WORLD BANK GROUP

ESMAP
Energy Sector Management Assistance Program

Results-Based Financing in the Energy Sector

CASE STUDIES

November 2012

This report was prepared by Vivid Economics (http://www.vivideconomics.com), GVEP International (http://www.gvepinternational.org), Council on Energy, Environment and Water (http://ceew.in), and Climate & Energy Solutions (http://climate-energysolutions.com) under contract to the Energy Sector Management Assistance Program (ESMAP), a multi-donor trust fund administered by the World Bank. It accompanies the report "*Results-Based Financing in the Energy Sector: An Analytical Guide*" published by ESMAP in January, 2013 as part of a broader activity titled 'Results-Based Funding for Energy Sector Development: Knowledge Products' (Project ID: P127532). However, unlike the main report, this output has not been subject to full peer review and editorial responsibility therefore lies with the authors. Further details on Results-Based Funding can be obtained from the ESMAP website at http://www.esmap.org/.

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Results-Based Financing in the Energy Sector: Case studies

Report prepared for ESMAP

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1 Improved stoves for schools in East Africa

An RBF intervention to incentivise improved cooking stoves

Section Contents:

This case study, prepared by GVEP International, on the market for cleaner and more efficient cooking in schools in Kenya and Uganda illustrates that the economic framework outlined in the main report is fit for choosing and designing an RBF mechanism in real world circumstances.

It follows the logical steps as set out in the analytical guide: first, whether the situation is appropriate to consider an RBF mechanism; second, what are the risks the potential agents can bear; and third, what form an RBF mechanism could take. It concludes with a brief outline of a possible design based on the analysis.

Figure 1. **An improved biomass stove in Kenya**

Source: GVEP

1.1 Introducing the challenge

Despite offering large cost savings, take-up rates of improved stoves are low

1.1.1 Problem definition

Many schools in Kenya and Uganda provide hot meals for pupils and, as a result, are large consumers of biomass. Cooking arrangements are generally inefficient. In Kenya, more than 95 per cent of around 20,000 institutions (schools, colleges and hospitals) use fuelwood as the main source of energy for cooking and heating water.[1] Only 10–15 per cent of educational institutions have switched from the traditional open fires to fuel-efficient institutional stoves,[2] and only a small number of schools use biogas for cooking. In Uganda the penetration of efficient stoves and the use of biogas are even lower. In general, schools employ their own cooking staff, and purchase fuelwood and food directly.

Most biomass used in the traditional form of cooking is harvested from natural forests at a highly unsustainable rate. Between 1990 and 2010, the area of forest in Uganda fell by 26 per cent, equivalent to a rate of deforestation of 88,000 ha per annum.[3] The rate of deforestation in Kenya is approximately 50,000 Ha per annum, resulting in fuel scarcity in many rural areas.[4] Despite this, government energy policy in both countries has tended to focus more on petroleum and electricity, and less on the development of the biomass energy sector.[5]

For schools, the cost of fuel for cooking is high—and rising. In densely populated areas, purchasing and transporting large quantities of firewood is expensive. A typical 300-student school in Kenya uses on average 69 tonnes of fuelwood per year at an estimated cost of US$63 per tonne.[6]

Cooking solutions that reduce schools' operational costs, as well as fuel consumption and pressure on natural resources, can be provided by several local manufacturers and traders. Hence, the annual value of savings for a school investing in efficient stoves that reduce fuel consumption by 50–70 per cent could be between US$600 and US$2,000, a sum which could be reinvested in educational opportunities such as additional teachers, tuition fee reductions, more books or improved facilities. There may also be opportunities to use the carbon markets, which are reasonably advanced in the region, to further boost the revenues of these projects, although most carbon cookstove initiatives in these countries have focused on the household segment of the market, and often exclude institutional stoves from their target group and baseline assessment.

[1] V. Matiru and J. Schaffler (2011) Market Transformation for Highly Efficient Biomass Stoves for Institutions and Medium-Scale Enterprises in Kenya, UNDP

[2] RETAP (2000) Report on monitoring and evaluation of RETAP projects in Kenya

[3] Senior Forest Officer, Ministry of Water and the Environment, Uganda

[4] E. Kituyi (2002) Lost opportunities: wood fuel data & policy development concerns in Kenya

[5] V. Matiru and J. Schaffler (2011) Market Transformation for Highly Efficient Biomass Stoves for Institutions and Medium-Scale Enterprises in Kenya, UNDP

[6] Based on a recent GVEP International survey of schools in Kenya

Improved institutional stoves in Kenya can range from US$1,200 to US$3,000 depending on cooking capacity.[7] In Uganda, where institutional stoves are usually brick-built in situ, the equivalent costs would typically be greater than those in Kenya. Broad price ranges for biomass cookstoves and biogas systems are presented in Table 1.

Table 1. **Price ranges for biomass cookstoves and biogas systems in Kenya and Uganda**

System	Expense category	Amount
Biomass cookstove	Retail	US$1,200–3,500
	Maintenance	US$70–200 every 2–3 years US$1,000–1200 every 8 years
	Annual reduction in firewood consumption	60-75%
Biogas system	Retail	US$19,000–70,000
	Maintenance	1–3% of retail price per year
	Reduction in firewood consumption	50–75%
	Additional sale of residue as fertiliser	US$2,200 per year
	Additional savings from maintaining latrines	US$600–1,200 per year
Previous firewood consumption		6–16 tonnes/month (depending on the size of the school) equivalent to around

Sources: Personal contact with Mutsinzi Jean Nepo, CTDP/ASOFATE on 18th September 2012; JEEP (undated) Energy Saving Stove (http://goo.gl/dKRvs , accessed 10th September 2012); African Review (19th October 2010) Biogas systems the way forward for Kenya? (http://goo.gl/ZEvyH, accessed 18th September 2012); Ashden Awards for Renewable Energy (May 2010) Case study summary Sky Link Innovators, Kenya (http://goo.gl/Kqqrx, accessed 18th September 2012); Personal communication with Samwel Kinoti, Skylink Innovators on 18th September 2012; Samwel Kinoti (2012) Presentation: Appropriate Waste Water Treatment System with Value Addition for Schools; and GVEP International (2012) Biogas (http://goo.gl/Ifyjk, accessed 18th September 2012)

Institutional biogas systems offer a range of additional benefits over other institutional stoves, an important one of which is the saleable, good-quality fertiliser produced by the residue. However, they are a viable proposition only in larger rural schools with access to a significant number of cattle. Biogas systems based on latrines are not widely used due to technical and cultural acceptability challenges. In addition, many of the foods consumed require cooking over firewood for long periods of time, and biogas meets only 50–75% of the energy requirements. We estimate, therefore, that only in a few circumstances would a more expensive

[7] GVEP International (2012) Kenya Market Assessment – Sector Mapping (Confidential Document)

biogas system be the economically favourable option. An example of a school biogas digester based on latrines and cow dung is presented in Box 1 below.

Box 1. **Biogas: Thumaita East Girls' Secondary School, Kenya**

The school has secured funding to install a bio-latrine system using both human and animal waste to partially meet the needs of its cooking system. It keeps a variety of animals, and grows a large proportion of its own food. Tenders to install the system have been submitted, ranging from US$47,000 to US$70,000.

Figure 2. **Comparing wood supply for one semester with the equivalent in biogas**

Source: GVEP

The school currently has extremely old institutional cookstoves, all reliant on fuelwood, with maintenance carried out annually by local stove manufacturers. It also has a petrol generator for lighting. The woodpile in the picture above will last for approximately one school term (semester).

The World Bank is providing 90 per cent of the funding for the biogas system, with the school having to contribute 10 per cent up front. Financing this up-front cost is a challenge, requiring parents to contribute extra funds. The cost of purchasing fuelwood has been a recurring problem for the school. The installation of the biogas system could largely eliminate these costs.

The market for institutional stoves is currently dominated by small-scale entrepreneurs and micro-businesses. Kartech Engineering, described in Box 2 below, is an example of such a business. In Kenya, the Improved Stove Association has around 500 members, including manufacturers, installers, traders and other participants in the value chain. One of the larger players in the market, Rural Technology Enterprises Ltd, has attracted considerable funding through UNDP and the Global Environment Facility (GEF) and is producing around 15 stoves for schools per month. In Uganda, the Biomass Energy Efficiency Technology Association has 26 members making institutional stoves. A small number of businesses outside of the association also supply quality stoves. Farouk, one of approximately 15 businesses in Kampala that manufacture stoves for schools, sells around only three per month, finding it difficult to acquire customers due to the high initial costs to the school.

Box 2. **Improved biomass stoves in Kenya: the case of Kartech Agencies**

Kartech Agencies Ltd, a manufacturer of institutional cookstoves, is based in an industrial part of Nairobi. The business employs 17 staff and ‘specialised artisans’ who produce cookstoves for institutional and domestic use. It also offers periodic maintenance as a follow-up service and to ensure that clients are satisfied. Most institutional stoves are sold to restaurants and small hotels that recognise the potential for the economic savings, and that are better able to pay up front.

Figure 3. **Kartech’s shop front (left) and installed cookstove boilers (right)**

Source: GVEP

Through GVEP’s loan guarantee fund, Kartech (along with three other cookstove enterprises) has gained support from a financial institution. This model enables Kartech to identify schools that wish to buy institutional stoves; once vetted by the lender, the approved school will put down a 30% deposit, after which the funds for the total loan are paid to the manufacturer in two instalments. The school then repays the financial institution, with GVEP covering part of the credit risk. After delivery of the cookstove, the school has up to two years to repay the loan.

The existing business model used by manufacturers such as Kartech Engineering focuses on the construction, sale and installation of stoves. In preparing this case study the authors asked stove makers and schools about alternative approaches. Different ideas were discussed, such as school meals being prepared off site and delivered to the school, or of the school kitchen being owned and operated by a third party who would be paid a fee to supply meals. Manufacturers were reluctant to move into this area. These small businesses are not keen to stray from their core competencies of manufacturing, and consider that venturing into a new field would be difficult given the existing financial constraints in their business. Furthermore, the remote location of many schools, and the logistics involved for the service provider, would make it difficult to coordinate delivery or monitor the service. The schools we interviewed were also not in favour of these ideas. They already have cooking staff, many of whom live on site, and that there is a perception that the cost of the meals would be greater if a third party provided them.

In short, there is a significant problem of scale, with a reasonable number of potential solution providers available. The challenge is accelerating the adoption of more efficient cooking methods by schools, and accelerating the growth of the market for such appliances in a sustainable way. In addressing this challenge, there are four key barriers that will need to be overcome.

1. Lack of benefit awareness: although many institutions may have heard about improved cookstoves or biogas, they are not fully aware of the economic benefits of these products.
2. Limited capacity of stove manufacturers to, a) promote growth in their market and, b) plan and execute the development of their businesses in order to capitalise on such growth.
3. Lack of quality standards: some stoves are of low quality and break down within months of installation, disincentivising prospective buyers. Similar quality issues exist with biogas digesters. This has been a particular problem in previous interventions.[8] Furthermore, while the Global Alliance for Clean Cookstoves (GACC) is developing an international standard for domestic stoves, we are unaware of standards being developed for institutional biomass stoves.
4. Lack of cash and/or credit, a) for schools to make the up-front investment in more efficient alternatives, and b) to enable local manufacturers to invest in the working capital and productive capacity necessary to support growth. Box 3 gives an example of successful intervention in the credit market for institutional stoves.

[8] Anna Ingwe (2005) Assessment of the Improved Stove Production Centers, GTZ

1.2 Policy objectives for an RBF mechanism

There are three distinct objectives

Policy objectives can be formulated in relation to this problem statement in a number of ways. The way a policy objective is expressed will influence the decision on whether or not to use an RBF mechanism. For the purpose of this case study three distinct types of objective have been formulated.

- Objective type 1: Stimulate the delivery of efficient cooking solutions to schools by the private sector, with an emphasis on facilitating the emergence of a commercial market at scale. This has the lowest cost for donors and governments, but may take time to reach significant volumes.
- Objective type 2: Rapid installation of efficient cooking methods in all schools within a defined timeframe. Such an approach could potentially achieve a high impact on biomass use.
- Objective type 3: Encourage the emergence of radical and innovative approaches to meeting schools' food requirements. This type of objective might be adopted where existing approaches are regarded as inadequate to meet the scale of the challenge. For example cooking facilities in a number of schools might be owned and operated by a single business which earns a fee for service. The business has an incentive to operate as efficiently as possible in order to maximise profits. Alternatively meals might be prepared off site and delivered to schools in the locality.

The theoretical framework developed in the main paper will be applied to each of the three types of objective, leading to a discussion of the opportunities and implications associated with the potential use of RBF instruments.

1.3 Application of the framework, parts 1 and 2

The first two parts focus on choosing between an RBF and a conventional intervention

1.3.1 Step 1

RBF-type instruments can be considered if the policy objective is to increase output in a market, create a new market or increase efficiency in procurement. All three types of policy objective outlined above potentially fall within these categories.

However, an RBF instrument is not necessarily the only approach to addressing the problem. Government could employ various policy instruments through mandates and regulations, as the Kenyan government appears to be planning to do. Schools could be required to install efficient cookstoves of a certain standard. State-funded schools could be provided with capital budgets to finance stoves, while private schools might be given incentives to finance the investments themselves. This may, however, be incompatible with social and equity objectives, especially if there is a risk that the funds required to cover the capital costs of the installed stoves come at the expense of educational facilities or result in higher school fees. For state-sponsored schools, a mandate would effectively be grant financing as they and are funded by the Ministry of Education, and therefore this can be considered in step 2.

A further approach to growing the market would be to facilitate credit through the creation of a large revolving fund, or the provision of a credit line through a financial institution. However, to the extent that any such initiative is supported through the use of (concessional) funds from development partners, this again represents a subsidy, and the appropriate question is whether that subsidy to financial institutions is provided through conventional means or through an RBF approach. This is discussed below.

1.3.2 Step 2

The second step in the decision framework deals with the risk transfer from the principal to the agent, and with the trade-off between the incentives and the higher cost of achieving the results that the agent will incur. In a pure RBF application, all delivery risk would be borne by the agent. The level of risk that can be transferred will depend on how well the agent is able to manage such risk.

A number of agents could be eligible to receive RBF payments. For this case study we have narrowed them to four likely candidates and analysed their ability to manage the risks inherent in an RBF approach. There are three potential agents for a purely private-sector-focused approach:

- manufacturers/suppliers of the equipment can be rewarded for installing good-quality stoves;[9]
- schools can be incentivised to make the decision to purchase a more efficient stove;
- financial institutions can be encouraged to provide loans to schools for the purchase of stoves.

[9] We were not able to identify a potential provider of outsourced cooking services.

A fourth possible agent is a company that is part state-owned, part private-sector-owned, created for the purpose of accelerating the uptake of more efficient cooking technologies. This type of structure has been used successfully in Bangladesh to promote sales of solar home systems. Such an entity could be incentivised by governments or donors to meet specific targets for the penetration of improved stoves in state-owned schools or other educational facilities.[10] This might take the form of a government/donor agreeing certain targets with the company, such as the percentage of schools with improved cookstoves in a certain area, and disbursing funds when targets are met.

The theoretical framework identifies a number of preconditions that the agents in question need to meet in order for an RBF approach to be viable. Two of these preconditions are presented in Table 2, along with the capability of the agents to meet them.

Table 2. **Capability of the different agents to fulfil the preconditions**

	Manufacturer	School/client	Financial institution	Public–private partnership
1) Sufficient access to up-front finance	Low and not very scalable	Poor	Good	Reasonable
2) Sufficient institutional capacity	Limited	Limited	Good	Likely

Source: GVEP International

1.3.3 Step 2 continued: Preconditions (i) sufficient access to up-front finance

Access to capital is a major barrier for both schools and manufacturers of institutional cookstoves and biogas systems. The cost of capital tends to be high in East African countries and, for smaller businesses, such as the typical manufacturers in this market, access to financial markets is limited. Schools also find it difficult to access loans. According to dealers who were interviewed in a study on improved stove manufacturers in Kenya, the main reason for low uptake of the improved institutional stoves is the lack of consumer credit. As discussed above, this could potentially be overcome by including a credit provider for enterprise and/or consumer financing in the design of the RBF instrument.

A manufacturer would normally require a down-payment of 60 per cent, although this can sometimes be less. The remaining 40 per cent is paid after installation. However, manufacturers find that once the equipment is installed, the incentive to repay the supplier credit may be reduced, and they spend time and resources recovering the second instalment. Clients are unable or unwilling to pay a larger instalment up front. This, in turn, has an impact on the manufacturer’s ability to pay for materials and labour necessary for production,

[10] Governments would often be the principal of an RBF scheme, particularly in an area such as education. Potential designs range from managing output-based disbursement (in procurement) to advance market commitments and voucher schemes. Here we consider the government as a possible agent.

resulting in increased lead times and therefore costs. In addition, the collateral they have to provide in order to gain finance from banks or other financial institutions limits the amount of credit they can provide.

Nevertheless, the manufacturers have a reasonable ability to finance around 50 per cent of the costs up front[11], but can offer this on only a limited scale, thus losing the benefit of economies of scale and thereby limiting the growth potential. The challenge for schools to obtain financing for more than 30–50 per cent up front is a further barrier to the market achieving higher growth rates. The example above shows that for a more expensive biogas installation, even 10 per cent of the cost is a significant burden to the school, requiring lengthy fundraising efforts.

Access to capital should not be a problem for financial institutions, though smaller micro-finance organisations may have liquidity challenges. A large public–private partnership (PPP) should not have problems securing capital. The cost of capital could be lowered through credits lines, soft loans or partial guarantees.

However, capital is likely to be a major issue for providers of innovative solutions, unless they are large companies with healthy balance sheets—in part because banks or other financial institutions will be unlikely to support unproven business models, and in part because the financing requirements will be greater than in the case of pure manufacturers and installers of equipment.

1.3.4 Step 2 continued: Preconditions (ii) sufficient institutional capacity

For both principal and agent, sufficient institutional capacity is a necessary precondition to consider RBF approaches to support market development. The principal administering the RBF scheme needs to be able to drive an efficient monitoring and disbursement process, which is likely to be delegated to a managing agent which may be a government department, a parastatal organisation, a financial organisation or an NGO. For East Africa, identifying a suitable managing agent should not be a challenge.

