



Universal energy access: can we make it sustainable?

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Energy poverty and the zero poverty, zero net emissions challenge

Humanity faces a historic moment: for the first time, the global eradication of extreme poverty is possible within a few decades. These same few decades are also our last window of opportunity to steer the global economy from climate disaster. Scenarios that give us even a moderate chance of avoiding dangerous climate change by limiting global warming to 2°C necessitate achieving zero net greenhouse gas (GHG) emissions by the end of the century (IPCC, 2014). Unless we stabilize the climate, the impacts of climate change will balloon beyond our ability to adapt, pulling hundreds of millions back into extreme poverty. This fact ties together the two goals of eradicating poverty by 2030 and beyond, and steering economies toward net zero emissions (Granoff, et al., 2015).

Nowhere is this link clearer than in the energy sector. Eradicating extreme poverty will require an increase in energy access and consumption for billions of people. Access to even small amounts of modern energy improves people's

quality of life. Clean and safe methods of cooking from better fuels and stoves reduce indoor air pollution, a leading environmental killer (WHO, 2014). Electricity provides poor people with better light, access to mobile phones and TV, and the refrigeration of food, medicines and vaccines. These turn into measurable impacts, like improved educational and health outcomes and increased productivity of micro- and small-enterprises (World Bank, 2008).

Yet this seems to present a paradox. We must improve the quality and quantity of energy consumed by billions of people without access, while at the same time rapidly decarbonising the world's energy systems, responsible for 72.8% of GHG emissions globally (WRI, 2014). To achieve zero net emissions economy-wide by 2100, the world's electricity supply must be decarbonised by as soon as 2050 (World Bank, 2015). This policy brief resolves this apparent paradox. It shows that universal energy access would largely be a win-win for the climate and poverty.



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The scope of the energy poverty challenge

Energy poverty remains remarkably widespread. Globally, 1.3 billion people lack basic access to electricity, and 2.7 billion lack access to clean and safe energy for household cooking. Most of these people are in sub-Saharan Africa and developing Asia (The numbers in this brief are based on IEA (2014b) data to align with IEA data about on-/off-grid costs. The good news is that SE4All (2015) found that those lacking electricity declined to 1.1 billion). Some have argued that energy poverty

is even greater, because access should be defined more ambitiously (Bazilian & Pielke Jr., 2013). It is important to acknowledge, though, that current policies will leave 1 billion without electricity and 2.5 billion without clean cooking by 2030 at even these basic levels. This brief focuses on what ambition is needed to ensure the most basic levels of universal access (IEA, 2014b).

Lack of clean cooking and basic electricity are often conflated.

In fact, these two distinct types of energy poverty have different solutions: just as different illnesses often require different treatments in the same person, so too do different types of energy poverty in the same household. Therefore, it is useful to count a total of 4 billion incidences of energy poverty globally, with many individuals suffering from the lack of both electricity and modern forms of cooking. This is shown in the outer ring of the pie chart below.

Incidences of energy poverty and the technologies and investment needed to secure universal access

