

ideas to impact.



STIMULATING SOLUTIONS TO ENERGY ACCESS THROUGH THE USE OF INNOVATION PRIZES

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This document is part of a suite of four papers (a guide and three thematic papers) that capture the learning from the first year of the Ideas to Impact programme. More specifically:

Innovation prizes: a guide for use in a developing country context identifies the stages required to define whether an innovation prize is a suitable instrument to help address a given development problem;



SEE OUR
GUIDE

Can innovation prizes help address water and sanitation challenges?

Introduces the concept of innovation prizes and presents a number of areas where they may have application;



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WASH
REPORT

Addressing problems in energy access through the use of Innovation prizes shows how the guide was applied in a specific context and sets out the challenges faced in using innovation prizes to support improved energy access; and



SEE OUR
ENERGY ACCESS
REPORT

A role for innovation prizes to support adaptation to climate change? An analysis of challenges, opportunities and conditions takes a theoretical approach to understanding the effects innovation prizes might have in the climate change adaptation field.



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Where text in this paper makes reference to one of the other papers in this suite, the relevant text will be highlighted and the icon representing the cross-referenced paper will appear in the margin.

At the time of publishing, Ideas to Impact is undertaking the detailed design of five diverse innovation prizes. The team expects to document further findings from this process through follow-up publications that will:

- Extend the Guide to include detailed design;
- Share further learning from experiences across the three themes (thematic papers currently go only as far as Stage 2 of the Guide in their analysis); and
- Provide guidance on how to establish monitoring and evaluation frameworks for innovation prizes.

Visit the Ideas to Impact website www.ideastoimpact.net and sign up to the newsletter to receive updates.

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Design: www.stevendickie.com/design

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EXECUTIVE SUMMARY

Ideas to Impact is a DFID-funded programme which is experimenting with the use of innovation prizes to solve development challenges. The programme covers three broad thematic areas: water and sanitation, energy access and climate adaptation. This paper examines the major problems relating to energy access and the potential application of innovation prizes to these challenges.

Key barriers to scaling up access to clean, modern energy were analysed through conversations with around 120 sector experts. The major problem areas were then evaluated using a Technology Innovations System (TIS) model to identify specific factors blocking wider access to technologies and fuels. The potential application of innovation prizes to these challenges was then considered, based on lessons from the literature on innovation prizes and dialogue with sector experts. A number of areas of potential intervention were identified, including some aspects of clean cooking, mini-grid development and raising public awareness of the value offered by certain technologies. Areas where innovation prizes might not be effective were also identified, including mobilising finance – an issue faced by many technologies – and policy reform.

The major conclusions from this analysis were:

- In most cases the factors limiting access to cleaner and more efficient energy supply are at the level of market formation, financing and policy. The challenges are not primarily of a technical/ engineering nature. This means that the challenges lie in areas where historically innovation prizes have not been widely used.
- In spite of this, we were able to identify a number of aspects of the problems where innovation prizes might be useful.
- Few, if any, of the problems lend themselves to 'global' solutions. The specific manifestations of a lack of access to energy vary from country to country, market to market, technology to technology. A detailed analysis of each specific context is required, followed by careful and appropriate prize design if an innovation prize is to be effective.

From this first phase of the research we believe that innovation prizes may be a useful tool to use alongside other types of intervention in specific contexts. Prizes linked to increased liquefied petroleum gas (LPG) access in Ghana will be run as a way of testing the usefulness of innovation prizes as a development tool.



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BACKGROUND

The Ideas to Impact programme is a £10m programme funded by the Research and Evidence Division of the UK's Department for International Development (DFID) to support research and development (R&D) in climate technologies for developing countries. The programme launched in May 2014 and is led by IMC Worldwide, with thematic leads on **water, sanitation and hygiene** (Trémolet Consulting); **low carbon energy** (GVEP International); and **climate adaptation** (Institute for Development Studies). The consortium also includes experienced prize designers (from InnoCentive) and independent monitoring and evaluation (led by ITAD).¹



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The programme is testing the use of innovation prizes as a funding mechanism that can stimulate the development and deployment of technologies and services for low-income consumers to improve their access to affordable clean energy, safe drinking water and/or resilience to climate change.

Innovation prizes, also known as 'inducement' prizes, offer a reward to whoever can first or most effectively solve or meet a predefined challenge. They act as incentives for innovation, rather than rewarding past achievement (prizes that do this, such as the Nobel Peace Prize are referred to as 'recognition' prizes). Innovation prizes are credited with achieving various benefits that broadly fall into two dimensions: (i) developing ideas, technologies, products, or services and (ii) engaging people, organisations and communities.

A more recent report by Deloitte (2014) built on the earlier McKinsey study and identified a further series of lessons for would-be prize sponsors. The Deloitte team emphasises the importance of being clear about goals and desired outcomes from the start. They also stress that prize design is a craft, and that good design takes time and resources. Other reports include the Harvard Berkman Center's Public-private partnerships for organising and executing prize-based competitions (Tong and Lakhani 2012) and Nesta's Challenge prizes: a practice guide (Ballantyne 2014). These two reports are process focused, setting out the steps to follow in creating a prize.

Despite the growing interest, robust evidence of the effectiveness of prizes remains scarce. The Manchester Institute of Innovation Research collated such evidence as was then available in a paper published in 2013 (Gok 2013). This summary of the literature suggests there is some evidence that prizes have helped stimulate ideas and inventions, and

The use of prizes to tackle social and economic issues has become increasingly widespread in recent years. In 2009, McKinsey published an influential report which documented this trend and highlighted factors associated with the **successful use of prizes**. The report identified four key lessons for creating effective prizes.

- The 'problem' must be appropriate for the approach, and a pool of solvers willing to engage at their own risk must exist.
- A prize is more than a 'purse' – goals, strategy, delivery and learning models are critical to impact.
- There are no short cuts – it takes time and resources to design a prize well.
- There is no single blueprint for success.



GUIDE
Stage 2
Figure 3

that they can help to raise awareness of an issue. Evidence of prizes changing behaviours or transforming markets is difficult to identify because rigorous studies of impact have not been undertaken.

Much of the recent development in the use of prizes has taken place in the USA and Europe, with governments and philanthropic foundations major drivers. The deployment of incentive prizes in the field of international development has been limited. DFID commissioned an evidence review on prizes, which concluded that while evidence existed of the effectiveness of innovation prizes, especially in generating ideas and inventions, it was difficult to say whether prizes were better value than other approaches owing to a lack of comparable data of cost and benefits (Everett 2011). Everett also argued that the effectiveness of prizes is influenced by the existence of parallel activities which support the innovation process such as policy reforms, grants and other funding and technical assistance.

A second report commissioned by DFID, prepared by the XPRIZE Foundation, tested support for the idea of using prizes in international development with leaders and thinkers in the sector and found widespread interest. As with the Everett report, the XPRIZE study recommended that prizes be developed within a wider programme of support. XPRIZE also advised that the implementation be managed outside of government and large donor institutions, to ensure that programme management remained 'nimble and entrepreneurial.'

This paper builds on the reports and studies mentioned above. It aims to help others considering the use of prizes by providing examples of where prizes might and might not be applicable in the area of energy access. The paper does not provide a detailed design of a specific prize.

