

## XII. SPECIAL SECTORAL CONCERNS

### A. ENVIRONMENT SECTOR

**Theme: INNOVATIVE, AFFORDABLE, AND COMPACT TECHNOLOGIES FOR THE ENVIRONMENT (I-ACT for the Environment)**

#### Call Overview

Most of the programs and projects supported/monitored under the Environment Sector were technologies on addressing environmental problems. This year's Call for Proposal will focus on the three sub-sectors, namely: (1) water/wastewater, (2) air quality, and (3) solid waste management. These topics would like to address pressing national problems by providing solutions through program for the prevention and control of water pollution, air pollution and innovative solutions to plastics wastes, respectively. In support of the said Call, the Environment Sector conducted a series of Focus Group Discussions (FGDs) to solicit vital information from various stakeholders including the private sectors, academe and other National Government Agencies (NGAs). The results of the discussions were highlighted in each areas of concern below.

#### Call Objectives

The main objective of this Call is to provide technological interventions for each sub-sector's pressing national problems. Specifically, the Call will provide the researchers an idea of the priority areas under the water/wastewater sector, air quality priority research and innovative solutions to solid waste concerns as a result of the FGDs.

The identified gaps cited by the industry, government agencies and academe were also highlighted in the CFP.

#### 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.

In addition, the PCIEERD S&T Water Environment Roadmap which was 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, in consultation with the key stakeholders from the private sector, academe other government agencies and non-government/civic organizations. The revised roadmap sets the direction of the water 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.

The Roadmap covering the period 2018–2022 envisions “**Sustained ecological functions & services of water ecosystems**”. The missions formulated were as follow: 1) to provide S&T support for the enforcement of guidelines and standards under Philippine environmental laws; 2) to strengthen the R&D of cost-effective waste management, treatment options and cleaner production options to reduce water pollution of various industries; 3) to build capacity for good environmental governance. The updated S&T Water Environment Roadmap tackled the following:

1. Water Security and Sufficiency
2. Wastewater Treatment and Management

The rapid increase in population, urbanization, and industrialization reduces the quality of Philippine waters, especially in densely populated areas and regions of industrial and agricultural activities. The discharge of domestic and industrial wastewater and agricultural runoff has caused extensive pollution of the receiving waterbodies. This effluent is in the form of raw sewage, detergents, fertilizer, heavy metals, chemical products, oils, and even solid waste. Each of these pollutants has a different noxious effect that influences human livelihood and translates into economic costs. Untreated wastewater affects health by spreading disease-causing bacteria and viruses, makes water unfit for drinking and recreational use, threatens biodiversity, and deteriorates overall quality of life.

Recently, PCIEERD conducted a Focus Group Discussion (FGD), in coordination with other stakeholders from the national government agencies, industry and academe. This FGD provided a technological platform of reviewing the existing water roadmaps and addressing the current water and wastewater concerns. Some participants presented the current initiatives, challenges, and next steps/way forward.

As per NEDA report, more than 12 million people are limited to unsafe water sources owing to poor development and limited coverage of water districts (WD) and other water service providers (WSP). Inadequate sanitation facilities have been identified as an underlying concern for more than four million people who are constrained to practice open defecation while an additional two million are limited to using unprotected pit latrines or buckets. Access to water and sanitation services in the Philippines stands at 89.9 percent and 89.2 percent, respectively, as of 2017. Historically, only about PHP 3 billion is appropriated by National Gov't annually in WSS. Statistics show that approximately 1/8 people are getting water from unsafe sources, 1/5 people still use pit/hanging/bucket latrines, 8/10 people in the ARMM do not have access to flush to piped sewer systems or septic tanks, 1/25 people still practice open defecation, and 1/2 people in the ARMM do not have access to improved sanitation facilities.

The Industry Sector has identified gaps/needs such as (a) fragmented sector handling water and wastewater concerns; (b) lack of universal access to clean water and resource water masterplan;

(c) lack of available technologies that can treat effluent in compliance to DAO 2016-08 standards (i.e., Phosphates, Ammoniacal-Nitrogen, Sulfates, Dissolved Copper, etc.); (d) challenges on microfiltration, disposal of sludge, used chemicals and resins; (e) and detection of the presence of CoViD-19 in wastewater. Despite the challenges, the industry sector is willing to share information/data, technical assistance, consultation and other collaboration in R&D.

