R&D SOLUTIONS

50 M

Nanodevice fabrication

for drug delivery and

pathogens, pesticide

determination of crop

residues, and

diagnostics (nanobots)

Agricultural detection of

Facilities and Services

Continuous support for ADMATEL and PATHS Center

Human Resources

- Increase awareness of Advanced Materials and Nanotechnology in STEM curriculum, and in industry and among consumers
- Send 10 researchers abroad to raise local talent to global standards by providing exposure and training in renowned research laboratories
- Establish programs to obtain visibility into industry needs and open channels for collaboration (e.g. internships, immersions)
- Introduce targeted training electives in Advanced Materials and Nanotechnology to promote employment readiness of graduates for certain industry applications
- Balik Scientist Program to consolidate resources and lead R&D and collaboration efforts in the field (through Advanced Materials and Nanotechnology Hub)
- Improve workforce preparation for opportunities with multinational

R&D Technologies

- Build and publish database with information regarding technology researches, publications, laboratories and equipment, and skills developed
- Partner with at least 10 entities for R&D applications and infrastructure co-development
- Materials Informatics R&D

S&T Policies

- Folicies
 Ensure communication of government 2020 stakeholders Materials development
- Nanosafety Policies / Standards

26 M

· Coatings of nanomaterials for lightweight and strength applications

- Smart packaging
- Strong and lightweight materials from nanocomposite, nanocement, magnesium alloys, etc.
- Nanodelivery applications
- Nanosensors applications
- Nanodiagnostic devices
- Nanotech-enabled solutions addressing climate change (More efficient materials. Light harvesting materials, Green technology)

10 M

- Nanofiber materials as food packaging;
- Nanomaterial composites for filter applications

Development of capabilities in coatings and nano-

> Development of Nanomaterial safety protocols

enabled materials

2022

300 M

Nanofabrication

techniques for electronics and materials manufacturing (NEMS, memory tech. blow spinning) Adoption of advanced materials such as intermetallics. nanoclays, and smart fibers



ilities functionaliti

2023

Enhanced capab

and applications Enhancement of deployment of nanosafety protocols including nanocertification and nanosafety

labelling

500 M

Development of

nanostructured materials for efficient energy conversion and storage devices Development of smart energy systems (nanoengineering of highly efficient conductors and superconductors) Development of nanostructured aerogels (application in insulation, energy, and environment) •Graphene R&D Nano-photonic materials Incorporation of Computational Nanotechnology (Reaction Mechanism, Structure determination, Prediction of new crystalline materials, Property prediction, Molecular



modeling, Materials design,

2024

Advanced capabil ities functionalitie s and applications

100 M

- Development of nanogenerators · Development of blue nanotech (blue nanomaterials, CO2 to carbon nanotubes conversion)
- Nano Biomimicry (wave and tidal Blue nanotech systems energy, bioluminescent household (consumer electronics, and street lighting)
- · Nanomaterials for efficient energy conversion and storage devices (Hydrogen energy storage, Solar energy conversion)
- Deployment of smart energy systems (Nano-engineering of conductors and superconductors)
- Development of nanostructured aerogels (Insulation, energy, and environment)
- Graphene R&D (Flexible electronics, solar energy, sensors, bio-imaging)
- Nano-photonic materials

2025

- Materials development
- Enhanced capabilities in nanofabrication techniques
- Development of nano-enabled energy devices and smart energy systems
- Enhanced capabilities of nanstructured aerogels.

100 M

- Assembly and deployment of nanogenerators
- CO2 to carbon nanotubes conversion)
- Nano biomimicry (wave and tidal energy, sensing, bioluminescent household, street lighting)
- Graphene-enabled consumer products (Solar panels, Flexible displays, Sensors, Imaging devices)



Materials

- development
- Deployed nanoenabled energy devices and smart energy systems
- Enhanced capabilities of nanstructured aerogels.

50 M

 Convergence of Nanotechnology and **Big Data Analysis** Further Development of Graphene-enabled **Consumer Products** Exploration of **Advanced Nanotech Applications** Ongoing Efforts in Computational Nanotechnology

50 M

Legend

(Text Font):

- · Convergence of Nanotechnology and Big Data analysis
- Grapheneenabled consumer product s (solar panels, flexible displays sensors, and imaging devices)



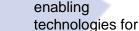
Materials

2027

Deployed nano -enabled energy devices and smart energy systems



development



Done

VISION

Provision of

applications

beneficial to

society.