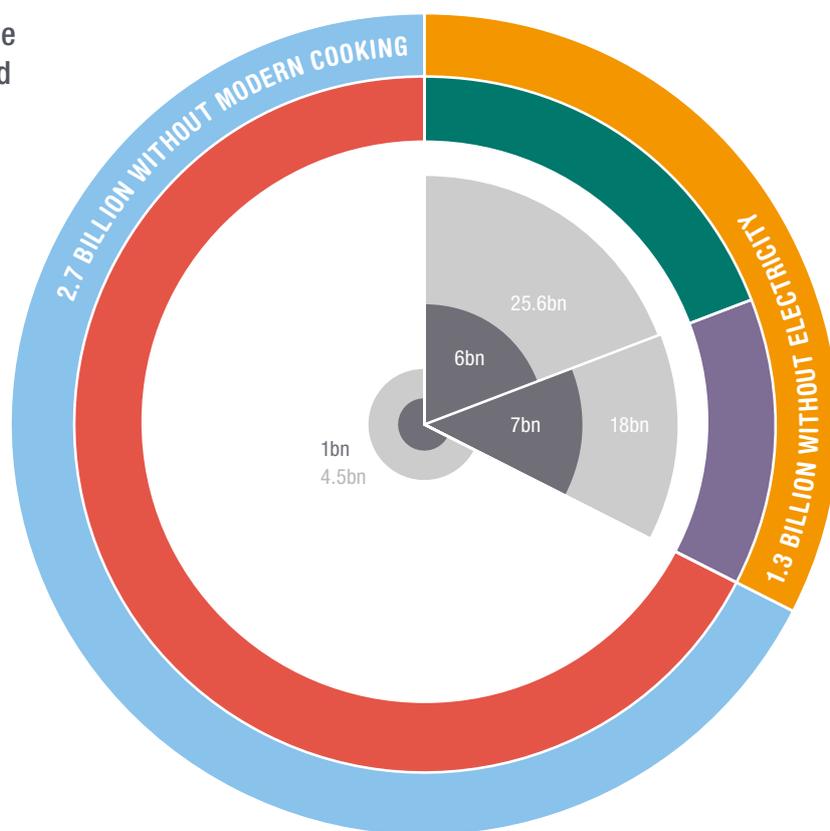
 **Cooking technologies**
67.5%

 **Distributed electricity**
19.25%

 **Grid connections**
13.25%

Spending (US\$):

-  Annual investment for energy access in New Policies Scenario (2010-2030)
-  Annual investment required to achieve universal access



The biggest energy access gap is not electricity

Over two-thirds energy poverty by headcount comes in the form of people who lack access to modern methods of cooking, and cook instead with solid fuels like fuelwood and charcoal (the blue outer ring of the pie chart). Generating and supplying electricity has little to do with improving access to modern cooking services. Even with grid access, electric cooking is energy-intensive and electric stoves are expensive, so new electricity consumers in Africa

and Asia rarely use electricity for cooking (World Bank, 2008). Scenarios that show a future of universal access to improved cooking require aggressively improving energy-poor households' access to cleaner burning gases like liquid petroleum gas and biogas, and the widespread adoption of high-efficiency, low-pollution biomass cookstoves (IEA, 2011). These cooking technologies are represented by the red middle ring in the pie chart.

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Distributed electricity is the cheapest option for most of the electricity poor

The remaining third of energy poverty comes from people lacking access to electricity, the orange ring of the pie chart. Almost 60% of these individuals (shown in the green ring) would be serviced most cost-effectively through off-grid and mini-grid systems powered by mini-hydro, wind, solar PV, or solar-diesel hybrids. These households are located in sparsely populated areas of Asia and Africa where grid-based electricity distribution is expensive, especially relative to the plummeting costs of solar electricity. Grid connections, represented by the purple ring of the pie chart, would be the cheapest option to provide electricity for approximately 41% of those that lack it – a mere 13% of the total incidences of energy poverty.

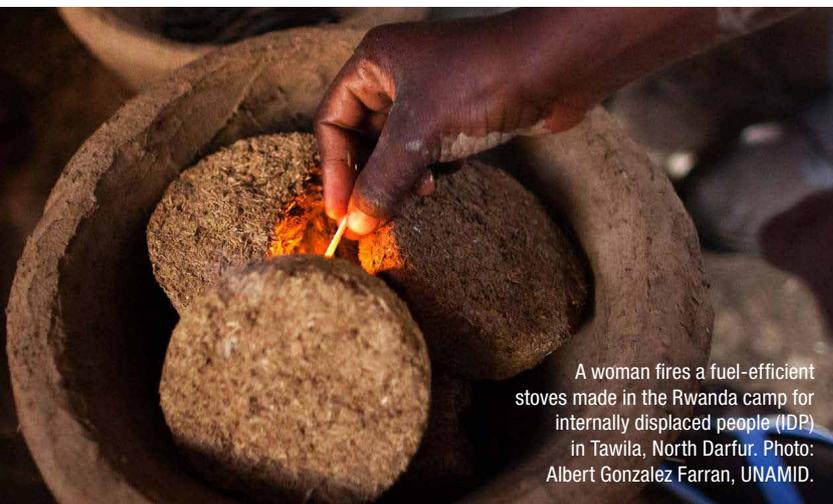
Projected energy investment falls far short of all universal energy access targets

The centre of the pie chart shows the annual capital investment necessary to achieve universal access by 2030, and the combined public and private investment that will occur in the IEA's business-as-usual scenario. The cost of achieving modern cooking technologies is US\$4.5 billion per year. Despite being the cheapest form of energy poverty to tackle, investment in access to modern cooking technologies is forecast to reach only US\$1 billion per year, 75% short of the mark. Distributed electricity faces the biggest financial gap: projected investments in mini-grid and off-grid technologies are estimated at US\$6 billion per year and investment needs are more than four times greater. Public and private investment in grid access will also fall short under business as usual, though to a lesser extent (IEA, 2011).