1. More details are available on the programme website: <http://ideastoimpact.net/>

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PROBLEM IDENTIFICATION



GUIDE
Stage 1
For more on
problem identification

In a typical US or European context where prizes are being used, a government department or private institution will have a problem or set of problems it wants to solve. With the help of a prize design expert the owner of the problem then explores whether a prize could help solve the problem. In the case of Ideas to Impact there was no predefined list of 'problems' to be solved – beyond the very high level 'problem' of lack of access to clean water, sanitation, electricity, etc. The initial phase of work therefore involved the identification of a short-list of specific problems which might potentially be resolved through the use of an 'innovation prize'. The very limited use of prizes within international development means that current owners of 'problems' are unlikely to have considered the potential of a prize to unlock that problem, hence the need for an active search for 'prizeable' issues.



There is no single internationally accepted and internationally adopted definition of modern energy access. *World Energy Outlook (WEO)*, published by the International Energy Agency (IEA), defines modern energy access as "a household having reliable and affordable access to clean cooking facilities, a first connection to electricity and then an increasing level of electricity consumption over time to reach the regional average". Their definition of access also involves consumption of a specified minimum level of electricity; the amount varies based on whether the household is in a rural or an urban area. The initial threshold level of electricity consumption for rural households is assumed to be 250 kilowatt-hours (kWh) per year, and for urban households it is 500 kWh per year. The IEA definition of 'energy access' also includes provision of cooking facilities which can be used without harm to the health of those in the household, and which are more

environmentally sustainable and energy efficient than the average biomass cookstove currently used in developing countries. This would apply primarily to biogas systems, LPG stoves, and advanced biomass cookstoves with very low emissions and high efficiencies.

An alternative multi-tier approach to measuring energy access has been proposed in the UN's Sustainable Energy for All (SE4ALL) Global Tracking Framework of 2013. This approach recommends "a five-tier measurement methodology based on various energy attributes, such as quantity, quality, affordability, and duration of supply. The approach makes it possible to compute a weighted index of access to energy for a given geographical area". This framework recognises that 'access' is not binary, is not a have/do not have question, but a matter of degree. The concept of tiered access allows progress towards greater levels of access to be assessed over time.

In the Ideas to Impact project, we have used the SE4ALL multi-tier concept. We considered a 'solution' to be anything which improved on any dimension of the energy access problem and moved energy users in the direction of improving access (including safer use). Our emphasis was primarily on inducing private sector led solutions, but as public sector policy is often critical to the success of private businesses operating in the energy arena, problems amenable to solution through public-private collaboration were also considered to be within scope. We focused on off-grid issues only partly to make our task more manageable, partly because grid-based power supply is highly regulated and complex to engage with through a 'prize', and partly because solving off-grid challenges was considered more likely to benefit low-income communities.

In order to generate a long-list of potential problems, conversations were conducted initially with 70 actors in the energy access space either through one-on-one interviews or through round-table meetings. These actors were drawn from a cross section of the energy access community – entrepreneurs, investors, NGOs, academics, policy makers and government officials. We interviewed people with knowledge of electricity access, clean cooking, business and project financing, and policy formulation. The aim was partly to ensure a comprehensive range of options were considered, and partly to identify issues which received frequent mention and which might therefore be of particular significance and interest. Interviewees were chosen from sub-Saharan African, South Asia, Europe and the USA.



GUIDE
Stage 1

For more on ensuring consistency with the objectives of all stakeholders

The interviews were conducted on an open basis. Our expert group was asked what they saw as the main barriers to achieving universal energy access and each of the identified challenges were explored in some detail to unpack the constituent elements. The interviewees were then asked if they felt a 'prize' could be usefully used to incentivise solutions to any of the challenges or aspects of the challenges they had identified. The interviews were conducted by three GVEP staff members (two based in East Africa), and by three external consultants. Round-table discussions were also hosted in Kenya and Ghana with 6–7 participants in each. Further conversations were then conducted with informants with specific knowledge of the different problem areas and countries as we explored the potential applicability of innovation prizes. In total around 120 experts were consulted in the course of our work.

The key problem areas or challenges identified by those interviewed were:

1. Clean cooking – cooking with biomass is now known to have major health implications. Globally 2.8 billion people still cook with biomass. There are a number of clean fuel alternatives at different stages of development.

There is a long history stretching back over decades of work on improved biomass cookstoves and clean fuels. In recent years strong evidence has emerged concerning the health impacts of cooking with biomass. The World Health Organization (WHO) estimates 4 million deaths per year are linked to household air pollution. Of particular concern is evidence that suggests the majority of 'improved' biomass stoves do not reduce exposure to harmful emissions enough to impact those health risks. The stoves may be fuel efficient and save the user money, but noxious emissions remain at levels which are considered harmful to health. Attention is therefore moving towards 'clean fuels' which do not pose a risk to health.

The most widely available 'clean fuel' is LPG, but it is expensive and used mainly by better-off households. It is also a fossil fuel. The major challenges in making LPG available to a broader customer base, assuming supply is not constrained, are (i) the cost of the cylinder, regulator and stove, (ii) the cost of the fuel itself, and (iii) government policies including tax, unregulated business practice, and health and safety issues.

Ethanol is potentially an alternative clean cooking fuel but is not widely used. A number of NGO projects and commercial ventures have demonstrated high user acceptance. The main challenge is supplying fuel at an affordable price. This is linked to government policy, including high levels of duty on alcohol.

Innovation is happening around both of these fuels. In LPG there are companies experimenting with small cylinders (e.g. PIMA gas in Kenya), with rural distribution models, and some governments have used subsidies to boost take up (e.g. Indonesia ran a very effective kerosene substitution campaign). The price of LPG used to be closely linked to oil but is decoupling as more shale gas comes on the market and the price of the fuel is expected to fall. The most promising markets for the industry are in Asia, but Africa is also a large potential market. Poor governance and regulatory environments are a major challenge in Africa.

With ethanol there have been a number of attempts to build markets most notably the Gaia-led process in Ethiopia and Cleanstar's commercial venture in Mozambique. Business models are being refined and have the potential to scale. The price of the stoves – as with LPG – is seen as a challenge by some. Others believe stoves can be made more cheaply through local assembly using imported components. Fuel supply however is the overriding problem here.

Other options mentioned by our interviewees were: highly efficient biomass stoves and off-grid electric cookers. Advanced, forced draft gasifier stoves exist and are very clean but are expensive and have yet to establish a market. One informant suggested that a highly efficient combustion chamber might be developed which could be mass produced and supplied to local stove makers for incorporation into their products. Energy saving induction hobs are increasingly popular with Asian households that have an electricity supply. Cooking with electricity without grid supply is theoretically feasible in the longer run but technical experiments in this area are in their infancy.

2. Micro-grids – technology and business models have been demonstrated. The main challenges in reaching scale are the policy environment and subsidies.

