal casting as silica has high melting point compared with other metals.

Call Objective

The call aims to investigate our local silica to develop industrial products such as silicon for solar cells and silica for metal casting.

Call Scope

Development of innovative products from silica for Energy and Metals industry application specifically the following:

- Silica to produce silicon for solar cells
- Localization of colloidal silica sand for metal casting technology application

The maximum budget allotted for the above priorities is Php 15,000,000.00 with a duration of two (2) years covering CY 2025-2026.

Program 3. Extraction of Critical Minerals from Metallic and Non-metallic Minerals

Call Rationale

Critical Minerals are the building blocks of the green and digitized economy *(nrcan.gc.ca/our-natural-resources/minerals-mining/critical-minerals).* These minerals and elements are highly demanded globally due to its significant use for advance green and emerging technologies, yet the supplies are at risk because of their natural scarcity and because of geopolitical issues and trade policies that complicate their distribution, among other factors.

Critical minerals include Aluminum, Antimony, Bismuth, Cesium, Chromium, Cobalt, Copper, Fluorspar, Gallium, Germanium, Graphite, Helium, Indium, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Niobium, Platinum group metals, Potash, Rare Earth Elements (REE), Scandium, Tantalum, Tellurium, Tin, Titanium, Tungsten, Uranium, Vanadium, and Zinc *(source: Canada's List of Critical Minerals).*

With the global demand of critical minerals for green and emerging technology application and with the vision of making the Philippines the hub for critical minerals, the DOST and PCIEERD have started funding proof of concept and/or at laboratory scale level research projects related to the geological characterization and viable extraction of potential minerals. An innovative technology for the extraction of critical minerals using Deep Eutectic Solvents (DES) has been introduced and currently testing its technical and economic viability using our local nickel and copper ores. Moreover, new research projects for bauxite and refractory gold ores to commence in 2023. A laboratory scale level extraction of mixed Ni-Co and REE for battery application has also been completed. However, technology readiness for the transition of the technology should also be looked-into. As such, as agreed during the Mining Stakeholders Meeting and meeting with other

agencies in 2022, for the 2025 CFP for the Extraction of Critical Minerals, the PCIEERD will continue the following: (1) investigate the application of organic solvents for the extraction of critical minerals in selected nonmetallic minerals and low-grade metallic minerals and (2) pilot scale level technology development of battery grade Ni and Co for battery application.

Call Objective

The call aims to investigate the geological characterization and viable extraction of critical minerals from low grade metallic and selected non-metallic minerals using organic solvents and pilot scale level extraction of battery grade Ni and Co for battery grade application.

Call Scope

Extraction of critical minerals from selected metallic and non-metallic minerals using innovative technologies:

1. Application of Organic Solvent for the Extraction of Critical Metals from Non-metallic and Low-Grade Metallic Minerals with the following components:
    - Characterization and study reaction of organic solvents in the extraction of critical minerals from clay, silica and gypsum at laboratory scale level
    - Characterization and study reaction of organic solvents in the extraction of critical minerals from low grade metals at laboratory scale level

    The maximum budget allotted for the above research is Php 30,000,000.00 with a duration of two (2) years covering CY: 2025-2026

2. Collaborative Research Program for the Extraction of Battery Grade Nickel and Cobalt for Battery Application

    The maximum budget allotted for the above research is Php 50,000,000.00 with a duration of two (2) years covering CY: 2025-2026

Program 4: <u>Phosphogypsum Tailings Treatment and Utilization to Valuable Products</u>

Call Rationale

Phosphogypsum (PG) is a solid by-product generated from processing of phosphate ore into phosphoric acid which is used in fertilizer. PG contains predominantly calcium sulfate dehydrate ($CaSO_4$ $2H_2O$) with heavy metals, rare earth elements (REE) and radioactive materials.

Currently, there is an estimated 10 million metric tons (MT) of PG stacked in one of the fertilizer plants in the Philippines. To reduce the environmental impact of the stockpiled PG, there is a need to utilize the PG and develop into something that could be of valuable use to industry such as construction materials and/or other industrial use.

Call Objective

To utilize phosphogypsum tailings to valuable products for industrial use.

Call Scope

Development of environmentally friendly products from phosphogypsum tailings with industrial application. The program will cover the following:

- Treatment of phosphogypsum tailings free from heavy metals and radioactive materials
- Development of treated phosphopgypsum tailings as construction material and/or other valuable products

The maximum budget allotted for the above research is Php 20,000,000.00 with a duration of two (2) years covering CY: 2025-2026

Program 5: Ex-ante Assessment of Offshore Mining

Call Rationale

Marine mineral resource development activities in the Philippines are expected to increase in the next several years, as the country holds rights to significant marine mineral resources within its EEZ offshore area of 2.2 million square kilometers. These are mineral resources that are potential ores of gold, silver, platinum, palladium, iron, manganese, cobalt, copper, and aggregate resources to name a few. The titano-vanadium-magnetite resources alone, are estimated to be approximately one billion tons of raw mineral material *(MGB Proposal on Marine Mineral).*

Based on some research, offshore mining could have environmental effects. The most direct impacts at mining sites are destruction of natural landforms and the wildlife they host, compaction of the sea floor, and creation of sediment plumes that disrupt aquatic life. *(Deep-sea Mining FAQ-Center for Biological Diversity).* It is therefore important that all offshore mining activities are guaranteed to be environmentally, socially, technically, legally, and economically sustainable.

As such, for the 2025 CFP, the PCIEERD is prioritizing the conduct of ex-ante assessment of offshore mining and develop the most appropriate science-based framework for the management of offshore mineral resources such as resource assessment and management, governance, policymaking, regulation and planning,

environmental impact assessments, environmental risks, mitigation, use of appropriate technologies, and performance monitoring based on the recommendation of MGB.

Call Objective

- To conduct ex-ante assessment of offshore mining and develop the most appropriate science-based framework for the management of offshore mining/ mineral resources such as resource assessment and management, governance, policymaking, regulation and planning, environmental impact assessments, environmental risks, mitigation, use of appropriate technologies, and performance monitoring.

Call Scope

- Ex-ante assessment of offshore mining covering the effect of offshore mining on several habitats (threshold area), socio-economic assessment and test of impact significance and issues

The maximum budget allotted for the above research is Php 30,000,000.00 with a duration of two (2) years covering CY: 2025-2026.

Specific Features Sought in this Call

- Proposals should be submitted by qualified Researchers from HEIs, RDIs and other government R&D institutes. Any proposals submitted by a private entity, consultants and the like shall be automatically disapproved.

- All proposals must submit at least one (1) ***Commitment Letter/Letter of Cooperation*** from an Industry Partner and concerned agency/ies that will adopt/use the technology. Failure to submit the said requirement is a ground for disapproval or non-consideration.

- The research proposal should have a potential to be transferrable to the industry and locality.

    - The proposal should exhibit clear Social and Economic Impact and should answer any of the seventeen (17) Sustainable Development Goals (SDGs).

- The ***Line-item Budget (LIB)*** should include a ***20% counterpart funding*** from the private industry or cooperator. Only eligible and allowable costs may be used for *counterpart fund* and/or *in-kind contribution* (ex. utility costs, office space rental, etc.), as determined by DOST-PCIEERD. The proposal must describe how the applicant will provide the counterpart fund/in-kind contribution.

G. METALS AND ENGINEERING SECTOR

Call Rationale

Metals and Engineering is one of the priority sectors of the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) that supports various industries (i.e., food, mining, agri/agro, environment, creative) through fabrication of appropriate machineries/equipment, upgrading/strengthening of S&T services through facility establishment, and the development of diverse metalworking technologies through R&D. This is the Council's support for the vital and significant role of the Metals and Engineering (M&E) industry 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 machineries and equipment, metal-based parts, and assemblies, among others.

To recognize and address the needs of the local industry in promoting its growth and competitiveness, the PCIEERD M&E sector spearheaded the development of a six (6)-year roadmap in 2020, covering the period 2020-2025 for the Machining and Fabrication Sector, Metalcasting Sector, Tool and Die Sector and Surface Engineering Sector. These roadmaps were identified by the stakeholders composed of representatives from the government, industry and academe during the conduct of online consultations in the following regions: NCR, CAR, I, II, III, IVA, IVB, V, VI, VII, VIII, IX, X, XI, XII and CARAGA. However, the data and information gathered from the conducted roadmapping sessions were broad and necessitates further verification. Thus, it needs to be refined thoroughly in order to translate into high impact plans and programs.

~~This year,~~ In 2022, the M&E sector conducted a series of industry consultations with the companies that are in the fields of Machining and Fabrication Sector, Metalcasting Sector, Tool and Die Sector and Surface Engineering Sector in Region III and in the National Capital Region (NCR) to revalidate the developed roadmaps and to better understand their pressing gaps and needs. It is also undertaken to create a strategic action that will support the metalworking industry.

Based on the consultations, there are many factors affecting the level of competitiveness of the metalworking industry. In the National Capital Region (NCR) the following industry gaps have been identified: (1) higher price of locally produced products over competitors due to high energy costs in their operation/production and logistics and container costs for imported raw materials (i.e., steel, sand, machines), (2) no standards for use of cupula furnace, (3) low number of clients, (4) need for equipment upgrading for metalcasting and fabrication processes and (5) no support mechanism such as government law that promotes the use of locally produced products to boost its market.

In Region III, the identified gaps of the industry are: (1) decreasing number of skilled workers in the field, (2) limited funds for equipment acquisition to support fabrication processes, (3) availability of cost-effective and efficient semi-automated and fully

automated equipment for agri-industry (e.g. lessening tedious task of laborious harvesting), and (4) high cost of equipment for operation such as CNC machines, thus, the company suggested to have a retrofitting program to convert the conventional machines to semi-CNCs.

Also, another area of concern identified is the Metrology. This area supports the entire works of the metals industry thru proper calibration of their tools and instruments being used in their manufacturing processes. Calibration aims to ensure that readings from the instrument are consistent with measurements from other instruments, determine the accuracy of the instrument readings and establish the reliability of the instrument. The Industrial Technology Development Institute (ITDI) of the Department of Science and Technology (DOST) established the National Metrology Laboratory (NML) to provide one national reference serving the country's industry, secondary calibration laboratories and regulatory authorities with credible calibration services in different measurement areas (e.g., mass, temperature, volume, pressure, etc.). NML is currently in the pursuit of R&D studies on establishing the S.I. units in the Philippines to become self-sufficient in terms of calibration in the field of Mass and Temperature. However, there are no established data on the demand for metrology services particularly in primary calibration in the field of Mass and Temperature (i.e., establishment of S.I. units). Thus, this needs to be identified through scoping prior to R&D of its S.I. units.

With these matters related to be critical to the stability and vigor of Metals and Engineering industry, therefore, the programs and projects to be generated under the said roadmaps will serve as a blueprint for the industry, academe, and research institutions in identifying appropriate interventions that could address these gaps and issues identified from the conducted industry consultations.

Call Objective

The objective of this Call is to enjoin qualified local institutions, engineers and scientists and individuals to take new advances in implementing R&D to produce world-class metal products/equipment/technologies that will bolster the progress and competitiveness of the local Metals Industry (i.e., Metalworking, Metalcasting, Surface Engineering, Tool & Die).

Call Scope

Below are the identified potential areas for R&D initiatives:

- Design and Development of innovative, cost-effective and appropriate Machinery, Parts and Engineered Products (MPEPs) for the following industries:
    a. food processing industry (i.e., membrane technologies, freeze concentration)
    b. agri-industry
    c. military weapon manufacturing
    d. creative industry
    e. e-Vehicle parts and components manufacturing

f. geotextile production

- Scoping for Physical Metrology (e.g., Mass, Temperature)
- R&D on Advanced Metal Casting Processing Technologies for Various Applications (e.g., vacuum sand casting, lost-foam casting, sand system, automated molding machine, standardization of cupula furnace)
- R&D on Materials and Metallurgy Technologies for Various Applications (e.g., ship recycling, construction and military weapon application/s, scrap metal utilization technologies)
- Design and development of molds and die for processors and fabricators applications (e.g., food industries, e-vehicle manufacturing, creative industries etc.)
- R&D on Metal Coating and Finishing Technologies (e.g., green electroplating, anodizing, plasma technology)

PCIEERD will fund/endorse maximum of 24 projects not to exceed Php600M covering all projects. The maximum duration for each project is 3 years.

Specific Features Sought in this Call

The proposal should have the following features and should be well written and included in the document to be submitted:

1. Baseline studies/ result of roadmap (if available).
2. Thorough Review of Literature, including patent search, showing no duplication of the proposed technology.
3. ~~Please include the~~ sustainability plan for the proposed equipment/technology to be developed (e.g., maintenance of the developed equipment or technology).
4. ~~Secure~~ Signed commitment letter from the identified beneficiary/end-user of the proposed technology.
5. For proposals with development of equipment, clearly specify (possibly quantify) these **NSDB-ME** in the proposal: Need, Solution, Differentiation (show this in a matrix), Benefits, Maintenance and repair and service commitment and economically viable.

Parameter	Existing Equipment / Process / Technique in the Market	Target Propose Fabricated Equipment / Process / Technique	Remarks
Process/Techniques			
Material			
Speed/performance			
Capacity			
Dimension/design			

Quality (e.g., produced product/equipment)			
Manpower Needed			
Cost			
Others (Pls specify other parameters applicable/suitable to the proposed equipment)			

H. ADVANCED MATERIALS AND NANOTECHNOLOGY SECTOR

Following the stakeholders' consultation to representatives in academia (UPD, DLSU, TIP, UM, USA, UST, MSU-IIT, etc.), RDIs (ITDI, MIRDC & PTRI), Government institutions (DTI & DOE), and private sectors (2DM, Manly plastics, Newtech Batteries, SMC, Motolite, P&G, Globe Telecom, Evap, etc.) in 2022, DOST-PCIEERD validated and identified electrochemical energy storage, smart packaging, and environmental monitoring applications as R&D priorities under advanced materials, nanotechnology, materials for energy, materials informatics, and additive manufacturing sectors.