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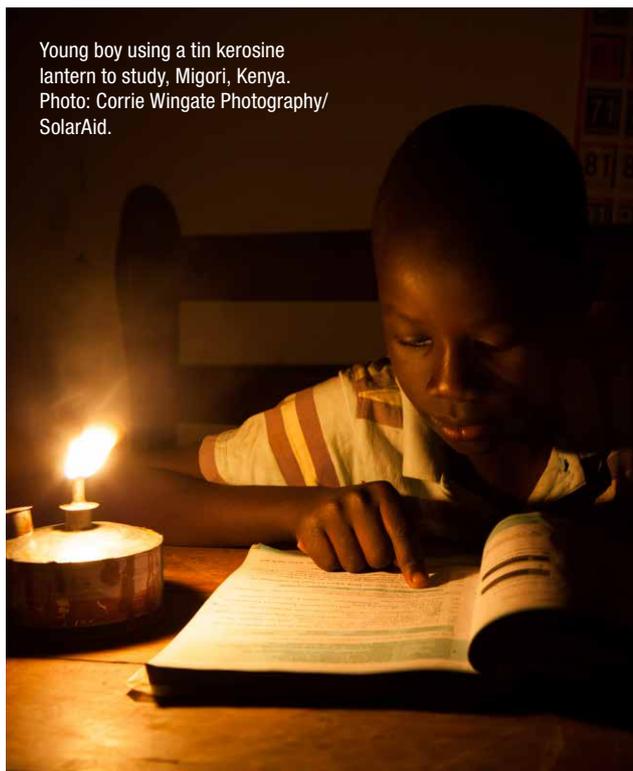
The US\$5 billion needed globally for universal access to modern cooking is a fraction of the global charcoal market, which in 2012 was valued at US\$11 billion in sub-Saharan Africa alone.

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A woman fires a fuel-efficient stoves made in the Rwanda camp for internally displaced people (IDP) in Tawila, North Darfur. Photo: Albert Gonzalez Farran, UNAMID.

Young boy using a tin kerosine lantern to study, Migori, Kenya. Photo: Corrie Wingate Photography/SolarAid.



Energy-poor households already pay a lot for poor energy services

The spending gaps are not for a lack of demand for the services provided by modern energy. The US\$5 billion needed globally for universal access to modern cooking is a fraction of the global charcoal market, which in 2012 was valued at US\$11 billion in sub-Saharan Africa alone (IEA, 2014a). Similarly, the energy poor spend nearly US\$40 billion per year on fuel for lighting, a fifth of global lighting expenditures (Mills & Jacobson, 2011). In other words, the amount the energy poor spend on fuel-based lighting is just about equivalent to the capital costs necessary to secure universal electricity access in both the on- and off-grid categories. Once connected, electric lighting through grids or off-grid/mini-grid systems costs significantly less than lighting through kerosene. As a result, energy-poor households pay more for light than the rich, and more than the cost of clean alternatives. They are trapped into low quality energy from paraffin candles and kerosene lanterns primarily because of their inability to afford the upfront costs of solar panels off-grid, or connection charges where the grid reaches.

The eradication of energy poverty will be driven by the market-based diffusion of consumer goods

In the majority of cases, closing the investment gap for energy access will be achieved by financing the market-based diffusion of distributed technologies, rather than large infrastructure. Given the amount that energy-poor households are already paying for lighting and cooking fuel, there is significant scope for modern energy technologies to be distributed through business models that recoup capital investments. Consumer finance can enable households to purchase solar home systems or clean cooking technologies, or fees can be charged for energy services provided through company-owned technologies. Promoting the market-based diffusion of these

technologies will require an entirely different set of government policies to those geared towards large-scale centralised electricity generation. Financial and technical support will be needed to nurture entrepreneurial manufacturers of clean cookstoves and biogas digesters; mini-hydro and solar technicians; and distributors of solar home systems, modern cooking technologies, and alternative fuels. Governments will need to take steps to bring down the upfront costs of distributed technologies and secure affordable loans for consumers. Finally, public information campaigns will need to increase awareness about the health risks of cooking with traditional methods.



Solar PV system, Rwanda.
Photo: Azuri Technologies.

The false paradox of climate and energy poverty

Modern forms of cooking will allow greater energy consumption per household, but end up reducing GHG emissions by relieving pressure on forests and making cooking far more efficient (Bailis, Ezzati, & Kammen, 2005). An aggressive electricity access strategy will likewise provide climate benefits, as it is best served by much greater investment in the diffusion of flexible, easily distributed, and

predominantly renewable energy technologies (IEA, 2011; Szabó, et al., 2011). Grid access for the remaining electricity-poor will make up a small amount of incremental additional demand by any measure. Expansion of renewable resources can easily match this demand, but the greater challenge will be connecting these households affordably. Priorities for energy access are thus largely a win-win for poverty and climate.

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