For institutional stove manufacturers and biogas constructors, the capacity to deliver quality stoves and biogas digesters in far larger numbers is limited. Maintenance contracts could add to the challenges companies face in meeting targets. The lack of credit facilities and tight margins have encouraged cost-cutting, resulting in the production of low quality stoves and biogas units. Few manufacturers can deliver to high standards with reasonable warranties. Thus, additional technical assistance will be necessary to ensure that this precondition is met.

Training may be required to familiarise lending institutions with the technology, and to enable them to assess and manage risk. Soft loans or partial credit guarantees may also be necessary to stimulate lending on a sufficient scale.

Schools generally lack the expertise to commission a quality stove or biogas unit, or to assess the quality of an installation. Manufacturers would need to be trained and qualified to ensure that schools are not carrying excessive risk.

[11] Information obtained in interviews

The capacity of providers of 'innovative solutions' will depend on their resources. A large company with related business might conceivably have the capacity to deliver a solution. Small businesses and start-ups are unlikely to have the managerial capacity or human resources required to deliver a solution at scale in a short time frame.

1.3.5 Step 2 continued: Preconditions (iii) Summary of preconditions

This analysis suggests that schools are comparatively less appropriate agents due to limited awareness of the technology and limited access to financial resources to fund the investment up front. Manufacturers will also need access to loans before they can take up the risks of financing more installations. Both enterprise and consumer financing for these products present risk to the financier – credit assessments involve resources; collateral might not always be available; and schools might default.

On the other hand, financial institutions and a government-backed PPP should not have difficulties in fulfilling the basic institutional or financial preconditions under RBF approaches, and would be more suitable agents.

There appear to be no potential providers of alternative solutions, which raises questions about capacity and the availability of capital. Where the policy objective is to encourage innovation, an RBF instrument is unlikely to be the optimal solution. Some form of up-front innovation grant might be a more appropriate starting point. The remainder of this case study excludes 'innovative solution providers' as a possible option

1.3.6 Step 2 continued: Detailed risk/incentive trade-off

This section explores the issue of possible agents, particularly with regard to their ability to handle the risks associated with an RBF scheme. The various agents identified are assessed within the matrix developed in the theoretical analysis. There are five key risk areas, as Table 3 sets out. Each area is investigated in detail following the table.

Table 3. **Capabilities of the possible agents to cope with RBF-associated risks**

		Manufacturer	School/client	Financial institution	Public–private Partnership
1)	**To what extent are the results under the agent's control?**	High level of control over results in terms of quality	Good control over results in terms of operation	Limited control over quality of results, but control of quantity	Good control over quality of results and quantity
2)	**Is there a clear 'line of sight' for the principal to the results?**	Clear	Clear	Clear	Clear

	Manufacturer	School/client	Financial institution	Public–private Partnership
3) Does the necessary investment stretch the agent's balance sheet?	For individual installations, no. For a rapid scale-up, yes	Yes, schools have difficulties finding a budget for an installation and credit is rare	Dependent on the size of the institution Smaller micro-finance institutions may have liquidity issues	Unlikely, but government perhaps unwilling or unable to borrow
4) Is the cost base largely variable?	Largely variable	The installation as well as the operating costs are treated as fixed costs	Yes, loan officers and monitoring costs proportional to number of loans	Variable
5) How long can the time horizon be for RBF payments?	Short (months) after installation	Mixed, with incentives for installation and operation (1–2 years)	Longer 1–2 years	1–2 years, perhaps longer

Source: GVEP International

To what extent are the results under the agent's control?

The various agents have control over different aspects of a potential RBF scheme. Depending on where the emphasis is placed, one agent might be more suited to bearing risks than others.

In the case of more efficient stoves or biogas units for cooking in schools, both the installation and, to a certain degree, the maintenance are under the control of the installer who is responsible for providing good-quality stoves or digesters. The school, on the other hand, has limited control over the quality of the installation, but a reasonable degree of control over the operation of the stove or biogas system.

A financial institution providing credit to a school or stoves business has limited control over the quality of work completed by a contractor, but it does have the ability to cease providing credit for contracts involving poor-quality providers. They have a high level of control over the quantity of installations through the number of loans provided. Financial institutions could increase their control of the quality of installations if they were to employ inspectors to ensure that installations meet agreed quality standards. However, this would add to their costs and hence potentially reduce the attractiveness of the scheme. In contrast, the number of eligible manufacturers could be limited to ensure that only good-quality products are installed. This discussion will be returned to in step 3.

A public–private collaboration is likely to commission work by a range of providers, but would be able to control both quality and quantity through inspections and the effective management of supply contracts.

Is there a clear 'line of sight' for the principal to the results?

A clear line of sight exists where the overall outcome is linked to a small, measurable and verifiable number of outputs. In the case of institutional stoves or biogas systems, this 'line of sight' is very strong since the number of operating efficient units is verifiable with reasonable costs and corresponds directly to the overall aim. The verification of installed stoves or biogas plants can be fairly simple, but is more time-consuming and costly if the emphasis is on operation of the stoves over time rather than only the installation.

Where a government-backed public–private entity is the agent, inspections could be used to verify quality, and manufacturers may need to be qualified and accredited. In this case some form of independent audit of the programme may be desirable before funds are disbursed. This would be in addition to the regular checks performed by the project itself. The purpose of an external audit is to provide the donor with confidence in the results being reported by the project.

Does the necessary investment stretch the agent's balance sheet?

The investment costs range from US$1,000 to US$3,500 for improved biomass stoves, and from US$20,000 to US$70,000 for biogas systems. The manufacturers in the East African market in are usually micro- or small businesses with limited production capacity and low annual turnover. In order to scale up their production, most would need to expand their facilities. Access to finance is limited for these businesses, and their creditworthiness is not always assured.

In the current setting of a slow-growing market, manufacturers can cope with receiving part of the funding following installation, but only for a small number of installations at one time. As discussed above, many manufacturers do not have the necessary working capital or facilities to be able to respond to a surge in demand.

Placing all of the risk on manufacturers in an RBF mechanism, whereby payment for the product occurs only after its verification and successful operation, would create capital requirements beyond the means of most of existing businesses. This might be less of an issue if larger businesses could be persuaded to enter the market, but otherwise the timeframe for RBF payments would need to be short (see below). Even if a business can borrow, the cost of capital is likely to be high. Start-up businesses hoping to serve a market yet to be created may need philanthropic financing to enable them to become established.

A similar issue arises where the school is the recipient of RBF payments. Most schools have insufficient capital to meet the initial costs and limited ability to borrow. Placing all of the risk on the school would again render the RBF mechansim unattractive unless there is also considerable support to access loans.

For financial institutions as agents of an RBF scheme, access to capital at affordable rates is less likely to be a constraint. For this reason, financial institutions are the most able to bear risk in this area among the possible private sector agents under consideration. However, they are likely to do so only where the technical solution being provided is tried and tested, and low –risk.

In cases where a government-backed public-private partnership is providing the capital, access to finance should not be an issue.

Is the cost base largely variable?

For institutional stoves and biogas plants, the fixed costs to manufacturers are limited to premises and core staff. Variable costs (materials, transport, day labour) dominate their microeconomics, which would favour an RBF support system. Schools, however, treat the costs of energy supply for cooking as a fixed cost with usually a fixed budget per school term or year.

For existing financial institutions or government, costs are largely variable since they are related to loans and inspections, and are therefore highly correlated with the level of activity and the results.

For a PPP costs would be largely variable, although there would be some initial set-up costs.

How long should the time horizon be for RBF payments?

The installation of efficient stoves and biogas digesters can usually be completed in a matter of weeks, and payments linked to installation should therefore be made soon thereafter (1–3 months after installation). This reduces the amount of capital required for the manufacturer and hence the level of risk it bears. If the incentive is placed on the long-term operation of stoves, the time horizon for RBF payments is longer and the manufacturer requires a much higher level of expensive working capital, which increases the risk premium of an RBF scheme (i.e., it becomes less attractive). Manufacturers suggest that payment beyond this time horizon (of 1-3 months) would not be an attractive business proposition.

However, certain payments to incentivise quality installations and sustainable operation might be made within a few years after installation. As discussed, payments for the installation only might not incentivise product quality sufficiently to result in lasting products. Nevertheless, the availability of financing for manufacturers to scale up is low and the cost of capital is high, thereby diminishing manufacturers' ability to cope with long repayment periods. A split in the payment, with the bulk of it being due on installation, might be the best option, with a further payment triggered by evidence of successful operation of the product after two or three years.

For example, under the Kenya Domestic Biogas Programme (KENDBIP), a subsidy is given to the consumer to fund the up-front costs of the system; however, 10 per cent of the subsidy is retained for one year after the installation. Where there are technical problems with the system, the retained portion of the subsidy is used to pay for the necessary repair. This bears some similarities with the suggestion above, although notably the manufacturer, which has most control over product quality, faces no additional incentive.

1.3.7 Conclusions from Step 2

These considerations of risk allocation suggest that, for efficient cooking solutions in schools, an RBF mechanism could be designed but that it would need to create incentives for both the solution providers (manufacturers/installers) and the financial institutions needed to provide the capital. Such a scheme is most likely to succeed if it is based on existing market transactions where the products and manufacturers are known. This is because financial institutions will not lend when the product is unproven and the risk associated with it cannot be evaluated. Product installers would need to be able to recover their costs over a short time scale, with schools repaying debt to a financial institution.

Where a PPP is incentivised to provide a rapid scale-up of efficient stoves and/or biogas installations for schools, the company would carry most of the risk, receiving RBF payments only on proof of successful operation of the improved facilities after a specified period. However, such an entity should be in a position to bear more risk than small manufacturers or individual schools.

1.4 Application of the framework, part 3

The third part of the framework is concerned with designing an RBF mechanism

Based on the above exploration of RBF-type instruments and their risk distribution, this section considers how a programme might actually be designed. Depending on the choice of principal and agent, a large range of options are available. A hybrid approach involving several different agents may be necessary to ensure success.

1.4.1 Overview

This analysis considers three possible interventions in light of the six design dimensions developed in the theoretical framework. In order to provide guidance on applying the methodology, agents have been specified for each option, although there are a number of other possibilities. The three examples provided are illustrative, and it is crucial that the design of an actual programme reflects local realities. The examples selected could potentially work in Kenya or Uganda subject to more detailed design work.

1. In order to reduce the up-front investment costs for the school, an RBF payment can be made to the manufacturer on the installation of stoves as a direct discount on the purchase price. This can start high and be progressively reduced over the life of the programme; the average might be of the order of US$500 (20–30 per cent of the stove costs). This would help address the issue of the school's ability to pay.
2. Even with an RBF payment reducing the purchase price, schools might not be able to finance the loan needed to purchase the stove. The savings from reduced firewood consumption may not be sufficient, particularly if interest rates are high, the loan duration is less than two years and/or if local firewood prices are low. Consequently, an RBF instrument for financial institutions to reduce the burden of lending might be considered. A reduction in the interest rate of 10 percentage points for an 18-month, US$2,000 loan, repaid quarterly, is worth around US$175. Care would need to be taken to ensure that RBF incentives that target financial institutions do not undermine existing risk management and credit control procedures; RBF payments linked to loan repayments would have the benefit of reinforcing good lending practice.
3. As a separate example, designed to satisfy the second policy objective set out above (rapid government-induced scale-up), an RBF scheme may be designed whereby payments from donors could be made to a public-private entity set up to manage the programme based on the number of stove installations (or a percentage of schools with improved stoves). These could be either per-unit or lump-sum payments. The PPP entity would also earn revenue from carbon credits generated.

In addition to these RBF instruments, the achievement of the policy objective and the success of the outlined RBF schemes will require non-RBF-type support. The two main areas where this support is likely to be important are as follows.

– In scaling up their production and improving the quality of their products, manufacturers will require technical assistance as well as up-front grants to enable them to invest in better materials, tools, workshop space and staff training.

– As explained above, financial institutions are not yet lending regularly for the installation of efficient stoves. To attract the financial sector, partial loan guarantees could be used to overcome the initial reluctance to lend. This would need to be combined with technical assistance to the financial institutions to enable them to understand the market, identify quality manufacturers and assess the risk of such a loan.

Table 4 provides a summary of the three illustrative schemes in the context of the six design dimensions.

Table 4. **Summary of six dimensions for three potential RBF schemes**

	Product subsidy	Interest rate subsidy	Targets-based scheme
1) Who should be eligible?	Manufacturers	Local financial institutions	PPP
2) What is the condition for triggering a payment?	Installation of stove	Signing of loan agreement	Number of operational stoves after one year
3) What is the structure of the payments?	Price subsidy tied to quantity (sales)	Interest rate subsidy	Lump-sum or per-unit payment based on achievements
4) How large would the RBF payments be?	Approximately $500 per stove, enough to make the payback time on the investment attractive	Around $400 per loan, enough to make the repayment affordable within an 18-14 month timeframe	Likely to be more expensive than the other options though not necessarily if carbon revenue included. Needs to be at a level which provides sufficient incentive for the agent
5) What is the role of the principal or programme sponsor?	Monitoring and providing subsidy	Monitoring and providing subsidy	Monitoring and technical advice as well as providing subsidy
6) What would be the duration and exit strategy?	Minimum 3 years, ideally longer to allow market time to develop. Level of subsidy would phase out over time as schools come to understand benefits	Minimum of 3 years but ideally longer. Subsidy would phase out as schools increasingly understand benefits of stoves and lenders gain confidence	Duration will depend on number of installations targeted. There may be sufficient revenue from carbon credits to enable the PPP to become self-financing.

Source: GVEP International

1.4.2 Who should be eligible?

The first two proposed RBF interventions would, in combination, target both manufacturers and financial institutions. Within these groups it will be necessary to define eligibility criteria. An economic analysis would favour allowing all potential stove suppliers to participate. If payments were for the sustainable operation of stoves rather than installation, there might be no need to limit potential manufacturers, since only those stoves that are still functioning after 1–2 years would be eligible to receive payment. But the analysis in the section above suggests that the payments to manufacturers would be required soon after the installation of the stove (see step 2). As such, there needs to be a way of controlling quality and the standard of installations so that public funding is not wasted. Ideally, manufacturers should be certified before they are able to benefit from the RBF support.

Financial institutions that provide financing for such clients are often semi-formal, such as Savings and Credit Cooperatives (SACCOs), or micro-finance institutions. Levels of regulation vary from country to country. Some care would need to be exercised in identifying financial institutions suitable to participate in the scheme.

In the third case, there would be only one eligible agent—the PPP company receiving RBF funds. Under this approach, the company might subcontract a number of stove manufacturers and would establish an appropriate level of quality which those subcontractors would be required to meet.

1.4.3 What is the condition for triggering RBF payments?

The trigger for payments should be linked as closely as possible to the desired outcome in order to reduce perverse incentives and mismanagement. At the same time, risks should be placed with those that are best able to control/bear them.

Ideally, the objective would be to have stoves or biogas units operational for a long period of time, and link the trigger of payment to the operational performance. In the case of manufacturers, a trigger based on the operation of stoves or biogas digesters will have drawbacks. First, the manufacturer does not have full control over the operation of the units; it can control only the quality of the construction and installation, which will only partly influence the durability of the product. Second, the availability of finance will restrict manufacturers' ability to respond to incentives that are linked to triggers far in the future.

Thus, in this case it is likely that the trigger will need to be the verified installation of a good-quality stove (80 per cent of incentive payment), possibly combined with a further payment after one or two years if the stove or digester is in good condition and operational (20 per cent of payment).

Similarly, in the case of an RBF scheme involving financial institutions, these institutions are better able to control risks around the installation rather than operation of the appliance. The signature of the loan agreement might be the most practical way to trigger payments. Payments would then subsidise the interest rate charged to the consumer by paying the difference to the financial institution, and thereby indirectly reduce the risk of default since part of the return is guaranteed. Incentives for financial institutions should be tied to repayment of the loan so that normal due diligence and credit management processes are not compromised.

Where a company established through a PPP is the agent, it is better able to take long-term risks, as discussed in step 2. In these cases the emphasis of the trigger can be more on the *operation* of the stove. The trigger for the payment could be linked to achieving pre-agreed milestones and closely related to the overall objective (a target level of adoption of stoves). If carbon revenue is included in the design the PPP will have a strong incentive to ensure the stoves function for many years. Specified lump-sum payments could be made for each predetermined increase in the percentage of schools equipped with efficient stoves.

1.4.4 What is the structure of the payments?

The economic analysis demonstrates that an RBF instrument can achieve the same results with a range of approaches, such as minimum-quantity targets, price guarantees, and per-unit subsidies. Under this framework, quantity-regulating instruments are preferable if costs are uncertain, and price instruments if demand is uncertain. The costs of institutional stoves are relatively certain: input prices for metal sheets and clay are given, and operational costs between firms do not vary widely. Demand is low but not uncertain or fluctuating. Fixing the price might therefore not be necessary, and for practical considerations and consistent costs amongst manufacturers, fixed subsidies per unit may be most effective.

Likewise for financial institutions the structure of the payments would depend on the number of loan agreements signed and repayment of those loans. Part of the interest would be paid from the RBF scheme rather than the customer over the repayment period.

For a scheme implemented through a PPP, the payment could also be coupled to the quantity of installed stoves. Alternatively, a non-market payment structure could be used, such as a lump-sum payment specified ahead for an increase in the penetration of efficient stoves in schools from 10 per cent to 25 per cent, with further payments for each step increase of 5 per cent.

1.4.5 What would be the size of the RBF payment?

Manufacturers might receive a per-unit contribution of, for example, US$500 from an RBF scheme towards the cost of installation, split between immediate implementation and subsequent operation in the manner discussed above. An RBF payment linked to a loan might be of the order of $300-400 for efficient cookstoves, or $2,000-5,000 for an institutional biogas system. This would be sufficient to make the loan repayment affordable within a reasonable timeframe, although further detailed work would be required for accurate calibration.

For the PPP the level of RBF payment will need to be set at a level which provides sufficient incentive for the PPP entity to establish itself and then continue to operate. This mechanism is likely to be more expensive than the options outlined above but the economics could work if the origination and sale of carbon credits is part of the design. This option would require detailed design work to determine the optimal size of the RBF payment.

1.4.6 What is the role of the principal or programme sponsor?

In many circumstances, the principal funding the RBF mechanism will not manage the scheme but outsource the management to a third party, such as a financial institution or a specialised managing agent or NGO. In the case of market-led scale-up, there will be no procurement elements. Where RBF payments are being targeted at stove makers and financial institutions, the principal's role will be the overall management of the scheme, disbursement of payments to participating agents, and provision of any capacity building support required. In the case of the PPP approach the principal would be involved in establishing the entity and would then monitor progress reports and disburse funds as appropriate.

