Legend | New/Ongoing | Completed | Target

ENERGY: Solar Energy Program

Updated as of 19 September 2023

Overall Strategies

- R&D to support capacity building on solar PV and concentrator testing, validation, repair services and maintenance for sustainability
- Development of forecasting model for solar installation and resources assessment
- Development of modular stand-alone mobile desalination unit for brackish and seawater
- Solar PV marine floating platform design optimization
- Establishment of Solar PV laboratory (certification-type)
- Recommendation of S&T-based policies to support microgrid RE utilization for off-grid/on-grid applications

POSSIBLE SOLUTIONS

2022

- CSP system for energy generation and heating purposes
- Demonstration site for Microgrid PV system
- Realtime solar energy forecasting using GIS
- Solar home energy management system
- Solar powered desalination system

2023

60M

- Localization of efficient solar thermal system, i.e. concentrators , for drying, portable water production
- Demonstration of Micro Grid RE system
- Development of forecasting model for solar installation and resources assessment
- Solar Home System Energy Use Optimization
- Modular Stand Alone and Mobile desalination unit for brackish and seawater

2024

60M

- Solar PV Marine Floating Platform Design Optimization
- Development of advanced RE system to support microgrid facility
- Establishment of Solar PV Laboratory (For Certification)

2025

- Robust Solar Marine Platform demonstration facility
- Data on performance of advanced RE system
- Solar PV R&D and Testing Laboratory

2026

40M

- Demonstration for New thin film solar pv farms and concentrator applications
- Integration of Solar PV energy to building component/structure
- Improving reliability and durability of BOS components

2027

- Thin film Solar farms and CSP application for electricity generation
- Adoption of solar pv technology as architectural application
- Improvement and bankable PV system components
- Cost effective balance of system components of PV, inverters, combiners and converters

50M

- Solar Energy evolution and diffusion (SEED) – small innovative applications
- CSP – mechanism for new thermochemical storage
- Increasing material efficiency
- Lowering material and process cost

2028

- Accelerated technology for solar technology
- Data on thermochemical conversion utilizing solar energy
- Affordable solar technology for household utilization

50M

- Next generation photovoltaics demonstration
- Resilient distribution system powered by solar energy
- Solar thermal energy storage and heat transfer media
- Solar thermal for industrial processes

- Performance validation for next gen system/facility
- Improved grid resiliency
- Improve intake of solar thermal applications by the industry

MILESTONES

VISION

Competitive solar PV industry, increase solar energy generation and lower solar electricity for human utilization

Overall Outcomes

Human Resource

- Increased capacity on solar PV and concentrator testing services
- New skills acquired for solar PV/concentrator services, repair and maintenance

R&D Technologies

- Optimized solar home system for off-grid areas
- Web-GIS based information solar data established
- Cost-effective solar desalination system for additional potable water source developed
- Cost competitive balance-of-system (BOS)

Facilities / Services

- Solar PV and BOS testing facility established

S&T Policies

- Microgrid RE system using solar PV exploited for off-grid areas

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Localization of efficient solar thermal system, i.e. concentrators, for drying, portable water production	Concentrated Solar Power: Design and Performance Evaluation of a Micro-Scale CSP Technology	-	-	-	-	-	-	-	Completed
Demonstration of Micro Grid RE system	Microgrid Solar PV System	-	-	-	-	-	-	-	Completed
Development of forecasting model for solar installation and re sources assessment	Solar PV Resource and Installation Assessment Using Geospatial Technologies	7,508	-	-	-	-	-	-	Ongoing
Solar Home System Energy Use Optimization	Integration of Machine Learning Inference on Home Energy Storage System (HESS) to deliver long term optimized self-consumption with Low probability of Power Loss	4,999	-	-	-	-	-	-	Completed
Modular Stand Alone and Mobile desalination unit for brackish and seawater	Renewable Energy Community Desalination Systems (RECoDeS)	4,979	-	-	-	-	-	-	Ongoing