Subsequently, the Government Sector also identified existing challenges in the water and wastewater sector. These are not limited to (a) inclusion of emerging contaminants in monitoring and regulating water bodies (e.g., resistant microbes, microplastics, nanomaterials, speciation of metals, antibiotic residues, veterinary drugs, feed additives, etc.); (b) degradation of water resources, shortage of water supply, irrigation water shortage and acute scarcity of water due to poor management during natural phenomenon; (c) challenges in monitoring and enforcement of existing regulations; (d) Unavailability of a centralized wastewater treatment plant for SMEs located to old existing economic zones; and (e) institutional fragmentation. Aside from the existing policy interventions, regulations, and programs on water and wastewater (e.g., DAO 2016-08, RA 9275, PEZA MC 2009-10, MARINA Circulars, BOI/PEZA incentives program, etc.), the government sector is also willing to provide available data and equipment.

As for the Academe Sector, the following were the concerns raised with respect to the conduct of R&D on water and wastewater, (a) need for an updated and dedicated equipment for wastewater analysis; (b) need for advance analytical equipment for monitoring; (c) weak academe-industry linkage (re: pilot-plant projects); and (d) lack of data availability from the industry. To leverage towards innovation, the academe sector is willing to provide the use of research laboratories/facilities, equipment, manpower, expertise and other technical assistance.

In summary, there is really a need to address the existing gaps/needs in water quality management and pollution control. The inputs from the stakeholders will help establish a ***“National Research and Development Program for the Prevention and Control of Water Pollution (NRDP-PCWP).”***

Recently, the Department of Environment and Natural Resources (DENR) issued a Special Order (SO) for the preparation of the NRDP-PCWP where DOST-PCIEERD is a member of the Technical Working Group (TWG).

## **Call Scope**

The Call for Proposal will support new interdisciplinary research and innovation. It tackles Sec. 24 Pollution Research and Development Programs, i.e., establish a National Research and Development Program for the Prevention and Control of Water Pollution. It is important to note that the program should be holistic in approach, closed loop technological interventions that are low-cost/cost effective and innovative, multi-disciplinary or trans-disciplinary to foster collaborative learning and inclusive solutions development with all stakeholders. Researchers from the environmental, social, and health sciences, stakeholders from NGOs, as well as public movements/civil societies could take part in this collaborative research. The trans-disciplinary approach envisions to jointly define the existing problem of water pollution and its health and other impacts. Participation of the industry /private partners is encouraged through a commitment letter and counterpart funding. In addition, concerned national government agencies/local government units should also be involved to ensure sustainability of the program. It is also necessary to seek for an endorsement/co-funding in cash or in kind from the end user to ensure buy-in of the developed technology. The proposals should also consider the socio-cultural, political, health and economic implications of water quality management and pollution control. The research should

provide scientific data to support/lead to policy formulations and updating of the Philippine Clean Water Act and the DENR Administrative Order 2016-08. It is also expected to establish a demonstration facility for the proposed technologies on water/wastewater including DOST/PCIEERD as the demonstration site.

## Call Objective

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. The following are the identified priority areas of R&D:

Priority Areas of R&D	Budgetary Requirement	Duration
<p>*To study and address concerns on <b>Nutrient Management and Dynamics on Lakes (NICER Program)</b></p> <ul style="list-style-type: none"> <li>To address <b>Emerging Contaminants in Water</b> (e.g., Resistant microbes, Microplastics, Nanomaterials, Speciation of Metals, Antibiotic residues, Veterinary drugs, Feed additives, etc.)</li> <li><b>Use of IoT</b> to improve data management and monitoring of water quality and wastewater effluents.</li> <li>To address <b>disposal of sludge, used chemicals and resins</b> from wastewater treatment processes.</li> </ul>	30M	2023-2025
To address <b>New Effluent Standards from DENR Administrative Order 2016-08</b> (particularly on Phosphates, Ammoniacal-Nitrogen, Sulfates, and Dissolved Copper)	10M	2023-2024
*To detect the <b>presence of CoViD-19 and other infectious diseases</b> in wastewater	33M	2022-2023
To <b>develop technologies</b> for water/wastewater quality (e.g., sensors, improved modular rainwater harvesting for drinking water, etc.)	10M	2023