1.4.7 What is the duration of the RBF intervention and the exit strategy?

For both the subsidy to manufacturers and the loan support, a minimum period of three years would be needed to allow the market time to respond. Over this period the level of the subsidy would reduce and eventually phase out as the economic benefits of the stoves become more widely understood and as financial institutions gain confidence in lending to schools. The design of the programme should ideally allow for a longer period than three years with milestones defined in terms of level of take up of stoves triggering a review of subsidy levels. These review milestones should be discussed with stove makers in advance.

For the PPP approach the duration of the RBF intervention depends on the number of stove installations being targeted. If carbon revenues form part of the business model it is conceivable that after a few years the PPP could become self-financing.

1.4.8 Risks

Supply-side limitations

Due to the insufficient supply-side capacity, large-scale subcontracting of the existing private sector parties would be unlikely to work in Kenya or Uganda. Nevertheless, a more modest project, targeting schools in specific areas (e.g. where firewood costs are especially high and rising) might be possible, provided that the initiative is proportionate to the supply capacity and there is an element of capacity building as well as provision for product quality. This might also be a constraint for a PPP scheme, but if carbon credits can be generated the PPP will have a strong incentive to find solutions to the supply bottleneck.

Windfall profits

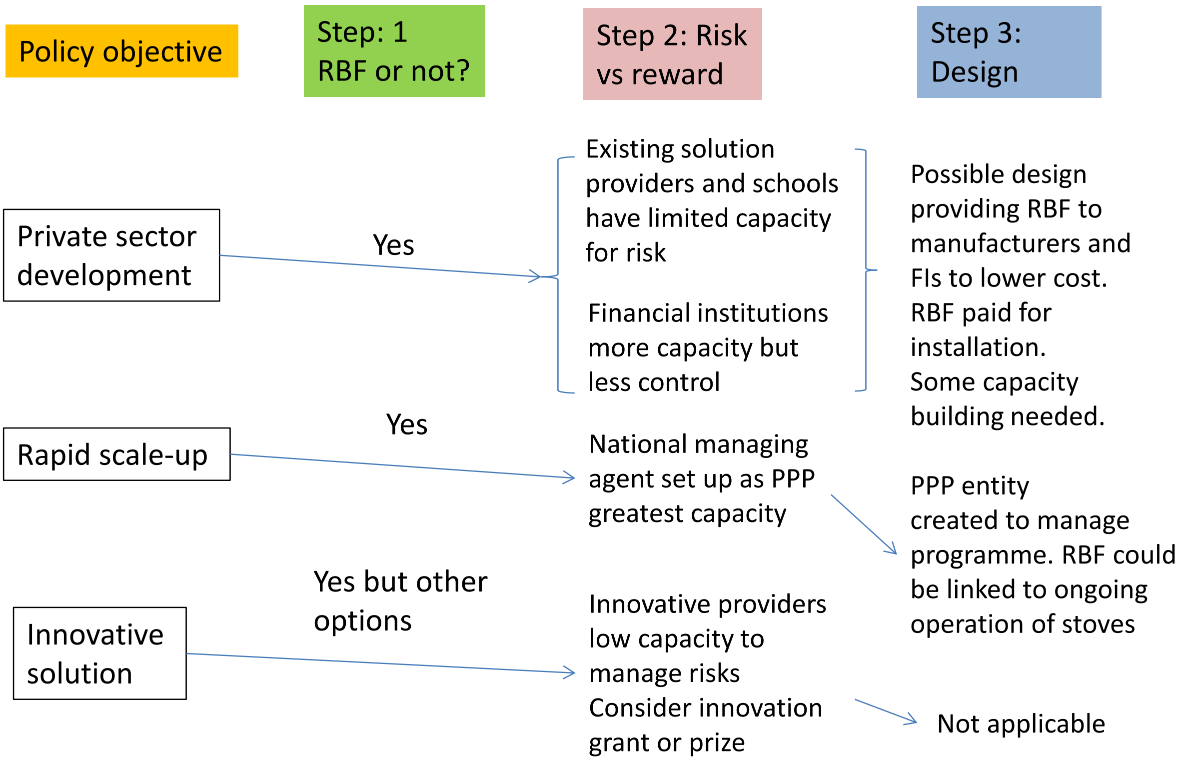
Industrial-scale production of institutional stoves would not necessarily reduce the costs of the product substantially because margins are tight and most costs relate to the purchase of materials. Nevertheless, the subsidies paid to manufacturers might need to be phased out over time in order to avoid a market collapse at the end of the RBF scheme arising from a sudden change in price and thus demand.

Prices for institutional stoves in Kenya and Uganda appear to vary by around 10% between manufacturers, suggesting that a fixed subsidy for all manufacturers may not lead to notable differences in profits. Quotes for biogas installations appear to vary more widely. However, lower-quality manufacturers are able to undercut those prices by a larger margin, introducing a risk of overly generous subsidies to these firms if a fixed price is paid per unit. If a selection and certification process could ensure a specified standard for stoves, windfall profits for those enterprises could be avoided.

1.5 Conclusions

A variety of RBF instrument designs could be devised to increase the output in the market for efficient and high-quality stoves for schools. They depend very much on the policy objective. Figure 4 below summarises the main conclusions for each of the options considered in this case study.

Figure 4. **Summary of options and conclusions**



Source: GVEP International

One RBF instrument that could be considered is the financing of perhaps 20–30% of costs for manufacturers of efficient stoves. This would need to be repaid reasonably soon after installation, because manufacturers' capacity to take up financing to fund the investment is limited and borrowing costs are high.

However, this would need to be one element of a package of policies. For manufacturers of institutional stoves and biogas digesters, an RBF instrument alone would be likely to leave too many risks with the agents. Parallel non-RBF funding for capacity development and quality standards would also be required. This might include up-front grants for business development, supply-side capacity building measures (e.g. business development grants), along with technical assistance and advice on the manufacturing process with a view to ensuring quality.

In conjunction with an RBF mechanism for stove manufacturers, financial institutions could be encouraged to provide financing to schools at reduced interest rates. In this case a school would borrow from a financial institution to purchase a stove and the RBF payment would subsidise repayments of that loan over the loan period. This may not be sufficient to overcome risk perceptions, so partial loan guarantees and assistance in understanding the market might also be necessary.

For a more rapid scale-up scenario, setting up a company as a PPP might be an effective way to install stoves, either directly employing masons or subcontracting work to existing installers. Such a company would be rewarded for achieving a certain level of installations. A government-backed business might be better able to manage the risks associated with an RBF mechanism, and may find it easier to borrow against such a scheme compared with small producers or clients. A PPP entity would be well placed to realise the value of carbon credits generated by the programme. This would provide a significant revenue stream for the business. The level and timing of RBF payments would need to be sufficiently attractive to induce a private sector partner to work at risk. The relationship with government would have to be clear, with the PPP entity able to operate in a transparent manner as a commercial business free from political interference.

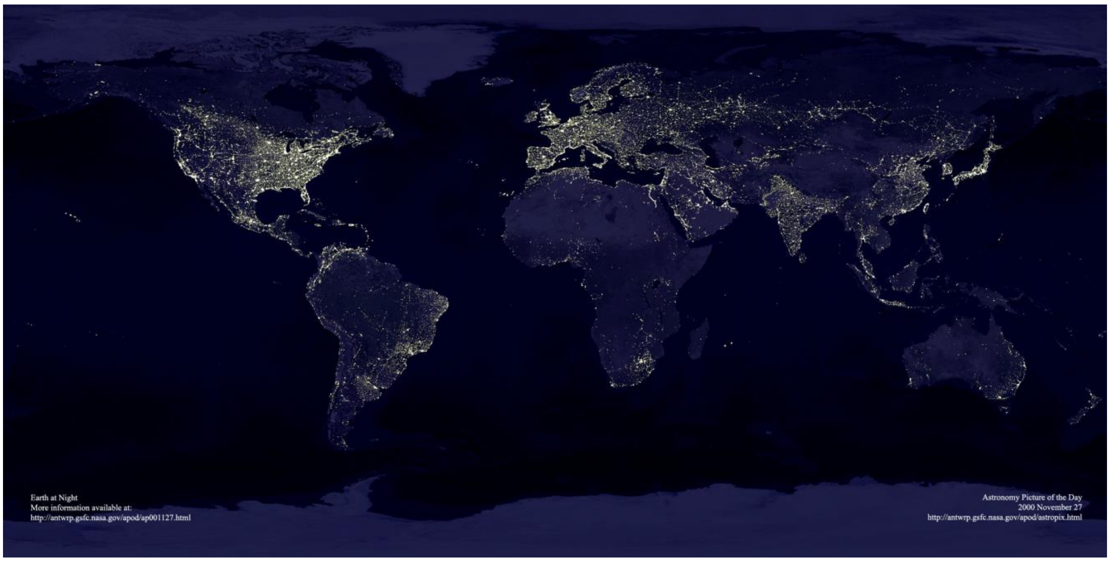
2 Lighting Africa

An array of RBF mechanisms to tackle multiple challenges

Section Contents:

Insufficient access to modern lighting persists in sub-Saharan Africa, and while the market for affordable off-grid lighting products has given rise to refined business models and product innovation, uptake has not yet reached scale and is unlikely to do so for some time in many countries. The Lighting Africa programme is considering an array of RBF schemes to incentivise expansion into new markets with currently low sales volumes. This case study prepared by GVEP International applies the conceptual framework developed by Vivid Economics in the main report to consider what RBF instruments may be most suitable.

Figure 5. **An image of the world at night, indicating the relative scarcity of lighting in Africa**



Source: *Data from Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC; visualisation by Craig Mayhew and Robert Simmon, NASA GSFC*

2.1 Introducing the challenge

What is holding back clean, off-grid, lighting and energy?

While the market for affordable solar products in Africa has given rise to refined business models and product innovation, uptake has yet to reach scale and is unlikely to do so for some time. Where solar products are available, they are not always of desirable quality and price for the consumer. The Lighting Africa programme is therefore considering RBF schemes to incentivise expansion into new markets with currently low sales volumes. This case study explores possible agents for an RBF scheme and considers their ability to meet the necessary preconditions and to take on the associated risks.

The case study presents the outline of four potential RBF mechanisms that each tackle a specific challenge to wider dissemination of off-grid lighting products:

- first, import costs are high for many landlocked countries and render products in these markets less affordable, which can be addressed through covering (partially) the import costs faced;
- second, establishing a distribution network in a new market may require incentives based on pre-agreed results;
- third, consumer financing remains a challenge to the sector which may be overcome by a combination of RBF- and non-RBF-type instruments;
- finally, in order to induce a step-change in the technology and overall consumer experience, a prize may be offered to manufacturers that develop a product meeting predefined specifications, or that create business models that deliver much higher levels of consumer satisfaction.

While Lighting Africa gave advice on the development of this case study, the views expressed in here do not necessarily reflect those of Lighting Africa, IFC or the World Bank.

2.1.1 Problem definition

Approximately one fifth of all households worldwide (or 1.3 billion people) are without electricity.[12] This affects many aspects of life, from adults conducting business to children studying after dark. As of 2010, total grid connection rates across Africa stood at 43%, leaving 590 million people on the continent off-grid. A number of countries, such as Burundi, Central African Republic or Chad, have grid connection rates below 5%. Similar rates are found for rural populations in Tanzania or Kenya.[13]

Although part of the solution, grid expansion will take decades, with the poorest African households unlikely to benefit. Many African nations have seen far slower grid expansion than a number of Asian and Latin American regions, for example, and would require growth of more than 2% per annum to counteract the effect of population growth alone.[14] This leaves those who are off-grid to use polluting, dangerous and/or

[12] International Energy Agency (2012) *World Energy Outlook* 2012 – Chapter 18: *Measuring progress towards energy for all*

[13] Lighting Africa/Dalberg (2010) *Solar Lighting for BoP – Overview of an Emerging Market*

[14] ibid.

expensive sources of light, the most common being kerosene (also known as paraffin).[15] Kerosene is the primary light source for 53% of households in Africa, and accounts for nearly half of the total expenditure on lighting.[16] Kenya's Environment Minister, Ali Makwere, has stated that the country spends more than US$600 million per annum on importing kerosene.[17]

The International Energy Agency has estimated that the median expenditure of off-grid households on traditional energy for lighting is US$5.50 per month,[18] while Lighting Africa research and other estimates suggest that 'base of pyramid' African households spend 10–25% of their monthly household budget on these fuels.[19]

Sometimes these expenses for lighting cannot be met and households rely on poor-quality lighting from kerosene lamps or candles. This limits business capacity, the ability to complete household chores, and children's study time. In addition, around 160 million people in Africa and 500 million people worldwide have a mobile phone subscription but no easy or cheap means of charging their phone.[20]

The impact on health of conventional off-grid lighting sources is also a concern, with emissions from fuel-based lighting causing chronic respiratory disease and injury. Kerosene can be clean if used in pressurised stoves; however, it is mostly used with cheap wick lamps, leading to high smoke emissions.[21] Injuries are a serious risk and, while there are no studies for Africa, research suggests that each year 2.5 million people in India suffer severe burns from accidents with lamps.[22]

These traditional lighting methods also affect the environment. Lighting Africa has calculated a conservative estimate for kerosene-linked CO_2 emissions in African households of 20 million tonnes. Toxic solid battery waste also has a detrimental effect on the environment, with hundreds of millions of dry-cell batteries sold annually for lighting in Africa.[23]

Alternative solutions to lighting exist but have not yet reached a fully commercial level. Solar home systems have been promoted since the 1980s by various donors and non-government organisations (NGOs), but technological and affordability constraints have prevented a large uptake. Over the last decade, focus has shifted towards portable lights, with and there is considerable optimism about this technology and its significance. Indeed, the solar lamp has been selected by the British Museum and the BBC as the 100th object in their series *A History of the World in 100 Objects*.[24]

[15] World Bank (2010) *Expenditure of low-income households on energy*

[16] Lighting Africa, GIZ, country census data.

[17] Lighting Africa (2012) *Kerosene-free Kenya: Rio +20 agreement to increase access to clean energy,* accessed at http://goo.gl/We3hR

[18] International Energy Agency (2011) *World Energy Outlook* 201 - *Energy for All: financing access for the poor*

[19] Lighting Africa/Dalberg (2010) *Solar Lighting for BoP – Overview of an Emerging Market*

[20] GSMA (2010) *Green Power for Mobile*

[21] HEDON (2010) *Household Energy Network*

[22] US National Institute of Health (2009)

[23] Lighting Africa/Dalberg (2010) *Solar Lighting for BoP – Overview of an Emerging Market*

[24] BBC (2012) *A History of the world – Solar powered lamp and charger*, accessed at http://goo.gl/uKdw

A range of companies from start-ups to large international corporations manufacture and retail small lighting products. The scale of these operations is currently small and affordability is a barrier, but the technology is improving quickly and business models are maturing.[25]

Lighting Africa is a programme initiated by the World Bank and the International Finance Corporation (IFC) to support private sector players as well as government in increasing access to modern lighting, with a focus on small consumer products. See Box 3 for further details on Lighting Africa.

Box 3. **Lighting Africa programme**

Lighting Africa is a joint World Bank–IFC programme, which was launched in September 2007 with the aim of improving access to clean, affordable lighting in Africa. The programme is working to facilitate and accelerate the development of sustainable markets for affordable, modern off-grid lighting solutions for low-income households and small enterprises. The programme has been implemented in Kenya, Tanzania and Ghana, and more recently in Ethiopia, Nigeria and Senegal. In addition, Lighting Africa is working with governments on regulatory and policy barriers.

The goal is to facilitate the transition from fuel-based lighting to clean, modern lighting in two steps. First, mobilise and support the commercial sector to supply high-quality, affordable, and clean lighting to 2.5 million people by 2012. Second, to then eliminate market barriers so that the private sector can supply high-quality, modern off-grid lighting products to the 250 million people in Africa without electricity by 2030.

Lighting Africa is part of the global Solar and LED Energy Access programme, an initiative of the Clean Energy Ministerial, which is a global forum encouraging the change to a clean energy global economy. In general, it aims to show the viability of the market to companies and investors by providing information on market size, consumer preferences and behaviour, and on appropriate business models and distribution channels.

Most of the high-quality products in the market for off-grid lighting are solar-powered, and a good number also provide phone charging which is a major driver of demand for off-grid electricity access (see Box 4.) This case study focuses on solar lighting products of the type supported by Lighting Africa.

These products offer clear improvements on traditional lighting methods such as candles and kerosene. Without the kerosene-related emissions, negative health and environmental impacts disappear. Furthermore, although research on the effects of improved lighting on education in Africa is limited, one study in Malawi found that 18% of participating households indicated that increased children's study time and reading was a major benefit.[26]

[25] International Energy Agency (2011) *World Energy Outlook* 201 - *Energy for All: financing access for the poor*

[26] Adkins et al. (2009) *Off-grid energy services for the poor: introducing LED lighting in the Millennium Villages Project in Malawi*

Box 4. **Solar technology as a business opportunity**

One of GVEP's entrepreneurs, Frank Gilbert, lives in Mahina, Kenya, where there is no grid connection; so like other villagers Frank used to travel 12km to charge his mobile phone. Following GVEP business development support, he has invested his savings in a larger 65Wp solar panel, and is now able to charge up to 50 phones per day, with a net income of around US$150 per month.

While solutions other than solar PV exist, lighting manufacturers have mostly taken advantage of the commercial potential of solar technology. In addition to lighting, many of the smaller individual systems can be used to charge mobile phones and power small electrical appliances. There are also possibilities for entertainment—something that is seen by many as a key driver for sales. Research by Lighting Africa shows that illumination from LED-based lighting boosts sales as a result of greater customer attention to displays and encouragement of purchase-oriented behaviours[27]

Based on research conducted by Lighting Africa and the Deutsche Gesellschaft für Technische Zusammenarbeit (GIZ),[28] the initial purchase price of a kerosene lantern is around US$5 in East Africa, while the average solar lantern is US$25. However, depending on local prices, national taxes and usage, kerosene costs can range from US$40 to US$80 per annum, while solar-powered lights need only a change of batteries and LED every two years. Therefore, estimates over a six-year period indicate that a solar lantern would cost around US$55, while a kerosene lamp would amount to around US$365. This is shown in Table 5.