ENERGY: Micro-hydro Power (MHP) Program

Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

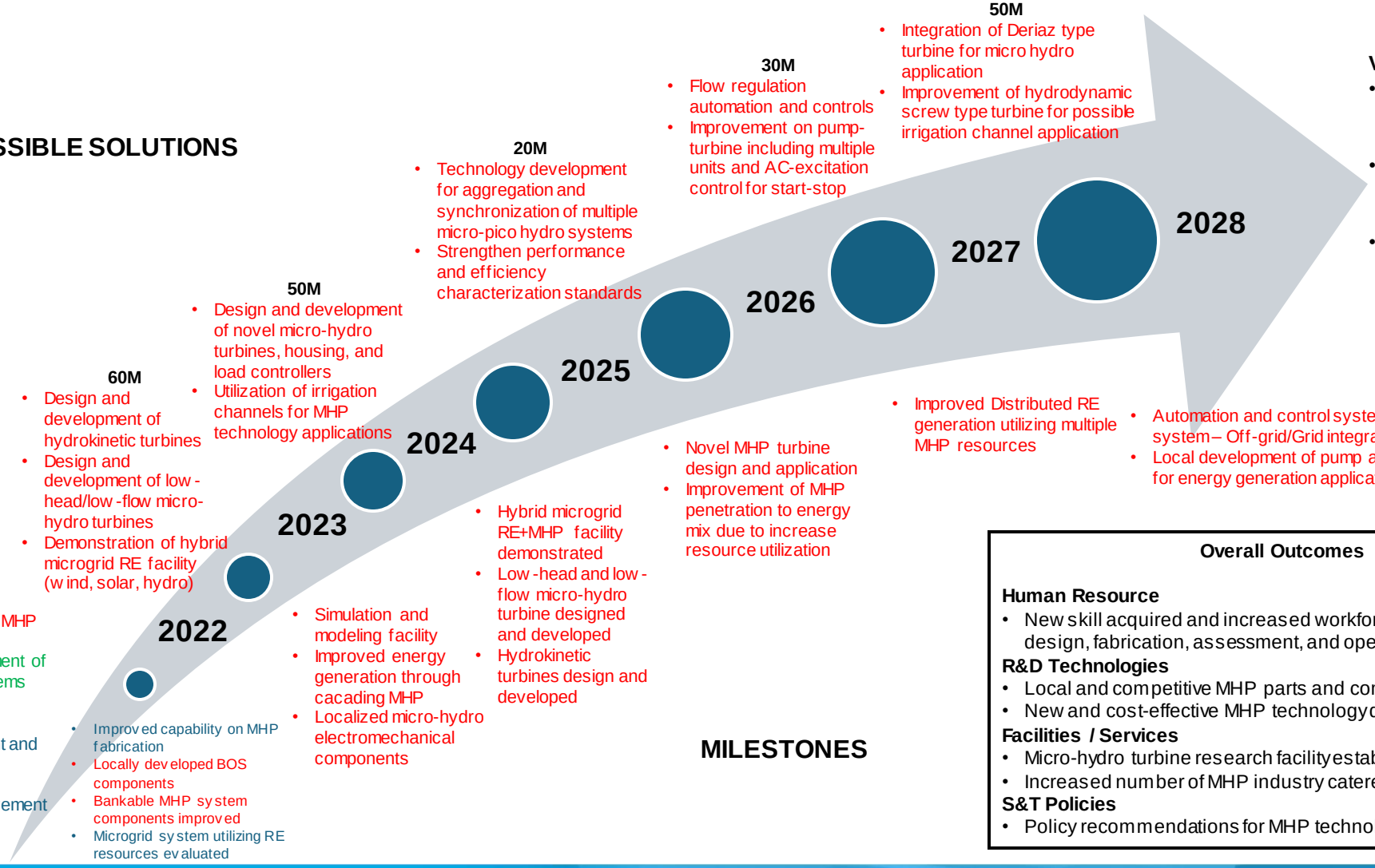
Human Resource
- Capacity building on Micro-hydro turbine design/fabrication
- Capacity building on Micro-hydro site assessment/evaluation
- Capacity building on Micro-hydro operation and maintenance

R&D Technologies
- New and emerging turbine technologies
- Localization of electromechanical components
- Development of hydrokinetic turbines
- Low-head, low flow hydraulic turbine technology
- Supply-chain analysis of available MHP technologies

Facilities / Services
- Establishment of Micro-hydro Turbine testing facility

S&T Policies
- Development of S&T-based policies for MHP technology

POSSIBLE SOLUTIONS



VISION
- Cost-effective and efficient MHP technology
- Increase energy reserve thru MHP utilization
- Competitive MHP industry

Overall Outcomes

Human Resource
- New skill acquired and increased workforce capacity on MHP design, fabrication, assessment, and operation/maintenance

R&D Technologies
- Local and competitive MHP parts and components developed
- New and cost-effective MHP technology developed

Facilities / Services
- Micro-hydro turbine research facility established
- Increased number of MHP industry catered thru the facility

S&T Policies
- Policy recommendations for MHP technologies

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Localization of electromechanical components	Improvement of Locally Designed Micro-hydro Turbines and Establishment of MHP test Rig	-	-	-	-	-	-	-	Completed
Localization of electromechanical components	TechnoEconomic Feasibility Study of a Microgrid in a Remote Community	-	-	-	-	-	-	-	Completed
Localization of electromechanical components	Sustainable development of cascaded MHP in a rural community	11,903	1,475	-	-	-	-	-	Ongoing

ENERGY: Ocean Energy Program

Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

Human Resource
- Capacity building on ocean energy resource assessment/ ocean thermal energy conversion
- Capacity building on ocean turbine system services, repair and maintenance for project sustainability

R&D Technologies
- Detailed resource assessment for remote island communities (wave, tidal, marine current)
- Design and development of mechanical harvesting device modeling tools
- Design and development of wave energy harvesting systems

Facilities / Services
- Establishment of ocean energy research facility (wave and marine current)

S&T Policies
- Development of S&T-based policies for ocean energy technology adoption

POSSIBLE SOLUTIONS

MILESTONES

2022
- 10M
- Ocean energy detailed resource assessment in remote island/ isolated communities and other strategic areas (wave, tidal, marine current)
- Mechanical harvesting device design and development modeling tools
- Performance assessment of mechanical harvesting devices
- Modeling simulation facility for Ocean/Hydrokinetic Technology

2023
- 7M
- Design and development of mechanical harvesting device modeling tools
- Resource assessment data for specific Mindanao areas (wave, tidal)

2024
- 50M
- Design and development of wave energy harvesting system
- Tidal Instream Energy Conversion (TISEC)

2025
- 5M
- Supply-chain analysis for ocean technology from generation to utilization
- Design and development of tidal harvesting equipment
- Wave tank and assessment equipment
- Floating platform for wave/tidal demonstration system
- ORE harvesting devices Modeling tools