Call Rationale

Energy Storage Applications

Electrical energy storage (EES) systems constitute an essential element in the development of sustainable energy technologies. Electrical energy generated from renewable resources such as solar radiation or wind provides enormous potential to meet our energy needs in a sustainable manner. However, these renewable energy technologies generate electricity intermittently and thus require efficient and reliable electrical energy storage methods. For commercial and residential end-use, electricity must be reliably available at any time of the day. In fact, second-to-second fluctuations can cause major disruptions at huge costs annually. Thus, the development of new EES systems will be critical in in electricity generation. Moreover, improved EES systems are required to enable the widespread use of hybrid electrical vehicles (HEV), plug-in hybrids, and all-electric vehicles. Improvements in ESS performance, reliability, and efficiency are needed in the development of modern portable electronic devices such as laptops and smart phones. Metal-ion batteries and supercapacitors, as well as fuel cells, are also playing an important part in our modern lives and have been commercially used as portable and stationary power sources for electronic devices.

Call Objective

Gearing towards Industry 4.0, we will provide support on R&D programs/projects related to advanced materials and advanced processes (e.g., Additive Manufacturing, Atomic Layer Deposition (ALD) process, plasma process, etc.) that will enable Internet of Things (IoT) technology for the benefit of sectors dealing with fuel cells/ hydrogen technology, supercapacitors, rechargeable batteries.

Call Scope

R&D on Electrochemical Energy Storage (EES) such as Fuel Cell / hydrogen technology, Supercapacitors, and Rechargeables batteries beyond Li-ion based chemistry (e.g., Na, Zn, Al etc.) for EV and stationary storage/ off-grid applications.

This includes the following:

a.) Synthesis, fabrication, and design of EES components (anodes, cathodes, separators/ membranes, and electrolytes)

R&D on conductive inks (active materials, additives & binders)

- Carbon-based nanomaterials (e.g., graphene, carbon nanotubes, nano-diamonds)
- Metal oxides (e.g., MnO_2, V_2O_5, NiO, etc.)

R&D on anodes & cathodes

- Conductive carbon textile & conductive polymers
- Air electrodes with high electrochemical activity and lower polarization/ resistance
- Zn-based electrodes (e.g., Zn-foam, Ni-Zn composites, etc.)

R&D on catalysts

- HER, OER, and ORR electrocatalysts (e.g., Pt- free, metal-free, new catalysts)
- Organometallic catalyst for air electrodes

R&D on membranes & separators

- Membranes/separators (e.g,. glass microfibers, polymers & composites)

R&D on electrolytes

- Aqueous electrolytes, non-aqueous electrolytes: ionic liquids, Deep Eutectic Solvents, DMSO-based, semi-solid (hydrogels), and solid electrolytes

b.) Efficient and advanced processes / fabrication techniques to fabricate electrode materials

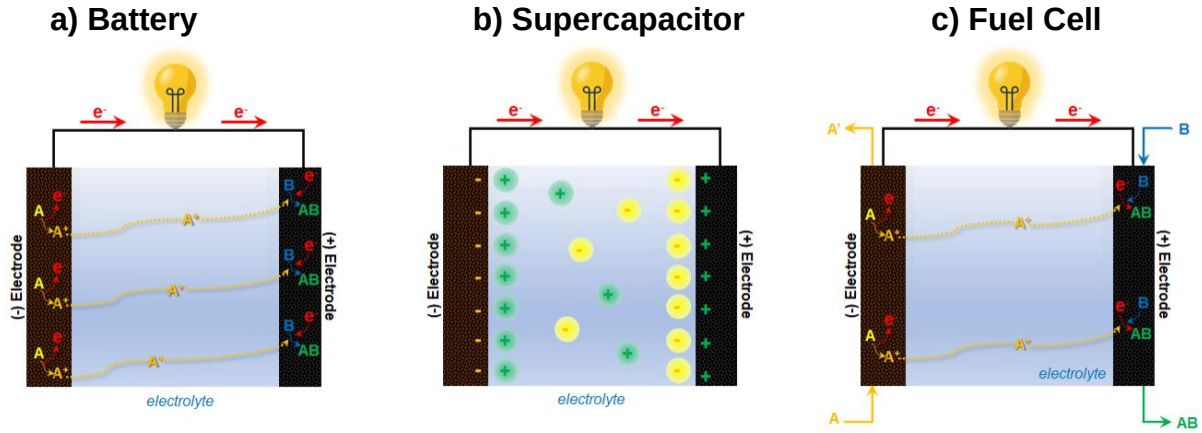
- Atomic Layer Deposition (ALD)
- Chemical Vapor Deposition (CVD)
- Plasma process

c.) Computational approaches in nanomaterials design to optimize energy storage and improve the electrochemical performance of EES (e.g., improved cycle life, capacity, stability, etc.) in ambient and extreme conditions (at elevated temperatures > 40 °C)

- Novel electrode materials discovery
- EES component design and fabrication
- Electrode-electrolyte interaction elucidation

d.) Development of Infrastructure

- Establishment of a robust research and testing infrastructure (nanohubs)
- Energy Research and Innovation Center (ERIC)



Specific Requirements

Prototype of safe, efficient, economical, and high-performance (e.g., wider cell operating voltage, improved capacity, improved energy density, improved cycle life) electrochemical energy storage devices such as rechargeable batteries, flow batteries, 3D printed batteries, supercapacitors / pseudocapacitors / EDLC, & fuel cells for stationary storage & power grid, EV, portable electronics (e.g., laptops, cellphone, smart watches, power bank), and flexible & printed electronics applications.

To ensure that the research output will be utilized by the target industry, a letter of commitment with counterpart (in cash or in kind) contribution must be secured. PCIEERD will fund fifteen (5) projects with a funding of **P5 M to 10 M** per project per year depending on the scope of work being proposed. Each

Call Rationale

Sensing and smart materials

The quality, safety, shelf life, and utility of smart packaging are determined by the advancement of sensor technology and materials.
Therefore, progress must be made in several areas for smart packaging to improve present packaging technology:

- Develop sensor technology to incorporate conventional and smart materials, enhancing and improving the entire food packaging supply chain.
- Future sensor technology will include nanotechnologies, smart materials, and thin film electronics that will be included into packaging. Therefore, they must be compatible with printing technology, ideal for mass production, inexpensive compared to the value of the food product, simple to use, ecologically friendly, and human safety.

- To be able to detect microbial growth, oxidation, and improve tamper visibility, new and sophisticated smart packaging for food products must concentrate on advanced food safety features. Additionally, this innovative technology ought to extend a product's shelf life and provide tracking, convenience, and sustainability capabilities.
- Integrated packaging sensors can be used to treat food waste and recyclable packaging. These sensors may retain data on things like the material(s) used to make the package, the date when food expires, the oxygen level, the temperature, the pH level, etc. The Industrial Internet of Things can transmit this data to food distributors, suppliers, and even packaging recycling companies.
- From the perspective of information and communication technology (ICT), the manufacturing industry must overcome several obstacles, including a seamless integration of their internal information technology (IT) and operational technology, to integrate smart packaging into the expanding number of horizontally and vertically integrated production networks as part of the Industrial Internet of Things and Internet of Services (OT). Future dispersed and completely autonomous smart manufacturing networks will be enabled by this so-called IT/OT convergence. Innovative approaches to cybersecurity, as well as assuring data security and IP (Intellectual Property) protection across the whole lifespan, are crucial.

Call objective

The proposals to be submitted should be able to develop technologies in the following focal areas identified by the stakeholders.

Call Scope

Priority areas identified are as follows:

R&D on advanced and nanomaterials for biomedical and environmental applications:

This includes, but is not limited to:

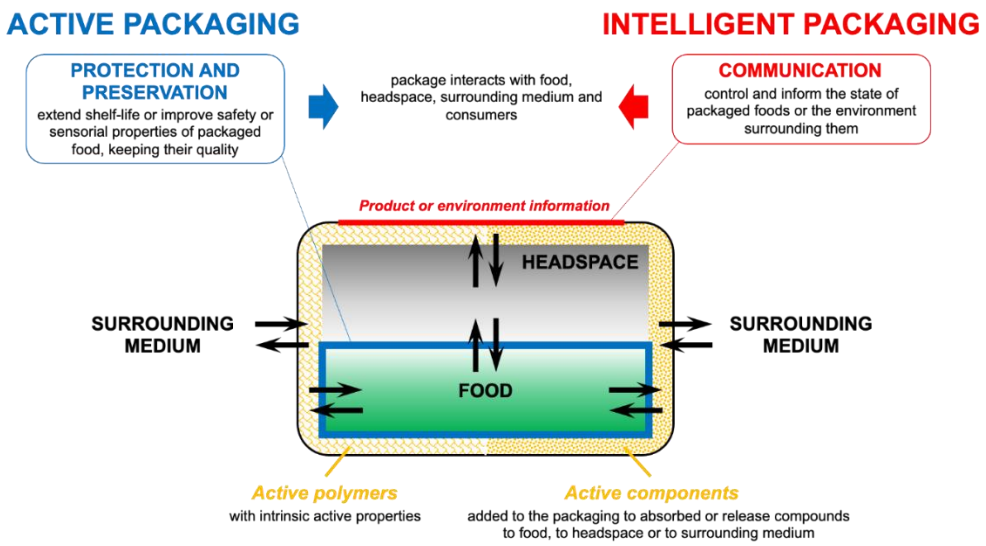
- Nano-sensors for environmental applications (e.g., Carbon Nanodots, Nanoclusters, Quantum dots)

- Smart packaging

Smart packaging describes new packaging concepts classified in one of the two main categories: active or intelligent packaging.

An **active package** is one that modifies the condition of packaged foods to extend shelf-life or improve its safety or sensorial properties, keeping its quality. On the other hand, an **intelligent package** is a packaging system capable of carrying out intelligent functions, such as detecting, registering, locating, communicating, and applying scientific logics, to

ease decision-making, extend shelf-life, improve safety and quality, provide information, and warn of potential problems.



Specific Requirements:

Prototype of sensors and smart devices that are biocompatible, cost-effective, environmentally friendly, and safe for wearables and IoT applications.

To ensure that the research output will be utilized by the target industry, a letter of commitment with counterpart (in cash or in kind) contribution must be secured. PCIEERD will fund five (5) projects with funding of **P10 M to 20 M** per project per year. Each project must also have a clear technology pathway.

MATERIALS INFORMATICS

Call Rationale

In pursuit of understanding, selection, and discovery of new materials, materials informatics is seen as one of the emerging advanced materials research fields today. With the advancement of machine learning and information processing technologies, it paves the way to understanding complex and multiscale information on structure-property-processing relationship of materials in a rapid and robust manner. The combination of data science, artificial intelligence, and materials science are now used to accelerate materials development and optimization in a shorter period and less cost.

Call Objective

To fund baseline R&D on benchmark datasets incorporating diverse tasks, sample sizes, materials systems, and data heterogeneity for materials informatics and applications that address an industry need including the following:

- Materials formulation and structure-property prediction
- Battery management system
- Materials design and prototyping
- New materials discovery, materials selection, life prediction, and failure analysis heavily depend on diverse materials information and knowledge

Specific Requirements: To ensure that the research output will be utilized by the target industry, a letter of interest together with a 3- to 5-year technology pathway must be submitted. PCIEERD will fund five (5) projects which should not exceed **5 M** per project per year depending on the scope of work being proposed.

ADDITIVE MANUFACTURING

Call Rationale

Today's use of Additive Manufacturing is already varied to include the ability to 3D print clothing, basic electronics, enterprise grade industrial components and machinery, human organs, lighting systems, solar cells, synthetic stem cells, vehicles and much more.

The future use for Additive Manufacturing is limitless. Over the next decade, as the components and processes that underpin the technology mature and become increasingly accessible, affordable, capable, and reliable, the rate of expansion and emergence of new specialist sub-categories 3D and 4D Printing, and Nano-Manufacturing will continue to accelerate.

In 2022, the roadmap was updated through the conduct of an Additive Manufacturing Conference-Workshop co-organized by AMCEN (MIRDC and ITDI) and DOST-PCIEERD last October 13, 2022 and was participated in by researchers from the government (MIRDC, ITDI, AFRDC), academe (BPSU, UP-NISMED), industry (Manly Plastics, ZCMC), experts/ resource persons from the US (UTK / ORNL), among others. The stakeholders recommendation are as follows:

- There is a need for extensive talent development and promotion through local demonstration projects
- Disruption is already felt --- bigger stakeholder involvement, stakeholders want to be involved, we still need more people
- Material understanding --- local/institutional levels needs to be established guided by leaders

In education, Education, Curriculum – Capacity Building – Sustainability:

- Start them young and “material-scied”. Creativity and innovativeness focused. More promotional activities, summer camps, internships / science investigatory project • Legislation and support from key gov’t agencies is needed – DOST proposed as lead coordinator
- There might be need for a large number of machines – after sales support
- Tap TESDA for technology-related vocational courses. Explore as a livelihood program (from culture of jobseekers to job creators)
- Documentation of “good projects and teach the teacher instances”
- Catching up and re-tooling are needed.

In manufacturing, the current roadmap is still acceptable as some private entities are already starting mainstream adoption.
• Availability of talent pool and expertise is crucial.
• Different manufacturing stakeholders segments have unique needs like environmental effects and surface quality, among others.

Call Themes

- Databasing of developed raw materials for Additive Manufacturing specifically for Manufacturing, Medical, Construction, and Consumer 3D applications
- Development of Prototype products of multiple material Additive Manufacturing specifically for Manufacturing, Medical, Construction, and Consumer 3D applications
- Development of novel materials from raw materials for Additive Manufacturing specifically for Manufacturing, Medical, Construction, and Consumer 3D applications
- Use of Additive Manufacturing in the development of minimally invasive surgical devices
- Solar water evaporation for clean water production from sea and wastewater for inland and remote communities (porous membranes – polymer, support layer for biomass materials, system)
- 3D printing with AI/ML and Robotics
- Materials for Aerospace, Electronics and Petroleum (oil and gas applications)

Specific Requirements: PCIEERD will fund six (6) projects and shall not exceed **10 M** per project per year depending on the scope of work being proposed.