[27] Lighting Africa/Dalberg (2010) *Solar Lighting for BoP – Overview of an Emerging Market*

[28] Ubbink East Africa Ltd. (2012) *Comparison with Kerosene Lamp*. http://goo.gl/MJoN8 (accessed on 10 September 2012)

Table 5. **Relative performance and costs of solar-powered lighting and kerosene lamps**

	Solar-powered LED	**Kerosene Lamp**
Amount of light created	Sufficient to read	Insufficient to read
Initial purchase price	US$25	US$5
Running costs	– Zero in first 2 years. – Replacement of battery and LED every 2 years. – Solar panel to last at least 20 years.	– US$40–80 per year, depending on local fuel costs, national taxes and household behaviour
Total cost of ownership over two years	US$25	US$125 (on the basis of average US$ 60 running costs per year)
Total cost of ownership over six years	US$55	US$365
Unwanted effects	Battery waste	Health-damaging fumes CO_2 emissions Risk of fire

Source: Ubbink East Africa Ltd.(2012) *Comparison with Kerosene Lamp (http://goo.gl/MJoN8)*

The market is also maturing. Despite the lack of standards and import quality checks, the market is starting to see more quality, longer-lasting products with innovative product designs, which are more responsive to the needs of the consumers. Ensuring that consumers understand how to make best use of these products is a challenge, and the greater value for money offered by better-quality products not always well understood. With scale-up and increased commercialisation prices will decrease further, but remain one of the key market barriers.

2.1.2 Barriers to market growth

A study from Lighting Africa, focusing on 15 African countries, surveyed over 70 market players to assess the potential for the portable solar lighting market.[29] All respondents considered the potential to be high, but gave five key challenges to yet higher growth:

- the ability to access finance;
- difficulty in distributing at scale;
- lack of benefit awareness;
- poor-quality products spoiling the market; and
- high taxes and tariffs driving up prices.

In particular, the inability to access finance can create problems along the entire off-grid lighting market chain, which affects both low-income consumers and small and medium-sized enterprises (SMEs): manufacturers face problems in financing R&D of new products; importers struggle with liquidity requirements to purchase products in larger and more efficient shipments; small retailers have limited

[29] Lighting Africa/Dalberg (2010) *Solar Lighting for BoP – Overview of an Emerging Market*

working capital; and customers cannot afford to pay lump sums, requiring credit schemes, which are risky to banks. The last point is arguably the most important challenge concerning access to finance. As discussed below, these features are particularly important in determining the appropriate role for an RBF scheme in this sector.

Another market barrier is the prevalence of cheaper but poor-quality alternatives. Although no clear estimates exist, products which have achieved certification by Lighting Africa for meeting minimum quality standards are thought to be a small fraction of the market for off-grid lighting. In larger markets such as Kenya, manufacturers complain about 'market spoilage' from low-quality solar products, which have negative effects on the perception of the product. In addition, many dry-cell battery torches that do not meet quality standards are disposed of shortly after purchase.

Due to the small market, most African countries lack the standards required to assess the quality of products at the import level. It also appears that consumers lack the knowledge to understand how the systems work and their potential health and environmental benefits. Poor use of quality products (e.g. failing to charge them properly) often results in disappointment and a perception that the products do not work adequately.

2.2 Policy objectives for this RBF mechanism

Objectives include higher market penetration and higher quality

Two objectives have been set for the purpose of illustrating the RBF theoretical framework with a case study on off-grid lighting.[30]

- Objective 1: To increase the number of off-grid lighting products, which fulfil minimum quality standards, sold in challenging markets with currently low sales volumes. (These which might include landlocked countries, and/or failed states, and/or particularly poor countries.)
- Objective 2: To increase the percentage of high-quality products on the market and raise levels of customer satisfaction.

These objectives were chosen based on discussion with Lighting Africa and other stakeholders. Other types of policy objective could be formulated, but this case study focusses on the two objectives outlined above. Below we explore a series of RBF interventions that could be used to meet either or both of these objectives. The discussion follows the structure in the related conceptual paper, consisting of three steps:

- step 1 reviews whether an RBF approach is worth considering as a potential intervention, given the policy objective and market context;
- step 2 analyses whether an RBF approach may be preferable to conventional up-front support in meeting one or both of these objectives in the Lighting Africa context; and
- step 3 provides a more detailed discussion on the possible design of four different RBF mechanisms.

[30] It should be noted that these do not correspond with the objectives of Lighting Africa itself.

2.3 Application of the framework, part 1

Should an RBF mechanism be an option on the table, given the objectives?

In Step 1, a decision is made as to whether to consider RBF approaches or whether the policy objective might be achieved by other interventions such as regulating or preventing an activity, in which case taxes, regulation or bans may be preferable.

2.3.1 Objective 1

Although there is regulation in a few countries in Africa mandating the use of energy-efficient light bulbs, no such regulation exists for portable off-grid lighting. Because in many cases the end-consumer does not have the available finance, a mandate to switch to solar technologies would not be practical; nor would it be enforceable. In addition, it is not clear whether a mandate would result in a (desirable) expansion of the market.

As discussed in the theoretical framework, regulation might be more effective in limiting an activity such as the use of kerosene for lighting. Subsidies for kerosene are still in place in many sub-Saharan countries, which disincentivises the use of solar or other modern off-grid lighting. For example, in 2011, general fuel subsidies in Nigeria, Cameroon and Ghana cost US$7.5 billion, US$600 million, and US$276 million respectively.[31] However, removing subsidies for kerosene can indirectly promote the use of alternatives, but this is politically sensitive as well as controversial from an equity point of view, and may result in even fewer people with very basic lighting. While kerosene can be bought in small increments, a solar lantern was, until recently, a one-off (and therefore significant) purchase.[32]

Tariffs and taxes also inhibit the growth of solar lighting. Costs associated with importing (customs duty) and VAT vary significantly by country. For example, while the East African Community has adopted a 0% customs duty and VAT rate, Ghana’s rates are 10% and 12% respectively. Although East Africa has created an attractive market, Lighting Africa has found through interviews that the procedures can be lengthy, that there is corruption, and that there are sometimes inconsistencies in tax applications. Rwanda, for example, charges VAT on solar products but not on LED products.

While the reduction of taxes for modern off-grid lighting products would certainly help to grow the market, it is questionable whether it will be sufficient to achieve Objective 1. As identified above, there are a number of non-tax-related barriers prevalent in landlocked and Least Developed Countries that prevent the market from expanding here. Thus RBF interventions should be considered as an option to reach Objective 1.

[31] African Development Bank Group (2012) *Fuel Subsidies in Africa,* http://goo.gl/53eAd (accessed 10 September 2012)

[32] Pay-as-you go technologies are evolving but initial costs are still far above kerosene expenditure in order to allow everyone to switch.

2.3.2 Objective 2

Similar considerations apply when analysing the appropriateness of regulation implemented to restrict imports of low-quality products in order to achieve Objective 2. Lighting Africa is working actively with a number of governments, such as the Ethiopian government, on import legislation. Nevertheless, as above, such products might be desirable for a segment of the population for which a higher quality and price is unaffordable. In general, bans and mandates are more likely to restrict the total number of lighting appliances used, which runs counter to Objective 1 and is undesirable for social and equity reasons. Developing and enforcing import standards would help to maintain a minimum level of quality in the market, but is not likely to contribute to the evolution of the technology and thereby make it more consumer-friendly. Translation of industry standards, such as the Lighting Africa Minimum Quality Standard, into nationally accepted standards and import regulation is missing. Therefore, incentivising enforcement is unlikely to be effective.

2.3.3 Conclusion

In conclusion, RBF mechanisms can be considered for both policy objectives, although complementary regulation and other interventions such as reducing taxation and improving permitting will also be important for the growth in the market.

2.4 Application of the framework, part 2

To reach the two objectives, RBF or a conventional approach?

The second step in the decision framework is driven by the possible risk allocation between principal and agent. For this case study, the Lighting Africa programme would manage the RBF scheme and be the principal.

The choice of possible agents is large, since the distribution chain for off-grid lighting products has a number of levels, each with many players: manufacturers of the products, with which Lighting Africa has already close links regarding quality standards and market intelligence, could be agents. Equally, within a country, there are importers, their dealers and retailers, and financial institutions offering enterprise or consumer financing; each of these could be the agents/recipients of an RBF intervention.

Below we analyse the possibility of designing an RBF mechanism for each of these four agent groupings to meet one or both of the objectives stated previously. Following the structure in the conceptual paper, this discussion is split into two elements: first, there is an assessment against a series of key preconditions; second there is a more detailed analysis of the risk versus incentive trade-off associated with choosing an RBF mechanism.

2.4.1 Review against preconditions

The theoretical framework identified a number of necessary preconditions that need to be met in order for an RBF approach to be viable: sufficient access to finance, agent capacity, and principal capacity. As the first two of these preconditions will differ depending on the choice of agent, an assessment against these criteria is provided for four different possible agents as set out in Table 6. In all cases, the principal is assumed to be Lighting Africa and this is covered separately at the end.

Table 6. **Capability of the different agents to fulfil the preconditions**

	Manufacturer	Importer	Dealer	Financial institution
1) Sufficient access to up-front finance	Good on pre-financing sales, reasonable regarding R&D	Variable	No	Reasonable
2) Sufficient institutional capacity	Good	Good	Limited	Reasonable, but largely dependent on country context

Note: Assessments of capability based on GVEP field experience

Source: GVEP

Sufficient access to up-front finance

Manufacturers and global corporations active in this space are usually well financed and have good links to investors.

By contrast, individual importers in a country vary in strength but are usually not able to purchase a large volume of products on credit, unless they have close links with the manufacturer (being a subsidiary, for example) and can obtain special credit terms. Nevertheless, these importers are often of sufficient size to potentially access financing against RBF payments, or have other business activities that can support borrowing.

Further down the distribution chain, local retailers as well as consumers experience problems in accessing financing up front and are unlikely to be ideal agents for this reason. Small shops and micro-entrepreneurs often do not buy more than five products at once (US$100–200 worth of stock). In Rwanda, even importers often buy fewer than 50 products at a time, purchasing every two to three months from Uganda. Nevertheless, having an effective distribution network for lighting products is crucial for growing sales.

Despite falling product prices and innovation, the initial investment for a solar lantern is still beyond the purchasing power of many consumers. Consumer financing for products is not usually available since transaction costs are high and loans risky. In cases where consumer financing is available, mainly as add-on loans for existing and known clients, this does accelerate uptake of products considerably.[33] In countries with a liquid financial system and a reasonable number of financial institutions that are able to penetrate rural areas and offer micro-finance, these banks and micro finance institutions (MFIs) could be appropriate agents for an RBF mechanism.

Sufficient institutional capacity

As with the discussion above, manufacturers and importers are usually mid-sized companies and are able to handle monitoring and accounting systems. A number of manufacturers, such as d.light design, Barefoot Power, Nuru Energy and ToughStuff, have started to tap into carbon finance markets. As carbon finance is results-based, this already provides very stringent monitoring and verification rules. On the other hand, smaller firms that do not have this capacity might be disadvantaged without additional support.

Financial institutions may also have sufficient capacity, but new markets and post-conflict countries may have an underdeveloped formal banking sector, with most lending activities being unregulated, which can complicate the administration and monitoring of RBF payments.[34]

RBF is attractive to public sector agencies who are willing and able to make long-term commitments

Given that Lighting Africa has expressed interest in developing RBF approaches to support the industry, it is assumed that this criterion is satisfied.

[33] Some of the more successful examples have been to link small off-grid lighting products to loans of existing clients are the Kenya Women Finance Trust (KWFT), Faulu Micro-Finance Kenya, or the One Acre Fund, an agricultural NGO in Kenya and Rwanda.

[34] There will also be examples of overregulated financial sectors, in which the incentive to lend for new risky products will also be low.

2.4.2 Detailed risk/incentive trade-off

This case study now turns to the most likely agents in the framework of risk allocation. An RBF scheme could target all levels of the supply chain, from manufacturers to dealers and consumers. Based on the above discussion on preconditions, manufacturers, importers and financial institutions seem the most appropriate agents, but for completeness, dealers are also discussed below. (An example of the pitfalls associated with conventional funding approaches is given in Box 5 below)

Box 5. **Risk transfer to agents/RBF recipients may encourage sustainable business practices**

Traditionally, support to grow distribution from Lighting Africa or other donor programmes has consisted of grants to companies in a range of countries, often chosen through business plan competitions or similar awards. There is at least one case where the growth of the distribution network initiated by grant support could not be continued after the support ended and had to be reduced to one sixth of its size because operating costs were too high.

In this case, more than 100 small shop-owners were selected and trained. In addition they could purchase products on credit from the supplier. This led to a spike in sales, but the nature of the grant support encouraged the rapid uptake by dealers that were not adequately committed, marketing that could not be sustained, and false incentives through credit. In this case, a level of risk transfer to the agent might have been desirable. Payments for growing the market based on results might have encouraged slower but more sustainable growth of the dealer network and the associated marketing effort. A possible implementation of this will be discussed below in Step 3.

In Objective 1, the expected result is higher sales, and importers as well as in-country distribution partners (dealers) are likely to be attracted by RBF schemes to support sales. Objective 2 targets a higher-quality product and a better consumer experience, for which the manufacturer has most control but where other players are also involved.

For each of these objectives in turn, the different possible agents, and the factors affecting the appropriateness of risk transfer implied by an RBF intervention, are discussed below. A summary is provided in Table 7 below.

Table 7. **Possible agents and factors of risk allocation**

		Manufacturer	Importer	Dealer	Financial institution
1)	**To what extent are the results under the agent's control?**	Good control over quality of products. Less control over how consumer uses and experiences product. Limited control over sales volumes.	Good control over results (dependent on the 'trigger' for payment, i.e. actual sales or indirect indicators such as retail outlets). Some control over consumer experience.	Direct control over sales. Potentially high level of influence on consumer's understanding and use of the product.	Good control over sales. Limited control over consumer experience.
2)	**Is there a clear 'line of sight' to the results for the principal?**	Limited for payments based on sales levels. Very clear for quality of products.	Good from a monitoring perspective.	Not ideal from a management and monitoring perspective.	Good from a monitoring perspective.
3)	**Does the necessary investment stretch the agent's balance sheet?**	Not for incremental improvement but possibly for large R&D requiring radical innovation in the product (e.g. battery technology).	Highly dependent on context and country.	Yes, retailers have difficulties expanding sales due to limited finances. Supplier credit is rare.	Dependent on the liquidity of the micro-finance institutions in the respective country.
4)	**Is the cost base largely variable?**	R&D are fixed costs, whereas production is largely variable.	Initially fixed costs will dominate and decrease only with scale and large sales levels.	Yes, largely variable.	Yes, loan officers and monitoring costs proportional to number of loans.

Source: GVEP

2.4.3 Risk/incentive trade-off for Objective 1

a) To what extent are the results under the agent's control?

Manufacturers of off-grid lighting products are typical clients of Lighting Africa support such as technical advice and market intelligence. Lighting Africa has also been working with the manufacturers to develop quality standards. However, such firms do not necessarily engage in the importation and distribution of products within a specific country. As such, they can only partly control sales through manufacturing a desirable product and packaging it well. Other factors that may affect sales are, to a significant extent, outside their control.

Importers often have established links to their in-country distribution network of retailers, for example through franchise agreements. This includes smaller retailers and dealers in rural areas, which are critical to achieving higher sales. These businesses have considerable control over sales and would be a preferred agent to deal with in relation to Objective 1. Nevertheless, establishing operations in a new market carries considerable risks, and RBF payments based on sales might leave large market risks with the importer. Step 3 therefore makes a case for RBF payments based on the number of distribution outlets.

If financial institutions are involved in enterprise or consumer loan products, then the provision of credit will be largely under the control of those financial institutions. The number of loans granted would be in direct correlation to the sales levels and therefore RBF pay-outs.

b) Is there a clear 'line of sight' to the results for the principal?

Ideally, the overall aim and policy objective can be easily observed and verified by all parties. Considering alternatives for measuring the results, sales are the most direct and easily observable indicator linked to policy Objective 1. Due to the portable nature of the products, verification of sales is challenging. The example of carbon finance for such products shows that sampling and verification is difficult. In order to encourage the establishment of distribution networks in new markets, RBF payments might also be based on the number of rural retailers that an importer has established, which would still maintain a close link to the objective. What constitutes 'establishment' of an outlet would need to be defined, with minimum monthly sales levels being an important dimension.

c) Does the necessary investment stretch the agent's balance sheet?

The nature of the enterprises importing solar lanterns varies from dedicated niche businesses to firms that try it as a sideline to existing business lines. Setting up a distribution system in a new market will require an initial capital investment by the importer, perhaps with start-up funding from an affiliated manufacturer which is interested in entering a new market. Often these firms are importing other energy-related products or have other business ventures, and thus have the available capital to enter the solar market. Especially in the initial phase manufacturers do not tend to give extensive credit periods unless the firm is a direct subsidiary, or they have an existing business relationship.

In new and challenging markets, one might expect a lower ability to purchase large volumes of products by these firms. This is, however, highly dependent on the country context. Some manufacturers found it much easier to find appropriate importers willing to take the risk in countries such as the Democratic Republic of Congo (DRC) or Somalia, which are cash-based economies with large disparities in wealth.

As discussed above, retailers face significant hurdles in accessing up-front finance to purchase stock from importers. Supplier credit is rare and their cash flow does not allow up-front investments that go beyond a few products at a given time. Despite many selling other electronic or household items—often in rural areas—solar lanterns are some of the higher-value products compared with the rest of the stock. Retailers cannot be expected to increase their purchases based on the promise of RBF payments without dedicated credit. Financial institutions with reasonable liquidity, on the other hand, should not find it difficult to fund lending activities for small solar products.

In general, when designing an RBF scheme, it should be borne in mind that different agents, even within one group (e.g. importers), vary widely in their ability and willingness to take risk, and that an RBF mechanism may give an additional bias to well-funded firms.

d) Is the cost base largely variable?

Different scenarios need to be distinguished here. In a scale-up and growth phase of an existing market, variable costs will dominate. However, setting up a business in a new market will involve first and foremost fixed and sunk costs. Additional regulatory barriers cost time and money, from business registration to unknown tax and duty schemes for imports. Unless these players are seen to have a sufficient appetite for risk, this may be a factor to favour up-front grants to RBF approaches for an initial phase when aiming to attract distributors into challenging markets.