**Note:** \*Directed Call

## 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.” The government policy relies heavily on the “polluter pays” principle and other market-based instruments to promote self-regulation among the population. It sets emission standards for all motor vehicles and issues on pollutant limitations for industry. The rules and regulations apply to all industrial emissions and other establishments which are potential sources of air pollution.

This Call is also aligned with the PCIEERD S&T Clean Air Roadmap with collaborative efforts among National Government Agencies (NGAs), academe, non-government organization and other stakeholders. PCIEERD acts to preserve the environment and public health, with the objective of improving air quality and fight against global warming. PCIEERD hopes to provide S&T support for the enforcement of guidelines and standards under Philippine environmental laws; 2) to strengthen the R & D efforts by providing effective air quality and pollution control technologies, treatment options and cleaner efforts to reduce air pollution of various industries and other potential sources of air (i.e., industry, transportation and energy consumption and emissions); 3) to build capacity for good environmental governance. The said Roadmap is aligned to the **DOST Harmonized R & D Agenda (HNRDA)**, **Sustainable Development Goals (SDGs)**, **the Philippine Clean Air Act of 1999** and the **Philippine Development Plan (PDP) 2017-2022**, the **first medium-term plan** to be anchored on a national long-term vision, or **AmBisyon Natin 2040**, which represents the collective vision and aspirations of Filipinos for themselves and for the country.

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

The need for the prevention and control of air pollution is backed-up with scientific data gathered by the Department of Health. Moreover, there is a need to monitor the effects and impacts of particulate matter, PM<sub>2.5</sub> in terms of health and the environment. Thus, development of real-time PM assessment tool / devices is also a recommendation to help reduce the health impacts of PM. Additionally, mobile sources remain the largest source of emissions in the country (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. 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. Although emissions from mobile sources increased from 65% in 2015 to 74% in 2018, the contributions from stationary sources decreased by 20% in the past three years, reflective of the larger coverage and management of stationary sources (including MSEs and standard generation sets). Despite the consolidated efforts to improve air quality status, there are still remaining challenges and needed actions in air quality management.

Based on the recent FGD conducted, the following are the challenges in Air Quality Management:

- New standards for ambient air pollutants (HAPS, VOCs, Metals, Black Carbon/SLCP)
- Guidelines on locally developed emission factor
- Updated guidelines for Emission Inventory
- Emission charge system
- Guidelines to monitor emission from docked vessels
- Guidelines on locally developed emission factor
- Updated guidelines for Emission Inventory
- Emission quota for industrial centers considered as sub-Airshed

- Requirement of stringent vehicle emission standards while allowing the second-hand motor vehicle industry
- Difficulty in monitoring of Private Emission Testing Centers (PETCs)
- Need in identifying the universe of Stack Emission Test (SET) results nationwide
- No real active enforcement partnership in the implementation of provisions under CAA
- Lack of baseline information on air quality per area/airshed
- Need for science-based data (metrology on gas and air)
- Insufficient real-time monitoring equipment/devices/stations
- Expensive maintenance of monitoring equipment
- Elimination of dust particles
- Elimination of volatile organic compounds
- Accessible facilities which are decentralized
- Fabrication of the sensors
- Support for Fundamental Air Quality Research

## Call Scope

The Call for Proposal will support new interdisciplinary research and innovation. It is important to note that the program should be holistic in approach, closed loop technological interventions that are low-cost/cost effective and innovative, multi-disciplinary or trans-disciplinary to foster collaborative learning and inclusive solutions development with all stakeholders. Researchers from the environmental, social, and health sciences, stakeholders from NGOs, as well as public movements/civil societies could take part in this collaborative research. The trans-disciplinary approach envisions to jointly define the existing problem of air pollution and its health and other impacts. Participation of the industry /private partners is encouraged through a commitment letter and counterpart funding. In addition, concerned national government agencies/local government units should also be involved to ensure sustainability of the program. It is also necessary to seek for an endorsement/co-funding in cash or in kind from the end user to ensure buy-in of the developed technology. The proposals should also consider the socio-cultural, political, health and economic implications of water quality management and pollution control. The research should provide scientific data to support/lead to policy formulations and updating of the Philippine Clean Air Act and other related guidelines/DAO.