2026
- 10M
- Capacity building on ocean thermal energy conversion resource assessment
- Ocean Thermal energy conversion (OTEC)
- Supply-chain analysis results for ocean technology available in the market
- Capacitated on ocean thermal energy conversion resource assessment

2027
- 15M
- Hydrokinetic turbine demonstration for grid integration.
- Wave array energy conversion modeling
- Power absorption geometry and controls

2028

VISION

- Competitive ocean energy industry
- Increase energy reserve through ocean energy utilization
- Increase number of rural electrification on island community

Overall Outcomes

Human Resource
- New energy research opportunities and skills developed
- Increased number of ocean energy researchers

R&D Technologies
- Updated and detailed ocean energy resource maps
- Locally developed ocean turbine technologies and systems

Facilities / Services
- Ocean energy research facility established (wave, marine current)

S&T Policies
- Ocean energy technologies exploited
- Increase energy reserve thru ocean energy use

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Ocean energy detailed resource assessment in remote island/ isolated communities and other strategic areas (wave, tidal, marine current)	Tidal Current Energy Integrated Resource Assessment Tool	-	-	-	-	-	-	-	Completed
Design and development of mechanical harvesting device modeling tools	Design and Performance Evaluation of an Ocean Renewable Energy System	-	-	-	-	-	-	-	Completed
Design and development of wave energy harvesting system	Utilizing marine renewable energy to satisfy community demand	-	-	-	-	-	-	-	Completed

ENERGY: Waste to Energy Program

Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

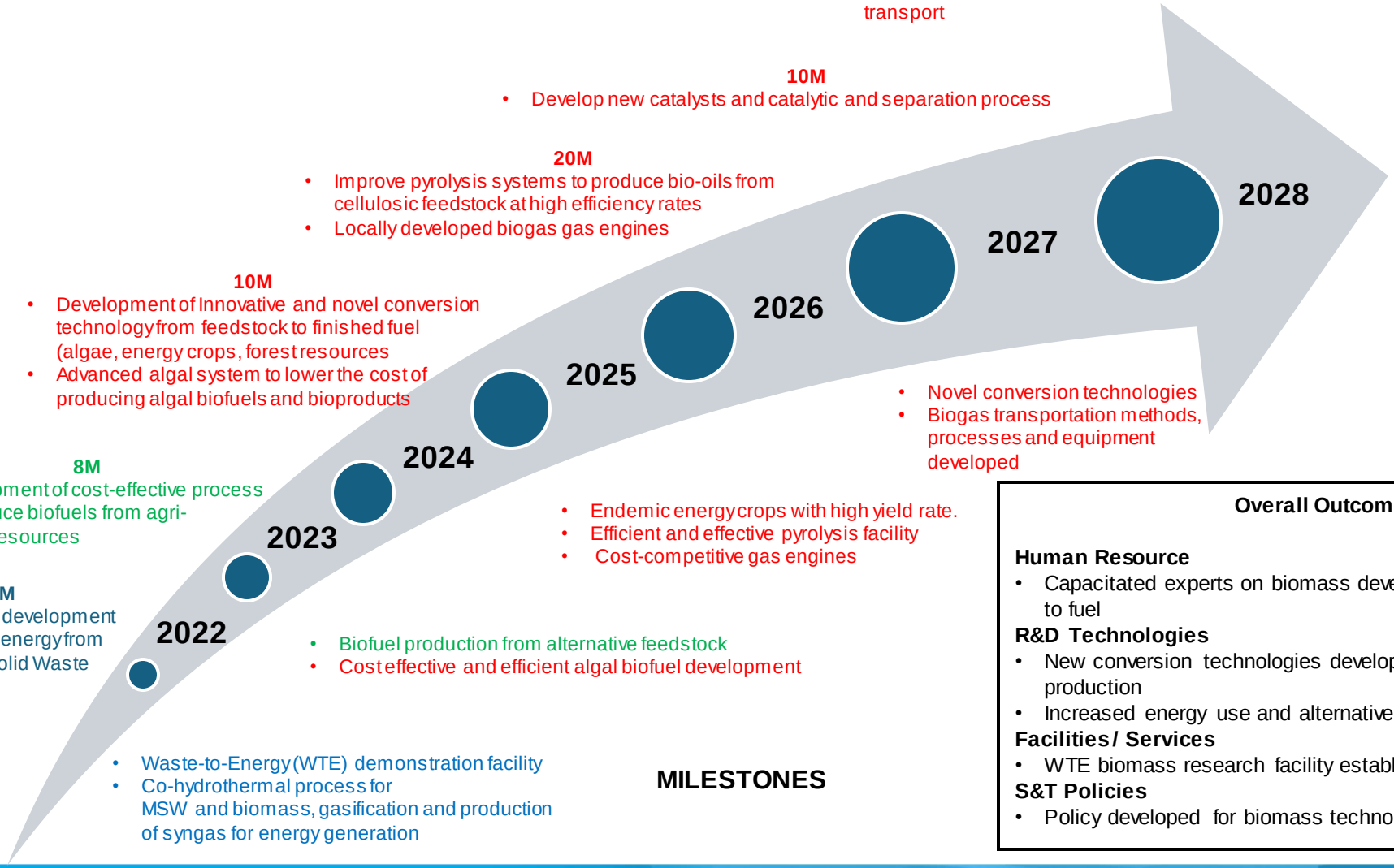
Human Resource
- Capacity building on hydrogen production using biomass technology