Financial institutions often operate on a commission basis, with performance targets for their loan officers. Therefore, costs should be largely variable; thereby leaving the risk-driven cost increase for the agent relatively small.

e) How long should the time horizon be for RBF payments?

Off-grid lighting products are consumer goods, and payments to incentivise their sale or purchase can be made very soon after the trade takes place. Depending on the administrative procedures involved and the required verification, this may be one to two months after the purchase.

One option that might be considered is to incentivise after -sales service and prolonged use by providing payments only after one or two years. However, this appears impractical for logistical reasons: tracking and monitoring such small and mobile devices for years after the sale is a challenge.[35] It might be more practical to impose an ex ante limit on eligible products based on quality criteria.

2.4.4 Risk/incentive trade-off for Objective 2

a) To what extent are the results under the agent's control?

With regard to policy Objective 2, to increase product quality and improve consumer experience, the manufacturer is probably the main agent in control of results, although distributors and retailers also have a role.

While the technical aspects of the product are under the control of only the manufacturer, a wider set of issues relates to how well the product performs for the customer, which the manufacturer has only limited control over. Not only is the technical quality important, but also how a customer can get the best out of a product, for example, by charging it correctly. After-sales service is also an important aspect here. Both of these factors are highly influenced by dealers who are in direct contact with the customer and take care of simple repairs or replacements of products. To ensure that the system is operated smoothly and across the distribution chain, some responsibility and control also lies with the importer.

b) Is there a clear 'line of sight' to the results for the principal?

Product quality and customer satisfaction are harder to define and will involve a range of parameters. Certain aspects of the product quality can be measured according to the product specifications, such as the battery lifetime or optimal lumen. If these specifications are set clearly in advance, R&D results can be measured against these performance targets. However, aspects relating to how the customer understands the proper use of the product are less explicit, including clear user instructions and appropriate advice at the point of sale on

[35] Although carbon finance payments have a similar time frame as well as stringent monitoring requirements, they have attracted interest from a number of manufacturers. Devices with GSM communication have also recently appeared in the market, but only in the pilot phase. Monitoring of these devices is considerably easier but could restrict the RBF option to this type of technology.

the right product for the customer's needs. Although these factors are part of a quality product, the 'line of sight' is very poor compared with the technical aspects. Customer satisfaction with a product is not easily measureable and verifiable.

c) Does the necessary investment stretch the agent's balance sheet?
To increase the quality of the product or decrease the price, manufacturers will need to make significant investments in R&D. Some manufacturers, such as Phillips, are large international corporations, but for smaller 'social enterprises' investments for step-changes in battery capacity, for example, may be difficult to fund from their existing balance sheet. Nevertheless, such ventures are often seen attractive for social and impact investors and they may be able to attract additional equity financing to finance research on product improvements. Moreover, research into areas for improving the customer experience, such as user instructions, will use company resources, but it is unlikely that it will go beyond the available budget. The retailers with the greatest customer contact would perhaps need specific training, which they themselves cannot afford, and so this cost would need to be met by the importer or manufacturer.

d) Is the cost base largely variable?
In the scenario for increases in product quality, R&D costs are fixed and not related to volume of sales of that product.

e) How long can the time horizon be for RBF payments?
RBF payments with the aim of fostering innovation, advancing product design and customer experience would be made further into the future (2–3 years), and are likely to target manufacturers as agents. This will reduce their attractiveness for the agent because the associated risks are much higher, which will increase the cost of capital to fund the associated R&D.

For such an RBF prizes could be a viable way to structure the payments, whether for technical innovation or development of business models that deliver higher end-user satisfaction. Prizes have been used to stimulate product design, but have not been tested in the area of consumer experience. The suitability of a prize mechanism will be discussed further in Step 3.

2.4.5 Conclusion

An RBF scheme can be considered in order to foster sales of solar lanterns and may be preferable to up-front grants. Given the analysis of risk distribution, the risk-driven cost increases should be lowest for importers and financial institutions. Nevertheless, the circumstances will vary from country to country, and Step 2 would need to be undertaken when there is an advanced level of detail for a particular geographic context. This implies that designing a regional or global RBF scheme may be challenging, and its success is likely to vary considerably between regions. A flat subsidy fee across Africa or a specific region would attract players to markets that are most profitable and where distribution is least-cost. This would run counter to the objective to sell in new and more difficult markets. The Clean Development Mechanism is a good example, with the majority of projects in only three countries, despite the global scope of the mechanism.

2.5 Application of the framework, part 3

Designing an appropriate RBF intervention

As explained above, there are a number of potential agents which could receive RBF payments in support of the policy objectives. Due to the fact that there are multiple barriers to market growth in landlocked or otherwise challenging countries, addressing only one level of the supply chain is unlikely to result in an effective implementation. In order to achieve higher sales, it will be necessary to establish a distribution infrastructure, increase marketing and improve access to loans for dealers and/or consumers

From the range of possibilities to incentivise these agents, this case study proposes a combination of four RBF schemes, with the following specific objectives:

- reducing and equalising import costs to incentivise sales in landlocked markets,
- mitigating the lack of distribution infrastructure,
- using consumer finance to address affordability to the consumer, without placing too much risk on the respective agent; and
- providing an innovation prize structure, either to foster more R&D at a manufacturer level or to encourage innovative business models.

These are illustrative examples and, depending on the circumstances in a specific country, will need to be adapted (for example, by choosing a different agent) or might not work at all and may require up-front financing.

2.5.1 Reducing and equalising import costs to incentivise sales in landlocked markets

The smaller the market, and the greater the distance from the sea port, especially on poor roads, the higher the price for the end-consumer. A low-cost portable solar lantern can retail for around US$12.5 in Kenya, whereas in Rwanda the retail price is typically US$20.[36] Small importers are often active in these markets. They buy from another importer in a neighbouring country with a larger market, add their margin and retail the products in a country whose market is too small to import in bulk. The Firefly Mobile from Barefoot Power can be purchased in Uganda for U$16 (wholesale) but is sold for US$25 in Rwanda. The combination of clearing times and the inability to import in containers and long freight routes means that some importers resort to much more expensive airfreight. For example, an importer in Malawi is airfreighting around 50% of their stock in order to sell it in a time frame in line with credit arrangements.[37] This is compounded by the fact that landlocked countries tend to be poorer, and purchasing power is therefore lower,[38] which further threatens affordability.

[36] For a d.light S10. GVEP market research.

[37] Private GVEP correspondence

[38] UN-OHRLLS, The Impact of the Global Financial and Economic Crises on the Development Prospects of the Landlocked Developing Countries, 2009

One possible way to achieve the policy objective of incentivising companies to engage in new and untapped markets would be to support the costs of importing the products through an RBF scheme. As an example, the import costs per product for a full container into a large supply hub, such as Mombasa or Dakar, can be estimated. If a company in South Sudan or Burkina Faso imports from such hubs in small batches due to low demand and capital constraints, or uses airfreight, some of the additional cost (especially that which is only caused by low sales volumes that prevent economies of scale being realised) could be compensated. It would be expected that through growth in these markets bulk imports would be possible in time. This would allow the phasing-out of subsidies as import costs per unit decline.

2.5.2 Using results-based support to establish a distribution network in a new market

New markets will require importers to create a distribution network in order to increase sales. A recent study by GVEP suggests that companies using active marketing strategies involving sales people at the village level achieve 75% higher turnover on products below US$100 than companies that do not actively market such products.[39] This typically takes up considerable resources and acts as a significant barrier to firms venturing into such markets. Retailers in the rural target areas will need to be identified, recruited and trained, and marketing campaigns launched. The sales level of the successful companies identified in the GVEP study are possible only as a result of donor funding because, initially at least, operational expenditures on distribution and marketing still outstrip profits from sales. Therefore, results-based payments can be made in order to support this growth and partially cover associated costs to set up an initial distribution network. For the importer, the risks associated with establishing retailers are lower compared with payments based on sales, due to the higher level of control (see Step 2). What constitutes ‘establish’ a retailer would need to be defined and would be likely to include minimum average monthly sales.

Given the high fixed costs involved in setting up a distribution network and the limited financial capacity of many firms that may have to do this, this element may need to include some elements of up-front financing and advice to the companies on marketing and distribution in a particular country. With this in place, further tranches of funding could be linked to the number of dealers trained, or for presence at a market day in a village or introduction of a newly branded franchise. Newly trained dealers would be required to demonstrate a specified level of activity and sales. These can be easily observed and serve as the trigger for payment. Minimum sales levels would also avoid incentives for overly ambitious distribution networks in areas where demand cannot sustain businesses.[40]

2.5.3 Consumer financing

The availability of credit will be a crucial element for the commercial uptake of solar products on a large scale in countries that have comparatively low purchasing power. Similar to the case study on institutional cookstoves, discussed in an accompanying case study, RBF payments might be used to incentivise lending. These can be subsidies on either the interest rate or the principal of the loan.

[39] GVEP (2012) *An analysis of the off-grid lighting market in Rwanda: sales, distribution and marketing*

[40] Most of these businesses will have other income streams through sales of other electrical equipment or hardware.

However, the level of readiness and risk-consciousness of local financial institutions will vary between countries. Informal lending and unregistered businesses might dominate in post-conflict states, which makes monitoring of potential RBF payments problematic. In addition, there may be inadequate institutional capacity to take advantage of the RBF scheme. In such cases loan guarantees might be more practical but would leave greater risks to the principal.

2.5.4 Product innovation prize

If manufacturers are seen to have the financial means to fund large R&D expenditures leading to a step-change in technology, an RBF scheme can be devised based on specific quality standards. This can take the structure of a prize with a lump-sum payment for the first manufacturer(s) to develop a product retailing at less than US$10, for example, with 100 lumen output and at least ten hours of battery life after a full charge. While manufacturers would naturally improve products on an incremental basis, this would be an incentive for a step-change in product technology. Prizes focused on product innovation have been used in the past. One weakness of this approach is that the winning products may never find their way to market. An alternative focus for a prize might be around delivering higher levels of consumer experience and understanding of the 'value proposition' offered by higher-quality products.

Designing effective prizes is technically complex and detailed work would need to be undertaken. While certain specific knowledge is required to define the prize 'challenge', possible solutions might vary widely. An alternative option would be to further develop existing quality standards, although this requires more in-depth knowledge on what features or outcomes are desired. of the desired outcome would be

Table 8 below discusses each of these four case studies against the different dimensions of RBF mechanism design outlined in the main report.

Table 8. **Summary of six dimensions for four potential RBF schemes**

Design dimensions	**Freight subsidy**	**Distribution and marketing support**	**Consumer credit**	**Innovation prize**
1) Who should be eligible?	Importers or manufacturers, satisfying minimum quality standards	Importers, satisfying minimum quality standards.	Local financial institutions.	Manufacturers and other potential players, depending on the prize.
2) What is the payment trigger?	Import receipts as a proxy for sales, if accompanied with checks.	Village-level entrepreneur training combined with minimum sales.	Consumer or enterprise loan agreement.	Product meets specified criteria.
3) What is the structure of the payments?	Per-unit subsidy.	Per-unit subsidy.	Per-unit subsidy on interest or principal of the loan.	Lump-sum payment.
4) Size of payment	Based on bring the end consumer price level with price in a more accessible market, e.g. Kenya	Based on costs of identifying and training a successful local sales representative, plus local promotional activity required to reach minimum sales level	Based on level of subsidy of interest required to make loans affordable to target population	Prize purse would need to be sufficient to motivate potential solutions providers
5) What is the role of the principal or programme sponsor?	Monitoring and providing subsidy.	Monitoring and technical advice as well as providing subsidy.	Monitoring and technical advice as well as providing subsidy.	Monitoring and technical advice as well as providing subsidy.
6) Duration and exit strategy	As demand grows the import cost per unit should fall allowing a phased reduction in the level of subsidy. Duration will be determined by length of time taken to build up volume of sales.	Duration could be fixed in advance, e.g. RBF funds available for 2 years. This could be a one-off injection of funds into businesses to help them build out distribution.	Consumer finance and loans to SMEs could be phased out over a number of years. Subsidies would benefit early adopters. As sales grow SMEs should be able to manage commercial rates on loans.	Prizes are a one-time payment. Duration of the process depends on how long solution takes to emerge.

Source: GVEP

Following the overview given in the table, a more detailed analysis is given below, structured by the six design dimensions of possible RBF interventions.

2.5.5 Who should be eligible?

Manufacturers are the only agents in control of product quality and are clearly favoured for innovation prizes with a product focus. If an innovation prize focuses on business models to deliver higher levels of consumer experience a range of players are likely to be involved, perhaps through a consortium.

Freight subsidies can be arranged either through manufacturers, which could offer free shipment with their products, or through the importers themselves. In order to avoid sub-standard products in the market which will disappoint customers and not be a good use of donor funding, only products that fulfil the 'Minimum Quality Standards' by Lighting Africa should be eligible. Further restricting the participants is likely to result in lost benefits.

For the RBF scheme on consumer loans, local micro-finance institutions or credit cooperatives should be eligible provided that they are registered with a national sector regulator and can comply with minimum reporting and monitoring requirements which are necessary for an RBF mechanism to operate successfully.

2.5.6 What is the trigger that releases payments?

The choice of trigger for the RBF payments is closely related to monitoring and verification; therefore these aspects are considered together. In the case of small portable products, the costs associated with monitoring and verification can be substantial. Monitoring can be undertaken at various levels in the supply chain, but monitoring costs for the principal will be reduced if the agent is at a higher level in the supply chain; as such, importers would be preferable to, on average smaller, dealers.

For the suggested freight subsidy, product sales may be a good trigger for payment as they are controlled by the importer, as described in Step 2. However, the verification of portable products after the sale has occurred might pose a challenge.

As an alternative to sales records, the import of products into a country can be used as a proxy for sales and as the trigger for payment, provided that spot checks and safeguards against re-exports are put in place. Thus, a subsidy to the freight costs could be based on VAT receipts or other evidence of import from the customs agency of the respective country. The limited paperwork of this proxy would be beneficial to the agent and increase the attractiveness of the RBF instrument. Similarly, manufacturers' sales records can be used, although the problem of re-imports remains.

Incentives for the set-up of distribution networks will also need a trigger for payment. For the reasons set out above, the importer as an agent is in control of how many retailers or franchises are operating in a country, but support to set up such distribution networks would be crucial. The number of dealers set up in a particular area or country can be a proxy for the policy objective, although some evidence of minimum levels of sales activity is probably desirable. For example, the payment can be made once a dealer has reached a minimum threshold of monthly sales. In order to keep payments within a manageable timeframe, as discussed in Step 2, these could be paid in tranches, in part directly after the verification of the training, and in part after successfully reaching average sales of 15 lanterns a month, or 100 in six months.

For the RBF scheme on consumer financing, a signed loan agreement for an off-grid lighting product could trigger an RBF payment to a financial institution to either reduce the outstanding principal of the loan or reduce the interest rate. To avoid perverse incentives (such as non-repayment if a large percentage of the loan is already paid) the payment could come after the complete loan repayment as an incentive to the bank. However, this has an influence on the risk allocation (Step 2: factor 5) as RBF payments would be made much later and would therefore increase the risk to the agent. Alternatively, this arrangement could be set up to simultaneously provide a loan guarantee or credit line. The disbursement of the partial subsidy might be given in the case of a successfully repaid loan, but also in the case of a default. So long as the cover is only partial, the bank would have an incentive to get the payment and, in either event, the RBF payments would still be the result of a product being with the customer.

2.5.7 What is the structure of the payments?

Since there is no procurement involved in the example cases examined here, quantity targets appear to be difficult to implement. Moreover, the fact that demand uncertainty is far higher than cost uncertainty means that price commitments would be preferable.

In all cases under consideration here it should be possible to structure the RBF intervention so that payments are tied to reported achievement of agreed triggers. Unless the agents face particular challenges in accessing working capital there should be no need to provide a pre-payment element.

Disbursements for subsidising import costs, supporting the set-up or growth of a distribution network, as well as incentive payments for loans, would be per-unit subsidies, as discussed in the section above, whereas an innovation prize would be a lump-sum payment.

For payments based on loan agreements, a per-unit subsidy is preferable to interest rate support as these consumer loans are very small and the interest is perhaps an important incentive to pay back the loan, which the bank already judges as risky.

2.5.8 How big should the RBF payment be?

The subsidy for freight costs would be the difference between the actual import price and the estimated import price for a bulk shipment with a container, or perhaps the Free On Board (FOB) price, which would be even more easily obtainable and verifiable. This can reduce costs of products by 5–20%, depending on the market, and would be a per-unit subsidy.

Subsidies for setting up a distribution network would be calculated based on the cost to the importer/distributor of identifying and, training local retailers, and the costs of local promotions needed to help the retailer secure a viable volume of sales. As an example of an existing RBF scheme in this area, the Energy for Rural Transformation (ERT) II Project in Uganda provides incentives to encourage solar companies to expand into remoter areas of the country. This incentive scheme is managed by the Private Sector Foundation Uganda, and consists of a US$5,000 grant per area paid out to the first company that expands into a previously unserved area. It appears that selling two solar systems per month in an area qualifies as having ‘expanded’ into a new area. Each company may receive a maximum of US$50,000 through this scheme, and the scheme as a whole has a budget of US$200,000. It is too early to be able to report results. In another scheme, the Ugandan Rural Electrification Agency is planning to operate a special grant programme to further support entry into specific areas, which will be disbursed through ‘output-based aid’[41]. Both of these programmes are in addition to subsidies for customers.

[41] Output-based aid is discussed in the literature review annexed to the main report.

For loan finance support the size of the RBF intervention will be determined by the gap between prevailing interest rates and the ability of the target population to pay those rates. In the case of a prize the 'purse' would need to be of a sufficient size to attract participation by potential solution providers. This will vary depending on the scale and complexity of the challenge and would need careful consideration during the designing of a prize.

2.5.9 What is the role of the principal or programme sponsor?

The objective here is explicitly set as the growth of a private market and distribution chain. Given this, the principal acting in a procurement role would be counter-productive. The role of Lighting Africa as the principal will largely consist of managing the RBF scheme, monitoring and supervision, as well as providing necessary technical advice and business assistance to the various market players.

2.5.10 What should be the duration of the RBF intervention and what is the exit strategy?

For import subsidies it would be expected that over time sales would grow in the target country resulting in a larger volume of imports and a fall in import costs per unit. The RBF subsidy could therefore be reduced over time as volumes increased. In practice it is likely to be very difficult to predict how quickly sales might build, so reductions in the level of RBF payments might be linked to certain volumes being realised. Establishing targets in consultation with the agents for the RBF intervention would be desirable. If imported volumes do not grow sufficiently within a pre-agreed timeframe the principal may wish to gradually terminate the scheme.