## Call Objective

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

The objectives are to:

Give special emphasis to research and development of improved methods and development of innovative technologies having industry-wide application for the prevention and control of air pollution specifically addressing the following concerns:

Priority Areas of R&D	Budgetary Requirement	Duration
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<p><b>Center for Aerosol &amp; gas analysis for quality of life (NICER Program)</b></p> <ul style="list-style-type: none"> <li>• Localized Ambient Air Quality Guideline Values and Standards</li> <li>• Continuous real-time monitoring devices and system</li> <li>• Modelling of air quality emission using prescribed methods/techniques e.g., use of mobile apps for air quality index.</li> <li>• Emission/Pollution control technologies and devices</li> <li>• Cost- effective recovery of volatile organic compound (VOC)</li> </ul>	35M	2023
Technologies for Industrial air quality monitoring (industrial sources & Docked Vessels )	10M	2023-2024
Use of modified minerals/materials as adsorbents of noxious and toxic gaseous emissions from industries/vehicles	5M	2023

### 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 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 shopping. 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 on **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 contributes about 56.7% of the generated wastes, commercial establishments 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 (DOH) then treated and bulky waste management proper SLF disposal for special wastes.

Alongside, PCIEERD has been contributing for this endeavor and recently in coordination with other government agencies, provided technological interventions through the deployment of appropriate technologies during the rejuvenation of Boracay. Another workshop was also held to identify possible technological solutions to address solid waste problems, particularly in coastal areas on combating marine debris in the ASEAN Region. In connection, as Member States of the Association of Southeast Asian Nations (ASEAN), PCIEERD signified in joining the ASEAN Community Vision 2025, particularly the ASEAN Socio-Cultural Community (ASCC) Blueprint 2025 on Conservation and Sustainable Management of Biodiversity and Natural Resources, which reaffirmed the commitment of strategic measures to *“promote cooperation for the protection, restoration and sustainable use of coastal and marine environment, respond and deal with the risk of pollution and threats to marine ecosystem and coastal environment, in particular in respect of ecologically sensitive areas”*.

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 3<sup>rd</sup> as the biggest source of plastics leaking into the oceans**; China emerged as the top contributor, with an estimated 1.32-3.53 MMT going into the sea, out of a total 8.82 MMT mismanaged plastic waste a year. Indonesia is next, with an estimated 0.48-1.29 MMT of plastic marine waste annually, followed by the Philippines, with around 0.28-0.75 MMT of plastic waste. Studies explained that people on the limited incomes in the Philippines like most developing countries are pushed to buy cheap goods in small quantities, this practice is dubbed as **“sachet economies”**. Single-use plastics from products sold by conglomerates, such as bags, bottle labels, and straws end up not being recycled and worst, sometimes end up mismanaged. Every year, our country contributes 1.88 million tons of "mismanaged plastic waste". Majority of the mismanaged plastic wastes 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”**. They can be divided into two main categories according to their source: (1) **primary** - directly released in the environment as small particles and accounts to 15-31% microplastics found in the oceans and (2) **secondary** - originate from degradation of larger plastic objects such as plastic bags, bottles or fishing nets and accounts to 69-81% microplastics found in the oceans. Those smaller than five millimeters may settle on sea algae and can be consumed by small fishes. 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 human food chain. The impact of ingesting microplastics has yet to be determined.