I. OPTICS AND PHOTONICS SECTOR

A. STRATEGIC PROGRAMS

Optics and Photonics R&D Program

Call Rationale

Photonics is the physical science of light (photon) generation, detection, and manipulation through emission, transmission, modulation, signal processing, switching, application and detection/sensing. Photonics technology detects light emission, then converts lights into electric signals through integrated fiber optics. The global photonics market has reached more than $600 billion and is continually growing. Countries such as Europe, United States, China, Japan, Singapore and Taiwan have heavily invested in photonics to further their economic development through science and technology. Given its current local capacity, the Philippines can benefit from the use of photonics. Our primary industries in agriculture, ICT, manufacturing and services as well as public goods such as utilities_(energy supply, water quality management, etc.), environment and healthcare have photonics applications.

Stakeholders' consultation, survey, and interviews were conducted face-to-face and virtually from May 2022 – August 2022 for Optics and Photonics while the nuclear S&T consultation was conducted on 12 October 2022. The stakeholder consultations were participated by researchers, engineers, and experts from academe, research institutes, and industry partners. The respondents were composed of representatives from the University of the Philippines (UP) Diliman, Ateneo de Manila University, De La Salle University, UP Baguio, UP Cebu, UP Los Banos, University of San Carlos, Philippine Nuclear Research Institute (PNRI), Analog Devices Inc (ADI), Power Measurements- TESCO, ON Semiconductor, and BitStoc Electronics.
The responses of the stakeholders during the consultations were analyzed into different sections such as (i) needs and challenges in the sector; (ii) strategies to address the challenges; (iii) priority areas, programs, and projects for 2025-2040, and (iv) key technologies/solutions for research and development.

For the nuclear S&T inputs, the priority areas were distributed in different sectors for energy, industry, and emerging technology. Based on the results from the consultations and surveys, below are the following priority areas for funding in FY 2025.

Call Objective

Proposals to be submitted should develop technologies aligned with the call scope within 2-3 years.

Call Scope

Proposals to be submitted should be aligned to the indicators specified under the **OPTICS AND PHOTONICS R&D ROADMAP** including the following priority topics:

- Delivery and processing of information (e.g. fiber-optic sensors & wiring, optical communication networks, optical field programmable gate arrays)

- Development of imaging materials, components, and devices (e.g. photodetectors, photosensors, ranging, visual sights, periscopes, and Terahertz)

- Materials testing and imaging techniques (e.g. neutron scattering, neutron imaging, holographic interferometry, laser scanning, hyperspectral imaging, hyperspectral imaging)

- Biophotonics, biomedical optics and optical sensing for medical diagnostics and therapy (biosensors, light therapy, terahertz, surface imaging, biophotonics-based early detection of diseases in wearable devices)

- Manufacturing applications (e.g. photolithography, optical amplifiers)

- Photonics application in renewable energy (perovskites solar cells, tandem cells (silicon and perovskites), new generation solar cells);

- Advanced characterization tools and methods for increasing efficiency of silicon solar cells and tandem cells;

- Perovskites based IR photodetectors, perovskites for highly-efficient LEDS, perovskites quantum dots

- Sensors for nuclear instrumentations, remote sensing, measurements, and other radiation-related applications

- LiDAR, cameras, sensors development for electric vehicles and traffic management.

Specific Requirements: To ensure that the research output will be utilized by the target industry/ adoptor, a letter of interest together with a 3- to 5-year technology pathway must be submitted. PCIEERD will fund five (5) projects and shall fund **P5-10 Million** each depending on the scope of work being proposed.

J. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT) SECTOR

Call Rationale

Information and communication technologies (ICT) are key enablers of innovation and encompass a broader array of activities. The overall strategies outlined in this roadmap are fundamentals in attaining the Networked Society. The key technology trends or R&D solutions that will stimulate innovations within the ICT industry in the coming years will create new value streams for consumers, government, industry and society. A technology-enabled ecosystem is made possible through a universal, horizontal and multipurpose communications platform. The R&D technologies in ICT Innovations is combined with the next generation of networks such as 5G provide support to IoT, creation of cyber driver dynamic content, retrieval and analysis, among other applications.

The priority topics identified were based on the following stakeholders' consultations and references:

- ASEAN Innovation Business Platform Conference and Exhibition Driving Digitalization Ecosystems in ASEAN, November 15-16, 2022.
- Griffin, M. April 2020. Exponential Technology Codex 2020 to 2070. Codex of the Future Series. 311 Institute.
- Harmonization of DOST-PCIEERD and DOST-ASTI Roadmaps on Electronics, ICT, and Quantum Technology, December 15, 2022.

Call Objective

The main objective of this call is to support research and development projects for ICT innovations particularly in the field of (1) data science, (2) computing, (3) connectivity, and (4) security. Proposals shall address the needs and strengthen the capabilities of the local industry in terms of facilities and services, human resources, R&D technologies, and/or S&T policies.

Call Scope

This call targets to support applied research projects on the following topics:

1. **Data Science**

- **Development of Smart Data Capture Software**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
  Smart data capture enables real-time decision making and workflow automation by capturing data from barcodes, text, IDs, and objects. It is a flexible, future-proof technology that connects retailers, frontline workers, and customers with real-time information to provide actionable insights, automate processes end-to-end, and deliver digitally-enriched experiences. It can be integrated into any application or ecosystem powering operational and customer-facing processes for store associates and shopping experiences for consumers. The technology enables retailers to transform any device with a camera into a high performance data capture and

visualization tool including smartphones, tablets, robots, drones, and wearables. Proposals shall include letter of collaboration and certificate of technology adoption with an industry partner.

- **Application of Data Ontology and Data Archiving for DOST Public Services**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 2 (PCIEERD-GIA)
  E-government services have now been developed to cover the basic services that should be delivered to citizens and enterprises. However, a number of issues regarding e-services has to be addressed including e-service composition, e-service cataloguing, change management, and administrative responsibility. This reveals the need for semantically rich means for representing the various aspects of e-services which can be addressed through data ontology. Hence, proposals shall focus on practical use cases of data ontology for e-government public services particularly intended for the Department of Science and Technology (DOST) R&D outputs.

2. **Computing**

- **Advancement in Distributed Computing**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Distributed Computing, which also encapsulates Edge and Fog Computing, is where data is ingested, processed, stored, and transmitted from a wide variety of devices and locations. As computing platforms continue to shrink in size, while at the same time increasing in power, computing capabilities can now be embedded, directed, and managed by Blockchain networks into devices of all shapes and sizes from gadgets, materials, and sensors, among others. Proposals shall include practical application of the distributed model in collaboration with an industry partner as end-user.

3. **Connectivity**

- **R&D Addressing Wave Spectrum Challenges with 5G Technology**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  5G, the successor to 4G, is a low latency, hyper connected multi Gigabit mobile wireless communications standard. While researchers see great potential with a high-frequency version of 5G, it comes with a key challenge as it is very short range. Objects such as trees and buildings cause significant signal obstruction, necessitating numerous cell towers to avoid signal path loss. Currently, multiple-input, multiple-output (MIMO) technology is proving to be an effective technique to address this issue. However, even with MIMO technology, line of sight will still be important for high-frequency 5G and massive base stations remain to be a necessity. Hence, proposals shall focus on addressing signal path challenges to expand the capacity of 5G connectivity.

4. **Security**

- **Application of Homomorphic Encryption**
  Maximum Budget Allocation: Php 20M per proposal

Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)

Homomorphic encryption is a method of performing calculation and analysis on encrypted information without decrypting it first. It is the field of research concerned with developing ways to securely encrypt information in a way that still allows third parties to analyze it without having to give the encryption keys. Today, homomorphic encryption is being used to give crowdsourced data scientists access to confidential data to mine for patterns and identify investment opportunities and trends in a way that would not have been possible using the traditional encryption technologies.

K. ELECTRONICS INDUSTRY SECTOR

Call Rationale

The Philippine electronics industry is the largest contributor to the country's manufacturing sector. The potential for the industry remains high as local firms intend to move to higher value-added manufacturing to meet global demand. According to the Semiconductors and Electronics Industries in the Philippines Foundation Inc. (SEIPI), member companies plan to improve current production capacities, to expand current research and development and design capabilities, and to further develop the labor force over the next several years. To support this, the industry recommends that the government shall continue with its programs in improving the country's business environment, conducting R&D capability development, and aggressively promoting local industries and SMEs. Hence, this Call was made in support of achieving the vision of carving a niche in the global electronics market, building a "Made in the Philippines" brand that will capture market opportunities among end-product manufacturers and end-users.

The priority topics identified were based on the following stakeholders' consultations and references:

- Griffin, M. April 2020. Exponential Technology Codex 2020 to 2070. Codex of the Future Series. 311 Institute.
- Institute of Electrical and Electronics Engineers. 2020. International Roadmap for Devices and Systems. Advancing Technology for Humanity.
- Nuclear S&T Consultation with DOST-PNRI, October 12, 2022.
- Harmonization of DOST-PCIEERD and DOST-ASTI Roadmaps on Electronics, ICT, and Quantum Technology, December 15, 2022.

Call Objective

The main objective of this call is to support research and development projects in electronics industry particularly in (1) integrated circuit design, (2) consumer electronics, (3) medical electronics, (4) automotive electronics, and (5) sensors. Proposals shall address the needs and strengthen the capabilities of the local industry in terms of facilities and services, human resources, R&D technologies, and/or S&T policies.

Call Scope

This call targets to support applied research projects on the following topics:

1. **Integrated Circuit Design**

- **Prototyping of Radiation-Hardened Electronics**
  Maximum Budget Allocation: Php 30M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Radiation-hardened electronics are electronic components, single-board computer CPUs, and sensors that are designed and produced to be less susceptible to damage from exposure to radiation and extreme temperatures. Rad-hard electronics may be applied for reactors, spacecraft systems, and other space and terrestrial applications.

Proponents shall identify the technology development necessary to get the proposed integrated circuit to the performance needed for the intended environment and application.

- **Prototyping of Biocompatible Electronics**
  Maximum Budget Allocation: Php 30M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Biocompatible electronics are class of electronics that are compatible with biological material and do not corrode or degrade over time. It is the field of research concerned with developing new forms of computing platforms and electronics that can be embedded and integrated into biological tissue. Recent breakthroughs in the space include the development of the first biocompatible transistors and biomaterials that can be embedded into the human brain without degrading over time and adversely affecting the organic tissue. Letter of collaboration from the Department of Health or other health institutions shall be secured.

- **Prototyping of Emerging Nonvolatile Memory Devices**
  Maximum Budget Allocation: Php 50M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Emerging memory technologies promise new memories to store more data at less cost than the expensive-to-build silicon chips used by consumer gadgets. These are being investigated and lead to the future as potential alternatives to existing memories in future computing systems. Emerging nonvolatile memory technologies such as magnetic random-access memory (MRAM), spin-transfer torque random-access memory (STT-RAM), ferroelectric random-access memory (FeRAM), phase-change memory (PCM), and resistive random-access memory (RRAM) combine the speed of static random-access memory (SRAM), the density of dynamic random-access memory (DRAM), and the nonvolatility of Flash memory and so become very attractive as another possibility for future memory hierarchies. Proposals must include product prototype and international collaboration with an external wafer fabrication facility.

- **Process R&D for 3D Integration Technologies**
  Maximum Budget Allocation: Php 50M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  3D Integration Technologies refer to the methods and processes used to vertically stack integrated circuits (IC) which are emerged as a viable solution for meeting electronic device requirements including higher performance, increased functionality, lower power consumption, and smaller footprint. This may include 3D on-chip integration, 3D IC stacking, and 3D packaging. Proposals must include technology innovation, simulation and design, product prototype, and international collaboration with an external wafer fabrication facility.

2. **Consumer Electronics**

- **Prototyping of Smart Wearables and Electronic Devices**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 2 (PCIEERD-GIA)

Wearable technology is a category of electronic devices that can be worn as accessories, embedded in clothing, or implanted in the user's body. The devices are hands-free gadgets with practical uses powered by microprocessors and enhanced with the ability to send and receive data. Proposal shall focus on novel specialized and practical applications including medical, safety, and security use cases.

- **Prototyping of Swarm Robotics**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
  Swarm robotics is the use and coordination of large numbers of multi robot systems to produce specific collective behaviors and interactions. It is the field of research concerned with developing robots, of all shapes and sizes, that are capable of coming together in swarms and intelligently collaborating and coordinating with one another to accomplish tasks that any one individual would have problems accomplishing alone. Recently, there have been a number of breakthroughs in the field including in the development of Artificial Intelligence based command and control systems that let the robots autonomously collaborate with one another without the need for external human input to evaluate, solve, and complete random tasks such as lifting and moving as well as coming together to form specific formations. Proposals shall include collaboration with relevant government agency or industry partner as potential end-user.

3. **Medical Electronics**

- **Prototyping of Digital and Handheld Medical Devices**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 2 (PCIEERD-GIA)
  PCIEERD recently supported projects on the local prototyping of ventilators and oxygen concentrators. With the pandemic, the Council targets to continue supporting projects that will develop other digital and handheld medical devices including smart inhalers, digital stethoscope, portable x-ray, handheld lasers, VR devices, portable ultrasound, multidiagnostic devices, and other innovative medical electronics. Letter of collaboration from the Department of Health or other health institutions shall be secured.

4. **Automotive Electronics**

- **R&D on Core Electronics, Connectivity, and Electrification for Autonomous Vehicles**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 2 (PCIEERD-GIA)
  R&D advancements on automotive technology include connecting to mobile devices, navigation assistance, remote keyless system, security systems, driving assistance, and recording. Autonomous driving and advanced driver assistance systems (ADAS) are getting better every year along with the steady spread of connected car services that utilize communications to deliver new value. The trend is now shifting towards a more integrated ADAS domain with centralized electronic controller units. Proposals

shall focus on prototyping of electronic components for self-driving architectures in collaboration with an industry partner.