Subsidising the cost of establishing sales and distribution outlets could be for a pre-set period, say two or three years. This is effectively a one off injection of capital into a group of businesses to help them grow their market. RBF payments would wind down at the end of the agreed period.

Support for credit provision would also be for a predetermined period. Regardless of whether consumer finance is involved, the reduced cost of credit would benefit early adopters. The demonstration effect of having quality products in use in communities should support further demand, and increase willingness of customers to pay. For loans to small businesses the increase in sales achieved as a result of the subsidised loans should generate cash which can be reinvested in stock, and the entrepreneurs should be better able to afford commercial interest rates. A phased reduction in support would be advisable in this type of intervention.

Prizes are one-time payments made when a solution is presented. Prizes can be open-ended and run for as long as it takes for the solution to emerge. Alternatively a timeframe can be set and the 'best' solution submitted by the deadline awarded a prize. Because this is relatively straightforward and transparent, an exit strategy is not needed in this instance.

2.6 Conclusions

A variety of players make up the distribution chain for small off-grid lighting products, and each of them faces particular challenges that an RBF scheme might best target. Through the analytical framework presented in the main report, these areas can be singled out and analysed in detail for a particular country. RBF interventions on a national level are preferable to a regional RBF intetvention that is not country-specific, because the latter instance runs the risk of disproportionately flowing towards countries in which sales are easier to achieve. This is an example of trading off economic efficiency (more sales of lamps, but concentrated in few locations, with some locations underserved) against a valid policy goal (*widespread* adoption of clean lighting).

Sales levels in landlocked developing countries are hindered by a number of factors including high import costs and the initial costs of establishing a distribution network. This study proposes two complementary RBF interventions to help address these challenges. The ability of importers to cope with the associated risk will need to be determined on a case-by-case basis as the nature of their business and ability to access finance varies widely. It should also be noted that larger, well-financed firms tend to find it easier to overcome supply chain barriers and participate in an RBF scheme, possibly crowding out smaller distributors; the designers of an RBF scheme will need to determine whether this is a concern. Using small and measureable indicators as proxies for sales (such as import or VAT receipts for a subsidy on freight costs, or trained retailers with minimum sales levels) has the advantage of making results more easily verifiable. Prizes based on sales levels could be considered, but might narrow the field of participating companies. A bank that is pre-funding investments will be likely to consider a prize as less bankable than a funding agreement for individual sales or distribution outlets.

Similar to the case study on institutional cookstoves, lending to consumers can be incentivised through RBF approaches. However, consumer financing for small, portable items carries higher risks to the financial institution. Nevertheless, an RBF scheme could be structured in such a way that the subsidy can be drawn on in the event of repayment or default, thereby acting like a loan guarantee. While being results-based (the product is with the consumer), this does leave some risk with the principal since it is unlikely that the banking sector would be willing to bear all the lending risks associated with such comparatively costly and low-return loans.

Manufacturers have full control over product quality and, in association with distributors and retailers, can influence the consumer experience. An innovation prize could be used to induce a step-change in product quality by stimulating a technological improvement that is within the financial reach of a large percentage of the population in sub-Saharan Africa, and/or enhances consumer satisfaction with the product. Compared with more incremental product improvements, it is an open question as to whether manufacturers would be able to respond to this incentive. While an RBF scheme can be effective in incentivising volume sales (hence the deployment of RBF mechanisms further down the supply chain), there are important, albeit intangible, aspects of customer satisfaction and experience that may be difficult to capture in any RBF trigger.

3 Solar Water Heating in South Asia

An RBF incentive for rolling out Solar Water Heating in India

Section Contents:

This case study, prepared by CEEW, is aimed at increasing the deployment of solar hot water (SHW) systems in urban residential buildings in India. It begins by analysing the problems present in the market for SHW systems in India and, based on the framework provided in the main report, proposes the most appropriate RBF mechanism design to achieve the desired policy objective.

Figure 6. **Installed SHW system on a rural home in Udupi district, Karnataka, India**

Source: Arunabha Ghosh

3.1 Introducing the challenge

Multiple factors adversely affect the deployment of solar hot water systems in India

This case study is aimed at increasing the deployment of solar hot water (SHW) systems in urban residential buildings. It begins by analysing the problems present in the market for SHW systems in India and, based on the framework provided in the main report, proposes the most appropriate RBF instrumemt design to achieve the desired policy objective.

3.1.1 Overview of the current market situation

Before proceeding to analyse the problems that exist in the market for SHW systems in India, it is important to highlight some preliminary observations. The potential for deployment of SHW systems is believed to be high, as water heating comprises a significant share of the total energy consumption of a residential building. Currently, India has about 5.83 million square metres (m^2) of collectors installed, 80 per cent of which are installed in residential buildings.[42] China, on the other hand, had 168 million square metres of rooftop solar thermal collectors installed by the end of 2010[43] – approximately 29 times India's installed capacity. China's goal is to reach 300 million square metres of rooftop solar water heating capacity by 2020,[44] while India's aim stands at 20 million square metres of solar water heating capacity by 2022.[45] Interestingly, large parts of Eastern and Southern China have solar radiation of 2.5 kWh/m^2 per day compared to India's 4 kWh/m^2 of radiation per day.[46] In comparison with China, India's existing deployment and available radiation suggest that there is significant market potential for additional SHW systems.

3.1.2 Existing price support for SHW systems

The comparatively high capital cost of deploying a SHW system can be a disincentive for customers. To address this issue, there is an extensive subsidy scheme in place to incentivise the adoption of SHW systems. Presently a customer is eligible for two kinds of subsidies: central government subsidy, and state subsidy.

Central government subsidy

The average price of buying a solar water heater (SHW) ranges between Rs.18,000 to Rs.25,000 (approximately \$330 to \$460) for systems with 100 litres per day (lpd) capacities.[47] For flat plate collector

[42] Ministry of New and Renewable Energy (2012) *Achievements – as of 31/08/2012*, accessed at http://goo.gl/nyyX1

[43] Earth Policy Institute (2011) *Harnessing the Sun's Energy for Water and Space Heating*, accessed at http://goo.gl/BrIq2

[44] ibid.

[45] Ministry of New and Renewable Energy (undated) *Jawaharlal Nehru National Solar Mission – Mission Document*, available at: http://goo.gl/jm6iy

[46] KPMG (2011) *The Rising Sun - A Point of View on the Solar Energy Sector in India,* at p.65; available at: http://goo.gl/MG9Ue

[47] The benchmark costs for a 100 lpd capacity FPC based systems ranges from Rs.22,000 to Rs.31,000, while for a 100 lpd capacity ETC based systems ranges from Rs.18,000 to Rs.20,000. However, based on multiple stakeholder discussions, the average cost of an FPC based system was pegged at approximately Rs.25,000 and of an ETC based system was Rs.18,000 (both with 100 lpd capacity).

(FPC) based systems each 100 lpd of capacity needs 2 m^2 of collector area, whereas for evacuated tubular collector (ETC) based systems each 100 lpd of capacity requires 1.5 m^2 of collector area. For General Category States,[48] the Ministry of New and Renewable Energy (MNRE) calculates the subsidy on FPC systems at 30% of the benchmark cost or Rs.3,300 per m^2 of collector area, whichever is less. In Special Category States,[49] the subsidy on FPC systems is calculated on 60% of the benchmark cost or Rs.6,600 per m^2 of collector area, whichever is less. For ETC based systems, the subsidies are slightly lower. For General Category States they are either 30% of the benchmark cost or Rs.3,000 per m^2 of collector area, whichever is less. In Special Category States it is 60% of the benchmark cost or Rs.6,000 per m^2 of collector area, whichever is less.[50]

In effect, the eligible subsidy for FPC systems ranges from Rs.6,600 in General Category States to Rs.13,200 in Special Category States. For ETC systems the range is from Rs.4,500 in General Category States to Rs.9,000 in Special Category States.[51] Another option for both kinds of systems and both categories of states is a soft loan (at an interest rate of 5%) for 80% of the benchmark costs. The loans are provided through all Scheduled Commercial Banks or Regional Rural Banks.[52]

The capital and interest subsidies bring down the cost of the SHW systems considerably, as shown in the three tables below. Table 9 shows the impact on the capital cost faced by the consumer; Table 10 converts this to the change in average payback periods across India; and Table 11 illustrates the potential geographic variation in this impact.

Table 9. **Impact of subsidy on the capital cost faced by the consumer**

All figures in Indian Rupees	**2 m^2 Flat Plate Collector (FPC)**	**1.5 m^2 Evacuated Tube Collector (ETC)**
Hardware cost - 100 litres per day capacity	25,000	18,000
Installation charge	2,000	2,000
Total cost without subsidy	27,000	20,000
MNRE subsidy	6,600	4,500
Final cost to the customer	**20,400**	**15,500**

Source: CEEW calculations based on data collected through discussions with stakeholders

[48] All states other than Jammu & Kashmir, Himachal Pradesh, Uttarakhand, and North Eastern states including Sikkim; Ministry of New and Renewable Energy (undated) *Financial Assistance*, accessible at http://goo.gl/JX8x0

[49] MNRE classifies Himachal Pradesh, Jammu & Kashmir, Uttarakhand, and the North Eastern states including Sikkim as Special Category States; MNRE (undated) *Guidelines to Domestic Users of Solar Water Heaters on Cost, Selection and Availability of systems,* accessible at http://goo.gl/Suc4A

[50] National Bank for Agriculture and Rural Development (2011) *Circular No. 245/ ICD – 45/2011,* accessible at http://goo.gl/bEQp3

[51] Ibid.

[52] See Ministry of New and Renewable Energy (undated) *Financial Assistance*; National Bank for Agriculture and Rural Development (2011) *Circular No. 245/ ICD – 45/2011*

The tables below contrast how the average payback period varies for SHW systems with and without the MNRE subsidy (Table 10), and for locations with more or fewer sunny days (Table 11).

Table 10. **Average payback period of SWH systems in General Category States**

	With MNRE Subsidy	**Without MNRE Subsidy**
Sunny days per year on an average	240	240
Units saved per year (1 Unit = 1 kWh)*	1200	1200
Rs. saved per year (Rs.5 per unit)	6000	6000
CO_2 emission prevented per year**	1.17 tonne	1.17 tonne
Price of system (in Indian Rupees)	FPC: 20,400 ETC: 15,500	FPC: 27,000 ETC: 20,000
Payback period	FPC: 3.4 years ETC: 2.58 years	FPC: 4.5 years ETC: 3.3 years

* *It has been is suggested that when operational, a 100 lpd system would replace a 2kW electric geyser for 2.5 hours, hence saving 5 units of electricity. See http://mnre.gov.in/file-manager/UserFiles/potential_electricitysSavings_swhs.pdf*

** *1 unit of electricity = 0.975 kg of CO_2 (when the source of electricity is coal); 1 tonne = 1000 kg*

Source: CEEW calculations based on data collected through discussions with stakeholders

Table 11. **Average payback period for SHW systems in General Category States for three scenarios based on the number of sunny days in the area**

	Location 1	**Location 2**	**Location 3**
Sunny days per year on an average	100	200	300
Units saved per year (1 Unit = 1 kWh) *	500	1,000	1,800
Rs. saved per year (Rs.5 per unit)	2,500	5,000	9,000
CO_2 emission prevented per year**	0.5 tonne	1 tonne	1.5 tonne
Payback period (without any subsidy)	FPC: 10.8 years ETC: 8 years	FPC: 5.4 years ETC: 4 years	FPC: 3 years ETC: 2.22 years
Payback period (with MNRE capital subsidy)	FPC: 8.16 years ETC: 6.2 years	FPC: 4.08 years ETC: 3.1 years	FPC: 2.27 years ETC: 1.72 years

* *It has been suggested that when operational, a 100 lpd system would replace a 2kW electric geyser for 2.5 hours, hence saving 5 units of electricity. See http://mnre.gov.in/file-manager/UserFiles/potential_electricitysSavings_swhs.pdf*

** *1 unit of electricity = 0.975 kg of CO_2 (when the source of electricity is coal); 1 tonne = 1,000 kg*

Source: CEEW calculations based on data collected through discussions with stakeholders

State subsidy

In addition to the MNRE subsidy, various states have introduced additional state-level subsidies to provide greater price support for SHW systems.

For instance, in New Delhi a customer is eligible for both the state as well as the central subsidy. The Delhi Government provides a subsidy of Rs.6,000 to each domestic consumer for installation of a SHW system of 100 lpd capacity from the approved and authorised manufacturers or dealers.[53] The subsidy reduces the payback period to approximately two and a half to four years in Delhi. In Bangalore, the Karnataka Government provides a rebate of Rs.0.50 per unit on the electricity bill up to a maximum of Rs.50 per month to consumers that have installed a system.[54] As a result, the payback period in Bangalore is approximately two to two and a half years.

Table 12 compares the costs of SHW systems and their respective payback periods between New Delhi and Bangalore. Despite the additional state capital subsidy in Delhi, the payback period in Karnataka is shorter. This is primarily due to the fact that Karnataka experiences an assumed 300 clear sky days as compared to Delhi's 150 clear days.[55]

Table 12. **Comparison of price of system and payback period between New Delhi and Bangalore**

	New Delhi	Bangalore
Sunny days per year	150	300
Units saved per year (1 Unit = 1 kWh)	750	1,500
Amount saved per year (Rs. 5 per unit)	3,750	7,500
CO_2 emission prevented*	0.73 tonne	1.5 tonne
State subsidy	Rs.6,000	Rebate of Rs.0.50 per unit of electricity up to maximum of Rs.50, which translates to a maximum of Rs.600 per year
Price of system (in Indian Rupees)	FPC: 14,400 ETC: 9,500	FPC: 20,400 ETC: 15,500
Payback period	FPC: 3.84 years ETC: 2.53 years	FPC: 2.51 years ETC: 1.91 years

* *1 unit of electricity = 0.975 kg of CO_2 (when the source of electricity is coal); 1 tonne = 1,000 kg*

Source: CEEW calculations based on data collected through discussions with stakeholders

The average payback period for SHW systems in India now ranges from three to four years. This is encouraging because most systems come with a minimum five-year warranty and a life span of 20 years with little maintenance required (as long as the original system is durable and adheres to technical standards).

53 Presentation by Dr. Anil Kumar (undated) *Solar Water Heating System – Delhi Experience*, accessible at http://goo.gl/R2CE6

54 Kredl (undated) *Solar Energy Thermal*, accessible at http://goo.gl/SWgHq

55 MNRE (undated) *Solar Water Heating System (Potential and Savings)*, accessible at http://goo.gl/KgoHS

Box 6. **Subsidy for Solar Water Heating Systems versus Subsidy for Solar Home Systems**

It is worth comparing the subsidy schemes for SHW systems with those for Solar Home Systems (SHS). Until February 2012, a consumer of a SHS was eligible for 30 per cent capital subsidy plus a soft loan (with an interest rate of 5 per cent) for half of the system cost (20 per cent of the system cost was needed as a down payment). From March 2012 onwards, however, a consumer is only eligible for a 40 per cent capital subsidy.

Figure 7. **Solar powered house in Udupi city, Karnataka (left) and in a forest dwelling in Shishila village, Karnataka (right)**

Source: Arunabha Ghosh

Different banks have tended to follow different norms in implementing the SHS subsidy schemes. In one case, the consumer had to pay interest on the capital subsidy amount as well until the funds had been received from NABARD. In another case the bank would not approve loans until the capital subsidy had been disbursed to them from NABARD.[56]

Both SHS and SHW have cumbersome processes. The difference, though, is that for SHS it often takes about six months for the capital subsidy to be disbursed, whereas in the case of SHW systems banks have not received the capital subsidy for nearly two years. This means that while consumers are paying interest on the subsidy amount for roughly six months in case of SHS, that burden extends to well over two years in the case of SHW systems. Table 13 illustrates that a customer has to pay an extra interest of Rs.1,271 due to delays in disbursement of the capital subsidy for SHW systems.

Table 13. **Pricing of Solar Water Heaters**

Item	Cost (In Indian Rupees)

[56] CEEW discussion with a Regional Rural Bank's Manager, Karnataka state, 1 October 2012

Price of a 1.5 m^2 ETC system	18,000
Down payment (20%)	3,600
Capital subsidy (30 per cent or Rs.4,500, whichever is lower)	4,500
Interest for 2 years at 12.5 per cent rate on a loan of Rs.14,400	4,066
Interest for 2 years at 12.5 per cent rate on a loan of Rs.9,900	2,795
Difference in interest	**1,271**

Source: CEEW calculations based on data collected through discussions with stakeholders

3.1.3 Challenges in expanding the market

Despite the price incentives and the shorter payback periods, there are different problems that continue to plague the SHW market and hinder the growth of SHW deployment in urban residential areas. These challenges are explored below.

Declining Quality

Capital subsidies are currently available only on benchmark costs. Even if a good quality system exceeded the benchmark cost, it would receive the same amount of subsidy as a lower quality system priced under the benchmark cost. Suppliers, in turn, cut costs and compromise on quality in a bid to respond to consumer desire to maximise the subsidy as a proportion of the system cost.[57] As Box 7 indicates, this is a problem which is by no means limited to India.

Also, with the cost of SHW systems highly dependent on the prices of aluminium, copper and glass, suppliers are reluctant to make significant investments in building inventories thanks to uncertain demand and volatile costs. The recent rupee devaluation has increased overall costs largely due to the rising prices of tubes imported from China. According to CEEW discussions with stakeholders and manufacturers, it appears that these price impacts are largely absorbed by the manufacturers or vendors of SHW systems and not passed on to the customers (India is considered a highly price sensitive market). Instead, many vendors begin to substitute lower quality components, resulting in a fall in the quality and efficiency of the systems.[58]

High Transaction Costs

Moreover, the subsidy schemes suffer from very high transaction costs because the documentation required to process the subsidy is riddled with bureaucratic hurdles and is extremely time consuming. After the customer buys a subsidised system, it takes about 6-18 months on average for the subsidy application to be processed, verified and for the funds to be disbursed to the vendor.[59]

[57] CEEW stakeholder discussion with Delhi-based SWH manufacturer on 5 September 2012.

[58] CEEW stakeholder discussion with Delhi-based SWH manufacturer on 5 September 2012.