R&D Technologies
- Design and development of cost-effective process to produce biofuels from agri-based resources
- Hydrogen gas production using environmentally sound technologies
- Assessment and evaluation of Non-food and other possible energy crops
- Methods and Tools development for enhancing Waste Analysis and Characterization Study (WACS)

Facilities / Services
- Establishment of WTE demonstration facility
- Shared service facility for feedstock analysis and evaluation
- NICER facility for WTE

S&T Policies
- Development of S&T-based policies supporting biomass technology utilization
- Science Based approach on promotion of WTE facility, including emission compliance

POSSIBLE SOLUTIONS



40M
- Design and development of waste-to-energy from Municipal Solid Waste (MSW)

8M
- Development of cost-effective process to produce biofuels from agri-based resources

10M
- Development of Innovative and novel conversion technology from feedstock to finished fuel (algae, energy crops, forest resources
- Advanced algal system to lower the cost of producing algal biofuels and bioproducts

20M
- Improve pyrolysis systems to produce bio-oils from cellulosic feedstock at high efficiency rates
- Locally developed biogas gas engines

10M
- Develop new catalysts and catalytic and separation process

15M
- Develop technologies to improve the use of hemi cellulosic materials
- Development and assessment for biogas storage and transport

MILESTONES

- Waste-to-Energy (WTE) demonstration facility
- Co-hydrothermal process for MSW and biomass, gasification and production of syngas for energy generation
- Biofuel production from alternative feedstock
- Cost effective and efficient algal biofuel development
- Endemic energy crops with high yield rate.
- Efficient and effective pyrolysis facility
- Cost-competitive gas engines
- Novel conversion technologies
- Biogas transportation methods, processes and equipment developed

VISION

- Cost-competitive biomass energy production
- Increase energy reserve thru biomass energy use
- Competitive biomass industry
- Utilization of waste resources for the benefit of the people

Overall Outcomes

Human Resource
- Capacitated experts on biomass development, from feedstock to fuel

R&D Technologies
- New conversion technologies developed in biomass energy production
- Increased energy use and alternative energy production

Facilities / Services
- WTE biomass research facility established

S&T Policies
- Policy developed for biomass technology exploitation

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Design and development of cost-effective process to produce biofuels from agri-based resources	Establishing a 25kW Waste to Energy Facility using Direct Combustion Process for Municipal Solid Waste	-	-	-	-	-	-	-	Completed
	Key Technological Research of Philippines and China on Mobile Power Generation based on Gasification of Municipal Solid Waste (MSW) and Agricultural Biomass pre-treated by Co-hydrothermal Process	7,997	-	-	-	-	-	-	Ongoing
	Project BIOSS: BIO Scrubber System using Effective Microorganism and Pressure Swing Adsorption	-	6,180	1,714	-	-	-	-	Ongoing
	Development of waste oil-fired porous media burner as substitute to fossil fuel fired-burner used in the food industry	-	4,157	2,096	-	-	-	-	Ongoing
	SPArC: Synergy in Solid Fuel production from agri-industrial wet biomass for industrial boiler	-	-	15,715	4,658	-	-	-	Ongoing

ENERGY: Wind Energy Program

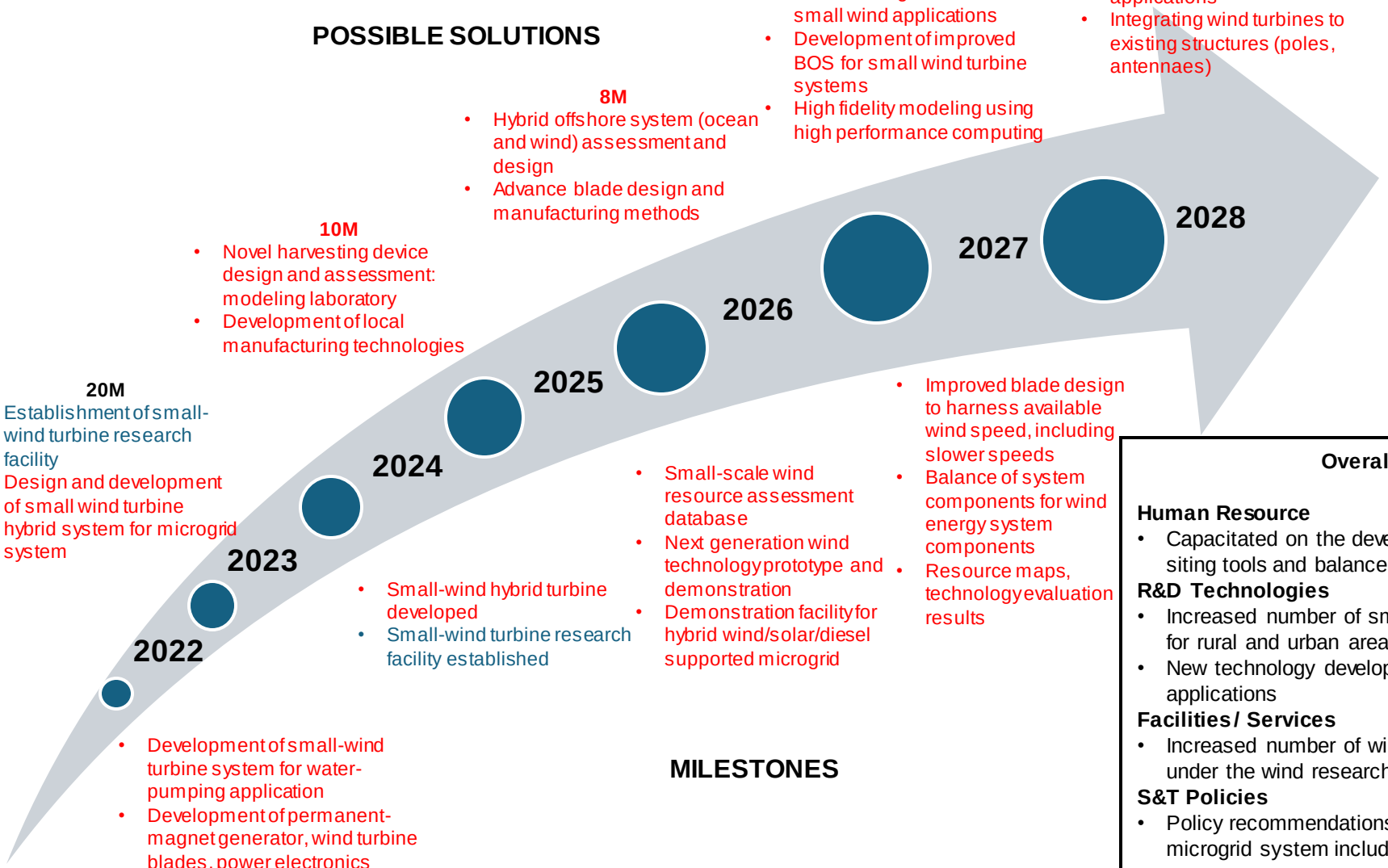
Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