5. **Sensors**

- **Prototyping of Biomimetic Sensors**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Biomimetic sensors are sensors that mimic the behaviors, capabilities, and functional properties of biological systems. Recent breakthroughs include the development of sensors that can mimic all five human senses which are thousands of times more sensitive. Today, biomimetic sensors are being used to create robots that navigate by the stars rather than GPS, biomedical devices that can smell disease, and virtual reality systems that expose the user to smells, tastes, and other sensations.

- **Prototyping of Hyperspectral Sensors**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Hyperspectral sensors refer to the sensing systems, both ground, sky, and space based, capable of sensing signals across the electromagnetic spectrum. Recent breakthroughs include advances in sensitivity which allows detection of increasingly weak signals including radio frequency signals from space and sensing of increasingly minute variations in field strength.

INDUSTRY 4.0

Call Rationale

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.
The priority areas are based on the needs of the stakeholders, which is also reflected in PCIEERD's Industry 4.0 roadmap. Last October 2021, a consultation with stakeholders from the semiconductor industry (SEIPI) was conducted to further refine the roadmap according to the current needs of the industry.

Call Scope

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:

- Development of Cyber-Physical Production Systems
- Development of autonomous industrial adaptive and mobile robots in a production line
- Product life cycle study; integration of vertical and horizontal value chains
- Development of the asset administration shell (AAS) as the interface of the digital and real machines
- Development of generic cloud-based Manufacturing Execution System (MES) for smart manufacturing
- Development of Supervisory Control and Data Acquisition (SCADA) or automation system that can connect factory equipment
- Development of modules on SCADA to accelerate connectivity and automation
- Develop digital transformation model (e.g. digital twin) for electronics industry companies
- Industrial Internet of Things (IIOT) for Lights-Out Production
- Augmented Reality Technology for Process Visualization Training and Maintenance

Specific Requirements: Proposals should be submitted with a letter of support from the target beneficiaries or adopters for sustainability. PCIEERD will fund three (3) projects under PCIEERD-GIA with a maximum budget of **10 million** per project per year and one (1) project under DOST-GIA with a maximum budget of **80 million**.

QUANTUM TECHNOLOGY

Call Rationale

Quantum Technology is an emerging field that has caught the attention of many different nations due to its potential to revolutionise the current technologies we enjoy today. DOST-PCIEERD aims to jumpstart and sustain Quantum Technology Research and Development in the Philippines to be able to utilize and benefit from its wide-range applications when the field matures enough for practical use. As evident in the roadmap of Quantum Technology, the mid to long-term goal of DOST-PCIEERD is the eventual establishment of the Quantum Innovation Laboratory. This facility will merge a wide range of scientific and engineering fields and will serve as a center of excellence in Quantum Technology of the Philippines.

The priority areas in this call are based on the Stakeholder's Consultations and capability survey to scope out the needs of the academe and industry, and to scope out the current capability of the HEIs and Industry in terms of Quantum Technology. The first Stakeholder's Consultation last 27 May 2021, which were attended by representatives from academe, government, and industry, serves as an initial reference on the Quantum Technology Roadmap where the call priorities are based. A much recent Stakeholder's consultation with a private organization was also conducted last 18 August 2022. This is when the theoretical foundation in Quantum Mechanics and Quantum Technology were stressed out by the Stakeholders. This call scope's objective is to further increase the number of researchers involved in Quantum Technology.

Call Objective

The objective of this call is to look for small project(s) that use available technologies such as the Quantum Circuit Simulator (DOST-ASTI) for validation and optimization of Quantum Algorithms, prototyping of Quantum Processors for development of actual Quantum Computer and experimental platforms for Quantum Simulation. Theoretical research proposals are also welcomed to develop stronger fundamentals in Quantum Technology and to capacitate the local community of researchers.

Call Scope

The call is looking for the following key research areas for possible funding:

II. ***Quantum Computation***

- Quantum Algorithms for Optimization and Machine Learning.
- Quantum Computing Experimental Platform
- Quantum Computation using the Quantum Circuit Simulator of DOST-ASTI
- Quantum Algorithm Development
- Quantum Error Correcting Code
- Quantum Decoherence

II. ***Quantum Materials, Optics and Sensing***

- Design, Fabrication and Characterization of Materials for Quantum Devices
- Quantum Sensing
- Qubits Fabrication
- Device Fabrication of Quantum Sensors

Specific Requirements: DOST / DOST-PCIEERD will fund at most five (5) projects under Quantum Computation with a maximum budget of **30 million** per project, and one (1) project under Quantum Materials, Optics, and Sensing with a maximum budget of **80 million** depending on the scope of work being proposed.

L. ARTIFICIAL INTELLIGENCE (AI) SECTOR

AI PINAS: AI ENABLING SOLUTIONS FOR EMERGING NEEDS

Call Rationale

DOST-PCIEERD covers 21 sectors generally categorized under industry, energy, emerging technology, and special concerns. The Council has a wide sectoral coverage that includes almost everything except for health and agriculture which is covered by the other sectoral councils of DOST. Artificial Intelligence is one of its priority sectors under emerging technology.

AI is one of PCIEERD's priority areas because it is tagged as one of the important technologies that will usher the country to the fourth industrial revolution. Although considered as powerful agent for good, AI can also disrupt traditional business models and processes, thereby making it a threat. And in order to maximize the benefits of AI, there is a need to develop our capability in this area.

In the latest Asia Pacific AI Readiness Index Report, 2021, the Philippines earned an overall readiness score of 46.3 out of a hundred, ranking ninth among other countries including Singapore, Japan, Hong Kong, India, Malaysia, Thailand, and Indonesia.

To start with the goal of building a community of skilled experts that can increase the country's global competitiveness in the field, DOST-PCIEERD initiated its series of training courses on data science, machine learning, deep learning, and AI in general. This was done in partnership with MOOCs PH, Coursera, Google Philippines, Thinking Machines, Inc. and the PCIEERD AI Board of Experts.

The priority areas in this call are based on the Stakeholder's Consultation last 22 November 2022, which was attended by the PCIEERD AI Board of Experts from the academe, government, and industry. The call focuses on thematic and mission-driven applications on artificial intelligence that is relevant for public good.

Call Objective

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. In the global market, major AI investments are on business and health care followed by finance and cyber security. Other AI applications supported include government services, recreation, sports, social network, education, smart home, and public safety, among other applications.

Call Scope

Proposed projects must develop technologies on the following priority areas with specific applications that will help address pressing national problem such as government services, banking and finance, Disaster Risk Reduction and Management, education, smart home, among others.

The proposal should support applications on the following topics:

1. Machine / Deep Learning
Maximum Budget Allocation: Php 15M per proposal
Target Number of Project/s to be Funded: 1 per topic (PCIEERD-GIA)

- AI for Government Operations and Services Delivery
- AI for Banking and Finance
- AI for Education/Learning

2. Natural Language Processing (NLP)
Maximum Budget Allocation: Php 15M per proposal
Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)

- Real-time Translation System for Multilingual Conversation

3. Computer Vision
Maximum Budget Allocation: Php 15M per proposal
Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)

- Computer Vision for Safety and Security with Edge Computing

4. Intelligent Robotics
Maximum Budget Allocation: Php 50M per proposal
Target No. of Project/s to be Funded: 1 per topic (DOST-GIA)

- Development of Autonomous Underwater Robot
- Local Prototyping of Robot for Radiation Detection, Monitoring, and Radiation Protection Services

5. Prototypes Demonstrating Emerging AI Platforms
Maximum Budget Allocation: Php 30M per proposal
Target No. of Project/s to be Funded: 1 per topic (DOST-GIA)

- Cognitive Computing
- Federated Artificial Intelligence
- Swarm Artificial Intelligence

Specific Requirements:

- To ensure that the research output will be utilized by the target industry or local regulatory agency, a letter of support / commitment / collaboration must be secured. The proponent should be able to secure training data sets from the target partner institution.

SMART CITY

SMART CITY CHALLENGE PH: Sustainability through Innovation in Cities in the Philippines

Call Rationale

The Department of Science and Technology aims to address challenges of urban and regional life in cities through the use of science, technology and innovation to enhance opportunities and address challenges relating to sustainable urban development against disasters.

The priority topics were based on the stakeholders' consultations conducted with relevant LGUs, academe, and government agencies with main goal of integrating the Smart City initiatives of the Council and develop novel digital solutions.

Call Objectives

The DOST Smart and Sustainable Communities and Cities Framework aims to enhance research collaboration and to fund excellent research with lasting impact. The specific objective is to fully exploit the potential of the regions talent pool and maximize the benefits of an innovation-led economy with the following perspectives:

- Integration of different dimensions of urban sustainability in the framework of the UN Sustainable Development Goals.
- Co-production - a way to extend research activities to bridge gaps between knowledge, understanding, and action
- Establish a multidisciplinary research community in digital twinning:

Call Scope

- Digital Twinning

engage and network with stakeholders in academia, industry and government locally and internationally

Assess and determine what the metro or region needs in terms of research, research infrastructure and skills to develop a national capability in digital twinning

undertake thought leadership in areas of ethics and human interaction, environmental sustainability, and security and resilience of digital twinning through publication of white papers

- Integrated Simulation and Synthesis
- Remote Management and Smart Surveillance
- Internet of Things
- Collaborative Diagnostics with Prescriptive Analytics
- Multidimensional Data Correlation

The following must be considered in the proposal:

5. It should be based on standard sets of data LGUs produce to report in different offices (DILG mainly). These include financial report, PSA data, land use cover, infrastructure utilities, facilities, and amenities
4. Level of reliance, access and availability of data to make local leaders' decisions and plans, and for people to be aware and partake in the process

4. Should include the development of a web system to curate / manage, and visualize input data and assessment of results
5. Assessment of readiness should make references to technology in terms of I) need of LGUs, 2) current level of use or access, 3) availability.
6. Applicants should come from a broad range of disciplines familiar with digital twinning.
7. We encourage submissions from a research team that has the ability to reach out across a breadth of disciplines and across the metro or region.

Specific Requirements

4. Present a novel concept or mechanism; or
6. Case of immediate application must be presented;
2. The program integrator / proponent must come from the pilot cities in partnership with DOST Regional Office and Higher Education Institutions (HEIs) with proven capability to conduct R&D projects;
2. Endorsement from the local government unit is required;
2. Collaboration with an industry or government partner committed to provide counterpart funding is an advantage;
2. Provide details on the technologies to be used. There is no limit to the number of technologies that may be used.
3. PCIEERD is interested in understanding the range of technologies that communities are considering as part of their applications to achieve perceived outcome(s). Cite available DOST technologies that can complement with the project.

Funding

Region IV-A (20M/project)
Metro Iloilo (30M/project)
Mindanao (20M/project)

M. SPACE TECHNOLOGY APPLICATIONS (STA) FOR PUBLIC SERVICES

Call Rationale

In the past years, DOST-PCIEERD funded various STA projects for disaster preparedness and mitigation, resources assessment (agriculture, coastal, forest, watersheds, and renewable energy), drought and crop assessment and forecasting, as well as monitoring of reforestation and irrigation projects to help enhance the mandated agencies in delivering key services for the Filipino people.

To date, we have different available satellite data from freely available satellite data to various satellite subscriptions and from the country's own DIWATA satellite, that must be utilized and/or translated into application to address different issues and improve public service delivery.

Call Objectives

Proposals should make use of space borne and/or remote sensing technologies like Geographic Information System (GIS), Global Navigation Satellite System (GNSS), Synthetic Aperture Radar (SAR), Light Detection and Ranging (LiDAR) for the call scope or priority areas.

Call Scope

Proposals to be submitted should be aligned with the STA Roadmap including but not limited to the following priority topics.

- Application of other remote sensing technology
    - Develop application for single-photon LiDAR (the next generation of LiDAR technology for 3D mapping)
    - Develop applications using space geodetic techniques such as Global Navigation Satellite System (GNSS), Very Long Baseline Interferometry (VLBI), Doppler Orbitography and Radio positioning Integrated by Satellite (DORIS) Satellite Laser Ranging/Lunar Laser Ranging (SLR/LRR), Satellite altimetry, and Satellite gravimetry
    - Develop application from hyperspectral imaging
    - Complementation of various remote sensing technologies to be used for indoor and underground applications

- *Development of Earth Observation (EO) Data Cubes and its applications*
    - Develop Earth Observation (EO) Data Cubes for Big Data Analytics and Management of EO data

    - Development Earth Observation Application Products from the Open Data Cube addressing Sustainable Development Goals and contributing to Global Policy Frameworks
    - Establishment of web-based or cloud computing services for big data EO analytics
    - Development of thematic applications for EO Data Cubes
- *Small satellite subsystem or components for research and applications*
    - Conduct of research on small satellite subsystem or components for various applications (e.g. M2M/IoT enabled satellite, AI for onboard systems)
    - Broaden the data access and processing, and small satellite development (including manufacture, assembly, integration, and testing) capabilities to regional universities, research institutions, and local industry through R&D

Development of laboratory-based and/or ground-based Synthetic Aperture Radar (SAR) to establish the system focusing on phase array antenna and signal processing of SAR.The priority topics identified were based on the following stakeholders' consultations, surveys and references:

i. R&D Consultation Meeting with UP Training Center for Applied Geodesy and Photogrammetry, December 20, 2022
ii. Harmonization of DOST-PCIEERD and DOST-ASTI Roadmaps on STA, Electronics, ICT, and Quantum Technology, December 15, 2022.
iii. Space Technology Application Baseline Survey conducted October 1-9, 2021

Requirements: Proposals should be submitted with a letter of support from the target beneficiaries or adopters for sustainability. PCIEERD will fund at most five (5) projects with a budget of 5-10 Million per year per project. A clear technology pathway must be also submitted.

Emerging Technologies for Virology and Vaccine Research and Development

Call scope

In addition to the call of the Process Sector on Virology and Vaccine R&D, a multidisciplinary program and project that uses emerging technologies such as material science, nanotechnology, molecular biology, biophysics, optics, photonics, and instrumentation, informatics, electronics, ICT systems and integration, among other disciplines to design and develop tools for the creation of new vaccines against emerging, re-emerging, and endemic pathogens shall be supported.

Call Requirements

Proposals to be submitted should be aligned to relevant policies and roadmaps. Budgetary requirements should be commensurate of the proposed scope and coverage of the proposal.