[59] CEEW stakeholder discussion with Bangalore-based SWH manufacturer on 6 September 2012.

Box 7. **China's experience: More aggressive policies, but similar problems as India**

The solar water heating industry in China has attracted attention on account of its high job-creation and revenue raising potential. For deploying SHW systems, China prioritised rural areas by making them eligible for a 13% capital subsidy. Provincial governments, in addition, introduced their own regulations for deploying SHW systems. The urgency to develop the local SHW industry meant that individual municipalities promoted favourable policies. (In one city, 3 out of 10 jobs were found to be solar related.[60])

For example, Dezhou city in Shandong province incentivised customers by providing additional subsidy and made it mandatory for new and renovated houses to install the systems. Additionally, the Dezhou government provided local manufacturers a stable customer base in its capacity as a major procurer of public infrastructure in the city. This, for example, led to the construction of public bath houses in 200 surrounding villages powered by centralised SHW systems.[61] Following the Renewable Energy Law of 2006, most local governments made it mandatory to install SHW systems for civic buildings that were higher than twelve floors.[62]

Despite such favourable policies, doubts are being raised about the sustainability of state government subsidies, monitoring and inspection of sites, and lack of trained technicians.[63] These challenges are very similar to those being faced in India. In addition, a recent report highlights manufacturers' scepticism towards the boom of SHW systems in China: unsafe equipment because of lack of mandatory safety regulations; shift of focus from R&D investments to price wars in order to attract more consumers; and bad reputation of the industry due to poor quality systems.[64]

The Chinese examples do indicate better numbers of installed SHW systems in the country, but there are increasing concerns over the poor quality of these systems. Even if India were to make its subsidy policies or regulations for solar water heating more aggressive, it could lead to a situation where the quality of the systems suffer a great deal due to over capacity, or unscrupulous vendors, or both. In turn, this could lead to a serious trust deficit among the customers and further drive them away from deploying SHW systems in their homes.

In the case of the interest rate subsidy, unlike the capital subsidy, there is no variation in the amount of subsidy offered across different states. Consumers in areas with fewer clear sky days have little or no incentive to opt for interest rate subsidies. At one level, this would be efficient, as more loans would be taken in areas with the highest solar potential. But since the capital subsidies do vary across states, consumers end up choosing them instead of interest rate subsidies. Moreover, the process for acquiring loans is also

[60] Li, Rubin and Onyina (2012) *Comparing Solar Water Heater Popularization Policies in China, Israel and Australia - The Roles of Governments in Adopting Green Innovations*, Sustainable Development, August 2012

[61] Ibid.

[62] thinkprogress (2012) *Solar Thermal Scales New Heights in China*, 3rd July 2012, accessible at http://goo.gl/Hc6A9

[63] MNRE – Solar Water Heating Solutions for India (undated) *List of State Nodal Agencies*, accessible at http://goo.gl/AhNNC

[64] CaixinOnline (2012) *Solar Heaters Have Safety Flaws, Firm's Chairman Says*, 15th August 2012, accessible at http://goo.gl/q7p1m

cumbersome (though not everywhere). In cases where the consumer expects to pay only the subsidised cost of the system, the capital subsidy would be preferred since the risk lies with the vendor who also bears the transaction cost of recovering the subsidy amount. In case the consumer has to apply for the subsidy (rather than the vendor) the choice between capital and interest subsidy would depend on which one is perceived to have a lower transaction cost.

In addition, banks claim that the transaction costs are very high for small loan sizes (between Rs.15,000 and Rs.20,000) and complicated procedures for crediting the subsidy amount against the interest payment obligations of the customer. CEEW also discovered that bank managers were at times unclear about changes in subsidy schemes and were often unable to disburse loans to customers due to the shortage of manpower and the lengthy documentation process.

Nevertheless, some reforms in response to the challenges of processing payments and disbursing subsidies are underway. The National Bank for Agriculture and Rural Development (NABARD), the agency responsible for administering the subsidy for solar water heating schemes, has started advancing funds to banks to ease the subsidy disbursement process.[65]

Multiple Actors, Unclear Governance

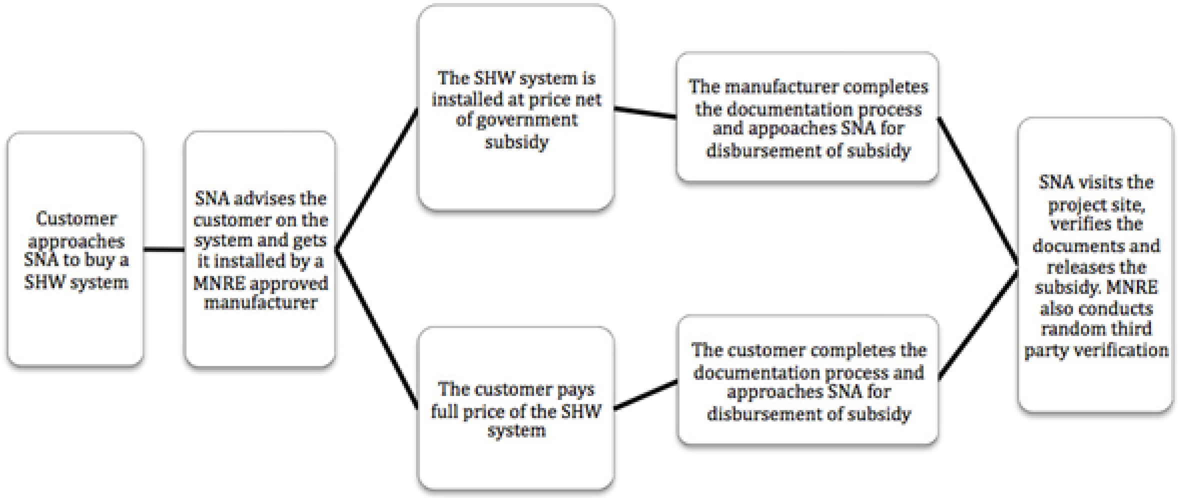
One reason why the transaction costs are high is the number of actors involved in the disbursement of subsidies and loans. A customer can purchase a government subsidised system in one of three ways.

- **Case 1 : Customer approaches State Nodal Agency (SNA) for installation of the system**
  The State Nodal Agency is an administrative department of the state government for implementation of the new and renewable energy programme. At present there are 35 state nodal agencies responsible for the same.[66] The SNA is responsible for verifying installed projects and disbursing funds, which could accrue to the vendor or the final customer (Figure 8).

[65] MNRE (2011) *Capital subsidy Scheme to be implemented by NABARD through Regional Rural Banks and other commercial Banks for Solar Lighting Systems and Small Capacity PV Systems*, accessible at http://goo.gl/Lp2Wt

[66] MNRE – Solar Water Heating Solutions for India (undated) *List of State Nodal Agencies*, accessible at http://goo.gl/AhNNC

Figure 8. **Step by step process of buying a subsidised system through a State Nodal Agency**



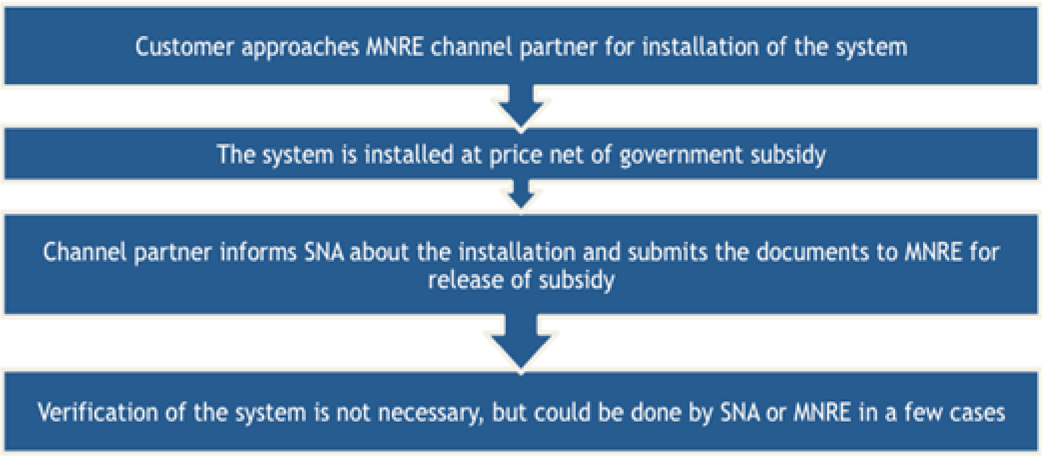
Source: CEEW

– **Case 2: Customer approaches channel partners**

Channel partners are solar water heater manufacturers that have been accredited by MNRE and have received a grading from a credit rating agency of MNRE's choosing. Here, the customer approaches a channel partner to install the system. Channel partners, since they have been vetted on a prior basis, can seek subsidies from the SNA without each project being verified (Figure 9). They are also eligible to submit proposals to MNRE for directly receiving central financial assistance. At present there are 41 channel partners accredited by MNRE.[67]

[67] MNRE – Solar Water Heating Solutions for India (2011) *List of Channel partners of Solar Thermal Systems – As on 31.10.2011*, accessible at http://goo.gl/mrtCj

Figure 9. **Step by step process of buying a subsidised system through a channel partner**

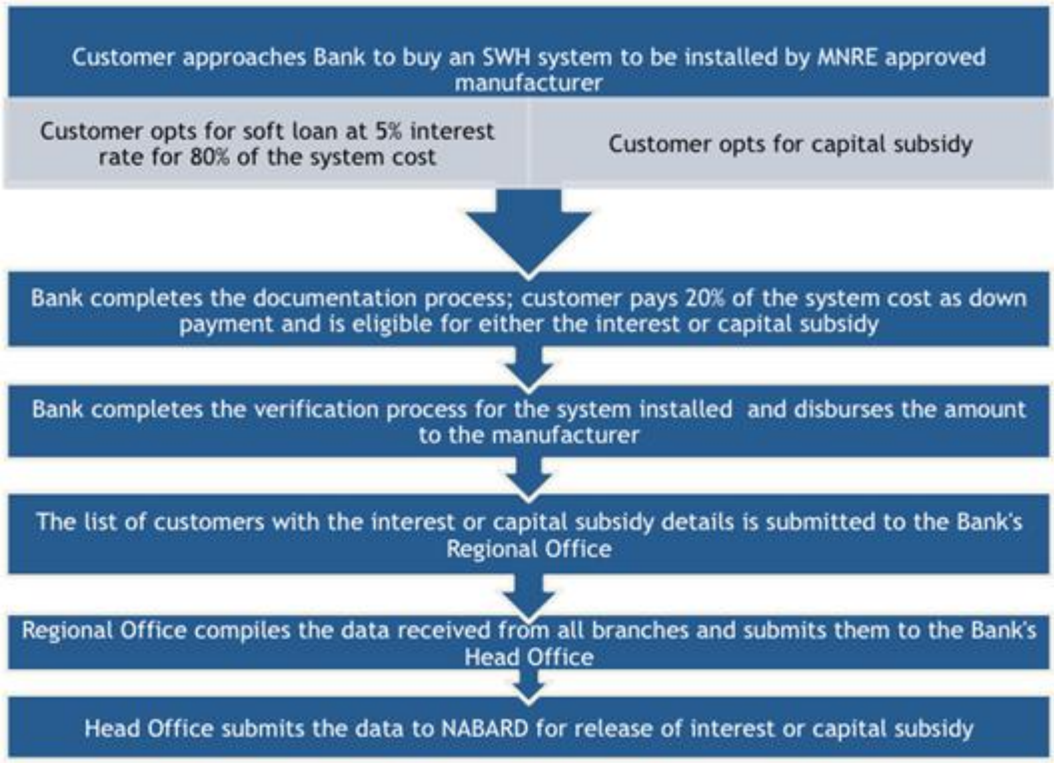


Source: CEEW

– **Case 3: Customer approaches a bank for either interest or capital subsidy to buy a SHW system**
  A third approach is for the customer to approach Scheduled Commercial Banks or Regional Rural Banks.[68] In this case, the bank takes the lead in preparing all the paperwork and disburses funds to the vendor. Once the project has been verified and details submitted to the regional head office, the bank approaches central government agencies to secure the subsidy amount (Figure 10).

[68] See generally, MNRE (undated) *Financial Assistance*, accessible at http://goo.gl/JX8x0; MNRE (2011) *Capital subsidy Scheme to be implemented by NABARD through Regional Rural Banks and other commercial Banks for Solar Lighting Systems and Small Capacity PV Systems*, accessible at http://goo.gl/Lp2Wt

Figure 10. **Step by step process of buying a subsidised system through a bank**



Source: CEEW

The three different ways highlighted above offer several avenues for the customer to purchase a government subsidised SHW system. In reality, however, the customer is left to navigate through a maze of different steps and multiple agencies, reducing the incentives to apply for subsidies in the first place.

In addition to the multiple actors, such as state nodal agencies, channel partners, and different banks, multilateral actors have also entered into the fray of SHW systems. The UNDP-GEF Project on Global Solar Water Heating was launched in 2008 in association with MNRE to 'accelerate & sustain SHW market growth by building up market demand, strengthening supply chain, adopting qualitative measures and establishing supportive regulatory environment'.[69] This project is due to end in December 2012. Another project was launched by UNDP-GEF and MNRE in August 2012,[70] but it is not clear whether it will fully replace the existing scheme, or whether it would be tied together with central or state government subsidy schemes. Conversations with the project consultants based at MNRE suggested that the process and modalities were as yet undefined.

[69] Presentation by Dr. A.K. Singhal (2012) *National Programme and UNPD-GEF Project on Global Solar Water Heating*, held at the National Workshop on Solar Water Heaters (23rd August 2012), accessible at http://goo.gl/mNBj4

[70] Global Environmental Facility (2012) *New GEF-UNPD Project on Solar Technology starts in India*, accessible at http://goo.gl/g4wwb

Insufficient and weak regulation

The market for SHW systems in India is primarily driven by regulation, with vendors mostly servicing large clients through large tenders based on where installation of the systems has become mandatory.[71]

Regulation of SHW systems varies across Indian states. The Delhi Government, for example, has made the use of solar water heating systems mandatory in buildings such as industrial units, hospitals, nursing homes, hotels, canteen, government buildings and residential buildings having an area of 500 m^2 or more. By contrast, the Haryana Government's regulation for residential buildings is for areas larger than 500 square yards (418 m^2) and the Karnataka Government's regulation makes it mandatory for residential buildings having 200 m^2 of floor area or 400 m^2 of site area.

At present, regulation alone is proving to be insufficient to stimulate investment and greater deployment of SHWs. Even if the regulations exist, there is little compliance due to the lack of strict monitoring and enforcement procedures. Further, even though SHW systems are mandatorily installed in some residential buildings, they suffer from quality degradation or breakdown.[72] There is a weak monitoring mechanism to check if the systems, against which subsidies are provided, are operating at the stated efficiency without any regular problems. In relation to these larger buildings, there is need for stricter enforcement of existing regulations.

[71] CEEW stakeholder discussion with Ahmedabad-based SWH manufacturer on 5 September 2012

[72] CEEW stakeholder discussion with Delhi-based SWH manufacturer on 5 September 2012

3.2 Application of the framework, parts 1 and 2

Considering and then choosing an RBF-type intervention

3.2.1 RBF Objective

It could be argued that there might be a case for strengthening the existing system of capital and interest rate subsidies. However, the complex subsidy structure, its impacts on payback periods in different cities, and the challenges with multiple actors and agencies, we believe that an RBF mechanism added to the existing subsidy structure would not be the best approach. Furthermore, the existing regulations are weak in providing incentives to expand to new sets of customers, and there is a lack of strict enforcement. In fact, even with stronger regulations, weak enforcement could result in poorer quality products (see Box 7). Introducing an RBF mechanism to bolster the existing system would only add additional layers of bureaucracy and complicate the process further.

However, despite all the schemes in place, there is still limited awareness among smaller clients and individual households regarding the availability of SHW systems and the subsidies attached to them. The need is to educate households about the available choices in water heating in order to drive an attitudinal shift in favour of SHW systems. The Indian urban residential landscape across different cities is a mix of high-rise buildings, large private bungalows, lower income housing developments, and unauthorised urban slums. Thus, homeowners in different parts of a city will need different types of SHW systems. Since there is limited awareness about the systems, the suppliers of SHW systems are also the ones best placed to offer alternative SHW designs to customers at different costs. They must be given incentives to inform consumers about these systems, their efficiencies and standards, financial implications and payback periods, and the choices available to the customer depending on their living conditions and needs. The key consideration for suppliers must not be merely the installation of SHW systems in buildings as prescribed by regulation. Rather, the sector has to mature to a level where vendors find it profitable to sell SHW systems across a much larger and more diversified set of residential users.

Currently, no incentive exists where new markets or new SHW needs are addressed. The proposed RBF scheme would potentially be used only to reach out to a wider customer base of urban residents, while overcoming the challenges posed by insufficient regulatory incentives and lack of awareness.

The main outcome we hope to target is higher sales among new and diverse sections of urban residential users. An RBF approach is employed when the aim is to increase output in a market or to create a new market. In the present case study, the ultimate objective would be to increase the number of SHW systems installed *and* cater to a new and diverse customer base of urban residential users. The added incentives, provided to the vendors through result-based payments, would be aimed at reaching out to customers with varying income levels and different system requirements. The basic idea is to use the RBF mechanism to stimulate competition in the market for SHW systems and incentivise the process of selling these products to new customers.

It is important to reiterate that this proposed RBF scheme will not be about solving all the problems in the SHW market in India.

3.2.2 The case for choosing RBF – (i) necessary pre-conditions

In order to proceed with the design of an RBF instrument, it is important to determine if the three necessary preconditions for using such instruments are fulfilled:

1. Sufficient access to upfront finance
2. Sufficient institutional capacity
3. Measurable and controllable outputs

Upfront finance: There are many subsidies and regulations in place to incentivise the installations of SHW systems in residential buildings. However, there is still a glaring gap in the adoption of these systems across residential users. The main issue for consideration, then, is to determine whether the suppliers/vendors have access to any upfront finance to drive the necessary behavioural change among customers to adopt SHW systems in residential areas. Being small or medium enterprises, most of the suppliers/vendors have limited financial capabilities to carry out extensive awareness drives or marketing strategies to attract customers. Bank loans are available at usual rates and the vendors do not receive any special rebates for operating in the solar sector. Thus, there is little incentive for them to reach out to a wider customer base. They continue to operate on a business-as-usual model and restrict themselves within the existing subsidy framework and the limited mandatory installations.