Micro-grids have existed for decades in many parts of the world. Typically, they are operated by an agency of government, or by a community organisation. In recent years there has been growing awareness that in sub-Saharan Africa and parts of Asia distributed energy systems represent better value than extension of the national grid. This is partly because solar photovoltaics prices have been falling. The international focus on 'energy for all' has led to an increase in interest in 'off-grid' solutions and a growing number of businesses have been piloting mini-grid businesses models, primarily using solar photovoltaics but some using biomass gasification. There is considerable donor interest in mini-grids because unlike household-level solutions they can provide enough power to support growth in economic activity.

Mini-grids involve high initial capital expenditures which, in a commercial model, are recovered through revenue over a period of years. No company in Africa has yet developed beyond a few demonstration sites and the economics of isolated mini-grids are yet to be proven. In India, Husk Power is the largest developer with 65 existing power plants. The regulatory regimes of most African countries are unhelpful, and the uncertainty surrounding the policy environment, lack of information about potentially viable sites and threats from grid expansion, means mini-grid developers find it hard to raise finance. The fundamental problem facing the industry is perhaps a lack of legitimisation. Because mini-grids (except where they connect to the grid or are run by the state/national utility and are subsidised) are not yet proven, host country

governments remain to be persuaded they can be part of the energy solution. Pioneers of the commercial mini-grid approach try to make progress 'below the radar' in the hope of eventually winning broader policy support. Technical performance and business models are constantly being refined.

In some of our early conversations it appeared that some technical aspects (smart meters, monitoring systems and customer relationship management packages) still presented barriers to operators looking to reduce costs and improve revenue collection. But following further interviews, it seems that several of the small to medium sized enterprises (SMEs) involved are solving these problems, and solutions are likely to be commercially available fairly soon. One interviewee suggested that innovation in battery technology would help bring systems costs down. This is undoubtedly true but, as other informants commented, the battery industry is already innovating on a huge scale.

3. Access to finance – this is probably the number one challenge voiced by our interviewees. It includes early stage equity, working capital and funding for consumer credit.

Financing is seen by most interviewees as being a major problem. The main challenge, they believe, lies in the riskiness of the countries where investment is being considered, and in some cases the technologies. Political and country risks are significant, and are the main reasons private investment does not flow. In the electricity sector some form of PPP is almost inevitable for businesses operating beyond the household level because of public interest issues (e.g. land and water use), and market structure (natural monopolies, capital intensive projects, long payback periods.) But coordinating investment cycles between private developers and public grant-making entities is complex and challenging. This results in a very high cost of capital which makes projects unattractive.

Investing in early stage product companies in the off-grid space was seen as particularly challenging. There are two kinds of challenge: early stage equity and working capital. Equity is very hard to secure and many of the businesses interviewed rely on their own resources or the support of business angels who were known to them when they created the venture. Philanthropic funding is the only other source of financing. As Monitor reported in their analysis of the Acumen portfolio almost all of the businesses Acumen invests in relied on philanthropic capital to get started (H. Koh et al., 2012). In more developed markets the state normally plays a role in mobilising equity for innovative start-ups. For example, the Israeli government through its Yozma programme played a critical role in creating a local venture capital sector to support an emerging ICT sector. Israel today is a world leader in innovation. In the developing markets of sub-Saharan Africa, grant funding is likely to be needed for some time.

The main challenge as mentioned above is demonstrating that commercially developed and managed mini-grids can meet the needs of significant numbers of people who cannot be serviced by the national grid. Governments need to be persuaded that viable businesses exist, that customers want their services, and that government stands to gain from supporting the expansion of micro-grids. This is what current actors are seeking to demonstrate.

Mini-grids do present significant policy challenges, not least the question of how much rural populations can and should pay for electricity. While in practice rural communities might pay an economic 'fee for service' some commentators argue that it is unfair that the poorer sections of a society pay a lot more for electricity access (in \$/kWh) than the urban middle class. Reducing the costs to rural users would mean subsidising services through some kind of public-private partnership (PPP), but this would add complexity and risk to the mini-grid business model.

Several informants felt that grant funding for early stage investment is not efficiently deployed and processes are too slow for fast moving small businesses. One informant suggested that funds needed to be invested in much the way venture capital (VC) would operate, with close ongoing follow-up with the investee company. Philanthropic funding for early stage ventures needs to be deployed with a more commercial approach if it is going to bridge to commercial investment further down the road.

Equally important is access to working capital. A key barrier to the spread of energy and **WASH products is affordability**. That means margins are thin and some form of consumer financing is usually required to support sales. Product businesses need large amounts of cash to finance inventory and customer credit. It is very difficult for smaller operators to access this funding. The cost of capital locally is high, and banks are generally cautious about lending. International financing on the other hand is very limited. The lack of working capital is a major constraint on the rate of growth of many of these businesses. Some crowd-funding platforms are starting to experiment with solutions.



4. Governance/policy environment – widely seen as a major challenge. Comments ranged from lack of appropriate policies in specific areas of the energy field to broader concerns about ease of doing business, political risk and corruption.

Almost every contact we interviewed talked about the lack of a supportive policy environment as a challenge. This covered a broad range of interlinked concerns. Power generation and distribution is significantly affected by broader governance issues (see for example Kwaku Wiafe, 2008; A. Scott & P. Seth, 2013).

The electricity sector has undergone major restructuring in the last 30 years with the state increasingly assuming the role of regulator/enabler and the private sector taking over generation and distribution of power. Supply of fuel and stoves for cooking is predominantly private sector. Appropriate policy formulation and improved governance are evolving areas and many actors are engaged with trying to influence current realities.

Interviewees believed that developing country governments could do more to stimulate and support innovative approaches if they chose to, and that the ultimate ability of any innovation to thrive will be shaped by national governments.

5. Awareness – low levels of **consumer awareness** of the products and services on offer is seen by many innovators as a barrier.



GUIDE
Stage 2
Figure 3

Many actors in the energy access arena talk about lack of consumer awareness as a major barrier. Product companies trying to sell solar lanterns or efficient stoves have to invest heavily to achieve sales as potential customers are unfamiliar with the products and wary of risking their limited cash on a product which may not live up to expectations. Public funding has been provided to help raise awareness of specific classes of products amongst potential consumers, for example the campaigns managed by Lighting Africa in Kenya.

However, the degree to which awareness is the primary problem in any given energy product market is not always obvious. The more pressing reasons why sales are not being achieved may have more to do with product quality, price, a weak value proposition, and product availability. This is not to deny that awareness is an issue but to stress that if a product is unaffordable, or the value proposition not compelling, no amount of public education will help.

6. Skills deficits – challenges in recruiting and retaining reliable sales people, weak technical skills hamper effective after sales support for a range of products.

The challenge of finding reliable, motivated and skilled staff is a real issue. Many companies experience high turnover. Skills deficits both of a technical and business nature are challenges for any business operating in developing markets. This is an aspect of the external environment affecting businesses and is difficult for individual firms to tackle.



GUIDE
Stage 2
For more on
grassroots innovation

7. Lack of involvement of the grassroots – failure to involve end users in solution design.

A number of interviewees suggested that the failure to involve the intended beneficiaries of a solution was often a reason for failure. Others argued that research into grassroots innovation, is limited, making factual evidence difficult to source. Grassroots Innovations appear to be mostly organic and incremental, and more often than not highly context specific (see Hargreaves et al. 2013, and Seyfang and Haxletine 2012.)

