

The purpose of this Project Concept Paper is to present a well-defined funding proposal that outlines a strategic approach to addressing Zambia's needs for research infrastructure and capacity building in the science and technology (S&T) sector. The idea for this project emerged during the "K-Innovation Partnership Programme" of the Science and Technology Policy Institute with the Cambodian government, where we became aware of the Official Development Assistance (ODA) programme funded by the Ministry of Science and ICT (MSIT) of the Republic of Korea. This programme provides two types of support: establishing research laboratories and implementing joint research projects. Given Zambia's current lack of proper research facilities to conduct S&T research, the former option is deemed more suitable. The template and detailed information about the programme—its purpose, types, contents, and budget—were provided by Hyunjoo Kim, a researcher at the National Research Foundation of Korea (joo6808@nrf.re.kr).

This funding proposal is directed at leveraging ODA programmes like MSIT's to support the Zambian Innovation Agency (ZIA) in helping domestic innovation actors secure funding. Additionally, the proposed research infrastructure and capacity-building efforts would enable the National Institute for Scientific and Industrial Research (NISIR) to provide technical services, such as testing, inspection, and certification, creating a sustainable financial source for its R&D activities. Lessons can be drawn from successful examples in Korea, including institutions like the Korea Research Institute of Standards and Science (KRISS) and the Korea Electrotechnology Research Institute (KERI), which balance R&D functions with technical services. Moreover, other international ODA programmes, such as Japan's SATREPS (Science and Technology Research Partnership for Sustainable Development), present alternative funding opportunities if funding from Korea is not secured.

The proposal further aligns with Zambia's strategic priorities in agriculture, mining, manufacturing, and tourism, as identified during the NIS Working Group's first workshop. Additionally, the recent decision by the Korean government to re-establish an embassy in Zambia provides a timely diplomatic opportunity to strengthen bilateral cooperation and secure funding for this critical project.

**Development Cooperation Programs of the
MSIT (Science and Technology)**

Project Concept Paper

**(2027-2029) Building Resilient Renewable
Energy Research Infrastructure for Enhanced
Energy Security in Zambia**

**National Institute for Scientific and Industrial
Research, Zambia**

23. 12. 2024

Application Form

I. Applicant Information

Project Type		☒ Establishment of Research Labs ☐ Joint research project
Beneficiary	Organization Name	National Institute for Scientific and Industrial Research
	Name	TBD
	Address	Kenneth Kaunda International Airport Road, Lusaka, Zambia
	Contacts	Tel: Email:
	Type of Organization	Please check a type of the implementing organization in the boxes. ☐ Central/national government ☐ Provincial government ☒ Public universities, institutes ☐ Others..... [please specify]
	Description of Organization	National Institute for Scientific and Industrial Research (NISIR)
	Capability of Organization in R&D and Technology	NISIR operates multiple research centers and projects, focusing on areas such as post-harvest food processing, livestock diseases, water resources, sustainable utilization of genetic resources, nuclear energy applications, and materials research
Size and Nature of the Organization	NISIR's primary mandate is to conduct and promote scientific, technological, and industrial research and address the needs of the industry and promote socio-economic development through R&D. NISIR works closely with the Ministry of Technology and Science (MOTS) to align its research agenda with national priorities and policies.	
Government Office	Name	Ministry of Technology and Science, Zambia
	Address	Maxwell House, Los Angeles Boulevard, P. O. Box 50464, Lusaka, Zambia.
	Contacts	Mwenya Mulenga, Assistant Director Mwenya.Mulenga2@mots.gov.zm
Cooperation Organization (Government Office) * *If the beneficiary does not belong to government entity, a government office is required *Role: fore environment, materials, market research and cooperation with Korean counterparts		

II. PROJECT OUTLINE

2-1. Research area

2-1-1 Priority cooperative research area

- ▣ Manufacturing – Renewable Energy

2-1-2. Specific research area

Establishment of a new research laboratory and improvement of public-private research collaboration in the field of solar PV

