**South Asia Group for Energy–Bhutan**

Bhutan’s energy system is already low carbon, using predominately hydropower, yet hydroelectric resources are reduced during the dry winter months. Beyond seasonal variations, climate change and other extreme weather events that result in variable and inconsistent water resources also threaten the reliability of hydropower power plants.

To mitigate these risks, Bhutan is working to enhance its energy system’s overall resilience by better understanding the impacts of climate change on its hydropower resources.

National Center for Hydrology and Metrology, the Department of Energy, the Royal University of Bhutan and others are partnering with the U.S. National Labs under USAID’s South Asia Group for Energy (SAGE) program to develop their solar capabilities, integrate solar energy into the grid, strengthen Bhutan’s energy infrastructure and efficiency and understand climate change impacts on hydropower.

**Project Activities**

**Resilience Planning**

1. **Hydrology Modeling and Data Development**

Under the SAGE program, Pacific Northwest National Lab (PNNL) is working with collaborators in Bhutan to develop hydrology and meteorology data sets and hydrology model workflow to evaluate the effects of climate change on water availability and hydro power. Using the Spatial Processes in Hydrology (SPHY) model, and the Distributed Hydrology Soil Vegetation Model (DHSVM), PNNL will explore how climate impacts, including glacial melt, will affect water availability and river management.

Stakeholders in Bhutan are particularly interested in managing extreme events from climate change, such as floods, and PNNL in collaboration with Bhutanese modelers will explore how these events will be impacted by climate change.

The hydrology modeling and hydropower modeling toolchain will be used to explore the characterization of extreme events and impacts including extreme precipitation and associated river flows. An exploration of how these events will be impacted by climate change will be conducted.

Collaborators in Bhutan include the National Center for Hydrology and Metrology, Druk Green Power Corporation, the Royal University of Bhutan College of Science and Technology.

1. **Multisector Modeling**

As a part of SAGE, PNNL is working with Bhutanese stakeholders to model Bhutan in the Global Change Analysis Model (GCAM). GCAM will be used to evaluate the impacts of climate change on water availability and hydropower and the resulting cascade of impacts throughout the economy in the context of Bhutan’s climate goals and energy policies. PNNL will facilitate stakeholder understanding of the multisector modeling so results may be incorporated into planning and decision making.

1. **Strengthening Capacity and Implementation**

SAGE will ensure partners in Bhutan are equipped to interpret the hydrology and multisector modeling results. PNNL will facilitate training and education on both hydrology modeling and GCAM to ensure that the models developed can be enduring tools used by local scientists, government, and decision makers. From this assessment, decision makers will gain knowledge on how the timing and magnitude of streamflow will affect hydropower output under varying climate change scenarios and potentially further examine changes in natural hazard risk like flooding from extreme precipitation. This modeling will also shed light on how these changes may affect the energy system and other sectors of the economy, providing valuable information for long term energy planning.

**Knowledge Cohorts on Essential Topics**

SAGE will facilitate knowledge-sharing sessions between Bhutan’s stakeholders. These sessions will cover critical topics such as building codes and retrofits, energy efficiency, and grid seasonal storage, and power system planning tools to accelerate Bhutan’s clean energy progress.

**About SAGE**

The South Asia Group for Energy (SAGE) is a consortium consisting of the U.S. Agency for International Development (USAID) and three U.S. Department of Energy national laboratories: Pacific Northwest National Laboratory (PNNNL), National Renewable Energy Laboratory (NREL), and Lawrence Berkeley National Laboratory (LBNL).

Through SAGE, governments, public institutions, and private sector partners in South Asia can access best-in-class energy expertise from U.S. national labs to support long-term planning and strategic development and receive consultation on complex energy challenges.

SAGE is committed to supporting Bhutan’s journey toward sustainable and efficient energy systems. Through these collaborative efforts, Bhutan is poised to develop the expertise needed to harness the potential of solar energy and advance its clean energy goals. Learn more and explore SAGE resources by visiting [www.sarepenergy.net/sage](http://www.sarepenergy.net/sage).