For these reasons grassroots innovations have often proved difficult to replicate. Variations in geographical conditions, and in human knowledge and skills, are major barriers to developing structured approaches for replicating successful grassroots innovations. Moreover, the lack of a detailed understanding of grassroots

innovation processes appears to make potential donors and investors wary of involvement. More often than not these innovations are not created with financial gain in mind and are not amenable to commercialisation. Lack of information also means governments do not incorporate innovations from the grassroots into policies and procedures. This is not to deny the critical role end users play in informing the design of a new technology and in adapting a technology to local conditions and needs. In the energy sector products intended for the low-income households have to respond to user's needs, and be robust enough to function in challenging environments. Users also frequently adapt equipment for uses not originally envisaged by the manufacturer.

8. Distribution – the costs of moving goods around a country are high. Last mile distribution is equally a challenge – recruiting and motivating local sales agents can be very difficult.

Almost all businesses involved in the selling of energy related consumer durables – lanterns, solar kits, improved stoves – report major challenges with distribution. Challenges exist at two levels – moving goods around a country, and last mile distribution/sales to the customer. Similar challenges exist for WASH products such as water filters and toilets. Businesses try to solve these problems by either developing the logistics capabilities themselves or using commercial couriers (formal sector) – both of which are expensive. Some have been able to piggy back on the logistics capability of a large company. Total, for example, distributes solar lanterns to petrol stations in several countries, and MTN distributes Fenix products to its agents in Uganda. Most businesses would like to be able to outsource distribution but cannot find affordable and reliable partners to work with.

Businesses and social ventures specifically focused on distribution of solar products do exist. Sunny Money, the commercial arm of Solar Aid, is the biggest retailer of solar lanterns in the world. Living Goods is a social venture built around distribution of a range of products – including energy products. One Acre Fund, which works with farmers, distributes energy products alongside agricultural inputs.

New start-ups are also entering the sector. The Climate Innovation Centre in Kenya, for example, is incubating a Kenyan distribution start-up, and the US NGO PATH recently reported on a pilot programme in Cambodia which resulted in the creation of a distribution business offering a range of products (water filters, toilets, lanterns, a gasifier stove, etc.) A number of early stage distribution businesses are supported by the D-Prize which provides financing to encourage more SMEs into this sector. The Shell Foundation has been studying the informal distribution sector in Kenya and considering ways to access this through smart technologies – a kind of Uber for moving product. Local stove makers in Kenya are already able to move large volumes of liners and stoves around the country and sell through a range of retail outlets but the sector is highly fragmented and difficult to engage with at scale.

Even where the transportation of goods around the country can be solved, the last mile remains a major hurdle. Businesses interviewed report that it is very difficult to recruit and retain motivated and capable sales people at the local level in Africa. In South Asia this seems less of a challenge and microfinance institutions are also often used to sell products (backed by a loan.) GVEP has had some success supporting independent micro-retailers in the energy sector. We witnessed these micro- businesses diversifying their product range as they became exposed to other technologies through encounters with other micro-businesses.

9. After sales support – challenges navigating the reverse supply chain, and lack of availability of technically skilled staff.

Another side of the distribution challenge is aftersales support. Reverse navigation of supply chains is difficult and expensive making it potentially challenging for product companies to service faulty goods and honour warranties. Misuse of products may often be a cause of failure and could be easily rectified by a local technician, but suitably qualified technical staff or agents can be difficult to identify. This links back to the skills challenge.

10. Lack of market information – limited availability of information which enables a business to identify suitable locations to target, e.g. for a micro-grid developer.

The difficulty of accessing information about a potential market is another huge issue which needs addressing. Businesses developing mini-grids or distributing pay as you go (PAYG) solar systems report challenges with obtaining information and data needed to support their business planning. This includes resources like wind and hydro maps, demographic data, grid expansion plans, policies and regulations, and standards. Businesses selling consumer durables also report a dearth of marketing data – who is buying what, at what prices, for what motives, etc. This kind of information is widely available (sometimes for a fee) in developed economies. In developing economies the lack of information is often a function of weak government, lack of transparency and market immaturity.

3

TECHNOLOGICAL INNOVATION AS A SYSTEM

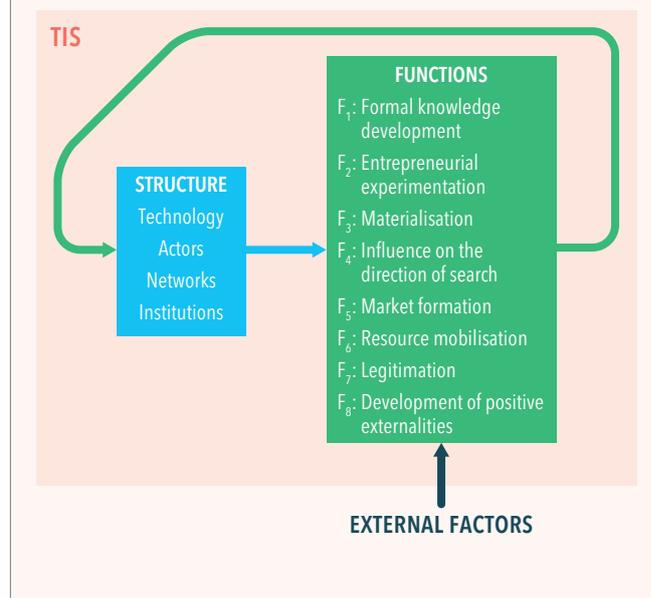


GUIDE
For more on
innovation systems

The model we used in conceptualising these energy access problems was the 'technology innovation system' (TIS). The way a new technology develops and eventually reaches market has been much studied and the concept of a TIS is widely used as a way of framing the issues. A significant body of academic literature exists on this topic providing a useful framework for the analysis of problem types. Given our interest in private sector solutions the TIS model was considered to provide a useful framework for structuring our approach. The model set out in A. Bergek et al., 'Legitimation' and 'development of positive externalities': two key processes in the formation phase of technological innovation systems (2008) was therefore adopted as a tool for problem analysis.

FIGURE 1: THE TECHNOLOGY INNOVATION SYSTEM

Source: Bergek et al. 2008



The Bergek model provides a way of understanding technology innovation systems allowing analysis of how the different components interact over time to bring an innovation to scale. Innovation is not a linear process. Over the life of an innovation various processes operate and evolve in parallel, linked by a series of complex feedback loops. The entire process may take place over decades and the challenges faced by an innovation will vary over time depending on both the maturity of the innovations system and external factors.

The structure of a TIS can be understood in terms of the technologies themselves, the various actors trying to develop these technologies and bring them to market, the networks which exist between these various actors, and the institutional framework (laws, taxes, policies.) Functionally there are a series of processes which can be isolated which are described in detail in Table 1. The whole system is influenced by external factors which evolve over time – increasing concern over climate change, economic growth, electoral changes etc.

Technology innovations typically face significant resistance from incumbent technologies and the processes by which legitimation is created are an important component of how a technology moves from niche to mainstream. The Bergek et al. paper also suggests that there can be benefits of mutual co-evolution between different technologies which cross apparent systems boundaries.