Provided the 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 Scope

In the recently conducted FGD, gaps and challenges on solid waste management in the country has been identified: *a.) No baseline data (local context) b.) Low uptake of existing studies (e.g. Life Cycle Assessment on carrying bag commissioned by ITDD) c.) Difficulty in determining alternatives d.) Lack of verification/safeguard/background check system for facilities that is not through endorsement e.) Redundancy of activities across sector covering the same sectors of waste f.) Need for National Action Plan on Waste to Energy (WTE) and lastly g.) Development of plastic biodegradability Laboratory.*

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. Furthermore, the proposals should be a collaborative research and with partner institutions clearly expressing commitment of support in a form of a letter specially the end-user institutions to ensure implementation even after the conduct duration of the will be project. If technologies are to be developed it must be sustainable and is for long-term function. Lastly, the proposal must have objectives that are specific, measurable, attainable, realistic and timebound to address the recurring problems of the country in solid waste management.

## Call Objective

The objective of this call is to support the inter-disciplinary research to understand the risks that plastic pollution poses and provide technological interventions. The following are the identified priority areas of R&D under this sub-sector:

Priority Areas of R&D	Budgetary Requirement	Duration
Development of alternative materials to plastic-based packaging and products under Non-Environmentally Accepted Products (NEAP) & Packaging (e.g., plastic stirrers/coffee cups)	30M	2023-2024
Development of Technologies for Upcycling/ Recycling of plastics/Co-processing	5M	2023
Appropriate technologies for the detection, measurement and treatment of microplastics and other marine litter	5M	2023
Establishment of a facility for biodegradability testing of plastics	30M	2023-2025
Development and promulgation of resource recovery plan for the plastic wastes generated from the consumer's shift to online shopping strategic waste management program for	10M	2023-2024

household infectious wastes and hospital-use plastic-based medical and healthcare materials in Pandemic		
Life Cycle Analysis (LCA) of single-use plastics with technological interventions	10M	2022

## **B. DISASTER MITIGATION SECTOR**

### **1. Disaster Risk Reduction and Climate Change Resiliency**

#### **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 3rd 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 2017 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 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), changes in precipitation patterns, temperature and sea level rise.

#### **Program Description**

The DRR-CCR 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 address 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 (CRR-CCA) related events have also been made.

In consideration of the above, the DRR-CCC 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

### **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 2022 – 2023: Total PhP 120,000.000.00**

### **Scope**

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

1. Disaster Risk Reduction
  - a. Seismic Hazards
    - Optimized Early Warning and Alarm Systems for Coastal Communities (preferred features: can detect tsunami wave at night, enough warning time to the LGUs)
    - Nationwide Earthquake Hazard Mapping and Modeling thru Alternative Methods
    - Lahar/ Landslide Models based on Climate Maps and Models
  - b. Hydrometeorological Hazards
    - Urban and River flooding
      - Flood Forecasting (near-real time) to LGUs
      - Risk Assessment Urban and River flooding- Nationwide or in a sample site
      - Street level/ barangay level/community level near-real time river monitoring and early warning system for all rivers nationwide
      - Dams Water Release Protocols and River/Tributary Control
      - Scenario/simulations for rivers and dams crisis with plan of action

- Typhoons
  - Cloud/Thunderstorms High-resolution Near Real-time Detection/Mapping/Monitoring for Micro-weather Forecasting
  - Ship Route Gale Warning Visualization
  - Weather Forecast Visualization
  - Bow Echo Detection for Tornado Warning

## 2. Climate Change- related Hazards

- Impact-based Forecasting for flooding, landslides, severe wind and storm surge

### ***Additional Call Document Requirements***

- Secure partnership and commitment from mandated government agencies engaged in natural hazard forecasting, hazard mappings, early warning issuances, among others (ex. PAGASA, PHIVOLCS, DENR-MGB, LGUs)

## **2. MULTI-UVS AND IOT-EQUIPPED MISSIONS (MAIM) FOR DRRM / UVS FOR RESILIENT SYSTEMS AND APPLICATIONS (URSA)**

### **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.

The Philippines 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. The UVS Program under the Disaster Mitigation (DM) sector of PCIEERD is aligned with the Harmonized National R&D Agenda (HNRDA 2017-2022). 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 Research and Development (R&D) programs/projects on innovative UVS in convergence with its relative exponential technology areas that include but not limited to Internet of Things, which will allow UVS technology to competitively go beyond its current applications for Disaster Mitigation (DM) that are specific to the Philippine situation.

