Solar Success: The 'ToughStuff' Story

It is estimated that around 1.4 billion people around the world lack access to electricity, with 85 per cent thought to reside in rural areas (IEA 2010). Meeting this demand with fossil-fuel based technology would have a detrimental impact on global efforts to avert climate change. Therefore, there is a pressing need to encourage the deployment of low carbon alternatives which can help meet development objectives whilst simultaneously contributing to climate change mitigation. In some developing countries, there is currently growth in SMEs and social enterprises offering small-scale renewable energy products with a low generating capacity. This case study examines the ways in which ToughStuff International solar PV kits contribute to mitigation, adaptation and poverty reduction objectives.

Scaling up solar home systems needs...

- initiatives that assist those with limited financial assets to obtain access to basic electricity services and reduce living costs; for example, in Kenya, ToughStuff has been piloting a 'rent-to-buy' scheme and a 'layaway' scheme.
- an evidence base of impacts on the ground to validate claims. Independent impact analysis could help validate the developmental and environmental claims made and would gather more support – political and financial – for scaling up.

Learning lessons from ToughStuff in Kenya

1 PV solar kits with a low generating capacity present a viable means of providing basic electrical services to the poor

The key to ToughStuff's commercial success lies in an understanding of the needs of the market it targets. The high cost of previous solar home system (SHS) offers has failed to reach low-income groups in the past. ToughStuff created an affordable and robust solar kit which is able to provide the poor with the basic services they need.

2 Low-cost solar PV kits with multiple functions can improve the wellbeing of the poor in several ways

By replacing a kerosene lamp with a solar powered lighting device, households can avoid exposure to fumes which are damaging to health *and* reduce the risk of fire. The ability to charge a mobile phone is important for communication, improves access to banking services and information central to some livelihood activities (i.e. local and regional market prices) and can provide a means of generating income (by charging others for the service).

3 Although solar PV kits can improve the lives of the poor, their capacity to reduce poverty is limited

The low-cost solar PV kits are likely to reduce the intensity of poverty felt by the poor; this is achieved by providing access to basic electrical services, such as lighting and the capacity to charge phones. However, this is the extent of the impact that such technology can be expected to achieve in relation to poverty reduction. Addressing poverty requires interventions which tackle the root causes of vulnerability. This entails both infrastructural and institutional change which improves access to a range of basic services, builds the asset base of the poor and reduces the invisibility of the marginalised.

4 Low-cost solar PV kits with multiple functions contribute to low carbon climate resilient development

By offering an affordable substitute to kerosene lamps, ToughStuff is helping to reduce carbon emissions in developing countries. The firm's products also improve the wellbeing and quality of life of the poor by providing access to basic electrical services. Finally, the practical and robust nature of ToughStuff's range has meant that they have been used by humanitarian agencies in post-disaster situations.

The emergence and growth of ToughStuff

Established in 2008, 'ToughStuff International' is a social enterprise which provides small-scale photovoltaic (PV) energy devices to developing country markets. Its aim was to form a commercial enterprise to improve the lives of low-income groups through the provision of off-grid electrical products at affordable costs (Ashden Awards 2011).

The company began research and development activities in Madagascar. Market analysis and the piloting of ToughStuff products eventually led to commercialisation in Madagascar the following year (*ibid.*). In the first two months of the firm's operation 125,000 units were sold on the Madagascan market (ToughStuff 2012). The rapid success of the enterprise led the firm to quickly spread to other developing countries, including Kenya. Now the company operates in ten African countries and distribution also occurs in the US and the UK (*ibid.*).

Cost of ToughStuff products on the Kenyan market

PV module	KSh 790 (US$ 9.3)
Phone connector	KSh 100 (US$ 1.2)
Radio connector	KSh 240 (US$ 2.8)
LED Lamp	KSh 650 (US$ 7.6)
Power pack	KSh 680 (US$ 8.0)

Source: Ashden Awards (2011).

ToughStuff recognised that potential exists even with a very low generating capacity and the strength of their kit relates to the range of services it is able to provide, combined with its affordability.

The firm utilises established product distribution and wholesale channels in order to supply products to outlets such as mobile phone shops, supermarkets and electrical hardware shops. However, this strategy is also combined with a micro-enterprise programme called Business in a Box (BIAB). The BIAB programme aims to generate employment and 'stimulate entrepreneurship in local communities' (ToughStuff 2012); it also helps diffuse ToughStuff products in more remote off-grid communities who lack access to conventional retail outlets.

Solar lights provide the conditions for friends to undertake schoolwork after daylight hours

Solar Village Entrepreneurs (SVE) are selected by staff and receive training related to the established ToughStuff business model. This process involves product and sales training, and access to networks and marketing support is given. The firm also works with donor organisations and microfinance institutions in order to provide SVEs with access to credit, to start an enterprise (Ashden Awards 2011). The company is also undertaking pilot studies in Kenya which include a 'rent-to-buy' and a 'layaway' scheme. The 'layaway' enables customers to incrementally build up savings through a 'mobile-phone based money-transfer system'; once enough savings have accrued the customer is sent a message to collect the phone (*ibid.*).

The company has won several awards including the Ashden Awards (2011), The Tech Awards (2011) and The Environment and Energy Awards (2010); it has also been nominated for a Global Mobile Award (2012).

Consumer confidence in solar energy products can be eroded by the diffusion of low-quality and cheaply constructed hardware. In fact, this is an issue that has been said to have affected Kenya (Yadoo and Cruickshank 2012). Quality standards can therefore play an important role in efforts to establish a successful market. The Lighting Africa initiative (a partnership between the International Finance Corporation and the World Bank) has developed a product quality assurance programme in an attempt to curtail the negative impacts of inferior solar lighting products. The ToughStuff Room Lamp Kit and Desk Lamp Kit recently passed the standards set by Lighting Africa.