Within the energy access world a large number of interlinked technology innovation systems can be identified which are at varying stages in their evolution. These TIS can be analysed at a global level, or within a specific country. The challenges faced will vary from country to country, but will also be influenced by developments in the global system. Understanding the current challenges faced by actors within these systems may point to interventions which could be made through a 'prize', helping to strengthen the innovation system and increase the chances of the technology moving to scale.

Our assumption is that a TIS develops primarily through the forces of its own momentum but that external interventions can positively influence the system. Because of their dynamic nature and vulnerability to changing external factors no intervention can be assured to deliver positive change. Many other actions are also required to deliver the innovation and this may take time. Ultimately a variety of external factors will likely influence the outcomes. Many innovations do not succeed and the existence of a TIS does not in itself guarantee that a technology will eventually reach scale.

The University of Utrecht has published a useful short manual on technology systems analysis (M. Hekkert et al., TIS analysis: a manual for analysts, University of Utrecht, 2011.) The approach recommended in this publication was adopted in our work. The authors of the manual stress that the functioning of a TIS needs to be assessed by experts and stakeholders involved in the system. This is because evaluation involves qualitative judgements and cannot be performed on the basis of quantitative criteria.

TABLE 1: FUNCTIONS OF TECHNOLOGY INNOVATION SYSTEMS (AFTER A. BERGEK ET AL. 2008)

| | |
|--|--|
| Development of formal knowledge | The breadth and depth of the formal, research-based knowledge base and how that knowledge is developed, diffused and combined in the system. |
| Entrepreneurial experimentation | Knowledge development of a more tacit, explorative, applied and varied nature – conducting technical experiments, delving into uncertain applications and markets and discovering/creating opportunities, etc. |
| Materialisation | The development of (and investment in) artefacts such as products, production plants and physical infrastructure. |
| Influence on the direction of search | The extent to which supply-side actors are induced to enter the TIS, or put more subtly, direct their search and investments towards the TIS. |
| Market formation | Articulation of demand and more 'hard' market development in terms of demonstration projects, 'nursing markets' (or niche markets), bridging markets and, eventually, mass markets (large-scale diffusion). |
| Resource mobilisation | The extent to which the TIS is able to mobilise human capital, financial capital and complementary assets from other sources than suppliers and users and the character of this mobilisation. |
| Legitimation | The socio-political process of legitimacy formation through actions by various organisations and individuals. Central features are the formation of expectations and visions as well as regulative alignment, including issues such as market, tax policies or the direction of science and technology policy. |
| Development of positive externalities | It reflects the strength of the collective dimension of the innovation and diffusion process. It also indicates the dynamics of the system since externalities magnify the strength of the other functions. |

APPLYING TIS ANALYSIS

Thinking about the problems identified by our experts in terms of the functions in a TIS, we see a range of problems relating to different parts of the innovation system. Some problems relate to more than one function. Some relate to more than one TIS. Five of the problem areas related to specific technologies, four cooking technologies plus mini-grids for electricity access. The challenges within the TIS for each of these is presented in Table 2 (the shaded areas represent the major areas of difficulty identified by our interviewees). Clearly the specifics will vary from country to country but in terms of high level analysis LPG is a well-developed technology the major issues being around the lack of incentive for businesses to expand supply. Ethanol, another very clean option, is much less developed than LPG though pilot businesses have been established in a few countries and stoves, stills and fuel distribution technologies exist, albeit with scope for improvement. Products which would allow poor households, not connected to the grid, to cook on electricity are in their infancy. Standalone mini-grids operating to a commercial model exist in a number of

developing countries, and the technology components exist. The challenges here are at the level of the business model, public policy, and finance. The areas of challenge identified in Table 2 are a function of the relative maturity of each TIS.

The other issues identified by our 'expert' group were general to a wide range of TIS. Finance, the most frequently voiced 'problem,' clearly relates to the 'resource mobilisation' function. Consumer awareness, product distribution, after sales services, skills deficits and poor market information all relate to 'market formation'. The role of the grassroots is an issue about who participates in the innovation system.

From this analysis it will be seen that in almost every instance the problems identified by our experts relate not to technical innovations – though these have a role to play – but in other aspects of the TIS, especially building markets, securing financial and human resources, and legitimation. To be useful in unblocking some of the obstacles to universal energy access innovation prizes would have to be capable of assisting with these kinds of challenges. Whether innovations prizes have something to offer is the subject of the next section.

TABLE 2: FUNCTIONAL CHALLENGES IN TIS FOR SPECIFIC TECHNOLOGIES

| Development of formal knowledge | LPG | Ethanol | Electric cooking | Combust chamber | Mini-grid |
|---------------------------------------|-----|---------|------------------|-----------------|-----------|
| Development of formal knowledge | | | | | |
| Entrepreneurial experimentation | | | | | |
| Materialisation | | | | | |
| Influence on the direction of search | | | | | |
| Market formation | | | | | |
| Resource mobilisation | | | | | |
| Legitimation | | | | | |
| Development of positive externalities | | | | | |

4

APPLICABILITY OF A PRIZE APPROACH

Drawing on the literature on prizes, the Ideas to Impact programme developed a tool to help guide decision makers on where and when prizes might be an effective approach to consider in a development context. This work was led by Vivid Economics. The tool offers a four-stage process for screening problems and potential prize solutions. The four stages in the Guide are summarised in Figure 2 below.



FIGURE 2:
A FOUR-STAGE GUIDE TO DISCERN WHETHER A PRIZE IS A SUITABLE INSTRUMENT TO ADDRESS A GIVEN PROBLEM

STAGE 1: PROBLEM IDENTIFICATION

- Would resolving the specific problem lead to the desired development benefits?
- Are available resources sufficient to resolve the problem?
- Is resolving the problem consistent with existing policy, the sponsor's objectives and beneficiaries' needs?
- Is there good reason to believe that the problem would **not be resolved** without further intervention?

STAGE 2: PRELIMINARY CHECK

Do any of the typical circumstances in which prizes are useful apply to the problem?

STAGE 3: THEORY OF CHANGE IN CONTEXT

- Is it clear how the prize competition will lead to sustainable development benefits?
- Are the conditions for winning the prize clear?
- Is it easy to measure when these have been met?
- Is it unclear to the sponsor how to meet these?
- Is meeting the conditions predominately a function of skill and effort rather than luck?
- Is there a diverse and suitably sized set of solvers with the necessary skills and access to resources?
- Is the theory of change supported by existing:
 - government policies,
 - development partners and stakeholders; and
 - beneficiaries' needs?

STAGE 4: DETAILED APPRAISAL

- Does the prize competition offer sufficient reward to incentivise entrants without placing inappropriate risks on the losers?
- Do the likely benefits, given the probability of achieving development gains and spillover benefits and the possible impact on beneficiaries and supporting networks, outweigh the risks for the sponsor?

This section of the current paper reviews each of the problem areas presented earlier and discusses potentially 'prizeable' challenges. The process described refers effectively to the first two stages of the guide outlined in Figure 2, with some of Stage 3 also informing the findings.