The call aims towards the development and deployment of UVS technology (land, air, water) that will create opportunities beyond traditional markets and provide non-traditional solutions in support of the Philippines moving toward Industry 4.0. Specifically, it aims to enhance the country's expertise on UVS technology and its utilization for disaster response and assessment, rescue operations, and climate change adaptation and monitoring in order to minimize the loss in

property and human lives, especially to those located in geographically isolated and disadvantaged areas of the Philippines.

**Total Allocation for 2022 – 2023: PhP 120,000,000.00**

## **Call Scope**

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

1. Design and Development of High Payload Capacity UVS Platform for Logistical Support (sense-and-avoid/collision avoidance, beyond-line-of-sight, and vertical landing and takeoff capabilities)
2. Collaborative multi-UVS (land, air, underwater) missions with application of its convergent technologies (e.g. AI, algorithm development/computing technology, control systems, V to V and V to X communications, 5G, standards, custom or repurposed payload) for DRR and resilient communications (logistics, pandemic response, agricultural and food security and climate change resilience in ecological systems).
3. Volcano crater monitoring as well as aerosol, volcanic fumes, lake and crater water sampling using High-payload UVS equipped with multispectral and thermographic camera
4. UVS automation software development for high-end applications (e.g. remote sensing, search and rescue, predictive analysis, tracking, surveillance)
5. UVS Intelligence, Surveillance and Reconnaissance (ISR) missions/operations with recovery features and secured/encrypted communication system
6. Land deformation detection (UVS with survey-grade GPS capable of producing accurate elevation models and Land-based networking for monitoring)
7. Potential application of indigenous/smart materials and new/innovative sources of energy and propulsion
8. Radio Frequency monitoring and measurement (for Broadcast, Telecommunication, Radio Communication - NTC regulatory monitoring, RF emission compliance and DICT Policy on the use of the limited natural resource); Implementation of resilient communications standards.

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 encouraged.

### ***Additional Call Document Requirements***

- Project duration cannot exceed 24 months
- Letter of Commitment from (1) UVS providers (technologies-services-products) and (2) UVS-concerned/mandated government agencies; Specific involvement must be identified in the letter (e.g. collaborator, 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 (should include a list and brief overview of available/commercial technologies that are related to the proposal)

## **C. CREATIVE SECTOR (FUNCTIONAL AND AESTHETIC CREATIONS)**

### **Call Overview**

Recognizing the contribution of the Creative Industries to a country's economy, the sector is considered as one of the fastest growing sectors in the global economy. Last year, the Philippines garnered 50<sup>th</sup> place in the 2020 Global Innovation Index. According to DTI (K. Hipol, 2020<sup>3</sup>), the Philippines sustained its rise in the Global Innovation Index from 100<sup>th</sup> place in 2014 to to 50<sup>th</sup> place in 2020, for the first time. This increase was due to the following: a. Market Sophistication, moved from rank 110 in 2019 to 86<sup>th</sup> place in 2020 b. Business Sophistication, moved from rank 32 in 2019 to 29<sup>th</sup> place in 2020 c. Knowledge and Technology Outputs, moved from rank 31 in 2019 to 26<sup>th</sup> place in 2020 d. Creative Outputs, moved from rank 63 in 2019 to 57<sup>th</sup> place in 2020. In addition, it was estimated that the Philippine Creative Industries value in 2019 (CECP, 2020<sup>4</sup>) amounts to PhP 1.27Trillion. While the sector and the creative industries ecosystem suffered from the COVID-19 crisis, the role of the creative sector to spur innovation and knowledge transfer remains significant.

On the recent S&T consultation with stakeholders, representatives from the Creative industries emphasized that most of the challenges encountered by their sectors can be addressed by R&D. Coming from different stages of development and background, the recent S&T consultation results provided a clear view of what gaps and challenges should be bridged and addressed through Science, Technology and Innovation. Stakeholders and survey respondents are on the same page when it comes to the following critical needs that should be addressed:

1. Facilities and laboratories
2. R&D programs and projects
3. Policies/Legislative

While the legislative is still on paper, it is on this backdrop, particularly for the challenges 1 and 2, that the Council is coming up with its call for proposals for FY 2023-2026.