Solar PV in Kenya

The solar PV market in Kenya has a relatively long history which goes back to the mid 1980s. It has been estimated that the country is home to more than 200,000 solar home systems (SHSs) (Hankins 2005 cited in Bryne 2011). The growth of this market has been heralded as a model example of market-based development. This approach is argued to be beneficial because of its potential to achieve multiple goals: the 'poor gain access to services; private firms increase profits; and society achieves cheaper development than through public sector intervention' (Bryne 2011). Claims regarding environmental and social benefits which are said to accrue from the development of private solar markets are well established.

However, field research examining SHSs in Kenya has challenged some of the dominant ideas of private solar use. Jacobson (2007) found that the vast majority of SHS beneficiaries formed part of the rural middle class, with few members of low-income groups being able to afford the technology. Rather than impacting upon poverty alleviation and increased economic productivity, solar electrification was largely being utilised by the relatively wealthy as a means to watch television and charge mobile phones. However, the falling cost of PV is likely to have impacted upon previous issues of affordability and is increasingly likely to offer robust electrical solutions. Moreover, though private sector development has been heralded as the key factor in determining Kenya's solar diffusion, recent research emphasises the role of public actors in the development of indigenous technical capacity (*ibid.*).

Instead of catering for larger electrical appliances, such as a television, ToughStuff's PV module has a very small generating capacity (1 Wp). This is a considerable strength in relation to developmental benefits as it increases the product's accessibility to low-income groups by ensuring that the retail cost is kept down.

ToughStuff: a 'triple-win'?

The rapid diffusion of ToughStuff's product range demonstrates that there is a demand for affordable PV technology amongst low-income groups in developing countries. But to what extent can ToughStuff's hardware be said to contribute to mitigation, adaptation and poverty reduction goals?

The spread of ToughStuff's solar powered LED lamps means that households no longer have to rely on kerosene for lighting (the prime source of lighting for many of the world's poor). This move away from fossil-fuel lighting contributes to climate change mitigation through the reduction of associated greenhouse gas emissions. If it is assumed that the purchase of a single ToughStuff lamp substitutes one kerosene-fuelled lamp, then this results in a saving of 24 litres of fuel over the course of a year. It has been estimated that the lamps in use at the time of March 2011 are avoiding 8,800 tonnes of CO_2 per annum (Ashden Awards 2011). However, this figure does not derive from peer-reviewed literature and it is uncertain whether this estimation is based upon a full life-cycle assessment (where the emissions deriving from the sourcing of materials, manufacturing and distribution are taken into account) of both a kerosene-fuelled lamp and a ToughStuff PV module and LED lamp. The figures may therefore be somewhat optimistic.

As well as reducing carbon emissions which derive from the combustion of kerosene, it can also be asserted that ToughStuff's commercial activities are helping to alleviate some aspects of poverty. Through its provision of basic electrical services, including light, radio and phone charging facilities ToughStuff has been claimed to contribute to wellbeing in the following ways:

- **Improved health.** Families are no longer exposed to the damaging health impacts which arise from toxic fumes from burning kerosene; this contributes to a reduction of respiratory illness. In addition, using an LED lamp instead of kerosene reduces the risk of house fire.
- **Income is saved.** Customers save money in the long run. The average daily wage for a labourer in Kenya is approximately KSh 100 ($1.2); phone charging is said to typically amount to KSh 60 a week and kerosene KSh 120 a week a (Ashden Awards 2011). A ToughStuff module with extras will, therefore, pay for itself in only a few months
- **Income generation.** Those in remote areas often have to walk a considerable distance to charge their mobile phone; this is time-consuming. Once an investment in a PV module and phone charger has been made, buyers can generate income by providing a service to their local community. Moreover, the BIAB programme is providing employment to rural 'entrepreneurs'. At the time of April 2011, ToughStuff was employing 250 SVEs in the countries it operates in (*ibid.*).
- **Productive benefits.** It is argued that the light provided from ToughStuff lamps can allow for increased economic productivity for micro-enterprises. Furthermore, lamps provide the conditions for children to study for school after daylight hours.
- **Enhanced social networks and access to banking.** In East Africa, a significant proportion of the population rely on mobile phones for banking services as well as communication. Therefore, phone charging capabilities can make a notable difference. Furthermore, for those from low-income groups, radio is a key method of staying abreast of current events (Ashden Awards 2011).

The above discussion highlights the benefits thought to accrue from the work of ToughStuff, but there is currently no rigorous research to back these claims up. It is therefore difficult to judge the extent to which each of the above benefits is realised. However, it is not unreasonable to surmise that the diffusion of ToughStuff technology is

improving the lives and wellbeing of those that come into contact with it. That said, the provision of ToughStuff products is only likely to alleviate the intensity of poverty for those able to afford them rather than lead to significant poverty reduction.

ToughStuff's impact upon many of the 'generic' indicators of adaptive capacity, for example, income, health and education (Wood 2011), outlined above, provides a contribution to efforts to enhance adaptive capacity. However, as noted previously, the developmental impacts of ToughStuff's product range have not undergone academic scrutiny and therefore remain anecdotal. That said, the money saved from kerosene and mobile phone charging does improve a household's financial asset base, and this is likely to improve adaptive capacity by awarding households with a heightened ability to generate savings and diversify livelihood strategies. ToughStuff International is an example of market-led development that provides a degree of co-benefits in relation to development and climate change mitigation goals, but has limited transformative potential.

Further reading

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Authorship

This *Case Study* was written by Guy Crawford, a Research Assistant at IDS. It complements the Low Carbon Energy Learning Cycle of the Learning Hub. The opinions expressed are those of the author and do not necessarily reflect the views of IDS.

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