The Social Value of Mid-Scale Energy in Africa: Redefining Value and Redesigning
Energy to Reduce Poverty

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Abstract

This short communication suggests the need to attend carefully to the social value of energy in designing projects to reduce energy poverty. We define the social value of energy in terms of the total value derived by an individual or community from the use of energy, including economic and other forms of value, less any risks or burdens that accompany energy production, transmission, and consumption. This simple definition enables two significant assessments. First, the social value of energy projects can be compared to their costs, to evaluate whether projects are worth investing in, even if they may appear uneconomic in narrower terms. This is especially significant in contexts such as off-grid or renewable energy projects that may have higher energy costs. Second, the socio-technical design of energy projects can be evaluated to determine whether the project will deliver the kinds of energy services, via appropriate strategies, that enhance social value.

Keywords

Social value, energy poverty, energy services, design, renewable energy, Africa

Short Communication

Reducing energy poverty is a key global objective for the 1.3 billion people who do not currently have access to electricity (Shyu 2014). This challenge tends to be formulated in terms of access to minimum levels of energy supply (International Energy Agency 2014; International Resources Group 2003; World Bank 1992). This approach has been criticized, however, for failing to ensure adequate provision of energy services that transform energy supply into value for the user and thus are critical to the ability of energy projects to help communities alleviate poverty (Pachauri 2011; Emordi 2015).

In this short communication, we suggest the need to go further to examine how much social value is obtained from energy services and to develop strategies for enhancing the social value of energy projects. This involves three steps: (1) defining the social value of energy; (2) understanding how energy projects deliver social value via discrete energy services; and (3) designing the socio-technical arrangements of energy systems such that they deliver enhanced social value.

We define social value as the total value derived by an individual or community from energy services, including economic and non-economic value and accounting for risks, burdens, and other negative externalities. Defined this way, increasing the social value of energy is critical for reducing energy poverty. In poor communities, available energy and financial resources are few, and new electrification projects are often relatively more expensive (Tenenbaum et al. 2014). The latter is especially true in the push to meet global sustainability goals with renewable energy projects (Caine et al. 2014), the focus of this Special Issue (Hancock 2015). Thus, new energy projects must not simply provide energy services but also, in so doing, create sufficiently high social

value for communities, companies, and governments to justify increased energy investments (PPEO 2014).

At the national scale, the concept of social value of energy can be observed in the variability of measurements of the human development index (HDI) as a function of per capita energy consumption (Steinberger and Roberts 2010; Shyu 2014). These studies show that some countries achieve much higher levels of human wellbeing than others at similar levels of energy consumption (or similar levels of wellbeing at far lower levels of energy consumption). This implies that some countries are deriving greater social value from their energy systems. As Table 1 suggests, cross-national variations can be stark.

Table 1. Selected measures of the human development index and the ratio of the two (HDI/kWh, normalized to India)

Country	Human Development Index (HDI)	Per Capita Electricity Consumption (kilowatt hours)	Relative Social Value of Energy (HDI/per capita consumption)
India	0.58	700	1
Denmark	0.90	6100	0.17
Canada	0.90	16500	0.06
China	0.71	3300	0.25
Costa Rica	0.76	1800	0.48

Sources: World Bank, 2011 (electricity); United Nations (HDI), 2011

Denmark, for instance, achieves comparable levels of human wellbeing to Canada at less than half the per capita electricity consumption. The same holds for Costa Rica and China. To ratio of HDI to electricity consumption measures the relative ability of a country to derive wellbeing from energy consumption. One might term this a relative social value of energy index. On this measure, India, one of the largest and most populous countries in the world, derives the greatest overall wellbeing from its modest consumption of electricity.