### **Call Objectives**

The objectives of the call are the following:

1. Develop a program/projects of multidisciplinary R&D that will provide technologies that addresses the challenges facing the Philippines Creative Industries sector.
2. Enable micro-businesses, small and medium-sized enterprises (SMEs) and large creative industry enterprises access to technologies and knowledge by the research base to develop new, products, services, and experiences.

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<sup>3</sup> FGD 2020

<sup>4</sup> Presentation Materials:

[https://pcieerd.sharepoint.com/:f/s/CREATIVEINDUSTRIES/EjXF3f18Eu9Llzy\\_2l\\_qoXUBE0wCiaZQhRg3SQkW5wbLKw?e=1YSldY](https://pcieerd.sharepoint.com/:f/s/CREATIVEINDUSTRIES/EjXF3f18Eu9Llzy_2l_qoXUBE0wCiaZQhRg3SQkW5wbLKw?e=1YSldY)

3. Encourage the building of long-term strategic R&D partnerships between academe, research and development agencies, creative enterprises and other relevant sectoral and local stakeholders, in order to offer new R&D capability and facilities.
4. Produce new creative products and experiences that are often the key driver for technology innovation in the creative industries.

## 1. R&D in Material Innovation

Total Budget: 50M

### Call Rationale

One of the identified challenges of the Creative Industries is the availability of quality and affordable raw materials. To address this challenge, the Creative Industries Cluster 4 (Functional and Aesthetic Creations) is calling for proposals for 2023-2025 on R&D in Material Innovation that will address gaps specifically for the Footwear, Jewelry and Furniture Industries.

### Call Scope

This is a Strategic Call for project proposals incorporating innovative solutions and research in Material Innovation that will cover the following areas/priorities:

- Integrating indigenous-related technologies in R&D for creative industries
- Development and application of local raw materials for the creative arts and industries

Project duration for projects should not be less than a year but not more than three years and for Program proposals, it should not exceed five years of implementation.

Grant amounts will range from PhP 5,000,000.00 to Php 10,000,000 per project however, requests for funding below this range will also be considered.

### Call Objectives

- To invite submission of S&T and R&D program/projects that will enhance and or develop the Functional and Aesthetic Creations aspect of the sector through Material Innovation.
- To enjoin qualified institutions, engineers and scientists and individuals to foster linkages with Council in the field of science and technological activities directed to Creative Industries Sector
- To develop and provide technologies to improve the productivity of Creative Industries sector and its allied sectors

The proposals should:

- Incorporate Industry roadmaps results (if available),
- Demonstrate collaboration in the form of written commitment from the partner industry / company
- Cost share: at least 15% counterpart funding
- Technologies should have potential for commercialization

## 2. Design/Product Innovation

Total Budget: 40M

### Call Rationale

Responding to the issues and challenges highlighted by the stakeholders of the Creative Industries sector on the previous consultations last December 2020, the sector would like to seek researches on design and product innovation from public and private research institutions. Through this call, support will be provided on projects that will develop design and product innovation that can be utilized for Creative Industries Sector's production/manufacturing and delivery of their services.

### Call Scope

The call will cover the following areas:

- **Strategic Call** for Ergonomic technologies for footwear and furniture industry
- **Mission Call**
  - Product design and/or innovation for the New Normal
  - Appropriate technologies that address issues on design and product development for footwear, furniture, and jewelry industry
- **Open Call**
  - Design and/or innovation for the preservation of cultural heritage including cultural and geo-heritage sites
  - Appropriate technologies that will enhance/improve the cultural tourism (i.e., geotourism, museums)

Project duration for proposals submitted under the Mission Call should not be less than a year but not more than three years. For program proposals submitted under the Strategic Call, it should not exceed five years.

Grant amounts will range from PhP 5,000,000.00 to Php 10,000,000 per project however, requests for funding below this range will also be considered. For program proposals, grant amount will depend on the research requirement.