- R&D to support capacity building on small-wind micro-siting assessment tools development for hybrid applications, BOS local development
- Improvement in turbine design, fabrication and manufacturing ability
- R&D on micro-sting tools for small wind remote area applications
- Design and development of novel harvesting device for small-wind turbine system – modeling using laboratory level
- R&D on wind turbine for hybrid offshore system
- Establishment of small-wind research facility
- Distributed wind energy system

POSSIBLE SOLUTIONS



20M
- Establishment of small-wind turbine research facility
- Design and development of small wind turbine hybrid system for microgrid system

10M
- Novel harvesting device design and assessment: modeling laboratory
- Development of local manufacturing technologies

8M
- Hybrid offshore system (ocean and wind) assessment and design
- Advance blade design and manufacturing methods

15M
- Active pitch control and Nacelle integrated inverters for small wind applications
- Development of improved BOS for small wind turbine systems
- High fidelity modeling using high performance computing

15M
- Adaptable single model for off grid or on-grid applications
- Integrating wind turbines to existing structures (poles, antennaes)

MILESTONES

- Development of small-wind turbine system for water-pumping application
- Development of permanent-magnet generator, wind turbine blades, power electronics
- Small-wind hybrid turbine developed
- Small-wind turbine research facility established
- Small-scale wind resource assessment database
- Next generation wind technology prototype and demonstration
- Demonstration facility for hybrid wind/solar/diesel supported microgrid
- Improved blade design to harness available wind speed, including slower speeds
- Balance of system components for wind energy system components
- Resource maps, technology evaluation results

VISION

Sustainable and competitive wind energy systems to support energy requirement of the people

Overall Outcomes

Human Resource
- Capacitated on the development of small-wind micro-siting tools and balance-of-system (BOS)

R&D Technologies
- Increased number of small-wind energy applications for rural and urban areas
- New technology developed for off-shore wind applications

Facilities/ Services
- Increased number of wind-turbine suppliers catered under the wind research facility

S&T Policies
- Policy recommendations on the use of hybrid microgrid system including small-wind turbine system

ENERGY: Hydrogen Production for Energy Applications

Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

Human Resource
- Consultation meeting with hydrogen industries and experts
- Improve local expertise on hydrogen development, from feedstock to utilization
- Capacity building on hydrogen storage design and development
- Capability building on hydrogen logistics and transportation

R&D Technologies
- Hydrogen production from biomass and other renewable sources
- Design and development of hydrogen production system
- Development of alternative storage of electricity from renewables to run electrolysers to produce hydrogen on-site
- Development of cost effective and durable catalyst and membranes
- R&D on hydrogen storage and transport

Facilities / Services
- Establishment of shared service laboratory/facility for biomass feedstock development and R&D
- Hydrogen evaluation facility

S&T Policies
- Minimial Life Cycle Cost and environmental impact on hydrogen production strategy and projects

POSSIBLE SOLUTIONS

MILESTONES

2022
20M
- Design and development of new methodology for hydrogen extraction using renewable energy

2023
- Demonstration facility for hydrogen production utilizing RE system (electrolysis)
- Innovative methodologies for hydrogen extraction using renewable energy
- Cost-effective and efficient locally-designed and developed electrolysis cells
- Hydrogen production through gasification

2024
30M
- Hydrogen production from biomass conversion
- Development of membrane technologies for separating and purfying hydrogen

20M
- Liquid biofuel conversion via liquid reforming
- Development of Dark Fermantative hydrogen production and microbial electrolysis cell

2025
- Biomass derived hydrogen
- Alternative hydrogen production via Renewable Liquid reforming
- Solar assisted hydrogen production
- Cost-effective and efficient membrane technologies for hydrogen separation and purification

2026
40M
- Design and development of hydrogen production system
- Development of water gas shift reactors and hydrogen compression technology

2027
35M
- Hydrogen Storage R&D, involving compressed and liquid hydrogen.
- Establishment of shared service laboratory/facility for biomass feedstock development and R&D
- Small scale distributed hydrogen production