GUIDE
Stage 1

For more on the problem identification stage

Applying the Vivid Economics Guide, we used the four screens in Stage 1 to review the problems and to check they met the basic conditions which would warrant consideration of a prize solution. The four questions considered were:

- Is there a good understanding of the wider context of the problem, such that they are confident that resolving the identified problem will lead to development benefits?
- Are there sufficient time and resources available, considering all relevant sources, to resolve the problem?
- Is the desire to overcome the problem shared (or at least not actively contradicted) by host governments, the sponsor and expected beneficiary?
- Is it unlikely that the problem will be solved without intervention?

Specific technology issues were considered separately from 'cross-cutting' functions applicable to several TIS, and the issue of grassroots ('actors' within the structure of a TIS.). Tables 3a and 3b summarises the scoring of the different problem areas from the step 1 review.

TABLE 3A: STEP 1 REVIEW OF TECHNOLOGY 'PROBLEMS'

| Problem | Likely benefits | Resources | Policy fit | Intervention needed |
|--------------------|-----------------|-----------|------------------|---------------------|
| Clean cooking | | | | |
| LPG | Yes | Yes | Yes | Yes |
| Ethanol | Yes | Yes | In some contexts | Yes |
| Electric off-grid | Yes | Yes | Yes | Yes |
| Combustion chamber | Yes | Yes | Yes | Yes |
| Micro-grids | Yes | Yes | In some contexts | Yes |

TABLE 3B: STEP 1 REVIEW OF CROSS-CUTTING 'PROBLEMS' (FUNCTIONS/ACTORS)

| Problem | Likely benefits | Resources | Policy fit | Intervention needed |
|--------------------|-----------------|---------------|------------------|---------------------|
| Finance | Yes | Yes | Yes | Yes |
| Policy | Yes | Yes | Yes | Yes |
| Consumer awareness | Yes | Yes | Yes | Yes |
| Skills | Yes | Yes | Yes | Yes |
| Grassroots | Yes | Maybe limited | In some contexts | Yes |
| Distribution | Yes | Yes | Yes | Yes |
| After sales | Yes | Yes | Yes | Yes |
| Information | Yes | Yes | Yes | Yes |

From a high level view most of these issues pass the Stage 1 test. In some contexts promoting ethanol as a cleaning cooking fuel or supporting mini-grids may conflict with government policy. There may be a strong case for seeking to change that policy, but without supportive policy a prize would be unlikely to be effective in these cases. Involving the grassroots in solution development may also be challenging in some political contexts.

Having established which of the problems passed our first screening stage, **we considered whether the potential benefits an innovation prize approach offers fits the nature of these problems.** As noted earlier, robust evidence of the effectiveness of innovation prizes is scarce. The paper by Gök identifies the following possible benefits:



GUIDE
Stage 2

- Generating new ideas/technological inventions or solutions;
- Creating prestige for prize winners;
- Creating public or sector awareness of a technology issue;
- Motivating potential solvers to participate in finding a solution.

The 2014 Deloitte report identified six types of outcomes targeted by prizes, with the majority of prizes being focused on ideation, technology inventions and awareness-raising. These are broadly the areas of perceived effectiveness mentioned above. However, a significant limitation of the typical prize challenge is that while it might result in the creation of a product, there is no guarantee that product will find a market. The Bogo light created by SunNight Solar with grant support from the Rockefeller Foundation and 'open innovation' design input sourced through InnoCentive is one example of such a product. Pure technology prizes do not provide a solution to energy access on their own, and anyway technology was not seen as the major challenge by our experts as reported earlier.

Prizes which aim to stimulate markets, change behaviour and inspire transformation are less common according to Deloitte. Prizes of this kind, with ambitious objectives, may prove effective but evidence either way is lacking. The Big Green Challenge organised by Nesta in 2008 in the UK is often referred to as an example of a successful prize which created behaviour change. The final evaluation report by Brook Lyndhurst published in 2010 was generally positive but raised questions about the sustainability and replicability of the initiatives supported. No cost benefit analysis was attempted by the evaluators though figures of 5,800 people engaged and 2000 tonnes CO2 avoided are given. The overall programme cost £3.5m.

The following sections review each problem area and consider the potential value of applying a prize approach. As with a TIS analysis, evaluating the applicability of a prize involves informed judgement and cannot be based on simple, quantitative criteria. The suggestions and observations which follow are informed by the views of experts we consulted.

4.1 CLEAN COOKING

As we have seen, this is a major public health issue. A number of potential intervention points were identified by experts we interviewed. A 'prize' might incentivise:

1. Development of lower cost appliances needed to use a fuel such as LPG or ethanol.
2. Development of delivery models capable of reaching poorer households.
3. Innovation in safety and/or devices to reduce theft of cylinders (a big problem in LPG).
4. Consumer behaviour change to improve safety of use (LPG) or stimulate uptake (ethanol).
5. Development of a high efficiency combustion chamber for biomass stoves.
6. Development of technology for electric cooking off-grid.

Further discussions with relevant experts suggested that delivery models for reaching poorer households, including consumer financing arrangements, helping to **stimulate markets** for clean fuels/appliances, and public awareness around safe use of LPG might have the widest impact. Other issues, such as proper maintenance of gas cylinders, did not appear amenable to being solved through a prize. This issue would be better addressed through regulation and enforcement of standards by governments.

The idea of a high-performance combustion chamber, capable of being incorporated into locally made stoves, is interesting. The technical knowledge required for design of such a device already exists. How such a product would be commercialised would need consideration, however, if the idea were to be developed. It is not clear how these devices would find their way into local stoves. Even if they did, encouraging the adoption of cleaner cooking stoves involves much more than developing a technology. Price would be a critical factor.

Cooking on electricity 'off-grid' is an intriguing idea and some early stage experimenting is happening with batteries and induction hobs. Currently the capabilities of the technology are limited and we are several years away from seeing any kind of prototype product. Costs are also high. A prize to stimulate product innovation might be applied to this issue but would likely need to allow for a significant timeframe for development.



GUIDE
Stage 2
For more on
stimulating markets.

Clean cooking challenges exist in many countries. We considered whether a **multi-country prize** could work – with solvers in different countries, or internationally competing to solve a given problem. Our conclusion was that market conditions vary so much from one country to another it would be very difficult to set prize criteria which would work for multiple countries, indeed it is complex establishing criteria in a single country. We decided that any intervention around cooking fuels or devices, would need to be at the level of a single country.



GUIDE
Stage 3

For more on consideration of the context.

We also considered whether within a given market multiple 'clean cooking solutions' might be incentivised – for example a technology neutral prize which simply specified the standards to be met by a winning solution. We applied these ideas to the Ghana market. In our view this again would be challenging as the different technologies are at varying levels of maturity and setting general prize criteria which are technology 'neutral' will inevitably benefit the most developed existing technology. While ethanol and advanced gasifier stoves could meet WHO health standards they are no cheaper than LPG. Given their current absence from the market any sales target which they might conceivably achieve in the next few years would be easily achieved by an LPG supplier. A stretch target for LPG would be well beyond the reach of anyone planning to distribute ethanol or gasifier stoves. Defining sub-categories of prizes might be possible where a specific prize for very early stage deployments was made with a lower results threshold defined, but the impacts might be small. A prize which set a target for sales to low-income households of a solution which meets WHO standards would involve the creation of a wholly new solution outside of the current market players, and would be a technology focused prize, with limited short-term impacts even assuming a solution exists. Limiting the prize to a single technology, such as LPG, of course runs the risk of creating barriers for other more nascent technologies, at least in theory. But the degree to which such a risk exists is difficult to assess and arguably any new product which offers all the benefit of LPG but at lower cost should find a place in the market.