### Call Objective

- To invite submission of S&T and R&D program/projects that will enhance and /or develop ergonomic technologies specifically for the furniture and footwear industries
- To develop technologies that addresses the New Normal to elevate and/or improve the productivity of Creative Industries sector and its allied sectors

The proposals should:

- Incorporate Industry roadmaps results (if available),

- Demonstrate collaboration in the form of written commitment from the partner industry / company
- Cost share: at least 15% counterpart funding
- Technologies should have potential for commercialization

### 3. Innovative Solutions for Craft and Artisanal Production

Total Budget: 10M

#### Call Rationale

The Philippines has been known to export locally produced goods to other countries. The Philippines with its large pool of creative skills and rich heritage can be a hub that produces quality artisanal products. But to encourage the next generation and maintain the current interest of those who are already engaged on Filipino-influenced crafts and products, the need to ensure and maintain the quality standard of the “Filipino” products is needed. This can be addressed by encouraging researches on innovative solutions for Crafts and Artisanal Production.

#### Call Scope

To encourage research projects that will increase productivity on crafts and artisanal production, this Call will cover proposals for the following:

- Ergonomic technologies for artisanal production
- Appropriate technologies for traditional processes

The proposed duration for proposals submitted should not be less than a year but not more than three years.

Grant amounts will range from PhP 5,000,000.00 to Php 10,000,000 per project however, requests for funding below this range will also be considered. For program proposals, grant amount will depend on the research requirement.

#### Call Objective

The objective of the open call is to come up with innovation technologies and solutions that will aid/enhance in the “mano-mano” or semi-mechanized production of the Creative Industries sectors specifically those in the areas of Jewelry, Footwear and Furniture Sector and their allied sectors.

The proposals should:

- Incorporate Industry roadmaps results (if available),
- Demonstrate collaboration in the form of written commitment from the partner industry / company
- Cost share: at least 15% counterpart funding
- Technologies should have potential for commercialization

## **D. CREATIVE INDUSTRIES SECTOR (Animation, Game and Film Cluster)**

### **Call Overview**

The Creative Industries are considered as one of the fastest growing sectors in the global economy and contribute significantly to Gross Domestic Product (GDP) of developed countries. 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. Therefore, it is necessary to address the pressing concerns in these sectors and strengthen the current capabilities through science and technology interventions.

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

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

### **Call Objective**

The proposed project should address the creative industry needs particularly in game, animation, and film development sectors.

### **Call Scope**

The following are the identified industry needs with the corresponding capabilities and recommended science and technology interventions:

#### **1. Serious Game Applications for Education**

Serious games refer to applied video games designed for a primary purpose other than pure entertainment. With the advent of virtual reality, augmented reality, artificial intelligence, and machine learning, digital games can now be used as an effective tool in the field of education.

Currently, universities are infusing serious game applications in the new curriculum. Serious games are being used as a learning tool for primary and secondary education in different subject areas including Mathematics, Chemistry, Biology, and Social Studies among others. Since serious game apps were shown to improve student engagement, motivation, and retention of knowledge, more serious game apps shall be developed and explored in K-12 program, tertiary education, and even in training of workers and professionals.

### **Call Objectives**

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

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

### **Call Scope**

- Proposed project should focus on tertiary education subjects.
- Possible adoption by the Commission on Higher Education (CHED) should be explored.

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

## **2. Local Development of Software and Engines**

### **Call Objective**

Proposal that aims to develop affordable quality software for game, animation, and film.

### **Call Scope**

Research and development for the creation of open-source, local version of existing software and engines to improve the efficiency and quality in game programming, audio engineering, storyboarding, art animation, 3D modelling, surfacing, character rigging, algorithmic video editing, and real-time UHD rendering, among others. Proposals shall involve an industry partner.

**Specific Requirements:** To ensure that the research output will be open for use of creative industries like a Libre Office and that a letter of support is secured from the industry partners to help test and adopt the product/s.

PCIEERD will fund at most six (6) projects with a maximum budget of Five (5) Million Pesos per year per project.