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4 To achieve significant increases in the value societies are able to derive from
5 energy will require moving beyond national-scale discussions towards conceptualizing
6 and operationalizing the social value of energy at the level of individual energy projects
7 and systems. The 2014 *Poor People's Energy Outlook* offers a potentially powerful set of
8 tools and frameworks for doing that, built around decentralized and off-grid energy
9 services that can help lift individuals and communities out of poverty (PPEO 2014). The
10 strengths of the PPEO's "ecosystem approach," which encompasses the Sustainable
11 Energy for All's Global Tracking Framework, is that it:
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- 20 (1) Identifies specific energy services necessary for supporting the activity and
21 growth of micro- and small-scale enterprises as well as the provision of
22 diverse community and social services;
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- 25 (2) Highlights the significance of all sources / technologies of energy;
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- 28 (3) Recognizes that not all uses of energy are socially or economically valuable
29 and that the externalities of energy use (e.g., health effects) can be
30 significantly detrimental; and
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- 33 (4) Emphasizes that developing appropriate social capacity, policy, and financing
34 will be critical to creating energy systems for communities that do not
35 currently have access to energy (PPEO 2014).
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41 To put the PPEO approach to work, the final step is to recognize that—at the level
42 of individual energy systems and projects—the ability to deliver the energy services
43 described by PPEO is a socio-technical problem (for an example of socio-technical
44 design of energy systems, see Ulsrud et al. 2015, in this Special Issue). Too often, the
45 issues of technology design and social design are viewed as independent from one
46 another, but this is not the case (Miller et al. 2015, 2013). Rather, the design of energy
47 technologies capable of reliably delivering socially valuable energy services must go
48 hand-in-hand with the design of capacity-building programs to support the knowledge
49 and skills necessary to build, maintain, and operate those energy systems; the design of
50 socio-economic arrangements that enable the financing of system construction, operation,
51 and maintenance; and the design of supportive regulatory and policy frameworks.
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At the level of individual energy devices, such as lanterns, stoves, and battery packs, the links between socio-technical design, energy service provision, and improvements in human wellbeing are relatively easy to identify. In work concerning cook stove adoption and use in a rural Western African village, for example, we found that improved stove technologies were rarely being used and had little impact on reducing fuelwood use or indoor air pollution or otherwise enhancing social value (Johnson and Bryden 2012). Table 2 illustrates data gathered from a group of women who owned three types of cookstoves, an example of what is commonly referred to as “stacking” in which a family owns and uses multiple stoves, each suited for specific energy services (e.g., cooking meals, heating water for bathing). The low rates of use of the improved cookstove was attributed to a few key design limitations: small size, not adaptable to pot sizes, low durability to large weighted meals or heated bathing water, slow to heat, and limited combustion area to stoke the fire and reduce time needed to tend the fire.

Table 2. Example dataset on cook stove usage

Meal	Percentage of meals prepared on cookstove (%)		
	Traditional stove A	Traditional stove B	Improved stove
Breakfast porridge (thin)	7.78	92.22	0.00
Breakfast porridge (thick)	8.97	91.03	0.00
Lunch or dinner porridge (thin) with sauce	7.34	92.66	0.00
Lunch or dinner porridge (thick) with sauce	9.04	90.96	0.00
Rice	50.00	50.00	0.00
Couscous	0.00	100.00	0.00
Porridge (prepared with sauce on two stoves)	0.00	100.00	0.00

Sauce (prepared with porridge on two stoves)	0.00	0.00	100.00
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Source: (Johnson and Bryden 2012)

The problem is more complex at larger scales, as systems move up from devices and individual households to mid-scale projects that deliver energy to communities or regions. The tendency in mid-scale projects is to focus almost exclusively on energy supply, leaving aside questions about the design of socio-technical arrangements that transform energy supplies into energy services that deliver social value. Yet, it is precisely in mid-scale projects that the success or failure to deliver high value determines whether community energy systems create positive feedbacks that enable them to grow over time, delivering even greater value, or ultimately fall into disrepair and disuse, as the community remains in poverty.

Therefore, to ensure mid-scale energy systems meet their objectives, a new emphasis is needed on several key innovations in energy systems design, including strategies for: evaluating the social value of energy services; successful community engagement in the prioritization of social value provision; and user-centered design of high-value energy service delivery that achieve effective integration of social and technical elements. We are currently working on projects relating to these areas and will relate the results in future articles.

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