References:

Bahl, S., Nagar, H., Singh, I., and Sehgal, S. 2020. Smart material types, properties, and applications: A review. Materials Today: Proceedings, Volume 28, Part 3, pp.1302-1306.

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Maurya, KK, Rawat, A., and Jha, G. 2020. Smart materials and electro-mechanical impedance technique: A review, Materials Today: Proceedings, Volume 33, Part 8, 2020, pp. 4993-5000,

SGV&Co. Inc. Emerging Technology Roadmaps and Action Plan. 2020-2024 commissioned by the DOST Philippine Council for Industry, Energy and Emerging Technology Research and Development, Department of Science and Technology (DOST-PCIEERD)

N. ENVIRONMENT SECTOR

Theme: Innovative Green Technologies for Sustainable Environment and Circular Economy

Call Overview

The 2025 Call for Proposals under the Environment Sector focuses on the three sub-sectors, namely: (1) water quality/wastewater treatment and management, (2) air quality, and (3) solid waste management. These topics would like to address pressing national problems by providing solutions through programs for the prevention and control of water pollution, air pollution and innovative solutions to plastic wastes, respectively.

In addition, the three (3) roadmaps of the Environment sector of PCIEERD namely, S&T Water Environment Roadmap, S&T Clean Air Roadmap and Sustainable S&T Solid Waste Management Roadmap which were developed with collaborative efforts among National Government Agencies (NGAs), academe, non-government organization and other stakeholders, will serve as basis for the development of new programs and projects to be included in the Call. The updated roadmap (2022-2040) sets the direction of each sub-sector which is also aligned with the different national programs such as the DOST's Harmonized National Research and Development Agenda (HNRDA 2017-2022) and the Philippine Development Plan (PDP) to complement the SDG 2030 Agenda and Ambisyon Natin 2040.

Additional Call Document Requirements

- Letter of Commitment from an industry/government partner or end user. Specific involvement must be identified in the letter (e.g. investor in technology development, adopter of the R&D output) as well as their counterpart support in project implementation (e.g., funding, or in-kind donation – equipment, personnel technical support, provisions for service facility)
    - If their counterpart is the use of the facility, estimated amount should be reflected in the LIB and the schedule on the use of the facility is shown in the workplan
    - If their counterpart is the personnel technical support, the number and the estimated salary for their period of participation is shown in the LIB and in the workplan
    - If they plan to adopt the technology, initial plan on the adoption should be reflected in the detailed sustainability plan after project completion
- Detailed Risk Management Plan
- Detailed Sustainability Plan after the Project Completion
- Technology Roadmap. A clear roadmap of project activities and outputs
- Socio-economic impact including the estimated level of increase in productivity and income of the laboratory, client firms, and industries through the project

- Data on how the project can contribute to the improvement of environmental conditions by including any possible environmental impact from the proposal
- Incorporate the socio-cultural, political, health and economic implications of managing pollution, impact to the industry and its target outcome
- Provide scientific data and conduct prior art search/technology vetting to support the research
- For project leaders with on-going projects, updated reports for their respective projects should be submitted (i.e., technical progress and terminal and audited financial report). For completed projects, clearance from the funding agency from any obligations under the project.
- Research outputs must lead to S&T policy formulations and decision support systems for sustainability

Program 1: National Research and Development Program for the Prevention and Control of Water Pollution

Call Rationale

The Philippine **Clean Water Act** of 2004 (**Republic Act No. 9275**) aims to protect the country's **water** bodies from pollution from land-based sources (industries and commercial establishments, agriculture and community/household activities). It provides for a comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectoral and participatory approach involving all the stakeholders. Under ***Section 24*** of the Philippine Clean Water Act, ***Pollution Research and Development Programs,*** it states that, the DENR in coordination with the Department of Science and Technology (DOST), other concerned agencies and academic research institutions, shall establish a ***"National Research and Development Program for the Prevention and Control of Water Pollution."*** As part of the said program, the DOST shall conduct and promote the coordination and acceleration of research, investigation, experiments, training, survey and studies relating to the causes, extent, prevention and control of pollution among concerned government agencies and research institutions.

Call Scope

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

1. R&D for Wastewater Reuse as input for the establishment of water quality standards
2. Pilot Demonstration of treatment / rehabilitation / remediation technologies (AI-based treatment, resource recovery, membranes)
3. Development of Rapid Test Kits for detection of pathogens in wastewater

Call Objectives

The main objective of this call is to give special emphasis to research and development of improved methods and development of innovative technologies

having industry-wide application for water quality management and pollution control. It is important to note that the program/project should be holistic in approach, closed loop technological interventions that are low-cost/cost effective and innovative, multi-disciplinary or transdisciplinary to foster collaborative learning and inclusive solutions development with all stakeholders. The research should provide scientific data to support/lead to policy formulations and updating of the Philippine Clean Water Act and its implementing rules and regulation, DENR Administrative Order 2016-08.

Note: PCIEERD will fund/endorse maximum of 5-7 projects not to exceed Php145M budget covering all projects. The maximum duration for each project is 3 years.

Program 2: 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." These agencies should align their efforts to come up with the national R&D program for air pollution prevention and control. The prevention and control of air pollution studies should be backed-up with scientific data gathered by the said institutions. There is an immediate need to monitor the effects and impacts of particulate matter at high time resolution, especially those with small diameters (e.g., $PM_{2.5}$, ultrafine particles, UFPs) that significantly influence human health and the environment. Thus, development of real-time PM assessment tools / devices is also a recommendation to help reduce the health impacts of PM. Additionally, mobile sources remain the largest source of emissions in the country (2018). Emissions from mobile sources increased from 65% in 2015 to 74% in 2018. Managing mobile sources for emerging megacities are also becoming a challenge, due to the dependence on motorized modes of transportation, and availability of more affordable motor-vehicles which enhanced substantially the traffic volume. Based on the National Air Quality Status Report (2016-2018), the monitoring capacity remains to be ~100 stations nationwide, and a major challenge is the nearing obsolescence of some of the equipment. Thus, it will be imperative to develop more monitoring stations together with DENR, particularly roadside measurement cabins, to fully capture the variability of pollutants generated from vehicular activities. Overall, despite the consolidated efforts to improve air quality status, there are still remaining challenges and needed actions in air quality management.

Call Scope

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

1. Development of real-time spatio-temporal emission inventory, monitoring and ambient air quality forecasting
2. R&D for locally developed emission factors and standards
3. Cost-effective air pollution treatment technologies focusing on abatement
4. Development of Green House Gas (GHG) emission monitoring & assessment tools and protocols (e.g., carbon meter, etc.)
5. Development of GHG capture & mitigation technologies

Call Objectives

The proposals to be submitted should be able to develop technologies that 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. Proposals should 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.

Note: PCIEERD will fund/endorse maximum of 7 projects not to exceed Php150M budget covering all projects. The maximum duration for each project is 3 years.

Program 3: Innovative Solutions to Solid Waste Management

Call Rationale

The Philippines' generation of solid wastes has been increasing directly proportional to the country's population and economic activity with infrastructure development and modernization among other factors. In the **National Solid Waste Management Status Report for CY 2008-2018**, basing on the per capita rate of 0.40 and annual projected population, the projected amount of waste generated in the year **2020 is 16,628,026 metric tons**. It must be noted that the data projection was pre-COVID-19 Pandemic and before the surge of consumer's shift to online purchase. DENR reports that the Philippines has endeavored to improve its management of solid waste through the passage of **RA 9003** or the ***Ecological Solid Waste Management Act of 2000*** which *provides for a systematic, comprehensive and ecological waste management program to ensure the protection of the public health and the environment.* In the recently conducted Webinar titled ***EU-ASEAN: GreenTech & Innovation Mapping Dialogue: Green Technologies for Plastic Value Chain Management,*** it was presented that currently, 52.31% of the wastes generated are biodegradable wastes, 27.78% recyclable wastes, 17.98% residual wastes and 1.93% are special wastes. residential sector contributes about 56.7% of the generated wastes, while commercial establishments is at 27.1%, institutional establishments at 12.1% and the 4.1% comes

from industrial establishments. Meanwhile, the LGU's compliance rate to RA 9003 remains very low. Out of 42,000 barangays only 31% has established Material Recovery Facilities (MRF) despite the mandate of the law for every barangay to put up MRFs. While the country's compliance to sanitary landfill (SLF) is around 22-24% although increasing, still falling behind the mandate of RA 9003. To address solid waste management concerns, the **National Solid Waste Management Committee (NSWMC)** initiates food waste management program, development of composting guidelines and energy recovery for the biodegradable wastes; increase recovery for recycling wastes and promotion of recycling for recyclable wastes; initiatives for arts and crafts, alternative technologies (i.e., construction materials like hollow blocks, eco-bricks, lumber, roads) and energy recovery (RDF, Fuel, Electricity) for residual wastes; hazardous wastes management at City/Municipal Centers (DENR), medical waste management program of DOH and lastly, proper Sanitary Landfill disposal for special wastes.

However, despite the efforts and 21 years after RA 9003 was passed into law, solid waste management remains a major problem in the country especially in urban areas like megacities (e.g., Metro Manila, Cebu, Davao). In 2015, a report was published by Ocean Conservancy and McKinsey Center for Business and Environment, where the **Philippines was ranked 3rd as the biggest source of plastics leaking into the oceans**; This study should be validated by local research with actual sampling and analysis. Plastics *per se* has its many advantages, is very cheap and easy to produce compared to other materials. Sadly, these same features are the same reasons for the mismanagement of this material. Single-use plastics from products sold by conglomerates, such as bags, bottle labels, and straws end up not being recycled and worse, sometimes end up mismanaged. Every year, our country contributes 1.88 million tons of "mismanaged plastic waste". Majority of these are made of Polypropylene or PP. It is a heat-resistant plastic commonly used in food and beverage packaging. When it is dumped in the sea, over time it breaks down into small plastic particles or **"microplastics"**. A study published in *Marine Pollution Bulletin* entitled ***"Microplastics in marine sediments and rabbitfish (****Siganus fuscescens****) from selected coastal areas of Negros Oriental, Philippines"*** analyzed 120 rabbitfish (*Siganid fuscescens*) bought from local fishermen in the cities of Dumaguete and Bais and in the towns of Manjuyod and Ayungon, all part of the Tañon Strait protected seascape, a major fishing area in the province of Negros Oriental. The study found that nearly half of the fish samples had microplastics present in their digestive systems. Therefore, confirming that microplastics have been introduced into the human food chain. The impact of ingesting microplastics has yet to be determined.

With the provided study results, data and the current situation where every household is generating infectious wastes e.g., facemasks while online shopping is being highly practiced resulting to the influx in the volume of single-used plastics, it can be inferred that significantly, there is a predominant need for innovative, affordable and or compact technology solutions for solid waste management.

Call Objective

The objective of this call is to support inter-disciplinary research to understand the risks that solid waste pollution poses and provide technological interventions. Therefore, this call requires the proposals to address the key gaps and to incorporate the socio-cultural, political, health and economic implications of managing pollution while providing scientific data that will support and lead to formulations of policies.

Call Scope

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

1. Value-adding studies of Wastes from Electrical & Electronic products (WEE) and from other sources
2. Development of technologies/strategies for marine litter prevention and reduction from point & non-point sources
3. Establishment of Recyclability/Biodegradability Testing Facility and development of database of Recyclables and Recyclables with Potential for Recycling including Plastics

Note: PCIEERD will fund/endorse maximum of 5 projects not to exceed Php210M budget covering all projects. The maximum duration for each project is 3 years.

O. DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION (DRR-CCA)

Call Rationale

The Philippines, because of its location, is vulnerable to numerous natural disasters and climate change causes which result to catastrophic loss of lives and property each year. In fact, the Philippines ranks 1st in the World Risk Index for Natural Disasters according to a study done by the United Nations University Institute for Environment and Human Security (UNU-EHS) in 2022 and 2nd in the Global Climate Risk Index as of 2018. Lessening the impact and/or reducing our different communities' vulnerability to the harmful effects of natural disasters and climate change over the years has remained one of DOST's primary goals over the years. These threats have ranged from multi-natural hazard such as tsunami, earthquakes, volcanic activity, landslides, typhoons, thunderstorms, severe wind, heavy rains, and floods as well as climate-induced hazard such as extreme weather phenomena (heatwaves, droughts, frost, hail, intense storms, etc), temperature rise, changes in precipitation patterns and sea level rise.

The Disaster Mitigation (DM) Sector is a priority for PCIEERD and is aligned with the Harmonized National R&D Agenda for Disaster Risk Reduction and Climate Change Adaptation (DRR and CCA). The DOST, in consultation with government and private research and development institutions, the academe, industry and other concerned agencies, prepared the Harmonized National R&D Agenda (HNRDA) 2017-2022 to ensure that results of S&T endeavors are geared towards and are utilized in areas of maximum economic and social benefit for the people. It is divided into five (5) sectors: Basic Research; Agriculture Aquatic and Natural Resources; Health; Industry, Energy and Emerging Technology; and Disaster Risk Reduction and Climate Change Adaptation. The formulation of the HNRDA is in line with the DOST's mandate of providing central direction, leadership and coordination of the scientific and technological efforts in the country. The priority programs also aim to help contribute to the attainment of the following Sustainable Development Goals as part of the 2030 Agenda for Sustainable Development, specifically:

1. Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
2. Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
3. Goal 13: Take urgent action to combat climate change and its impacts.

Program Description and Roadmap Creation

The DRR-CCA program has three (3) Sub-Programs as follows:

1. Multi-Hazard Assessment Tools and Systems

Various multi-natural hazard and exposure maps have been created such as Tsunami Susceptibility Maps, Earthquake Hazard Maps, Seismicity Maps, Philippine Fault Zones, Volcano Hazard Maps, Rainfall-induced and Earthquake- induced Landslide Maps, Typhoon Tracks Map, Heavy Rains, Severe Wind, Flood Maps and Drought Maps. Due to these outputs, it is also now possible to generate near-real-time multi-hazard reports for tsunami, earthquakes, volcanic activity, landslides, typhoons, severe wind, heavy rains and floods. These maps can be used for further research and other applications to DRR-CCA.

