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LED advances accelerate universal access to electric lighting

Les avancées dans le domaine des LED accélèrent l'accès universel à l'éclairage électrique

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ABSTRACT

A rapid increase in the performance and quality of white LED light sources has changed the dynamics of electricity access in the last 10 years, reaching tens of millions of people with electric light who previously had no viable alternatives to fuel-based lighting, which is dangerous and expensive. Eliminating fuel-based lighting is a key public health, safety, social equality, and environmental opportunity that is now achievable. Technology advances in LEDs, other super-efficient appliances, solar photovoltaic generation, advanced batteries, and coordinating information technology systems have combined to significantly expand the reach of off-grid energy systems. With support and effort, it is plausible that small "pico-solar" and "solar home" systems could serve over a billion people within a generation, providing basic but highly valued services. Continued progress can be achieved with attention to continued improvements in technology, supporting a growing range of new businesses and enterprises in energy access markets, and synergy with broader human development effort around access to clean water, financial inclusion, and fair access to resources.

RÉSUMÉ

L'accroissement rapide des performances et de la qualité des sources LED de lumière blanche a changé la dynamique de l'accès à l'électricité au cours des dix dernières années, permettant à des dizaines de millions de gens qui, auparavant, n'avaient pas d'alternatives viables à l'éclairage au pétrole, qui est dangereux et cher, de bénéficier de l'éclairage électrique. L'élimination de l'éclairage au pétrole est un enjeu clé de santé publique, de sécurité, d'égalité sociale, et une opportunité environnementale qui est à présent à notre portée. Les avancées technologiques dans le domaine des LED ainsi que d'autres appareils domestiques extrêmement efficaces, la génération photovoltaïque solaire, les batteries de nouvelle génération et les systèmes coordonnant l'information se sont associés pour étendre significativement la portée des systèmes électriques hors réseau. Avec soutien et effort, il est plausible que de petits systèmes « pico-solaires » et « maison solaire » puissent alimenter un milliard de personnes en l'espace d'une génération, procurant des services de base, mais de grande utilité. Un progrès continu peut être atteint si l'on porte attention

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à poursuivre les améliorations technologiques, qui soutiendront un nombre croissant de nouvelles activités et entreprises sur les marchés de l'accès à l'énergie, en synergie avec les efforts de développement humain autour de l'accès à l'eau propre, l'accès aux ressources financières et l'accès équitable aux ressources.

1. Introduction

For the 1.2 billion people who live without access to electricity in 2017 [1], and up to a billion more whose connection is unreliable day and night [2], the options for lighting after dark have typically been stark: kerosene lamps, candles, wood, and other fuels have been the conventional approaches for over a century. Fig. 1 shows a range of fuel-based lamp examples.

While nearly as many people live without electricity today as did in the late 1800's, when modern utilities first started business, there are now new options for reaching those who are deprived of access [3]. Based on significant and rapid changes in the capabilities and cost of solar photovoltaics (PV), batteries (often based on lithium chemistry), and efficient appliances like LED lights, a range of decentralized electricity options are now available as alternatives that extend beyond the reach of traditional regional grids. Importantly, these technologies are improving dramatically compared to fuel-based lighting. These newly available *pico-solar lamps* and *solar home systems* (*SHS*) power valuable loads including LED lighting, mobile phone charging, televisions, fans, and other small appliances. Fig. 2 illustrates a selection from among hundreds of varieties of small-scale solar energy systems that are currently available.

1.1. The high and diverse costs of fuel-based lighting

Achieving universal electricity access globally is one of the key human development challenges of this century [4]. Replacing inferior fuel-based lighting with modern lighting is a critical part of this transition and could help improve equality in access to resources, supporting important aspects of family and community life that are enabled or enhanced with adequate lighting: socializing, studying, reading, working, cooking, commerce, nighttime security, and more. In addition to the benefits of improved service, there is also a significant opportunity related to elimination of fuel-based technology systems for lighting, which impose high costs and lead to easily avoidable damages to local and global societies.

Some of the most significant damages from fuel-based lighting are public health and safety risks, resulting in thousands of deaths and hundreds of thousands of significant injuries per year through inhalation of smoke, accidental poisoning from ingestion of fuel, and burns [5–7]. Poor indoor air quality from solid fuel combustion is a significant cause of premature death globally, with a recent analysis of the global burden of disease estimating 2.2–3.6 million deaths annually [8]. While indoor cooking is the main driver for these pollution-related deaths kerosene for lighting is also a factor, albeit with significant uncertainty in the number of additional deaths attributable to lighting since most individuals using fuel-based lighting also cook with solid fuel [6,7]. Poisoning from accidental ingestion of fuel is a particular risk for children who mistake improvised fuel bottles for water, with an average mortality rate of 7% among those who are unfortunately exposed; it is

Fig. 1. Typical fuel-based lighting technology (left to right): 'Hurricane' lamp with glass wick cover, pressurized fuel lantern, and open-wick lamp made from a recycled consumer goods canister. Photos by Peter Alstone.

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