2-2. Title: (2027-2029) Building Resilient Renewable Energy Research Infrastructure for Enhanced Energy Security in Zambia

Project Duration: 2027-2029

Budget: USD 340,000 per year (USD 1,020,000 in total)

2-3 Objectives and Necessity

Overall objective: *Contribute to the STI-based sustainable development of Zambia through the establishment of a new research laboratory and improvement of public-private research collaboration in the field of solar PV*

Necessity:

Zambia generates 88% of its electricity from hydroelectric power, making it heavily reliant on this source. However, frequent and prolonged power outages have become a common issue due to recurring droughts. To address the ongoing energy crisis, the Zambian government has pledged to diversify the country's energy mix by increasing non-hydro renewable energy sources by at least 30% by 2030. Despite this commitment, Zambia faces significant technical and financial challenges in achieving this goal. Therefore, the country requires technical and financial supports from development partners to establish a new research laboratory. This

facility would facilitate public-private research collaboration and provide technical services such as testing, inspecting, and certification.

Through the implementation of the project, we anticipate achieving the following outputs and outcomes by the project's conclusion and thereafter:

☐ **Expected outputs**

Establishment of essential facilities on research and technical services: The project will construct and equip the institute with state-of-the-art solar PV research centers. It also provides technical services on test, inspection, and certification.

Enhanced capacity of local experts: Training programs for local researchers, engineers, and technicians in renewable energy technologies will enable local experts to conduct independent solar PV research and provide technical services that facilitate commercialization of renewable energy technologies in Zambia.

Establishment of international collaboration platform: The research facility will facilitate the establishment of partnerships with international research institutions and universities and implement pilot projects to test and demonstrate solar PV technologies in Zambia.

☐ **Expected outcomes**

Energy security: enhanced energy security through diversified energy sources and reduced dependency on hydro power.

Economic growth: creation of job opportunities and stimulation of local economies through the promotion of the renewable energy sector.

Technological advancements: advancements of renewable energy technologies in local institutes and enterprises tailored to Zambia's specific needs and conditions.

Environmental benefits: reduction in greenhouse gas emissions and reliance on fossil fuels, contributing to climate change mitigation and resilience.

2-4 Target Location

National Institute for Scientific and Industrial Research (NISIR) under the Ministry of Technology and Science, Kenneth Kaunda International Airport Road, Lusaka, Zambia

NISIR is a key research institution in Zambia with the mandate to conduct and promote scientific, technological, and industrial research across various disciplines. Its primary roles and responsibilities include:

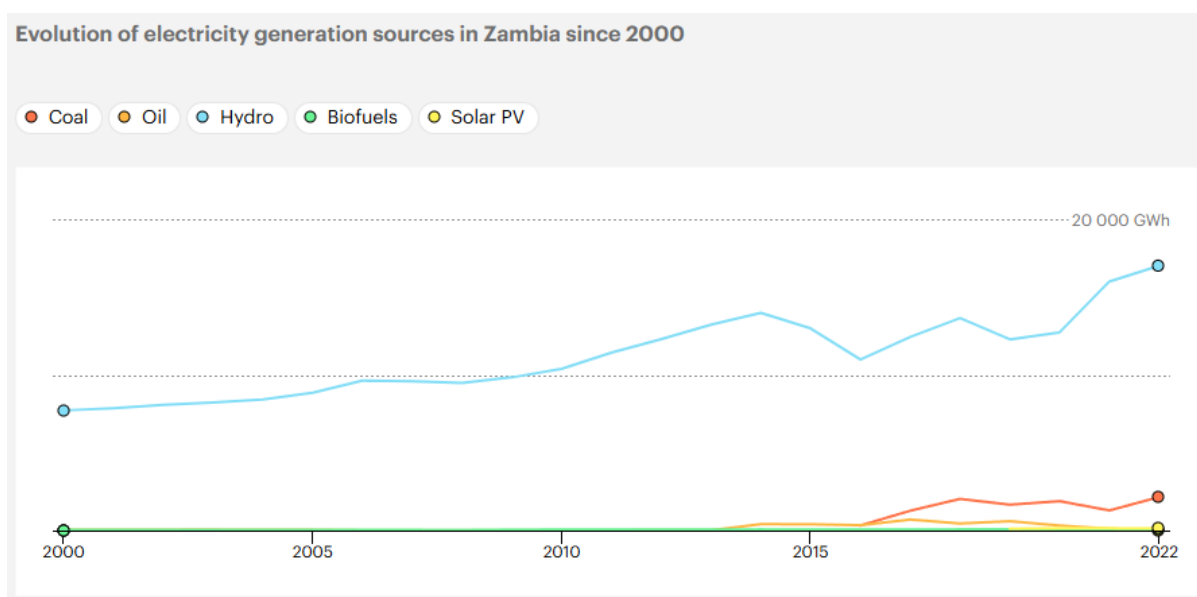
- **Research and Development:** Conducting advanced research in fields such as renewable energy, food science, biotechnology, nuclear science, and more.
- **Innovation and Technology Transfer:** Developing new technologies and innovations that can be transferred to industries to promote economic development.
- **Technical Services:** Providing testing, inspection, and certification services to ensure the quality and safety of products and technologies.
- **Training and Capacity Building:** Offering training programs and workshops to enhance the skills of researchers, engineers, and technicians.
- **Collaboration and Partnerships:** Establishing partnerships with local and international research institutions, universities, and industries to promote collaborative research efforts.

The Ministry of Technology and Science (MOTS) plays a crucial role in guiding, supporting, and overseeing NISIR's activities to promote scientific and technological advancements in Zambia. NISIR's research agenda and activities are aligned with the policies and strategic priorities set by MOTS to ensure they contribute to national development goals. In addition, MOTS provides funding, resources, and technical support to NISIR, enabling the institute to carry out its research projects and initiatives effectively. Last but not least, MOTS monitors and evaluates NISIR's activities to ensure compliance with national standards and policies, and to assess the impact of its research efforts.

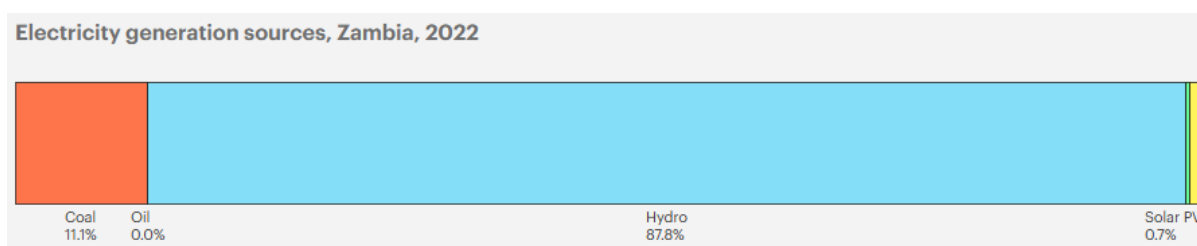
III. SITUATIONAL ANALYSIS

3-1. Current Situation

While the electricity generation in Zambia is steadily increasing since 2000, Zambia heavily relies on hydroelectric power for its electricity production, with 88% generated from this source and 11.1% from coal, according to the IEA (2022)¹. This dependence on water resources makes Zambia's energy supply very vulnerable to climate change.



Source: IEA homepage



Source: IEA homepage

Zambia's electricity is mainly consumed by the mining sector, which consumed approximately 56.2% of the total electricity production, 7,650.9 GWh, followed by households, 32.2%,

¹ <https://www.iea.org/countries/zambia/electricity>, accessed 22/12/2024.

4,387.7 GWh.

Electricity consumption by sector

National consumption in gigawatt hour (GWh) .