2. Vulnerability Assessment, Risk and Warning Communication Systems

With the generation of reference maps mentioned above, addressing, and assessing local vulnerabilities to help planners and managers mitigate the impacts of natural hazards and disasters are easier. Mandated agencies, through developers and programmers, are also able to create warning communication systems thru integrated web-based and mobile phone-based warning and information systems. In this way, there is an enhancement of the capabilities of high and moderately vulnerable communities to assess, and national and local risks to mitigate and quantify the impacts, and damages due to natural hazards.

3. Localization of observation and Forecasting Tools & Monitoring Networks

Across several projects, locally developed/manufactured, cost-effective sensors and prototype instruments for effective monitoring of Disaster Risk Reduction- Climate Change Adaptation (DRR-CCA) related events have also been made.

In consideration of the above, the DRR-CCA S&T Program has essentially accomplished the following for the period 2010-2021:

1. Enhanced capacity of the high and moderately vulnerable communities to assess and address local risks to mitigate and quantify the impacts, and damages due to natural hazards.

2. Developed/fabricated an improved and enhanced all-hazards monitoring and forecasting through an accessible and reliable, real-time to near-real time end-to-end risk communication systems.

3. Locally developed/manufactured, cost-effective sensors and instruments prototype for effective monitoring of DRR-CCA related events.

4. Locally fabricated and upgraded monitoring system, tools & techniques for risk assessment.

5. Established and reliable observation and operating systems for disaster management

PCIEERD's DM Sector conducts the internal program development for DRR-CCA- related Hazards thru a cyclic process. First, Project Managers revisit and/or reassess the current roadmap draft specifically regarding yearly call topics and themes, expected milestone indicators, requested funding amount and overall strategies vis-à-vis expected overall outcome. Next, copies of the roadmaps are sent and are vetoed by agencies with research and development mandates regarding CCA which include but are not limited to:

1. Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST- PAGASA)
2. Philippine Institute of Volcanology and Seismology (DOST- PHIVOLCS)
3. Advanced Science and Technology Institute (DOST- ASTI)
4. Climate Change Commission (CCC)
5. Department of Environment and Natural Resources' Mines and Geosciences Bureau ((DENR)- MGB)
6. Climate Change Services (DENR-CCS)
7. Academe (State Universities and Colleges and Higher Education Institutes)

Once initial comments and inputs are generated from these agencies, a Focus Group Discussion (FGD) is conducted per agency or similar agencies for further discussion and validation of data. A major deliverable of the FGD is generation of additional call topics/ research gaps/ specific R&D intervention needed that are not yet identified in the current draft of the roadmap as well as the prioritization of said call topics per year and tentative funding amount to be allotted for the said call. During the FGD, other information are also generated such as potential implementing agencies, potential program/ project leaders, potential collaborators/partners, facilities and equipment needed. Call topics are then generated from said date and divided into regular call topics and/or directed call topics.

In 2021, there were two (2) rounds of FGDs conducted, one in February and one in September. FGDs done in February was the basis for the CCA Call Topics during the May-June Call for Proposals while the one in September was the basis for the special Call for Proposal done in December and again in May-June of 2022. For the 2023 funding, all FGDs were done from October to November this year, in preparation for the Call for Proposals on May- June next year. All inputs from the previous FGDs were the basis in the creation of the current version of the DRR-CCA Roadmap.

Call Objectives

The objective of this call is to alleviate the effects of disaster and climate change through enhancing the current methodologies, technologies and capabilities of the mandated agencies such as PAGASA, PHIVOLCS and DENR-MGB. Specifically, the call should address concerns and research gaps relating to seismic, hydrometeorologic and climate- related hazards.

Total Allocation for 2024 – 2025: **Total PhP 450,000.000.00**

Scope

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

R&D Priority Areas for CFP 2025

1. **Disaster Risk Reduction (Total: 370M)**

a. Tsunami (2-3 Projects at Total: 20M)
   - Tsunami Hazard Modelling, Exposure Database Development, and Impact Assessment (20M)

b. Earthquakes (2-3 Projects at Total: 20M)
   - Quantifying Earthquake Impacts (Damages, Casualties and Losses) (20M)

c. Volcanic (1-2 Project at Total: 30M)
   - Geomorphological mapping and modeling of Active Volcanoes (30M)

d. Tropical Cyclones (3 Programs with 2-4 subcomponent projects at Total: 110M)
   - Typhoon Structure Change Modelling (20M)
   - Muti-hazard Impact-based Forecasting Approaches, with tentative sub-projects: (30M)
     - Flood, landslide (with MGB), storm surge translation to risk
     - Socio-economic benefit of met services
   - Detection/ Mapping/ Monitoring/ EWS for Micro-weather Forecasting (60M)
     - Cloud/Thunderstorm High-resolution Near real- time Detection
     - Ship Route Gale Warning Visualization
     - Composite radar Visualization w/ Ship Tracking capability
     - Bow Echo Detection for Tornado Warning

e. Landslides (3-4 Projects at Total: 30M)
   - Rainfall threshold analysis for landslide hazard mapping and modelling for various geological and geomorphological conditions (30M)

f. Floods and heavy Rains (2 Programs at Total: 60M)
   - Development of operational hydrodynamic model for operational flood forecasting and warning for major river basins of the Philippines (30M)
   - Coupled Atmosphere-Hydrological (WRF-WRFHydro) for Flood Forecasting (30M)

g. Multi- hazard/ Cross-cutting (3-5 Projects at 100M)
   - Updating of the exposure database nationwide specifically for seismic and hydrometeorologic hazards (100M)

2. **Climate Change Adaptation (4 Projects at Total: 80M)**

- Impact-based Forecasting focusing on probabilistic Forecasting, Modeling and Risk Assessment (80M) for:
  - Flooding
  - Landslides
  - Storm Surge

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P. CREATIVE INDUSTRIES

I. FUNCTIONAL AND AESTHETIC CREATIONS

Call Rationale

The 2022 Global Innovation Index (GII) reported that the Philippines maintained its position as one of the countries in the middle-income group that performed above expectation for level development in terms of innovation. As one of the 2022 Innovation Achievers and ranking 2nd in High Tech exports, the Philippines exhibited notable improvement and performs on innovation outputs at comparable levels to high-income group economies like Lithuania and Greece with a lower level of innovation inputs. It was noted that the three innovation pillars, Business sophistication, Knowledge and technology outputs and creative output are contributory to the catch up in the Index.

Parallel to GII ranking of the country, the renewed appetite and commitment on the Creative Industries has been felt in the past few years with 2022 as the year wherein the Philippine Creative Industries Development Act (PCID) or RA 11904. The PCID mandates the creation of a long-term plan for the promotion and development of creative industries.

The various aspects leading to the maintained position in the GII's innovation pillars and the changing policy that are beneficial to the industry are significant factors to steer research and innovation on areas that will help the Creative Industries sector. It is against this setting that the Council is providing support to programs and projects that will contribute to future innovative waves and ensure that they are aligned with the priorities of the Creative Industries' Functional and Aesthetic Creations specifically on the areas on Footwear, Furniture, Heritage, Jewelry and Musical Instruments.

Call Objective

The Call generally aims to provide support to qualified S&T research proposals on programs and projects with innovation and provide solutions to identified priority areas of the creative industries sector particularly on areas footwear, furniture, heritage, jewelry, and musical instruments.

Specifically,

1. To increase research and innovation that are relevant to future innovation waves in the creative industries sector
2. To spur collaboration across innovation stakeholders in the Creative Industries and encourage long-term R&D partnerships between academe, research and development agencies, creative enterprises, and other stakeholders.
3. To encourage development of homegrown technology and technological capabilities that are relevant to the sector

I. ***Footwear Design and Innovation Program***

The footwear industry is considered a mature and stable industry in the county but noted to be heavily concentrating on subcontracting arrangements with foreign and large domestic companies that produces branded footwear and has always shied away from venturing into exports. As part of the creative industries sectors, the industry has been steadfast despite the pandemic. In the 2022 focus group discussions and validation, results indicated that the S&T roadmap of the Footwear Sector remains within the sector's intended future directions. As indicated in the roadmap, the industry will benefit from interventions of the science-based research to address the gaps particularly on the availability of quality and affordable raw materials, technologies that will improve productivity such as digital applications and software.

Target Program/Projects: 5
Total Budget: Php 30,000,000.00

Call Scope

The program covers project proposals incorporating innovative solutions and research in material innovation on the following areas/priorities:

- Integration of indigenous-related technologies in R&D
- Development and application of local raw materials for footwear design and parts
- Local software application for footwear design and production
- 3D application technologies for Footwear design and parts

II. ***Furniture Applications and Design Program***

The Philippine Furniture industry has been gaining traction in the international trade because of its known talent on craftmanship, handmade work, hand finishing, and design. The industry is gearing towards attaining its goal of sustainable growth through availability of sustainable and environment-friendly raw materials and establishment of supply hubs for semi-process materials.

To catalyze the industry's productivity through S&T, the Creative Industries sector is calling for proposal for material manipulation and technology innovations that can be utilized by the furniture sector for their design and production of their products and furniture parts/implements. This year's call is a response to the gaps and challenges of the industry that was manifested in their sector reports to DTI, previous focus group discussions and the inputs of the industry during the special hearing of the House of Representatives in 2022 for the Furniture Industry.

Target Program/Projects: 2
Total Budget: Php 15,000,000.00

Call Scope

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Project proposals to be submitted are expected to incorporate innovative solutions and research in material innovation that will cover the following areas/priorities:

- Integrating indigenous-related technologies in R&D
- Development and application of local raw materials including but not limited to wood and non-wood to furniture and furnishing
- Green and smart furniture technologies
- Asian-based ergonomic design and parts
- 3D application technologies
- Local software and tools for design and makers

III. ***Jewelry Design and Innovations***

The worldwide jewelry industry is expected to expand by 2030 and despite the recession and financial crisis, consumer preferences are leaning towards branded or established brand jewelries due to unique design, trustworthiness, and authenticity. Technology played an important role in transforming the international industry scene, from technologies on mining to 3D printing, cloud solutions and e-commerce platforms prompting the growth of the jewelry industry. However, the local industry is yet to catch up despite the reported abundance supply of gold and silver, source availability of semi-precious stones such as jade and onyx, south sea pearls and other cultured pearls.

The Philippine jewelry is composed of two sectors: fine jewelry and costume jewelry. For this year's call, the focus will be on fine jewelry designs and innovation.

Reports[1] and 2020 Creative Industries Summit and FGD stated that the fine jewelry making is still dependent on labor-intensive production which is still a manual production or hand operated tools (mano-mano) although there are a few that already acquired casting machines and wax injectors. Through research and development, the technologies from the projects and programs will contribute on improving the productivity of the industry and increase the interest of the next generation to continue the business hence the retention of traditional crafts using professionalized technical skills.

Total Program/Projects: 1
Total Budget: Php 10,000,000.00

Call Scope

The call will prioritize funding of Research and development program/projects on the following:

- Fine Jewelry technologies including design, production, innovation, and safety
- Digital technologies including software, applications and other relevant technologies for Fine Jewelry making

IV. ***Music Instruments Innovations***

The pandemic has emphasized our relationship with music. With home confinement and isolations, the musical related events worldwide were expected to decline but music found a different platform and most shifted to digital. The music did not standstill, and so does the use of musical instruments. In the Philippines, music mirrors the diversity of the Filipino culture. DOST PCIEERD has already initiated through different projects on bamboo the innovation on musical instruments. Addressing the challenges highlighted during the FGD with stakeholders last December 2022, the call for proposal signifies the continuity of providing support through research and development to the local music industry including but not limited to the project and programs that will be applicable to our local musical instruments.

Target program/project: 1
Total Budget: Php 10,000,000.00

Call Scope

The call will prioritize funding of R&D program/project focusing on Development and Design of Musical Instruments in relation to the following areas:

- Digital technologies relevant to musical instruments including but not limited to standardization, design, software, mobile applications, and virtual simulation
- Technologies for protection/ maintenance of instruments
- Development of ergonomic instruments (i.e, instruments for children)
- Green packaging technologies for musical instruments

V. ***Cultural Heritage: Preservation and Recovery***

Culture heritage is shaped by the community, and an inheritance from the previous generations. It is the driver of cultural and creativity of the locality. The Philippines cultural heritage is rich and diverse. While policy and laws are in place to preserve the cultural heritage, the role of science in the preservation and recovery has yet to be emphasized and realized. With the advancement of technologies, research, and development projects/ programs will provide available sustainable management of the preservation and recovery of our cultural heritage.

Various Philippines laws[2] covers the preservation and recovery of heritage. For this year's call, the call will focus on research and innovations by supporting projects on appropriate technologies and/or methods or processes that will enhance the preservation and recovery of our heritage.

Target program/project: 1
Total Budget: Php 10,000,000.00

Call Scope

The call will prioritize funding of R&D program/project that will focus on the following:

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- Technologies and innovation including methods/procedure on historical building recoveries
- Technology-aided cultural heritage and structures preservation

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II. GAME, ANIMATION, AND FILM CLUSTER

Call Rationale

The Creative Industry is considered as one of the growing sectors in the global economy which contributes significantly to Gross Domestic Product (GDP) of developed countries. The Philippines is among the developing countries with rich cultural heritage and pool of creative talents that can potentially boost the economy through its creative goods. The country has the potential to be a creative hub in Asia through developing the different creative industries including the game, animation, and film.

In 2022, the Philippines ranks 58th among the 132 economies featured in the Global Innovation Index in terms of creative outputs. To improve the ranking in this pillar, innovation investments must be effectively translated into more and higher-quality creative outputs including intangible assets, creative goods and services, and online creativity. To achieve this, the Council will support applied research and development projects that will address pressing concerns and strengthen the current capabilities of the local creative industries, particularly the game, animation, and film development sector. This is in coherence with the research and development and innovation support provided by the Department of Science and Technology for the creative industries as specified in Section 12 Chapter IV of RA 11904, otherwise known as the Philippine Creative Industry Development Act. This is to finally achieve the vision of making the country the top creative economy in ASEAN in terms of size and value driving competitiveness and attractiveness of the local creative talent and content in the international market.