2028
- Solar Driven water gas shift reactors
- Hydrogen storage facility including, high pressure tanks, metal/chemical hydrides

VISION

Locally developed cost effective and sustainable energy generation from hydrogen resources

Overall Outcomes

Human Resource
- Increase in expertise and skills in hydrogen production technology

R&D Technologies
- New industry and business opportunities in the hydrogen production sector
- Uptake on Hydrogen application, including power generation and vehicle

Facilities / Services
- Shared services facility and linkages for hydrogen development and utilization

S&T Policies
- Recommended S&T based policy I=on hydrogen development and utilization

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Localization of efficient solar thermal system, i.e. concentrator s, for drying, portable water production	Concentrated Solar Power: Design and Performance Evaluation of a Micro-Scale CSP Technology	-	-	-	-	-	-	-	Completed
Demonstration of Micro Grid RE system	Microgrid Solar PV System	-	-	-	-	-	-	-	Completed
Development of forecasting model for solar installation and resources assessment	Solar PV Resource and Installation Assessment Using Geospatial Technologies	7,508	-	-	-	-	-	-	Ongoing
Solar Home System Energy Use Optimization	Integration of Machine Learning Inference on Home Energy Storage System (HESS) to deliver long term optimized self-consumption with Low probability of Power Loss	4,999	-	-	-	-	-	-	Completed
Modular Stand Alone and Mobile desalination unit for brackish and seawater	Renewable Energy Community Desalination Systems (RECoDeS)	4,979	-	-	-	-	-	-	Ongoing

ENERGY: Integrated Program on Energy Efficiency & Conservation

Legend: New/Ongoing | Completed | Target

Updated as of 19 September 2023

Overall Strategies

Human Resource
- Capacity building of MSMEs in energy management and conservation
- Capacity building on local development of energy monitoring software & hardware systems
- Strengthening DOST regional offices energy auditor's capability

R&D Technologies
- Establishment of Philippine MSMEs energy profile using innovative methods and technologies
- Selection and adoption of low-carbon technologies for MSMEs application
- Technology demonstration of online energy monitoring and reporting system for government offices
- Local development of energy-efficient devices and equipment (reluctance electric motors, lightings, waste-heat recovery systems, energy data analytics, full energy management control systems)

Facilities / Services
- Establishment of Energy Research and Innovation Center (NICER)
- Establishment of Energy-Efficient Technology Aggregator Hub

S&T Policies
- Development of policy recommendations for MSMEs incentive for the use of energy-efficient technologies

POSSIBLE SOLUTIONS

2021

30M
- (**Smart Energy/ IoT**) Monitoring & Network/ IoT) Technology demonstration of energy monitoring systems for government offices
- (**Smart devices**) Design and development of local energy-efficient electric motors
- Design conceptualization of energy-efficient technology research center (NICER)
- Design and development of energy-efficient lighting control systems

2022

60M
- Energy profiling of Philippine MSMEs using innovative methods and technologies
- (**Energy Recovery**) Local development of low-carbon technology i.e. heat recovery system/ HVAC energy management systems/ control system software and hardware design
- Energy auditing of **24 large industries in NCR**

2023
- Energy-efficient government offices compliant to GEMP/ RA11285
- Locally developed reluctance motor
- Energy-efficient Tech Research (NICER) preliminary concept proposal developed
- Energy-efficient lighting control systems

2024

147M
- 7M: Energy auditing **of 26 large industries in Region-3** ESCOs techno-demo of low-carbon technologies for MSMEs
- 60M: Energy profile establishment (ice plant facilities, food manufacture, logistic facilities)
- 80M: Installation of smart EMS for selected LGUs (10) and government buildings (10)
- Philippine MSMEs energy profile established
- Low-carbon and energy-efficient technologies adopted for MSMEs application
- Locally developed energy-efficient equipment, management systems and controls
- 24 industries audited (NCR) / food manufacture, plastic and rubber products, electrical/electronics

2025

20M
- **(Smart Energy)** Technology scoping for next-generation energy-efficient systems research and development (lightings, devices, equipment)
- Energy management adoption and exploitation for government offices
- Next-generation energy-efficient technology developed
- Energy-efficient government offices compliant to GEMP/ RA11285

2026

2027

2028

VISION

- Cost-competitive locally developed energy-efficient technologies
- Energy-efficient MSMEs and Government Offices

Overall Outcomes

Human Resource
- Technology equipped and energy-efficient MSMEs
- New skills developed on energy management systems software/hardware design
- DOST regional offices energy auditors capacitated on new technology trends
- Increased numbers of energy researchers and developers

R&D Technologies
- New industry business opportunities on the development of local technologies (reluctance motors, EMS control systems, software and hardware systems)
- Increased numbers of energy research and development projects

Facilities / Services
- Network and linkages established for local R&D collaboration thru NICER
- Central hub established for energy-efficient technology acquisition (supply and services)

S&T Policies
- Recommended S&T-based policy on the use of energy-efficient technologies

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
Technology demonstration of online energy monitoring and reporting system for government offices	Deployment of Energy Monitoring Application and Network at DOST (DEMAND) as Demonstration Site	672	-	-	-	-	-	-	Completed
electric motor with integrated motor drive for low voltage applications	Design of a Modular Stator, Segmented Rotor Switched Reluctance Motor	3,764	-	-	-	-	-	-	Completed

