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# The geography of energy and education: Leaders, laggards, and lessons for achieving primary and secondary school electrification

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## ARTICLE INFO

## Article history:

Received 11 December 2014

Received in revised form

18 September 2015

Accepted 21 December 2015

## Keywords:

Rural electrification of schools

Children and energy poverty

Rural isolated communities

Electricity access

Electricity and education

## ABSTRACT

Even though large-scale electricity networks have existed for more than a century, thousands of primary and secondary schools have no electricity. More than 80 percent of children in Sub-Saharan Africa attend primary schools that lack electricity, more than a quarter of village schools in India lack electricity access, and fewer than half of Peruvian schools are electrified. Collectively, nearly 200 million children attend schools not connected to any type of electricity supply—a number greater than the populations of Nigeria, Bangladesh, Russia or Japan. Throughout the globe, certain countries and regions lead the way in school electrification while others lag behind. Through the lens of energy and education geography, this Article identifies a series of interconnected challenges to electrifying schools. Obstacles span financing and technical reliability to bias in educational and energy funding to inability of electrification to yield net positive learning outcomes. Despite these challenges, solutions do exist, as the activities of emerging energy leaders demonstrate. High upfront costs can be mitigated by tapping into diverse financing streams and distributing risk through public private partnerships. Technical problems can be countered by stable policy frameworks with strong technical standards and certification schemes. Electrification efforts can be coupled with household and cooking programs that build community. This Article shows that schools can provide students with the light, heat, and modern tools of teaching they deserve if planners, investors, and policymakers make determined, coordinated efforts at providing energy for education.

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## 1. Introduction

Visitors arriving at the international airport at Conakry, the capital city of Guinea, witness an unexpected sight: hundreds of children studying under the parking lot streetlights. Amidst the din of jet engine exhausts, honking taxis, and rumbling buses, they write in notebooks and read textbooks [1]. These children gather in the publicly-lit areas to study and complete their homework because they lack electricity at home and at school.

The scene at Conakry is repeated across thousands of parking lots in the developing world. As one education expert laments, “we focus largely on pedagogy and little on access to energy” [2]. Such an absence of focus is detrimental because, as another study put it, “education is also widely recognized as one of the most essential components for poverty reduction” [3]. Lack of electricity at primary and secondary schools therefore creates considerable obstacles towards escaping poverty, and it correlates with many factors that contribute directly towards it.

Utilizing a cross-national geographic framework, this review illuminates leaders, laggards, and lessons in achieving greater school electrification. This review complicates existing literature on the global state of school electrification by highlighting nations and regions that have achieved great successes and comparing them to localities achieving the least in their respective regions and continents. For instance, numerous studies and recent data demonstrate that roughly four out of every five primary and secondary schools in African countries lack access to electricity [4], along with almost three-quarters of village schools in India. But the latest data gathered by United Nations Educational, Scientific and Cultural Organization (UNESCO) illustrates notable gains by the small island nation of Cape Verde, great variance among West African states, and unsurprisingly high electrification rates in some of the wealthiest nations on the continent, including Tunisia and South Africa. Such findings suggest research and policy-export opportunities among the highest achieving nations, as well as opportunities for regional bodies such as the Economic Community of West African States (ECOWAS) to both aid in the neighborly diffusion of technical and political solutions and advance collective electrification initiatives through infrastructure cost-sharing, aid-seeking, and the like. This sort of regional cooperation for electrification is an emerging theme within energy policy studies [5–10], but one that still needs development.

Accordingly, this review mines academic and policy literature published during the past 10 years concerning electricity and education and the rural electrification of schools. Scholarly findings are supplemented by information drawn from more than a dozen datasets used by nation states, regional actors, and the international community in shaping aid flows, loan packages, and policymaking. This review also analyzes geographic variances in electrification in the context of the educational benefits of electrification of primary and secondary schools, including lighting and access to information and communications technologies (ICTs)

and improvements in staff retention, student completion, and graduation rates.

This article’s geographic orientation foregrounds the distinct impacts that innovations in energy access can occasion in various locations. For instance, one could argue that electrification investment in Ghana might benefit students less than in Guinea or Togo, because Ghanaian students have a lower student–teacher ratio and perhaps a lower need for extended instruction time of self-study. Or, one might note that the three nations have relatively typical student–teacher rates in their region, even given interstate variances, and determine that the next big push for the region should be in school infrastructure, followed by teacher training in information and communication technologies (ICTs), which many teachers will employ for the first time post-electrification. The point of this geographical analysis is that a cross-indicator, cross-national review of existing data and scholarly literature complements existing conceptions of leaders, laggards, and lessons for the future. We need such insights, because the way forward will be difficult for many un-electrified schools and communities.

The final two parts of this review, drawn from energy policy, development studies, and recent advances in finance and public–private partnership literatures, discuss the challenges facing school electrification, such as lack of financing and technical problems with equipment, along with solutions such as innovative financing schemes (e.g., public–private partnerships) and coupling school electrification with household energy access programs. Such solutions often cut across traditional disciplinary and geographic boundaries.

## 2. Research methods

Two systematic information gathering techniques were employed in this research. First, an inter-disciplinary literature review was conducted across more than a dozen fields, including: educational evaluation and policy, energy policy, forestry, geography, health policy, information science, international economic development, public administration, political economy, and sustainable development. In selecting articles to feature in this review, we considered currency, impact, and topical relevance. Topical relevance was the most important criterion because the intersecting fields of education and electrification are quite broad, the issues involved in electrification of primary and secondary schools are unique, and solutions are not always transferable from other contexts (e.g., electrification of road lighting). When reviewing the literature, we focused on five questions:

1. What are the major cross-study and cross-disciplinary findings?
2. Is there a consensus on certain sub-issues, such as how lack of electricity affects achievement?

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