Evening the Score: Integrated Long-term Energy Planning for Rapidly Developing Economies (A Case Study of Megaproject plans in Malaysian Borneo)

Rebekah Shirley[1], Daniel Kammen[1,2]*

[1]Energy and Resources Group, University of California, Berkeley, California, USA
[2]Goldman School of Public Policy, University of California, Berkeley, California, USA
* Corresponding Author: rebekah.shirley@berkeley.edu
310 Barrows Hall, Mail Code: #3050, University of California, Berkeley, CA 94720-3050
Phone: (510) 642 - 1640/ Fax: (510) 642 - 1085

Abstract

Malaysian Borneo is the currently the subject of contentious state-led development plans that involve a series of mega-dams to stimulate industrial demand. There is little quantitative analysis energy options or cost and benefit trade-offs in the literature or the public discussion. In this study we compare the generation and environmental costs of different energy technologies through modeling the capacity expansion necessary to meet Sarawak's demand in 2030 under four different energy demand growth assumptions. We use the commercial energy market software PLEXOS to prepare a load following dispatch and capacity expansion model for the state of Sarawak including existing generation, resource constraints and operability constraints. We also incorporate emissions and direct forest loss costs. We devise and model different scenarios to observe technically feasible options for electricity supply that satisfies future demand under high growth assumptions and to observe economic and environmental trade-offs. We find local resources including solar and biomass waste technologies can contribute to the generation mix at lower cost and environmental impact than additional dam construction. Our case study of Borneo represents many energy related megaprojects being developed in emerging economies and our proposed method of assessment can support the current conversations on exploitation of natural resources and potential sustainable solutions.

Keywords: Renewable Energy, Economic Development, Development Tradeoffs, Borneo

Kampung Capacity: Analyzing Local Energy Solutions in the Baram River Basin, East Malaysia

Rebekah Shirley[1], Daniel Kammen[1,2,] and Gabriel Wynn[3]*
[1]Energy and Resources Group, University of California, Berkeley, California, USA
[2]Goldman School of Public Policy, University of California, Berkeley, California, USA
[3]Green Empowerment, Portland, Oregon, USA

* Corresponding Author: kammen@berkeley.edu
310 Barrows Hall, Mail Code: #3050, University of California, Berkeley, CA 94720-3050
Phone: (510) 642 - 1640/ Fax: (510) 642 – 1085

Abstract
Most rural villages in East Malaysia are not grid connected, and rely heavily on high-cost diesel fuel for electricity and transportation. Improved rural energy access has been a key component of sustainability advocates, however little quantitative data on demand and potential is often available. Sarawak state-led plans to construct a series of mega-dams in order to stimulate industrial demand have dramatically raised the profile of these rural communities and the stakes in local energy services versus a larger development agenda. We conduct a case study in the Baram Basin – the next basin to be flooded for a hydroelectric dam reservoir in the state - which explores the potential of renewable energy as a bottom-up solution to satisfy the energy needs of these impacted communities. Through interviews and site visits we estimate current energy demand and supply in these communities. We then use HOMER, a hybrid optimization model, to determine least cost energy system options for various villages. We find least cost options for energy services can come from a mixture of locally managed small-scale hydroelectricity, biogas generators and accompanying batteries and the net present value of such systems can be 20% less expensive than the current diesel scenario. Our study highlights the potential of villages in rural Sarawak to satisfy their own energy access needs with local and sustainable resources and suggest a need for exploring a radically different strategy for expanding rural energy access.

Key Words: Rural Energy; Microgrids; East Malaysia

Estimating biodiversity impacts without field surveys: A case study in Northern Borneo

Justin Kitzes[1], Rebekah Shirley[1]
[1]Energy and Resources Group, University of California, Berkeley, California, USA

310 Barrows Hall, Mail Code: #3050, University of California, Berkeley, CA 94720-3050
Phone: (510) 642 - 1640/ Fax: (510) 642 – 1085

Abstract
The rapid economic growth sustained in Southeast Asia throughout the new millennium has led to a surge in large-scale infrastructure projects to facilitate industrial productivity and consumption. Here, as in many regions of the world, there is often little quantitative information available for discussion on the impact of major land use changes that can accompany these developments, such as palm oil expansion, or hydroelectric dam inundation. Direct biodiversity impact assessments based on field surveys are often unavailable or incomplete due to time and funding limitations. Indirect methods for estimating impact based on non-local data sources and ecological theory are useful complementary solutions. In this study we take the new slate of hydroelectric dams being built in Sarawak, Borneo as a case study and use global species range data, GIS tools and revised species/endemics area scaling relationships to predict three distinct measures of biodiversity impact for four major taxonomic groups (mammals, birds, plants and arthropods): the total number of species with ranges affected by the dams, the number of individuals affected and the number of potential species extinctions that could result. We find that at least 331 bird species and 164 mammal species will be affected by the dams. This represents 57% and 69% of Bornean bird and mammal species. Given Borneo's high rate of endemism, these are significant species impacts. Our assessment methods are applicable to any data-limited system undergoing land use change, and we provide instructions, equations, and computer code to assist researchers in applying these methods to other systems.

Key Words: impact assessment, extinction, GIS, biodiversity, hydroelectric dams