The priority topics identified were based on the following stakeholders' consultations:

- **Stakeholders' Consultation in Animation Sector**, August 5, 2022
  Participants: Animation Council of the Philippines Inc., Animation Vertigo Asia, Creative Content Creators Association of the Philippines Inc., Taktyl Studios, Kampilan Productions, Treston International College, Ateneo de Naga University, Malayan Colleges Laguna, and Negros Occidental Language and IT Center
- **Stakeholders' Consultation in Game Development Sector**, Sept. 1 and 9, 2022
  Participants: Game Developers Association of the Philippines, Ateneo de Manila University, University of the Cordilleras, Western Institute of Technology, De La Salle University, Occidental Mindoro State College, University of the East, Philippine Science High School System, Far Eastern University, De La Salle – College of St. Benilde, University of Makati, CyberCraft Philippines Association, Minnapad, Mata Technologies Inc., Imagine Realities Inc., WBagadion Consulting Inc., EIAPI, NEM PH, Cebu Chamber of Commerce and Industry, and Department of Trade and Industry
- **Stakeholders' Consultation in Film Development Sector**, November 17, 2022
  Participant: Film Development Council of the Philippines

Call Objective

The main objective of this call is to support research and development projects in creative industries particularly in game, animation, and film development sectors that will address

the needs and strengthen the local capabilities in terms of facilities and services, human resources, R&D technologies, and/or S&T policies.

Call Scope

Creative industries have been interlinked and heavily influenced by information and communication technologies (ICT) including artificial intelligence, Internet-of-Things, cloud computing, big data analytics, extended reality, wearables, and intelligent interfaces among others, which are still considered in the Philippines as emerging technologies. These ICT tools will not only address the need but will also drive economic transformations and disruptions in the creative sector in the coming years.

To enable innovations, this call targets to support applied research projects on the following topics:

Program 1: GAME-ONE – Game Apps and Metaverse Ecosystem for Online and Novel Experiences

- **Development of Serious Games and Gamification Apps for Tertiary Education, Corporate Sector, Banking, and Cultural Preservation**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 2 (PCIEERD-GIA)
  Currently, PCIEERD already supported projects on developing serious games as learning tool for primary and secondary education particularly in Mathematics, Physics, Chemistry, Biology, Health, STEM, and Social Studies and even for tourism and cultural heritage preservation. Since serious game apps were shown to improve student engagement, motivation, and retention of knowledge and schools are now infusing serious game applications in the new curriculum, more serious game apps shall be explored and developed but this time for tertiary education, corporate sector, banking, and cultural preservation.

- **Development of Input Modalities for Extended Reality App Simulation and Training**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 2 (PCIEERD-GIA)
  Extended reality is a universal term inclusive to immersive learning technologies such as virtual reality, augmented reality, and mixed reality. These technologies extend reality by simulating the real world through digital materials providing multisensory environment for more interactive technical training programs. This is practically applicable to high-risk industries allowing safe experiential learning and providing convenience to scale and reuse.

- **Development of Metaverse Platform with Digital Marketplace**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  A metaverse marketplace is a platform trading digital assets such as virtual lands, in-game assets, and other non-fungible tokens (NFTs). All transactions done on the

platform are based on blockchain technology. It offers a way to enable consumers to buy, sell, or trade NFT art, digital images, GIFs, audios, videos, gaming assets, and virtual real estate and explore products and services interactively. It also allows users to attend virtual galleries, explore game previews, attend presentations, conduct conferences, join live auction through avatars, and other unique online experiences.

Program 2: CInEMA – Creative Inventions Enhancing Moviemaking and Animation
The following R&D projects may be proposed towards the establishment of Interactive Moviemaking Facility and Creative Innovation Hub for Graphics Design and Motion Capture:

- **Development of Motion Capture Technology for Facial, Body, and Hand Gestures**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
  Motion capture is a core part of modern film, game, and app development. Traditionally, motion capture requires special equipment, cameras, studios, and software. Recently, researchers have developed a machine learning algorithm that works with any off-the-shelf camera to track face, hand, and body gestures, eliminating the need for markers on bodysuits. This markerless motion capture technology will allow animators and filmmakers to animate characters easily and in real-time.

- **Integration of Artificial Intelligence in 3D Animation and Character Simulation**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
  Artificial intelligence and advanced physics simulation are now being integrated to create more realistic animations offering a better alternative to the tedious and labor intensive method of traditional keyframe animation. Using deep learning, a character control system is being developed to assist characters to walk, run, jump, avoid obstacles, and carry objects using simple control commands in real-time. This allows creation of virtual worlds filled with naturally behaving characters which go beyond video games and animated films.

- **Process R&D on Graphics Design and Computer-Generated Imagery (CGI)**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
  The art of computer graphics is highly technical and often requires hundreds of highly skilled artists. Hence, research and development on the process of graphics design would be beneficial for animators to easily achieve a certain creative look and feel. Moreover, advancements in computer-generated imagery technology would assist the local moviemakers to create a more realistic special effects. Aside from film development, CGI software may also be explored in anatomical modelling, architectural design, engineering, and other interactive simulation and visualization.

- **Development of Algorithmic Video Editing**

Maximum Budget Allocation: Php 10M per proposal
Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
Algorithmic video editing is now being used to assist editors with footage organization and rough cutting. Recently, researchers were able to develop an algorithm designed to choose the best shots and string them together with continuity. While the future of post-production will not likely fall to the robots anytime soon, the applications for algorithmic film technology are becoming more practical that tech-savvy editors can use to optimize the post-production workflow.

- **Development of 3D Pre-visualization Software**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  3D Pre-visualization (pre-viz) revolutionizes the pre-production value chain by integrating fully immersive digital replicas of the physical sets or locations to be used on a live-action production before the actual cameras begin to roll. The digital playgrounds of 3D pre-viz provide filmmakers the time and space to explore and experiment without incurring unnecessary expenses. With 3D pre-viz software and game engines, directors can better refine visual designs, production designers can increase construction precision, directors of photography can take the guesswork out of technical solutions, and producers can optimize the logistical flow of the entire production.

- **Application of High-End Real-Time Rendering Technologies**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Real-time rendering is a powerhouse technical solution that allows changes to a digital environment to be made near instantaneously without the tediously long render times. By being able to both see and alter the interactions between physical and digital components in real time, filmmakers can work faster with more precision and more options for experimentation. From traditional animation to green screen, real-time rendering is now shaping the future of filmmaking technology.

- **Prototyping of Autonomous Drone Cinematography System**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Drones have made capturing aerial footage more convenient and accessible. However, shooting cinematic motion videos using a drone is challenging because it requires users to analyze dynamic scenarios while operating the controller. Today, researchers have developed autonomous drone cameras specifically designed to film live actions with all the necessary knowledge of filmmaking, camera angles, and techniques. The developed prototypes are also provisioned with the ability to avoid obstacles in flight and capture moving objects which are basically needed to produce unique shots and make a good film as compared to static cameras.

- **Development of Interactive Moviemaking Technology**
  Maximum Budget Allocation: Php 20M per proposal

Target Number of Project/s to be Funded: 1 (DOST-GIA)
With the drift of film history into greater realism and higher audience immersion interests, interactive films are now emerging allowing viewers to take control of the outcome of the story. With the customized movie experience, through downloadable standalone app, it is expected that several movies in the future will appear with custom plots and visuals presenting an innovative entertainment choice and unique storytelling narrative for the general audience.

- **Volume Technology for Immersive Digital Filmmaking**
  Maximum Budget Allocation: Php 50M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Volume technology refers to the usage of massive LED walls to display pre-recorded images in the background of a shot while live-action elements are filmed in the foreground – a process designed to achieve a seamless, in-camera composition of physical and digital components. Instead of the conventional green screen, the technology involves filming actors and practical set pieces while surrounded by a high-definition LED video wall displaying computer-generated backdrops. By combining the game engine, real-time rendering, and video wall technology, the Volume offers an easily customizable and highly immersive digital filmmaking solution, speeding up production times and amplifying the reality of visual effects.

Program 3: IIMiG – Innovations for Intelligent Music Generation
The following R&D projects may be proposed towards the establishment of Creative Innovation Hub for Audio-Post Production:

- **Automatic Music Generation and AI-Assisted Sound Engineering**
  Maximum Budget Allocation: Php 10M per proposal
  Target Number of Project/s to be Funded: 1 (PCIEERD-GIA)
  Audio-postproduction software for automatic soundtrack generation has been recently developed to streamline the process of implementing audio into films. The technology will help sound engineers to rapidly locate and apply sounds in scene footages considering sync points, genre, and intensity, providing an infinite range of alternate compositions.

- **Prototyping of Personalized Sound Control Technology**
  Maximum Budget Allocation: Php 20M per proposal
  Target Number of Project/s to be Funded: 1 (DOST-GIA)
  Personalized sound control technology is a loudspeaker technology that brings only the target sound to the listener without causing sound leakage. It can be applied in cars, in movie theaters, or even in airplanes enabling passengers to listen to different music or watch different movies without using earphones or without others in the room hearing them.

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Q. UNMANNED VEHICLE SYSTEMS

Call Rationale

Unmanned Vehicle Systems (UVS), particularly unmanned aerial vehicles (UAV), are still among the latest technology trends sweeping across and disrupting a broad spectrum of industries. For more than a decade in the global market, UVS has been the face of intelligence, disaster response and assessment, warfare/military, humanitarian relief, among others. With the inclusion of the land and sea applications, the benefits of unmanned systems will extend beyond these sectors.

Currently, the UAV industry in the Philippines is comprised of technology & service providers, users, hobbyists/enthusiasts, technology developers from research and academic institutions, UAV parts & component suppliers. The country will benefit a lot if the vast and fast-evolving UVS technology applications are explored and adopted.

Call Objective

The objective of the call is to develop and deploy Research and Development (R&D) programs/projects on UVS technologies (land, air, water) in the field of disaster risk reduction, defense, logistics, and industrial applications which are specific to the Philippine situation.

The country is highly vulnerable to numerous natural hazards and climate change. There is a need to develop and sustain capabilities for post disaster assessment, rescue operations, and response to climate change in order to minimize the loss in property and human lives, especially to those located in geographically isolated and disadvantaged areas. UVS technology will also create opportunities beyond traditional markets and provide non-traditional solutions for industrial applications in support of the Philippines moving toward Industry 4.0.

Its vision is to provide resilient communities, competitive industries, and strategic logistics for the people through locally developed UVS technologies and sustained capabilities.

Total Allocation for 2024: PhP 90,000,000.00

Call Scope

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

1. Development of UVS with Intelligent Autopilot System (IAS) capable of addressing the limitations in Automatic Flight Control Systems (AFCS)
2. Unmanned underwater survey and imaging
3. Secured communication infrastructure/systems (e.g., resistance to hacking, interference from other communication frequencies)

4. Development of platforms with smart/indigenous materials
5. Innovative/hybrid energy sources (e.g., hydrogen-powered, solar-powered, fuel cells application, etc.) and autonomous recharging for UVS endurance
6. UVS with advanced imaging technique/system for disaster response and industrial applications

To achieve long-term sustainability of the UAV S&T intervention program, there's a need for a strong partnership with the industry sector. S&T collaboration among the academe, service providers and end-users to develop UAV hardware, software and applications is required.

Additional Call Document Requirements

- Project duration cannot exceed 24 months
- Letter of Commitment from an industry partner/UVS provider (technologies-services-products). Specific involvement must be identified in the letter (e.g. investor in technology development, adopter of the R&D output) as well as their counterpart support in project implementation (e.g. funding, or in-kind donation – equipment, personnel technical support, provisions for service facility)
- Pre-feasible business models for the innovative commercial application

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R. SCIENCE COMMUNICATION SECTOR

Call Overview

The Philippine Council for Industry, Energy and Emerging Technology Research and Development (DOST-PCIEERD) of the Department of Science and Technology (DOST) is offering support for Science Communication proposals for 2025 funding. The call is open to all science communicators, researchers, DOST information officers, and other key players of the discipline. It is anticipated that the R&D funding will lead to an inclusive, integrated, and innovative approach of science communication in the country.

I. ***Call Rationale***

Science Communication (Scicom) is a growing area of practice and research (Burns, 2003) that plays a vital role in today's development challenges. The Philippines, although having a rich documented history of science and its development (e.g. Anderson, 2007 Velasco & Baens-Arcega, 1984), still needs to delve into the "identity" or "face" of Scicom in the country.

The University of the Philippines—Los Banos, College of Development Communication (UPLB-CDC) led roundtable discussions to begin efforts to mainstream science communication in the nation. These internal workshops, which were held successively in 1999, 2002, and 2016, established the specific characteristics, scope, fields of application, and role of science communication. It also includes other fields of development and issues such as disaster risk reduction and management, food security, and health, among others. In 2021, DOST-PCIEERD in collaboration with UPLB-CDC hosted the Fourth Roundtable Discussion on Science Communication to identify the needs, priorities, and skills of the primary stakeholders in science communication from industry and research institutions.

In 2022, Focus Group Discussions were conducted by PCIEERD's Information Group which focused on the role of scientific communication in the nation, the value of science centers as a vehicle for communicating and disseminating information in science, and the emphasis on research extensions on accelerated communication to some of PCIEERD initiated projects.

Gaps such as the need of basic research, evaluation metrics, and technologies on Scicom were identified in these FGDs. Thus, it is vital to maintain endeavors towards an

integrated, inclusive, and innovative strategy on Science Communication in the country thru R&D support.

The following are the specific objectives of the call:

1. To provide R&D support for research on science communication
2. To provide R&D support for the establishment and/or development of science communication infrastructure, technologies, human resource development plans, and among others.

