Sub-theme 3.3. Energy Resources Development and Utilisation

Rationale

Globally, humanity faces profound challenges in meeting the increasing energy demands in the face of climate change and the skyrocketing oil prices. In particular, lack of alternative energy sources has led to deforestation, land degradation, food insecurity, and desertification in Ethiopia. The development and application of small-scale technologies for energy conversion and efficiency is an essential component amongst the collection of strategies for confronting these challenges. Technological progress in this field is swift with new development promising leaps in cost reduction, efficiency, and flexibility of applications. However, regardless of technical efficiency, new technologies will only make a difference as long as they are successfully integrated into people's living environments.

Ethiopia, in this regard, is bestowed with huge potential of energy sources which must be harnessed and developed. Being one of the countries that developed a policy of zero carbon emission economy by the year 2025, the nation needs to invest in research and development that guarantees a green economy. Besides, the government is striving to realise rural electrification and has also designated an ambitious plan to be the powerhouse of Africa.

The challenge in the future will be the issue of balancing energy production and supply with the ever increasing demands. We also need to deal with energy accessibility to the rural community living in a sparse environmental setting vis-à-vis exporting power to neighbouring nations with the aim of generating foreign currency.

The solution will, therefore, be research and development that may reduce the cost of energy development i.e., its production, transmission, and storage efficiency. Research will be focused on a number of areas critical to the future of energy in Ethiopia. Focus will be particularly given to policy collaborations on energy that address energy security issues, specially focusing on millions of rural Ethiopians who lack access to clean energy and are unable to climb the

energy ladder. In this endeavour, a multitude of complex issues in a cross-disciplinary approach spanning science, technology, social science, and policy interventions will be researched.

Aim

The aim of this sub-theme is to provide accurate and quantitative information on energy feasibility, potential, efficiency, and synthesis of various energy sources, and characterisation and design of cost-effective photovoltaic cells that are scalable for commercial purposes.

Description

The sub-theme focuses on research to deliver a robust estimate of the temporal and spatial distribution of unutilised potential of renewable energy sources and investigates the impact of energy exploration on the environment. It investigates the physics of photovoltaic cell focusing on efficiency and low cost method of scalability. At lower levels, it also aims at investigating and developing wind turbines that could be used at household levels. The sub-theme further explores the possibility of designing energy-efficient inexpensive stoves with locally available raw materials.

Potential Collaborators

International and national institutes, organisations, universities/colleges working on energy and power

Expected Output

- Generated quantitative data on the potential of renewable energy sources in sparsely populated areas
- Generated information on efficiency and performances of wind farms, solar, geothermal, and hydropower in the country
- Designed and developed wind turbines for use at household level; and

- Synthesised, characterised and developed photovoltaic cell and modules.

Research Areas

3.3.1. Wind energy

This research area focuses on potential, feasibility, and efficiency of wind farms and developing wind turbines.

3.3.2. Solar energy

This research area focuses on accelerating the development and implementation of cost-effective solar-based technologies. The research and development activities in this area will target the development of solar photovoltaic-based devices and developing electrical energy storage in battery systems. It also focuses on photovoltaic cells synthesis, characterisation, development and construction of photovoltaic modules.

3.3.3. Hydropower energy

Hydropower research includes mechanical, civil, and electrical engineering focusing on turbine and generator development, transformer and power electronics, fluid dynamics, construction as well as environmental and economic aspects. The research area focuses on analysis of the environmental implications of hydropower schemes bringing environmental and sustainable engineering into a range of disciplinary inputs.

3.3.4. Geothermal energy

This research area focuses on innovative tools and techniques for resource exploration and development; improved investigative methods and models for more sophisticated and detailed reservoir management; advanced techniques for remote sensing and detecting potential geothermal resources; improved techniques and materials for well construction and restoration; and technologies and techniques to improve energy extraction at existing production areas.

3.3.5. Fossil fuel energy

The research focuses on research related to the exploration, feasibility study, extraction and technological innovations for improved fossil fuel development and utilisation. It also addresses problems related with research in technological innovations for fossil fuel systems, with the primary emphasis on carbon dioxide emission mitigation, and control of fine particle and other pollutant emissions.

3.3.6. Bio-energy

This research area aimed at developing bio-energy from different plant-based and other biological resources, its adaptation, and implementation.

3.3.7. Nuclear energy

This research area focuses on research related to harnessing nuclear energy as an alternative source of power. It also deals with research on the enhancement of knowledge, human power and technical capacity development for nuclear sciences. The research area also includes topics related to the application of nuclear-based technologies in health and medicine, research laboratories, etc.

Beneficiary

Scientific communities, industries, policy makers, and the wider community