	Mining	Household	Finance	Manufacturing	Agriculture
2023	7,650.9	4,387.7	907.4	354.5	312.2
2022	7,355.1	4,548.5	908.3	384.6	286.5
2021	6,551.3	4,477.3	835.4	375.4	293.7
2020	6,062.8	3,814.6	628.2	381.8	261.4
2019	6,551.3	4,477.3	835.4	375.4	293.7
2018	6,829.5	4,336.9	713.9	593.1	297
2017	6,320.2	4,146.9	640	503.4	261.5
2016	5,977.6	3,382.9	498.6	469.8	227.9
2015	6,313.8	3,482	516.9	530.8	260.4
2014	5,933.5	3,250.8	487.4	479.2	241.4

Source: ZESCO Created with Adobe Illustrator and Datawrapper

Therefore, the Zambian government promised to improve the country's energy mix by increasing at least 30% more non-hydro renewable by 2030².

3-2. Problem Statements and Solutions

Problem Statements: Recent years have seen significant reductions in water levels due to recurring droughts, resulting in frequent and prolonged power outages. For example, the 2023–2024 El Niño exacerbated this situation, causing severe droughts, with low water levels observed at the Zambia's three primary hydro plants: Kafue Gorge Lower, Victoria Falls, and Kariba North Bank Power Station. As a result, with national electricity production in the first half of 2024 dropping to 8,113 GWh from 9,486 GWh in 2023³, which is 14.5% less than the

² <https://www.pdu.gov.zm/blog/zambias-energy-minister-addresses-ongoing-energy-crisis>, accessed 23/12/2024.

³ <https://pulitzercenter.org/stories/zambias-power-shortages-worsen-drought-deepens?form=MG0AV3>, accessed 20/12/2024.

previous year.

These severe electricity shortages have a profound negative impact on daily life and economic activities in Zambia, highlighting the urgent need for alternative electricity sources. Diversifying energy production is crucial, with renewable energy sources like solar power offering more climate resilience and sustainability. These sources can complement hydroelectric power and reduce dependence on it. Incorporating renewable energy not only supports global goals but also ensures a stable and secure energy future for Zambia.

Recognizing the ongoing energy crisis, the Zambian government announced measures on August 1st, 2024, to mitigate the electricity deficit⁴. These measures include:

- **Tax-Free Imports on Solar Equipment:** To encourage the adoption of solar energy.
- **Net Metering and Solar Initiatives:** Allowing users to generate their own power from renewable sources and feed excess electricity back into the grid.
- **Presidential Solar Initiative:** Promoting the widespread use of solar energy.

Despite these initiatives, solar PV accounted for only 0.7% of the country's electricity production in 2022, according to the IEA. This highlights the significant potential for renewable energy development in Zambia.

Acknowledging the ongoing energy crisis, August 1st, 2024, the Zambian government announced measures to mitigate the electricity deficit in the country. Among them, there are promotion measures of solar energy, including Tax-Free Imports on Solar Equipment, Net Metering and Solar Initiatives (allowing users to generate their own power from renewable sources and feed excess electricity back into the grid), and Presidential Solar Initiative. Nevertheless, solar PV currently only covers 0.7% of the country's electricity production in 2022 according to IEA. This leaves a huge potential of renewable energy in Zambia.

⁴ <https://www.pdu.gov.zm/blog/zambias-energy-minister-addresses-ongoing-energy-crisis>, accessed 23/12/2024.

Proposed Solutions:

Establishment of a new research laboratory and improvement of public-private research collaboration in the field of solar PV

- Establishment of a new research laboratory in the field of solar PV
- Establishment of a technical service portfolio in testing, inspection, and certification in the field of solar PV
- Capacity-building and training programs on sustainable operation and maintenance of to be established research laboratory for Zambian government/public officers, researchers, recommended experts, and other related personnel.
- Collaboration partnerships with international institutions and universities.