A. Science Communication for Innovation

II. *Call Scope*

The following are the identified call themes of Science Communication proposals with the corresponding objectives and recommended science and technology interventions:

1. Research on Science Communication

Call Objectives

The proposed project should be researches on collective relationship of Filipinos to science. Below are the specific objectives:

- A comprehensive mapping of key players in science communication, multi-sectoral platforms and/or initiatives
- A market study of the perception measurement on science, low R&D adoption, and among others.
- Development of information materials in the mother tongue

Call Scope for Research and Budget

PCIEERD will fund research on science communication with a maximum budget of Three (3) Million Pesos per year per project. Proposed project should run for a period of one (1) year only.

2. Research Studies on Evaluation of Science Communication

Call Objectives

Proposal that aims to evaluate science communication activities and programs based on a framework. (i.e. evaluation and roll out of the harmonized science communication framework)

Call Scope for Research and Budget

PCIEERD will fund research on science communication with a maximum budget of Three (3) Million Pesos per year per project. Proposed project should run for a period of one (1) year only.

3. **Capacity-building Programs on Science Communication**

Call Objective

Proposed projects that are aimed to capacitate not only science communicators but also researchers and other key players in strengthening science communication. Below are specific objectives:

- Basic literacies on science, technology, research, development, and innovation
- Functional literacies on science, technology, research, development, and innovation
- Development of a toolkit for Science Communication of R&D projects
- Science Communication human resource development programs and trainings

Call Scope and Budget

PCIEERD will fund capacity-building programs on science communication with a maximum budget of Three (3) Million Pesos per year per project. Proposed project should run for a period of one (1) year only.

4. **Development of Infrastructure for Science Communication**

Call Objective

- Proposed project for the establishment of a center for Science Communication that will cater activities and programs relative to the said discipline. (i.e. Science Communication centers in different state universities and different regions in the country)

Call Scope and Budget

PCIEERD will fund infrastructure project on science communication with a maximum budget of Ten (10) Million Pesos per project. Proposed project can run for a period of four to five (4-5) years only.

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5. **Development of Science Communication technologies**

Call Objective

The proposed projects should be intended for the development or use of technologies for science communication needs or applications. Below are specific objectives:

- Use of technologies for the needs of science communicators and/or relative science communication stakeholders
- Development of technologies for science communication
- Digital asset management
- A thorough examination of knowledge management systems and how they can aid in the advancement of science communication.
- Investigate the causes of low R&D adoption and knowledge management system uptake.

Call Scope and Budget

PCIEERD will fund technology projects on science communication with a maximum budget of Five (5) Million Pesos per project. Proposed project can run for a period of four to five (4-5) years only.

Qualification Requirements

This Call is open to all researchers, science communicators, stakeholders, and other key players of Science Communication.

B. Advancing Science Centers' Innovation through Research and Development (ASCEND) Program

To uplift the status of science centers in the country, this program will provide support to address gaps in the science center ecosystem through research and development.

1. **Researches on Science Centers**

Call Objective

- Proposed project should seek to address research gaps in the science centers' ecosystems geared towards development of policy issuances.

Call Scope and Budget

PCIEERD will fund research on science centers with a maximum budget of Three (3) Million Pesos per year per project. Proposed project should run for a period of one (1) year only.

2. **Technologies for Science Centers**

Call Objective

- Proposed projects should be intended for the development of technologies to address gaps in science centers' operations, development, and systems.

Call Scope and Budget

PCIEERD will fund research on science centers with a maximum budget of Five (5) Million Pesos per year per project. Proposed project should run for a period of two to three (2-3) years only.

3. **Human Resource Development**

Call Objective

- Proposed projects that are aimed to develop capacity building programs for stakeholders in science centers

Call Scope and Budget

PCIEERD will fund research on capacity building with a maximum budget of Two (2) Million Pesos per year per project. Proposed project should run for a period of one (1) year only.

Qualification Requirements

This Call is open to all researchers, science centers, stakeholders of science centers, and other key players of science centers.

A. **Science Communication for Innovation Program Research Extension to Accelerate Communication Hub (REACH) Program**

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To extend assistance to researchers and innovators who have completed the council's R&D training and aim to diversify the study's integration to create science and technology-based solutions. The program will focus on showcasing the research output through information and dissemination initiatives that cater to a specific audience of their information and dissemination activities.

1. **Development of Information & dissemination activities**

Call Objective

- Proposed projects that are aimed to develop any of the following:
    a. Capacity building among targeted beneficiaries (seminars, conferences, town hall meetings)
    b. Advertising and promotional efforts like press conferences, media engagements, media buying, exhibitions

Call Scope and Budget

PCIEERD will fund research on development of information and dissemination activities with a maximum budget of Two (2) Million Pesos per year per project. Proposed project should run for a period of one to two (1-2) years only.

2. **Production of IEC materials**

Call Objective

- Proposed projects that are aimed to develop materials to include traditional and non-traditional methods such as learning management systems, knowledge management systems, websites and social media accounts, video production, physical kiosks and among others in selected locations

Call Scope and Budget

PCIEERD will fund research on development of information and dissemination materials with a maximum budget of Two (2) Million Pesos per year per project. Proposed project should run for a period of one to two (1-2) years only.

QUALIFICATION REQUIREMENTS

- Completed R&D and Non-R&D Projects supported by DOST-PCIEERD that aim to conduct activities for knowledge sharing and information dissemination. (Supported with terminal reports)
- The initiative's project leader can continue to serve as the project leader with assistance from a co-project leader who is a science communication expert and

who will serve as the focal person for information sharing and promotions. (Supported with CV and track record)

- With measurable projected outcomes that can benefit its intended audience with a minimum of one year-period or a maximum two-year period project implementation
- With sustainable plans to guarantee that the project will continue its effort to disseminate information even after the project completion.
- Letter of commitment from beneficiary agency, partners, cooperating organizations/stakeholders.

Science Communication for Innovation Program	Budget Allocation	Duration
Call Themes		
Research on Science Communication	Php 3,000,000.00	1 Year
Research Studies on Evaluation of Science Communication		
Capacity-Building Programs on Science Communication		
Development of Infrastructure for Science Communication	Php 10,000,000.00	4-5 Years
Development of Science Communication Technologies	Php 5,000,000.00	

ASCEND Program	Budget Allocation	Duration
Call Themes		
Researches on Science Centers	Php 3,000,000.00	1 Year
Technologies for Science Centers	Php 5,000,000.00	2-3 Years
Human Resource Development	Php 2,000,000.00	1Year

REACH Program	Budget Allocation	Duration
Call Themes		
Development of Information & Dissemination activities	Php 2,000,000.00	1-2 Year/s
Production of IEC materials	Php 3,000,000.00	2-3 Years

Application Requirements

1. Letter of Intent and Commitment *
2. Endorsement letter from the Head of Agency or Institution

3. Application Form
4. Curriculum Vitae

* Letter of Intent and Endorsement should be addressed to:

DR. ENRICO C. PARINGIT
Executive Director
Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD)
Department of Science and Technology (DOST)
5th Level, Science Heritage Building, DOST Compound
Gen. Santos Ave., Bicutan, Taguig City

For further inquiries on the Call, please contact:

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S. CAPABILITY DEVELOPMENT

Call Rationale

Science, technology and innovation (STI) plays a crucial role in the progress of a developing nation. Harnessing the STI's full potential by building on current capabilities to benefit all sectors has been part of the game plan to sustain a lively research and development ecosystem. With the limited resources for R&D at hand, there is a need to provide support to the development of institutions, particularly where there is inadequacy of facilities and/ or R&D expertise. Through this capability development program, it is hoped that DOST will continuously hone research capabilities and advancements in the industry, energy and emerging technologies *via* provisions involving R&D facilities and/or development and upgrading of human resource competencies.

Call Scope

This call covers capability building projects in industry, energy and emerging technologies that cannot be accommodated under regular human resource and institution development programs of PCIEERD. Specifically, this call focuses on funding research-based institutions/ research and development institutes with a comprehensive plan in developing facilities and human resource capability/competency in the following themes/ areas:

1. **Energy Research and Innovation**

Developing materials for electrical energy storage systems (EES) which could provide efficient and reliable electrical energy storage methods for commercial and residential use is essential and critical in energy generation. Intermittent generation of electricity causes major disruptions and significant costs. To address this huge loss, there is a need to develop facilities and expertise to improve EES. EES will also enable development and use of hybrid electrical vehicles (HEV), plug in hybrids and all-electric vehicles that will also help lessen our carbon footprint. Specifically, this proposed facility is expected to focus on capability building on Battery R&D which includes but is not limited to development of battery components, cathode/ anode, membrane/separator and electrolyte for e-vehicles. Expertise on electrochemical characterization, prototyping, failure analysis, etc. is also expected to rise through the facility.

2. **Quantum Technology Research and Development**

Quantum technology as an emerging field encompasses technologies that rely on properties of quantum mechanics. To name a few, emerging quantum technologies include quantum computing, cryptography sensors, simulation, measurement, and imaging. With its potential to revolutionize the current technologies, it is imperative that quantum technology research be developed and sustained in order to benefit from its myriads of applications. As contained in the Quantum Technology roadmap, the mid to long-term goal is the eventual establishment of the Quantum Innovation Laboratory that will serve as a center of excellence in Quantum Technology in the Philippines. This call is expected to give way to the establishment of the innovation laboratory that will lead to developing capability in prototyping of quantum memory storage device, quantum repeater, quantum random number generator, quantum simulators, quantum-enhanced sensors, etc.

3. **Applied Integrated Circuits and Devices Research**

As the largest contributor to the country's manufacturing sector, the electronics industry needs support to move to higher value-added manufacturing to meet global standards and demands. The support includes improving the country's business environment, conducting R&D capability development, and aggressively promoting local industries and SMEs. In order to support the electronics industry, a facility or laboratory involving capability/ capacity building

on integrated circuit design, robotics, advanced sensors, consumer electronics (wafer fabrication, flexible and paper-based electronics, dynamic random-access memory (DRAM), Flash memory, smart wearables, etc.) and medical electronics (portable/ hand-held devices) is needed.

4. **Blockchain Technology - Data Security and Integrity**

The Blockchain Program is an initiative of the Department of Science and Technology, through the Philippine Council for Industry, Energy and Emerging Technology developed in consonance with the discussions at the United Nations' Intersessional Panel Meeting of the Commission on Science and Technology for Development (CSTD) participated by the Philippines last January 2021. This puts the spotlight on the untapped potential of blockchain technology in the Philippines.

Blockchain technology would be a game changer with a potential to revolutionize processes of government public services (UNCTAD, 2021). Growth in the global blockchain technology market can be attributed to the increasing venture capital funding in blockchain technology companies. Furthermore, it also encourages the market players to make more efforts to improve their services to gain a competitive edge. These efforts made by the companies are expected to make blockchain technology more effective and efficient soon. A good R&D ecosystem for blockchain technology is therefore recommended. Hence this call was made to help develop capabilities on blockchain technology and provide a research and infrastructure platform where our researchers can build on and grow, developing capability on blockchain applications, data security and integrity. Also, increasing research capacity will support our researchers, training practitioners and experts who understand and implement blockchain.

This call for proposal focuses on establishing a test net and main net for the development of capability of our researchers and practitioners in the country. It will also develop research and development through blockchain designs, protocol design, optimization and scaling as well as policies towards institutionalization of the blockchain efforts.

5. **Design and Development of Fine Jewelry**

A "fragmented" industry is what the jewelry industry in the Philippines is often called. Small/ cottage-type firms abound particularly in the countryside, mostly family-run, with crafts being passed like an heirloom through generations and with little investments in modern tools and equipment. Goldsmiths are now a dying breed since younger generations are no longer interested in learning the craft and prefer more prestigious jobs. Quality of the jewelry produced cannot compete with the products of other countries whose government has invested significant share in upgrading skills (through capability building/ training programs) and tools, making use of appropriate/ more advanced technologies particularly in the design and development of fine jewelry. It is with this premise that the design and development of fine jewelry is included in this call – there is an urgent need to capacitate our jewelers to craft fine products. Only then can our jewelry industry compete in the international market. Also, with research and development and new technologies involved, younger generations can become more engaged in the craft. The facility / laboratory is expected to focus on research and capability- building activities in technology-aided gemology, design and production of fine jewelry and oyster pearl production and jewelry design

6. **Pyrotechnics manufacturing**

Pursuant to Executive Order 28 and Republic Act 7183, regulating the sale, manufacture, distribution, and use of firecrackers and other pyrotechnic devices, DOST is giving its share by supporting our pyrotechnic industry to innovate and produce quality and safer products

through provision of an R&D laboratory and capability building activities on pyrotechnics. The R&D facility on pyrotechnics is expected to focus on the design, innovation, safety and ecology of pyrotechnics leading to the development of advanced pyrotechnics.

Call Objectives

1. Establishment / Enhancement of DOST-affiliated research facilities leading to improvements in the above research topics as measured by concreteness of 6Ps.
2. Sustained research output of the DOST-affiliated research facility or grantee as indicated by the planned research programs in the submitted proposal
3. Interdisciplinary promotion, hence better impact of science and technology in the DOST-affiliated research facility or DOST grantee

Specific Features Sought in this Call

A. **Eligibility Requirements:**

The call is open to research and academic institutions which satisfy the following eligibility criteria:

- DOST-attached Agencies, DOST Regional Offices, Higher Education Institutions (HEIs), Local Universities and Colleges (LUCs), and government research institutions (Private non-profit research institutions may be considered under meritorious cases);
- Have a five-year research agenda/ strategic thrust or equivalent
- Have at least the basic facility for conducting research in PCIEERD priority areas or HRDA;
- Have demonstrated potential capability in research; and
- With ability to provide counterpart of at least 15% (for SUCs and other Government institutions) and 20% (HEIs and other private institutions)

B. **Documentation Requirements**

- Endorsement from the Head of Institution
- Proposal with Budgetary requirements and Workplan
- List of proposed equipment with clear sample picture, price quotations, and corresponding functions/use
- Proposed location and layout of the laboratory/center within the institution
- Institution's R&D Agenda and associated with this a 10-year plan for the establishment and sustainability of the proposed research program facility
- List of R&D to be undertaken in the next 5 years using the facility
- List of Researchers with their corresponding degree program, fields of expertise and research undertakings in the past 3 years
- Curriculum Vitae of the proponent