ENERGY: Energy Storage

Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

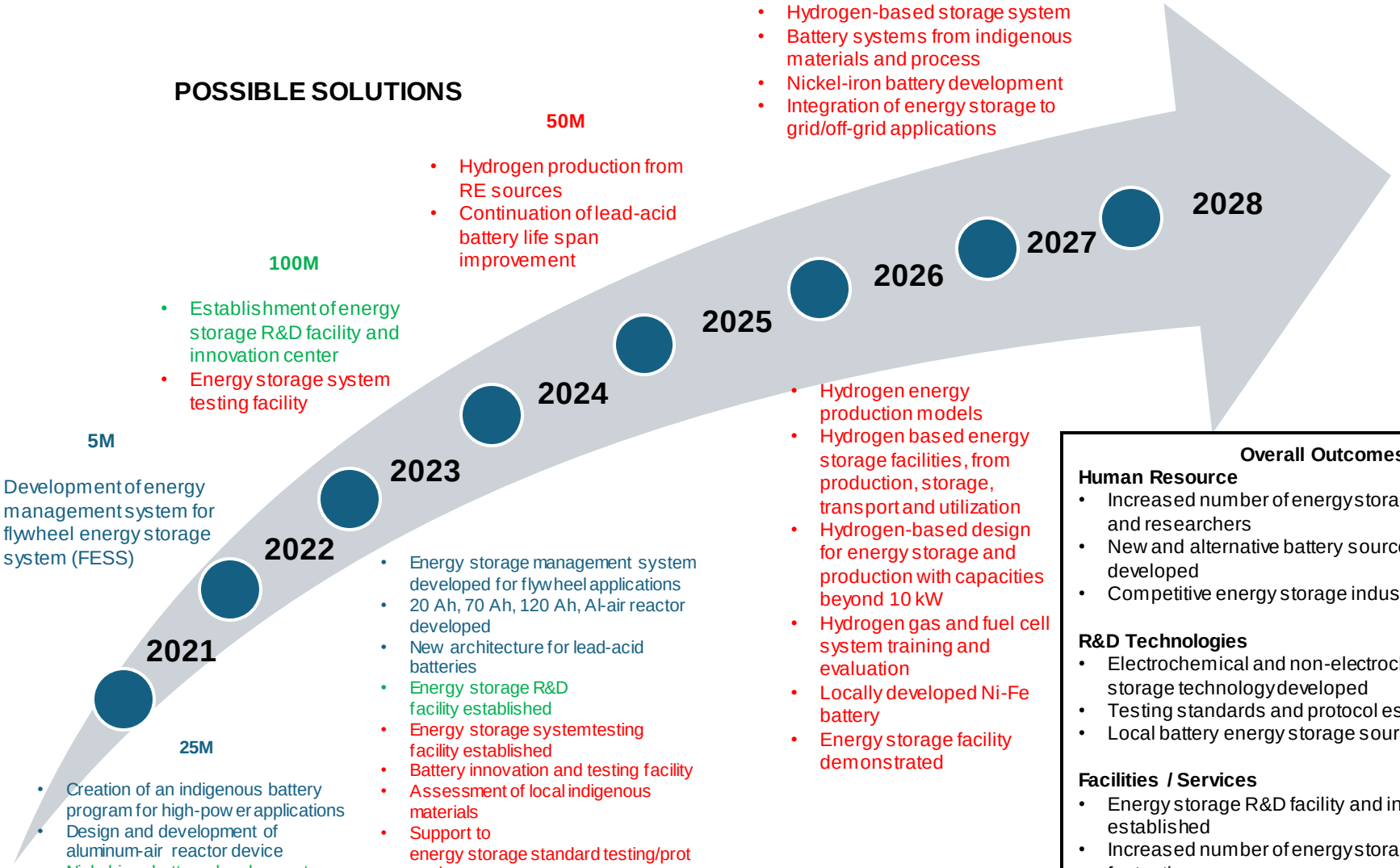
Human Resource
- Hiring of experts and consultants for energy storage development
- New battery architecture training and development
- Indigenous material assessment
- Design, development, and simulation program/experts
- Training on energy storage assessment/evaluation
- Establishment/organizing energy storage system association

R&D Technologies
- New and emerging energy storage system technologies
- Analysis of industry and energy storage stakeholders
- Development of chemical, electrochemical, and mechanical energy storage systems
- Development of standards and testing procedure/protocol for energy storage system
- Local material utilization for battery systems
- Household integration of energy storage systems

Facilities / Services
- Energy storage R&D facility and innovation center
- Indigenous materials for energy storage assessment and evaluation facility
- Energy storage system test facility

S&T Policies
- Development of S&T-based policies for energy storage technologies

POSSIBLE SOLUTIONS



5M
- Development of energy management system for flywheel energy storage system (FESS)

25M
- Creation of an indigenous battery program for high-power applications
- Design and development of aluminum-air reactor device
- Nickel-iron battery development
- Advanced lead-acid development
- Lead-acid battery life span improvement

100M
- Establishment of energy storage R&D facility and innovation center
- Energy storage system testing facility

50M
- Hydrogen production from RE sources
- Continuation of lead-acid battery life span improvement

70M
- Hydrogen-based storage system
- Battery systems from indigenous materials and process
- Nickel-iron battery development
- Integration of energy storage to grid/off-grid applications