As Zambia does not yet have a proper research facility to conduct S&T research in emerging industries such as renewable energy, it is important to first provide the necessary research infrastructure. This ODA project aims to specifically address the lack of research infrastructure. Then there is the question of how to secure sustainable financial support for innovation activities, including research and development, with an established research infrastructure. If the research laboratory is equipped with a facility that can provide technical services, this can create a sustainable source of funding. The proposed solution should take these factors into account when deciding on the content of a new research laboratory and technical services portfolio.

IV. PROJECT IMPLEMENTATION

4-1. Scope of Project (Research)

This project involves establishing a solar PV research laboratory in NISIR under the Ministry of Technology and Science, promoting public-private research collaboration with technical services such as test, inspection, and certification.

4-2. Participants (Research Personnel)

Project Implementation Organization

- National Institute for Scientific and Industrial Research (NISIR)

Public Sector Stakeholders

- Ministry of Technology and Science
- Ministry of Energy
- Zambia Electricity Supply Corporation (ZESCO), the state utility

Private Sector Stakeholders

- Universities and related institutes specializing in solar PV technologies
- Private sector companies and industry associations related with renewable energy
- Community organizations and NGOs.

4-3. Main Activities

Activity 1: Diagnostic Analysis of Current Research Facilities and Demand Survey on Renewable Energy Technologies in Zambia

Activity 1 involves a comprehensive evaluation of the current status of research facilities focused on renewable energy technologies, along with a demand survey tailored to local needs and conditions. It will include the following:

1.1 Assessment of Technology Advancements: Evaluate the level of advancements in renewable energy technologies within Zambia's public and private sectors.

1.2 Review of Existing Facilities: Examine existing research facilities and

equipment related to renewable energy technologies in both the public and private sectors.

- 1.3 Demand Survey:** Conduct a survey to assess the need for specific research facilities and equipment.

Activity 2: Design and Implementation of a New Research Laboratory at NISIR

Activity 2 involves the detailed design and establishment of a new research facility and the acquisition of equipment at NISIR, tailored to local needs and conditions. It will include the following:

- 2.1 Identification of the Priority Research Field and Laboratory Design:** Identify the priority research field through key stakeholder meetings and develop a design for a new research laboratory, prioritizing the selection of essential equipment at NISIR.
- 2.2 Procurement and Installation:** Procure, transfer, and install the listed equipment at NISIR.
- 2.3 Testing and Guidelines:** Test the installed equipment and provide operational and maintenance guidelines to researchers and technicians in NISIR.

Activity 3: Capacity Building Programs and Dissemination and advocacy Workshop

During the course of Activity 1 and Activity 2, development partners will host capacity-building programs for Zambian government/public officers, researchers, recommended experts, and other related personnel. The workshops will share key functions of the listed equipment and provide guidance on operation and maintenance.

- 3.1 Capacity Building Programs:** Organize workshops, seminars, and training programs and provide necessary knowledge and knowhow to researchers and technicians to operate the new research laboratory.
- 3.2 Dissemination and Advocacy Workshop:** Organize workshops involving government/public officers and key stakeholders in Zambia, including researchers and technical experts on renewable energy technologies from both public and private sectors. This will facilitate the dissemination of outputs of the project.

ACTIVITIES		1 st year				2 nd year				3 rd year				Planned Budget (USD)
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Activity 1: <i>Diagnostic Analysis of Current Research Facilities and Demand Survey on Renewable Energy Technologies in Zambia</i>	1.1 Assessment of Technology Advancements		X	X										\$ 40,000
	1.2 Review of Existing Facilities		X											\$ 20,000
	1.3 Demand Survey				X									\$ 20,000
Activity 2: <i>Design and Implementation of a New Research Laboratory at NISIR</i>	2.1 Identification of the Priority Research Field and Laboratory Design					X	X							\$ 20,000
	2.2: Procurement and Installation							X	X	X				\$ 650,000
	2.3 Testing and Guidelines									X	X			\$ 30,000
Activity 3: <i>Capacity Building Programs and Dissemination and advocacy Workshop</i>	3.1 Capacity Building Programs			X			X				X			\$ 150,000
	3.2 Dissemination and Advocacy Workshop				X				X			X		\$ 90,000
Planned Budget (USD)		\$ 160,000				\$ 620,000				\$ 240,000				\$1,020,000

