



In partial fulfillment of the requirements for the degree of

Doctor of Philosophy
Saurabh Biswas

will defend his dissertation

**Creating Social Value of Energy at the Grassroots:
Investigating the *Energy – Poverty Nexus* and Co-producing
Solutions for Energy Thriving**

Thursday, May 28, 2020
4:00 PM

[Zoom Meeting ID: 940 440 2757](#)

Faculty, students, and the public are invited.

Supervisory Committee:

Dr. Clark A. Miller, chair
Dr. Arnim Wiek, member
Dr. Marcus Janssen, member

Abstract

Energy systems provide critical services interlinked with human well-being, particularly eradication of poverty in its diverse forms. Recent research on the United Nations Sustainable Development Goals (SDGs) underscores the complexity of such interlinkages. Simplifying energy systems to passive technological infrastructures with objective characteristics is detrimental to an equitable, fair and sustainable energy transition, especially in marginalized communities. Energy systems are socio-technical constructs with non-dual characteristics; at times, being the 'means' and at others an 'end' unto themselves. Understanding the anatomy

and metabolism of these constructs, is crucial to the determination if it will be a source for generating or extracting well-being in human societies. Based on results from the investigations of the energy-poverty nexus and intervention strategies to reverse the energy-poverty nexus, this research proposes a paradigm shift in energy transitions from simplified targets of universal access or decarbonized energy systems, to Energy Thriving. Energy Thriving proposes that the rationale for creating access to clean and affordable energy should be to generate social value through energy systems that are deliberately co-produced to be sustainable, and not only remedy human well-being deficits, but create conditions for progressively discovering higher forms of well-being.

This research begins with a systematic meta-analysis of the literature on the interdependencies of the human condition and energy systems, leading to the identification of the Energy-Poverty nexus dimensions. It is found that the commonly used indirect and access-based measures of energy are insufficient to capture the dynamics of the nexus and the translation pathways of energy services to well-being outcomes. To capture the co-evolving and contextual metabolism of energy in generating or extracting well-being among individuals and communities, the concept of Social Value of Energy is expanded to develop a methodology for systemic mapping of the benefits, burdens and externalities and its cross-impact analysis in correlation to the energy system. A variety of energy-poverty phenomena is investigated in communities in Nepal, India, Brazil and Philippines, using a mix of retrospective study and prospective experiments. Social value of energy maps identifies functional and economic capabilities in users, and the stressors and trajectory thresholds in the energy-poverty relationship- which are critical design parameters for interventions aimed at disrupting the energy-poverty nexus, and monitoring the translation of energy services to socio-economic wellbeing.

To test design strategies and develop a primer for grassroots actors to effectively participate in sustainable solutions, a test bed for community sustainability interventions was created in the village of Rio Claro in Brazil. Following transformational sustainability solutions methodologies, the Sustainable Rio Claro 2020 initiative served as a longitudinal experiment in participatory collective action for sustainable futures. It produced important insights in problem identification and reframing, pilots-based intervention testing and anticipatory design of projects within the resource and information constraints.

Finally, to validate the hypotheses on energy-poverty nexus, social value of energy and applicability of multi-criteria interventions design toolkits, a collaborative project with grassroots entities in Uganda, Bolivia, Nepal and Philippines was undertaken. The Ecosystems Approach to project design converged insights in earlier stages and created practitioner toolkits to analyze past successes and failures, integrate insights to operations and design new projects.