MILESTONES

- Energy storage management system developed for flywheel applications
- 20 Ah, 70 Ah, 120 Ah, Al-air reactor developed
- New architecture for lead-acid batteries
- Energy storage R&D facility established
- Energy storage system testing facility established
- Battery innovation and testing facility
- Assessment of local indigenous materials
- Support to energy storage standard testing/protocols
- Improvement on bankable PV energy storage system
- Hydrogen energy production models
- Hydrogen based energy storage facilities, from production, storage, transport and utilization
- Hydrogen-based design for energy storage and production with capacities beyond 10 kW
- Hydrogen gas and fuel cell system training and evaluation
- Locally developed Ni-Fe battery
- Energy storage facility demonstrated

VISION

Cost-effective and efficient energy storage system for the people utilizing indigenous materials

Overall Outcomes

Human Resource
- Increased number of energy storage system experts and researchers
- New and alternative battery source identified and developed
- Competitive energy storage industry

R&D Technologies
- Electrochemical and non-electrochemical energy storage technology developed
- Testing standards and protocol established
- Local battery energy storage sources identified

Facilities / Services
- Energy storage R&D facility and innovation center established
- Increased number of energy storage industry catered for testing

S&T Policies
- Policy recommendations on energy storage utilization

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
On-going development of different cathode materials	Project: Project 1: Advanced Cathode Materials for Next Generation Batteries (NextGen) Implementing Agency: UPD Status: Ongoing Y2	34,169	7,057	7,925	-	-	-	-	Ongoing
Proof-of-concept of a nickel iron battery	Project: Project 2: REBCell: Rechargeable Edison Battery Cell for long-lasting high energy density applications Implementing Agency: UPD Status: Ongoing Y2	18,233	6,763	6,886	-	-	-	-	Ongoing
1 draft design of embedded ultrasonics in a battery casing	Project: Project 3: Advanced Lead Acid Batteries with Embedded Ultrasonics (ALAB-EU) Implementing Agency: TIP Status: Ongoing Y2	54,113	3,718	4,235	-	-	-	-	ongoing

ENERGY: Nuclear Power

Updated as of 19 September 2023

Legend: New/Ongoing | Completed | Target

Overall Strategies

R&D Technologies
- R&D on Nuclear Fuel Cycle focusing on indigenous/local source of uranium/thorium in Philippines
- Nuclear materials exploration and recovery (NuMER)/ Nuclear extraction methodologies
- Site survey and site selection for nuclear installations (Power plant site assessment and selection)
- Nuclear radioactive waste management arising from NPP operation and decommissioning including detailed site nuclear waste disposal survey and assessment.

Human Resource
- Nuclear education and human resources development (re-tooling of engineers and scientist)

Facilities
- Establishment of NuMER facility

S&T Policies
- Policy recommendations on the long-term commitments related to the front and back-end of the nuclear fuel cycle addressing the needs for adequate capacity for spent fuel storage at the reactor site, the possibility of interim storage of spent fuel at a dedicated facility and any plans for reprocessing.
- Clear allocation of responsibilities for development of the fuel cycle policy and strategy (front end and back end) to be undertaken during Phase 2
- Policy recommendations on the amounts and types of radioactive waste generated by a nuclear power plant and consider options for their management.

POSSIBLE SOLUTIONS

110M
- Nuclear materials exploration and recovery (NuMER)
- SMR/NPP-Related Studies (siting and assessment, baselining, nuclear reactor design, stakeholder's acceptance)
- Rad Waste Management (siting, processing, storage, pre-disposal, disposal, borehole disposal)

150M
- Expansion of Nuclear Fuel Cycle assessment to other potential locations
- R&D to support preparatory works for NPP construction including nuclear waste management

MILESTONES

2025

2026

2027

2028

2029

2030

Milestone Output 1 (2025-2027)
- Preliminary studies on Nuclear Fuel Cycle based on INIR recommendations
- 3 candidate sites for NPP verified
- NuMER facility established
- Nuclear S&T workforce capacitated
- Policy recommendations on nuclear spent fuel storage facility and potential locations.

Milestone Output 2 (2028-2030)
- Policy and strategy recommendations for Phase 2

VISION

- Stable and Self-Sufficient Energy Production from Nuclear Power
- Affordable and reliable energy source for the people

Overall Outcomes

R&D Technologies
- Nuclear Fuel Cycle assessment conducted and established as supporting documents for the establishment of National Fuel Cycle Strategy.

Human Resource
- Increase number of workforce for nuclear energy and power generation (engineers, researchers. and scientist)

Facilities
- Nuclear Materials and Recovery (NuMER) facility established
- Potential nuclear waste/spent fuel site locations identified

S&T Policies
- Policy recommendations on long-term front and back-end nuclear fuel cycle and nuclear waste management.

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

R&D Technologies	Project Title	Budget Allocation ('000)							Status
		2022	2023	2024	2025	2026	2027	2028	
IP application for adsorbent for seawater recovery (improved and enhanced adsorbent efficiency)	Front-End: Nuclear Materials Exploration and Recovery (NuMER)	-	-	36,776	8,976	-	-	-	New
Patent or utility model on NMSS is expected during the lifetime of the ADSuN	Nuclear Reactor Technology Assessment and Development (NuRAD)	-	-	17,176	7,039	-	-	-	New
Conceptual design of radioactive waste management facility for LILW.	Back-End: Strategy for RadioActive Waste Management (StRAW)	-	-	15,905	30,984	-	-	-	New
Locally-developed and available NPP simulator to support future plant activities	Establishment of Nuclear Plant Simulator and Analyzer Facility for R&D and Capacity-building for the Philippine Nuclear Energy Program	-	-	13,344	3,594	-	-	-	New