The optimal approach will vary from market to market. Where an existing technical solution is already dominant in a given market a focus on expanding access to this technology is likely to have greatest immediate impact. Where more than one solution is widely available favouring one of these would not be desirable. Attempting to stimulate any market through an external stimulus brings risks. Unless the intervention is carefully designed an innovation prize could distort the market, reinforcing existing monopolies and driving activity which is not necessarily market optimising. A detailed economic appraisal of the market should be carried out prior to launch. Judging the right level at which to provide incentives is complex and needs detailed analysis and consultation with stakeholders.

Any interventions will also have consequences for other linked markets. Growth in LPG use in Ghana will reduce demand for charcoal, affecting the livelihoods of those who currently produce, transport and sell charcoal. Moving to clean cooking solutions of any kind will displace dirty fuels and the jobs associated with them. But for poor consumers increased use of LPG by better-off households might reduce the cost of charcoal as supply would exceed demand. This is an 'impact' which it might be interesting to try to track.

4.2 CROSS REFERENCE TO PRIZE OUTCOMES

From the earlier analysis we saw that for mini-grids the key challenge is demonstrating a commercially viable and scalable business model. Could a prize **aiming to stimulate the market help?**

The industry view was that mini-grid businesses are trying to do this already trying to this so they would be unlikely to change strategy significantly as a result of a prize. But a prize might help with legitimisation and could make it easier for innovators to mobilise funding if the prize purse was substantial. **A prize would help draw the attention of national governments to the potential of mini-grids and meeting the prize could only happen in a country where the policy environment was not obstructive.**

Demonstrating deployment of commercially operated mini-grids at scale might result in increased awareness and interest amongst host country governments and improvements in the policy environment which would in turn result in improved capital flows. So a 'market stimulation' type prize might be of some potential value – though largely through the visibility it would create. The prize might create a 'buzz' around mini-grids which might help with issues of legitimisation. Against this it was argued that the substantial levels of donor funding flowing into this area will drive the required change anyway.



GUIDE
Stage 2

For more on stimulating markets.



GUIDE
Stage 3

For more on considering obstructive policy environments.

4.3 ACCESS TO FINANCE

Finance is a component of energy access (and WASH) TIS and is an issue across almost every technology. The majority view of our experts was that the industry already has the tools and instruments and is perfectly capable of creating effective financing vehicles. The reason finance does not flow is primarily about risk, not lack of clever financing instruments.

Interviewees saw effective PPPs as key for larger projects. For smaller projects they suggested that a challenge might be created to encourage portfolio investing, and create new types of partnership to reduce risk. This might help create greater predictability for investors. One of the South Asia interviewees suggested bundling of projects with standard documentation to enable investors to better understand risk, an idea which could be applied to grid-connected electricity generation.

Raising funds and investing them takes time, and results in terms of significant growth in sales to consumers is likely to take several years. This is a critical issue common to a number of TIS but an area where innovation prizes probably have a limited role.



GUIDE For more on changing the
Stage 2 policy environment.

4.4 GOVERNANCE AND POLICY REFORM

Government and the policy environment are an aspect of both a TIS itself (the structure), and of the external environment of a TIS. Legitimation and the institutional aspects of a TIS are clearly critical to its success. A technology innovation involves different actors coming together to create networks and influence governments, policy advisors, funders, and the media in ways which are supportive of the innovation. This is a complex process, with additional challenges in a context of weak governance and high levels of corruption. Could an innovation prize help alter the policy environment?

Many of the experts we interviewed expressed scepticism about using a prize to incentivise policy reform. Indeed some interviewees were sceptical about the ability of a prize to have any impact on energy access issues given that they are complex and require major policy shifts. In the round-table meeting conducted by the Kenya Climate Innovation Centre the participants believed public-private partnerships were 'difficult to make work'. The assumption in this paper is that trying to use a prize to directly incentivise changes in national government behaviour would be unlikely to be effective, though we are aware that attempts have been made to use prizes to influence leadership behaviours (the Ibrahim Prize for Achievement in African Leadership is perhaps the best known example.) Apart from anything else, such approaches would be difficult for multilateral or bilateral donors to fund.

A better approach might be to try to involve a part of government – for example, a specific agency, or a local authority – and have them play a role within a plan that involves other actors. Policies often evolve from trials on a small scale, in one district or city: so-called policy experiments. Often these are motivated by energetic local leaders/administrators. These may create niches where technologies can evolve with a certain degree of protection until they are ready to compete on a more level playing field.

Another option might be to support a TIS in other ways so that the chances of achieving legitimation are increased. A 'prize' might encourage existing actors in a TIS to work together in new ways, and might bring in new actors, with a resulting increase in the influence of the TIS on policy makers. In other words a growing body of evidence, and expanding community of interest, over time increases the likelihood of the innovation being adopted. For this to be likely governance structures within a country would have to be capable of being influenced.

4.5 CONSUMER AWARENESS

Prizes have been used by public bodies to solicit ideas for public education campaigns, the process of gathering ideas itself being an educative process. Typically the prize purses are small with recognition being the primary reward. The Stop Bullying Video Challenge run in the US is an example. Recently, the International Livestock Research Institute (ILRI) launched a prize for ideas on how to effectively communicate with pastoralist communities about the benefits of index-based livestock insurance. Similar techniques and approaches might be applied to some of the awareness issues cited by experts we interviewed.

Any intervention focusing on engaging people, organisations and consumers creating consumer awareness, and more importantly demand, would have to be in support of a specific product or class of products where it could clearly be shown that issues of value, quality, price and availability were not the main constraints. Where such conditions obtain a prize might be used to generate novel and effective ways to engage the consumer. Where a number of legitimate product providers are active in a market care would have to be taken to ensure any intervention did not favour one company over others.

Awareness prizes also work best where the target audience is clearly understood, another reason why focusing on a specific class of products in a specific market is advisable. As well as generating ideas for how to raise awareness of products, prizes might also be used to help design consumer education about proper use of a product, for example the appropriate use of an advanced biomass stove.

SKILLS

It might be possible to incentivise creative and effective collaborations between capacity building entities/training providers and client businesses, thereby creating models of good practice for others to follow. The African Management initiative is a social venture partnering with top African business schools to try to address the skill gap faced by innovative SMEs. Part of their operating cost is recovered from fees. There is a market for higher education and professional qualifications, and for profit models might be viable. For more basic technical and salesforce skills it may be more difficult to persuade individuals to pay for training. Many donor supported programmes provide training for free, and some even pay an attendance allowance. Where non-commercial solutions are under consideration solvers may want to see evidence of future funding to support whatever solution is created. Whether a prize could help in this area was not entirely clear, but the idea might merit further research.