Target

2028

- Materials development
- Deployed nanoenabled energy devices and smart energy systems

OVERALL OUTCOME

Locally-developed products and services intended for wide-range of applications

MILESTONES



Republic of the Philippines

DEPARTMENT OF SCIENCE AND TECHNOLOGY PHILIPPINE COUNCIL FOR INDUSTRY, ENERGY AND EMERGING TECHNOLOGY RESEARCH AND DEVELOPMENT OneDOST4U



List of Nanotechnology Projects (for the whole duration of the roadmap)

				-				-	-
R&D Technologies	Project Title	Budget Allocation ('000)							
		2022	2023	2024	2025	2026	2027	2028	
Nanotechnology	Development of Nanosilica-based Anti- Corrosion Coating Formulations for Carbon Steel Reinforcement Used in Farm Structures	3,828,555.38							Completed (PCIEERD-GIA)
Nanotechnology	Photoluminescent metal nanocluster to detect, disinfect, and suppress the spread of coronavirus and other microorganisms	4,889,192.00							Completed (PCIEERD-GIA)
Nanotechnology	Environment-Friendly Electrosynthesis of Urea from CO2 and Nitrate over Rationally Designed Cu-based Bimetallic Nanocatalysts			8,512,048.40	3,529,548.40	2,969,548.40			Ongoing (DOST-GIA)
Nanotechnology	Evaluating the Performance and Disposal of Kapok Sorbents for Marine Oil Spills (K4MOS)		7,949,367.40						Ongoing (PCIEERD-GIA)
Nanotechnology	Nanocellulose Self-Disinfecting (NACS) Filter: R&D Validation of an Innovative Low- Cost Nanotech-based Face Masks	7,990,079.00							Completed (PCIEERD-GIA)
Nanotechnology	Development of Biodegradable Nanofiber Filters as an Active Material for Medical- grade Facemasks	4,831,574.40							Completed (PCIEERD-GIA)



List of Nanotechnology Projects (for the whole duration of the roadmap)

			_						
R&D Technologies	Project Title	Budget Allocation ('000)							
		2022	2023	2024	2025	2026	2027	2028	
Nanotechnology	eAsia: Developing Green Degradable Polymers from Plant Based Oils and Investigation on Its Subsequent Functionalization and Utility as Heavy Metal Sequestrants	6,824,291.00	2,824,291.00						Ongoing (DOST-GIA)
Nanotechnology	Project 2: Nanostructured Scaffolds from Natural Fibers as Platforms for Stem Cell Growth and Differentiation	6,785,264.00							Completed (PCIEERD-GIA)
Nanotechnology	Design of Highly Active Kapok Fiber Electrodes for Energy Applications	1,361,014.88							Completed (DOST-GIA)
Nanotechnology	Kapok Fibers Absorbent With Switchable Hydrophobicity/ Hydrophilicity For Oily Water And Wastewater Treatment	2,668,416.64							Completed (PCIEERD-GIA)
Nanotechnology	Fabrication of Graphene-based Nanostructure Substrates for Applications in Ultrasensitive Detection	8,736,608.12							Completed (PCIEERD-GIA)
Nanotechnology	Heterojunction of Graphene-based Composites for Membrane Applications in Covid19 Pandemic Mitigation	3,194,900.80	2,173,900.80						Ongoing (DOST-GIA)
Nanotechnology	Development of Electro-responsive Membranes (DERM)			5,907,560.00					Ongoing (DOST-GIA)



List of Nanotechnology Projects (for the whole duration of the roadmap)

R&D Technologies	Project Title		Status						
		2022	2023	2024	2025	2026	2027	2028	
Nanotechnology	In Silico Nanotoxicology Evaluation of Engineered Nanomaterials: Bridging the Data Gap on Experimental Approaches for Toxicity Appraisal with Implications to Nanomaterial Risk Assessment and Nano- safety	4,032,515.93	965,447.74						Completed (PCIEERD-GIA)
Nanotechnology	Printed Electronics and Nanotech Materials for the New Normal: Breathing with Coughing Sensor, Antiviral Nanotech for Air Circulator Filters, and Non-Invasive Health Monitoring through Sensor Array Patch	7,146,649.00							Completed (PCIEERD-GIA)
Nanotechnology	eAsia: Development of Innovative Nanobiodevices Based on Hybrid Materials by Combination of Endemic South Asian Biomolecules and Nanocarbons	2,334,019.09							Ongoing (DOST-GIA)