4-4. Management and Utilization Plan

The project will be managed by NISIR, under the supervision of the Ministry of Technology and Science, in partnership with ZESCO and the Ministry of Energy. The newly established research laboratory at NISIR will continue to make efforts to develop solar PV-related research projects and provide technical services to support local solar PV companies. These efforts will help ensure the financial viability and scalability of the new laboratory at NISIR.

In addition, the project will adopt measures of monitoring and evaluation and impact assessment as follows:

Monitoring and Evaluation:

Performance Monitoring: Establish Key Performance Indicators (KPIs) to monitor the performance of the research laboratory and ensure alignment with project goals.

Regular Reviews: Conduct regular performance reviews and audits to assess progress and identify areas for improvement.

Key Performance Indicators (KPIs) can include the number of equipment and researchers for the research laboratory, the amount of additional funding secured for the research laboratory and training programmes, the number of participants in capacity building and training programmes for local technicians and engineers, the number of partnerships established with local and international organisations.

Impact Assessment:

Outcomes Evaluation: Evaluate the impact of research projects and technical services on the local renewable energy sector.

Feedback Mechanisms: Implement feedback mechanisms to gather input from stakeholders and make necessary adjustments to improve services.

If the laboratory becomes successful, we can assess indirect outcomes such as the increase in the number of solar PV installations in the country, the amount of energy produced from solar PV installations in the country, the reduction in carbon emissions due to the increased use of solar PV technology, etc.

4-5. Exit strategy and plan

This exit strategy aims to ensure the financial viability, operational efficiency, and human resource sustainability of the project. To ensure the sustainability of the project after its conclusion, the following exit strategy addresses key areas such as finance, operations, and human resources.

Finance:

Government Support: Ensure ongoing financial support from the Zambian government through budget allocations for the research laboratory.

Overseas Grants: Apply for grants from international organizations and development partners to support research and operational costs.

Revenue Generation: Implement a fee-based model for technical services such as testing, inspection, and certification provided to local solar PV companies and other stakeholders.

Operations:

Standard Operating Procedures (SOPs): Develop and implement SOPs for laboratory operations to ensure consistency and efficiency to maintain high standards in research and technical services.

Collaboration and Partnerships: Foster ongoing collaborations with local and international research institutions, universities, and industries to enhance research capabilities and share resources and participate in conferences, workshops, and seminars to stay updated on the latest advancements in the field.

Human Resources:

Capacity Building Training: Provide ongoing training and professional development opportunities for researchers, engineers, and technicians to keep their skills updated.

Career Development: Create clear career development paths and opportunities for advancement to motivate and retain employees.

4-6. Risk management plan

This project entails several potential risks that could impact its successful execution of the project objectives. These issues range from technological challenges to funding sustainability. In order to ensure the project's successful implementation and long-term success, key measures to mitigate and manage risks are outlined as follows:

Risk Category	Risk Description	Mitigation Action	Responsible Entity
Organizational	Limited technical and organizational absorptive capacity	Adjusting capacity building programs in order to grow local absorptive capacity	Development Partners and NISIR
Operational	Policy shift in electricity sources may occur during the project implementation	Including and keeping communication with key government stakeholders in the project from the beginning	Development Partners, Ministry of Energy, ZESCO and NISIR
Operational	Limited participation by private sector	Holding workshops inviting private sector stakeholders and advocating the activities of the project	All
Financial	Insufficient long-term funding plan could limit sustainability	Obtaining additional grants in partnership with international organizations, and securing budget from technical services to ensure financial sustainability.	Development Partners, MOTS NISIR