4.6 ROLE OF THE 'GRASSROOTS'

The issue of **grassroots** involvement is interesting and deserves some discussion; it cuts across many of the prize outcomes. Most of the interviewees who raised this did so in the sense of 'is the prize just going to be a competition for graduates of Ivy League colleges or are poor people themselves going to be able to shape the solutions?' There was a strong feeling that the reason many interventions produce disappointing results is that the end user is not sufficiently involved. This is a good challenge and suggests that a prize programme should look at ways to involve the 'grassroots' in the problem solving and judging processes. This is more about which actors are involved in an innovation system rather than functions.

As an activity in its own right, 'grassroots innovation', does not obviously lend itself to an innovation prize approach, and none of those we interviewed suggested it as a specific focus. By its very nature grassroots innovation tends to be localised and context specific, and there appear to be very few examples of successful bottom-up initiatives being widely replicated. Indeed the value of grassroots innovation may lie more in the 'democratisation' of innovation efforts, allowing communities to influence change, rather than as a 'source of new products and models' which can be standardised and copied, an approach which would anyway imply a linear concept of innovation very different from the systems approach adopted in this paper.

For the Ideas to Impact programme we took the view that it would not be possible to generate solutions at scale in the energy access sphere just using grassroots processes. However, there are opportunities to involve the 'grassroots' in finding viable solutions to specific challenges, e.g. productive applications of energy to support the economics of mini-grids, consumer education, and product design.



CLIMATE CHANGE
ADAPTATION
Section 3.1



GUIDE
Stage 2

For more on grassroots innovation

4.7 DISTRIBUTION

Distribution can be both an aspect of a TIS (market development) and, where companies are focused on selling a range of third party products, a TIS in its own right. In either case a range of technologies may be deployed in managing and operating the distribution function. As far as energy products are concerned 'distribution' is an innovation system at a fairly early stage of development with a lot of experimentation going on amongst the few actors in the space. A prize might help to shine a spotlight on the problem area and incentivise a network of more solvers to join the small community currently working on these issues. Distribution companies including the informal sector, some transnational corporations (Total, Coca Cola, Unilever, etc.), manufacturers of energy/WASH consumer durables, small-retailers, some NGOs, Climate Innovation Centres and other incubators, and philanthropic foundations might all be engaged. A prize might accelerate innovation by encouraging more cross sector collaboration benefitting a number of technology specific TIS where distribution is a major challenge in building market.

Ascertaining effective, transferrable ways in which existing distribution infrastructure can be leveraged to accelerate product distribution to the last mile would be a value-add initiative. But identifying an appropriate intervention for this problem area proved complex. Energy product markets in developing countries are still early stage and evolving, with a considerable amount of experimentation happening. Detailed discussions with a range of companies, industry bodies and umbrella organisations like Lighting Africa and the Global Alliance for Clean Cookstoves led to us identifying significant risk that a prize incentivising specific practices could distort the market and potentially impede rather than foster growth.

The problem we are trying to address is multi-faceted and there is insufficient clarity on the best ways to address individual component issues. To run an inducement prize we would need to be able to define the 'problem' narrowly enough for the evaluation of proposed solutions to be possible. But any intervention would also need to guard against overly influencing the market in any specific direction by prioritising one specific sub-component of the problem over others. We considered prizes focusing on sales force motivation and retention, penetration of community networks, and engagement with the informal economy. We concluded that focusing on any specific aspect of distribution risks privileging one area over others, and the chosen area may not be as relevant for some actors as for others. The industry view is that broad-based experimentation is still required at this stage of market development.

4.8 AFTERSALES SUPPORT

Aftersales services as we have seen is closely linked to distribution as the ability to receive back and replace faulty goods is part of the distribution challenge. We believe distribution is the more fundamental challenge. The observations above concerning the difficulty of identifying an appropriate intervention for an innovation prize for distribution would apply also to aftersales.

4.9 MARKET INFORMATION

Lack of market information is a challenge and efforts are being made by some funders to fill the gap. Given the nascent state of most of the technology markets under consideration here market information will have to be provided as a public good for some time. Few companies could afford to pay a commercial rate for such data. Given this, it is difficult to see how a 'prize' could solve the challenges.

5

NEXT STEPS

Based on the conclusions presented above we decided to focus on cooking with LPG as a potential area for testing prizes. We chose to do this in Ghana because the government is engaged in a major policy reform, with support from the LPG industry and multilateral funders. Ghana has its own gas reserves and a developed LPG infrastructure, and various market studies have been carried out as part of the policy reform process. The government has ambitions to increase the proportion of households using LPG from the current 20% to 50% by 2030.

LPG is the only clean cooking option capable of meeting the needs of large numbers of households in the immediate term. There is no alternative available in the market. In choosing to work with LPG we recognised that we would not be reaching the poorest sections of the community. But genuinely clean cooking solutions which are affordable for the poorest households do not yet exist. We decided to favour a fuel we know brings major health benefits to those who can afford it, rather than focus on low cost biomass stoves which have limited health impact.

Through conversations with local government officials and other key stakeholders we identified three areas where an innovation prize might help. These three areas are:

- Incentivising the local LPG distribution businesses to reach out to more geographically remote households and lower income groups.
- Raising public awareness about the reasons for the policy changes.
- Finding a solution for the reuse/disposal of old gas cylinders.

These ideas are the subject of a more detailed research focus which will result in detailed prize designs being presented to the government of Ghana. The prizes will be implemented alongside the policy reform process and link in with activities planned by other key stakeholders. See www.ideastoimpact.net for further information.

6

CONCLUSIONS

Through a series of expert interviews a wide range of challenges in the field of energy access were identified and evaluated. Each of these challenges was then analysed using a TIS model to enable us to conceptualise the problems. Most of the challenges identified were not primarily about technical issues but about market building, investment, human capital and the policy environment. These are areas where innovation prizes have not been used extensively and where robust evidence of the effectiveness of a prize is virtually non-existent.

Ideas for how innovation prizes might contribute to finding solutions were identified in a number of the problem areas.

- Some of the challenges around clean cooking might lend themselves to the use of innovation prizes. Public awareness, business model innovation and some technical fixes might be achieved through prizes. In most cases detailed study of a specific technology and specific market would be needed to design an appropriate prize. The TIS model might be used to develop a detailed diagnosis of the challenges faced by an innovation in a given context, and might help identify appropriate points for prize based and non-prize related interventions. Innovation prizes would be most likely to succeed where aligned with other complementary activity.
- An innovation prize might also help to raise awareness of the potential of commercially operated standalone mini-grids. This might be a multi-country or global prize with winners most likely in countries with non-obstructive policy environments.
- Innovation prizes might be applied to issues of public awareness and behaviour change across a range of products and services. Engaging directly with end users is advisable in improving the design of solutions.
- There may be scope to use an innovation prize to stimulate the creation of skills development products for particular skills gaps. This requires more investigation.

Other areas of challenge such as financing, policy reform, and distribution infrastructure for consumer durables, would appear to be less easy to influence through innovation prizes.

Specific innovation prizes will be tested in Ghana in a further phase of the project to assess their effectiveness as a tool.

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