With major information gaps and potential market failures, financial markets are not likely to warm up to the SHW systems sector without strategic interventions to create a robust financing ecosystem. A range of funding channels, financial institutions, and other stakeholders exist in the financial ecosystem that could be relevant for the SHW systems market. These financial stakeholders include multilateral funding channels, Indian public and private sector banks, public sector (non-bank) financial intermediaries (for example, Indian Renewable Energy Development Agency), bilateral funding channels, venture capital and private equity firms, new market mechanisms, and government fiscal support. But these institutions lack cohesion and information sharing. However, in order to increase bankability and overall solar market development, the different types of institutions need to be strategically coordinated at the programmatic level, at the project level, and in terms of ancillary support measures. Many of the following current and contemplated regulatory programmes need improvement or expansion to build confidence and awareness among financial groups and thereby increase bankability.[73]

Public sector non-banking financial institutions such as Reserve Bank of India (RBI) or the Indian Renewable Energy Development Agency (IREDA) can play an important role when setting policy directions whereas non-financial supporting institutions such as the Solar Energy Corporation of India, the Bureau of Energy Efficiency (BEE), the Solar Energy Centre, and the India Banks' Association could help to channel funds, provide necessary skills and help in component certification.

[73] Council on Energy, Environment and Water, and Natural Resources Defense Council (April 2012) *Laying the Foundation for a Bright Future: Assessing Progress under Phase 1 of India's National Solar Mission*, accessible at http://goo.gl/JkgIA

The suggested RBF mechanism could provide vendors with the additional finance needed as an incentive to tap new customers and sell more SHW systems. The design of the RBF mechanism, however, must also try to ensure that it assists the market players in overcoming some of the challenges they face in accessing upfront finance. If the pay-outs are linked to early stage results, then the result-based payments could help create an enabling environment for the market players to continue their operations by providing them with additional financial support to ease their initial working capital requirements.

Institutional capacity: The institutional capacities of the agents (suppliers/vendors) are seemingly in place. However, in terms of the principal, there are multiple agencies that could be tasked with the implementation of the new RBF scheme. Any one of the government ministries such as Ministry of Finance, Ministry of Science and Technology, Ministry of Micro, Small and Medium Enterprises, Ministry of Housing and Urban Poverty Alleviation, or Ministry of Urban Development could play a pivotal role in channelling the necessary funds and providing the required assistance for the RBF scheme.

However, none of them has a specific mandate to work on clean energy related projects. If one proceeds to narrow down the institution based on technology, then the implementing ministry could be the Ministry of New and Renewable Energy (MNRE). This selection could have the merit of being able to test the viability of the RBF scheme, as compared to other ongoing MNRE programmes on solar water heating. However, this could also prove to be a demerit as an MNRE-managed RBF scheme could end up confusing vendors who already have to navigate the existing MNRE channels for various kinds of subsidy measures.

There is a new institution in the making which has not yet fully matured but could potentially also have a role. The National Clean Energy Fund (NCEF) has been created for 'funding research and innovative projects in clean energy technology'. The corpus of the NCEF is created through the levy of a clean energy excess on coal produced in and imported to India at a rate of Rs.50 per tonne.[74] Presently, if a new agency, such as the NCEF, is tasked with the RBF instrument then it may have insufficient institutional capacity to achieve the desired results. This is because the NCEF's mandate has not been finalised and, to the extent some guidelines exist, they are not being followed. The Operational Guidelines of the NCEF are inconsistent with the NCEF's stated objectives to further research and projects in clean energy technologies. Moreover, the projects being funded do not adhere to the stated objective of the NCEF; rather funds are being spent to cover budgetary shortfalls of some ministries.[75] If the NCEF becomes one of the new agencies through which RBF funds are channelled, then its capacity would have to be strengthened.

The main consideration in this regard is not whether there is any upfront finance or institutional capacity. There are various sources of potential funding and there are enough institutions that could be tasked with implementing an RBF scheme. The question, then, would be one of choosing one or two partner institutions from the given set of options.

[74] Press Information Bureau of the Government of India (2010) *Proactive Steps in Budget 2010-11 for the Environment*, 26th February 2010, accessible at http://goo.gl/bn01w

[75] CBGA (2012) *Framework and Performance of National Clean Energy Fund* , accessible at: http://goo.gl/OaYyC

Measurable and controllable outputs: Here, the output would not be merely the number of SHW systems installed overall but rather the number of systems installed in areas outside the purview of mandatory regulations. So long as there is independent monitoring of the installations, the outputs could be measurable. Another key factor for success would be how well the monitoring and verification systems are designed within the final RBF intervention. Monitoring and verification should not be considered to be the final output on which the payment will be contingent. It should be looked upon as one part of the entire RBF scheme, so that there is a legitimate process of monitoring and verification before any disbursement of payments.

3.2.3 The case for choosing RBF interventions – (ii) the risk-incentive trade off

In order for RBF to be preferred over conventional instruments such as an upfront grant, the gains from stronger incentives should outweigh the increase in costs thanks to transferring a portion of the risk to the vendors.

a. Is the result under the control of the agent?

The results are likely to be largely in the hands of the vendor, since they are the ones who would be selling the SHW systems to different categories of customers. Whether they use an awareness strategy or other marketing tools to increase their customer base is immaterial, as long as the final outcome is increased sale of SHW systems to different consumer segments outside of the purview of existing regulations. There is a risk that, a vendor's best efforts notwithstanding, the demand to buy SHW systems is insufficient.

b. Is there a clear line of sight for the principal to the result against which the result-based payment is being made?

Yes. There could be predefined segments of urban residential users based on:

- Income bracket (lower income households installing the systems would yield a higher premium);
- Locality (large number of installations in a low income locality in relation to a high income area would receive a higher premium);
- Kind of building (retrofitting in older buildings would receive a higher premium compared to installations in new buildings).

It should, thus, be relatively easy to assess the number of SHW systems sold by the vendor among each segment as long as a credible system of monitoring and verification is in place.

c. Does the RBF intervention stretch the balance sheet of the agent?

Yes, the balance sheet of the agent would be stretched as the vendor would have to increase spending on advertising, better marketing tools and other costs that might be incurred while tapping into a potentially new customer base. However, these tasks would not be much different from what the agent has to otherwise undertake with existing customers. To the extent that the costs would be recovered in the normal course of business, an RBF intervention targeting new customers or new types of dwellings and buildings is unlikely to prove prohibitive.

d. Is the cost base largely variable?

The cost base of vendors is relatively variable: if they sell fewer SHW systems then their revenues are lower, but so are their costs. The main cost-related risk would arise if there is a significant investment in building up the inventory of solar hot water systems targeted at new sets of customers and associated marketing and advertising costs. However, even these can be adjusted according to levels of throughput relatively easily. This implies that should the vendor choose to continue its earlier business model of selling only to large enterprises rather than service smaller or poorer households, it would not suffer any substantive losses from sunk costs.

e. What is the time horizon of the RBF intervention?

The time horizon of the RBF intervention is unclear. It should ideally be in place until it manages to create an enabling environment for the market players to thrive within the expanded customer base. However, the pay-out periods should be shorter than the time it currently takes to secure the subsidies. Otherwise, the RBF programme would not be any different from existing schemes with long drawn out payment schedules. The payments could be made based on clear targets for increasing sales of SHW systems within a given quarter, half-year or at most a year. The results-based payments would also assist the vendors in reducing their upfront capital costs for deployments in subsequent time periods.

3.2.4 The case for choosing RBF – (iii) positive spill-over effects

Bank managers in India continue to remain sceptical about solar technology, repayment of loans and delayed subsidy disbursement. A clear policy and line of sight with decreases in bureaucracy and time could mitigate some of their concerns and result in more lines of credit for SHW entrepreneurs. With wider deployment, confidence in the systems among customers and financiers could increase.

Moreover, anticipating an opportunity to enter new markets, several new companies could start manufacturing systems. This could lead to more jobs across the value chain. The growth of small and medium sized entrepreneurs may, however, be partially constrained, leading to consolidation of the industry since large corporations have an advantage of economies of scale.

More importantly, the process would require initial investments, which may be procured as bank loans. But since the payment is linked to results, there is a possibility that a few could miss a threshold minimum target before the RBF payment is made. For these vendors the risk would be the sunk investment in procuring the systems but without the price support that would allow them to start repaying bank loans. To be sure, such an outcome would not be a failure of the RBF mechanism *per se*. It is part of normal business risk where loans are taken and investments made based on certain expectations of potential market size. The failure to fulfil that potential is a risk that the vendor (and its financiers) would have to bear.

3.3 Application of the framework, part 3

Options for RBF interventions appropriate to the challenge

In designing an RBF intervention based on the analytical framework, we will detail the following: eligibility, conditionality or trigger for paying out the RBF funds, structure of the pay-out, size of the payment, and the role of the principal.

3.3.1 Eligibility

Although eligibility could be open to incumbent and new vendors, the vendor selection should be based on certain minimum operational guidelines and minimum quality standards, to ensure that there is no adverse selection of poor quality vendors. At the same time, the technical eligibility criteria should not be so tedious that nascent firms are excluded by default. In a market that already has few firms, it is important to structure the RBF mechanism to lower barriers to market entry for new firms.

3.3.2 Conditionality

The ideal trigger for releasing the payment would be the successful installation and consecutive use of an SHW system. However, it is infeasible to shift the risk of use of systems entirely on to the vendors. For the RBF programme to the successful we therefore recommend that the vendors be incentivised on achievement of partial results within certain stipulated timeframes; in particular we propose to pay out the incentive upon verification of installation and the installed SHW system being in operation. This would help the vendor by reducing her/his financial risk, while still placing the trigger reasonably close to the ultimately desired outcome.

It is also necessary to make the pay-out dependent on third party monitoring and verification. The risk of low-quality systems being installed is high and could undermine potential demand among prospective consumers. To reduce monitoring and verification costs, the pay-out could be bundled for a large number of projects, giving the vendor the option to opt for a one-time verification. This could reduce the average cost of verification per system.

3.3.3 Pay-out structure

The structure of the incentive payment could be a basic pay-out plus certain premium bonuses based on three pre-defined criteria (as discussed in the earlier section):

- Income bracket (lower income households installing the systems would yield a higher premium);
- Locality (installations in a low income locality would receive a higher premium than installations in a high-income locality);
- Kind of building (retrofitting in older buildings would receive a higher premium compared to installations in new buildings)

The differential rates of premium available to the vendors could serve as the added incentive for them to increase awareness of SHW systems and, in turn, increase sales through a new and diverse customer base.

This way the RBF intervention is designed both as a grant for deploying additional systems *and* a prize for reaching new types of customers.

Furthermore, we propose that the basic incentive should not vary linearly with the result as it may have the effect of discouraging vendors from exploring new markets and business plans once they are comfortable with a partial result. The incentive per unit could be increased as more results are achieved. One possible way to design this would be to make the incentive vary exponentially where the disbursed amount increases with the number of systems sold.

In addition, the vendor could receive an extra incentive per unit by servicing predefined segments of the urban population based on income bracket, locality and retrofitting in older buildings. This extra incentive may vary from segment to segment and would act as a top-up to the earlier mentioned incentive based on the number of systems installed (Box 8).

While the lump-sum basic payment would serve as an incentive to break into new markets, the per-unit additional payment would act at the margin.

Box 8. **Hypothetical calculation of the result-based payment based on the conditionalities**

A vendor would be eligible for an incentive (I) on completion of the threshold target. But, this incentive would be disbursed in phases. An example of this phased pay-out is shown in Table 14 below:

Table 14. **Example of a phased pay-out structure**

Percentage of threshold target achieved	Portion of the incentive disbursed (per cent)	Cumulative incentive disbursed (per cent)
25	10	10
50	15	25
75	25	50
100	50	100

Source: CEEW

The top-up amount could vary according to categories of customers served (table on next page):

Table 15. **Example of additional premium bonuses**

Category of customer	Incentive per unit sold
C1	X
C2	Y
C3	Z

Source: CEEW

Let us assume the threshold target for receiving the total incentive I is 10,000 systems.

A vendor is able to sell 5,000 systems. He services three categories of customers C1, C2 and C3 by selling 1,000, 1,500 and 2,500 systems respectively.

In this example he would be eligible for 25 per cent of amount I since he has sold 50 per cent of the threshold target. In addition, he would be eligible for a top up of (1000X + 1500Y + 2500Z).

Hence the total incentive received would be 0.25I + 1000X +1500Y + 2500Z.

3.3.4 Size of the payment

Lack of awareness and easy availability of a conventional electrical heater as a cheaper option is one of the major challenges to the upcoming solar water heating industry. It is assumed that the incentive provided to the vendor would be passed to the customer to reduce the difference in costs. Since electrical geysers consume power in the order of kilowatts it is suggested that while calculating the difference between the two systems the cost of electricity avoided is also included.

In terms of proposing an appropriate payment amount, a possible design of incentive could be the difference between the initial cost of a solar hot water system and the sum of a conventional electrical geyser with one year's consumption of electricity. Since the yearly bill of the conventional geyser may vary from location to location it is recommended that the RBF incentive also be site specific.

Thus, the size of the incentive could be calculated as follows:
Size of Incentive = Initial cost of SHW – (Initial cost of conventional geyser + one year of electrical bill)

3.3.5 Role of the principal

A crucial role of the principal in this case would be to provide a part of the finance to the vendors *ex ante* in order to assist them in raising awareness of SHW systems among customers and creating a competitive market for SHW systems. The principal would not be purchasing systems; rather it would be providing incentives to the vendors to reach out to a new customer base, disaggregated by type of customer. Additionally, the principal would also need to ensure that there is a credible and independent system of monitoring and verification in place. The final payments would hinge on the success of the vendors, thus making it crucial to have a third-party assessment of their systems. Ultimately, the aim of the principal would be to increase the number of SHW systems installed *and* to ensure that agents tap into a new and diverse customer base, by providing high quality systems customised to different needs in urban residential buildings.

3.3.6 Exit strategy

The main idea behind proposing this RBF mechanism is to create a self-sustaining market for SHW systems in urban residential areas. As per the main report, a phased exit strategy in such a case would be the best option. The principal should then look to reduce RBF payments after a stipulated minimum period by which time the market has reached the point of self-sufficiency.

The main report measures self-sufficiency as the gap between the price at which firms are willing to offer the good and the price at which consumers are willing to buy the good. In order to arrive at this point, the principal could either set a fixed time period for the RBF payments or a maximum total funding that the RBF scheme would undertake in totality.

We propose that the principal set a fixed time period by which a certain number of systems must be sold to a predetermined number of households in each category of urban residential buildings.

Also, in case of a situation where the RBF-induced market development does not work out as planned, the main report suggests that the principal should prepare itself and the agents for the next possible steps based on certain intermediate checkpoints. A likely situation could be that a vendor does not meet the set number of target households to be eligible for the RBF intervention. In such cases, instead of not disbursing any results-based payments at all, the principal could consider including an intermediate checkpoint that stipulates that the payments would reduce in proportion to the extent by which the target is missed. For instance, even for grid-connected solar projects under India’s National Solar Mission, the government signs contracts with project developers that allow it to encash bank guarantees should the developers fail to commission projects on time. Such partial penalty-based schemes could reduce the risks for the RBF principal, yet offer vendors incentives and compensation in proportion to their effort and success in deploying SHW systems among new customer segments.

3.4 Conclusions

This case study began by highlighting the potential for deployment of SHW systems in urban residential households. It then moved to a detailed analysis of the various problems plaguing the present market for SHW systems in India, which ranged from declining quality and high transaction costs to multiple actors and unclear governance.

However, it was then pointed out that, even if these problems were fixed, there is little incentive for vendors to expand their markets. This is due to insufficient regulatory incentives and a lack of awareness. An assessment of the three necessary conditions for an RBF intervention to be viable led us to propose an RBF mechanism that is targeted at vendors to increase sales among new and diverse sections of urban residential users. In absence of external subsidies vendors may find it difficult to pitch solar systems against conventional geysers.

Hence, it seemed necessary to incentivise vendors through external grants in the form of an RBF intervention. The main aim of the RBF scheme would be to increase the number of SHW systems installed *and* to ensure that vendors reach out to a new and diverse customer base of urban residential users. The proposed RBF scheme is designed using a basic incentive to stimulate outreach into new markets, and a per-unit additional incentive, in order encourage additional sales. The size of the payments is calculated so to make SHW systems competitive with traditional heating geysers, assuming that vendors pass on the subsidy via lower end-prices.

4 Stimulating R&D in energy access technologies

Incentives for innovation in India

Section Contents:

This case study prepared by CEEW considers innovation across the energy access value chain. This includes both innovation in business models (the ‘software’ of the value chain) and innovation in technologies (the ‘hardware’ of the value chain). While RBF interventions for the two most pressing technological innovation needs, better energy storage and more energy efficient off-grid (DC) compatible appliances, do not seem feasible, an RBF intervention supporting an innovative business model may be an effective way of increasing energy access.

Figure 11. **A solar energy kiosk in in Dharmasthala village, Karnataka**

Source: CEEW

4.1 An RBF intervention for R&D in energy storage technology?

Pre-financing requirements and the absence of clear targets disfavour an RBF intervention for R&D into energy storage technology in India

4.1.1 Introduction

Lead acid batteries have been commercially used for over a century with little technological improvement. A typical 40Ah (ampere-hour) battery that can be used to run four lights weighs 15-18 kg depending on the manufacturer. The battery weight comprises mostly lead (70 per cent) and sulphuric acid; and most of these batteries require maintenance once every six months.

However, gel batteries have been developed where sulphuric acid is mixed with silica fume, which causes it to stiffen. This reduces the weight of the battery by 15 per cent - 20 per cent but increases the cost by 25 per cent - 30 per cent. Furthermore, these batteries do not require any maintenance.

Another recent technological improvement in lead acid batteries relies on replacing one of the electrodes with activated carbon. This, in turn, decreases the weight by 30 per cent, and increases the efficiency and life of the battery.[76]

Figure 12. **The exterior (left) and interior (right) of a solar energy kiosk renting out solar-charged lamps and batteries in Dharmasthala village, Karnataka**

Source: Arunabha Ghosh

[76] Cnet (2012) *New lead-acid battery angles for micro hybrids,* 6/1/2012, accessible at http://goo.gl/1AaD8

In order to increase energy access to consumers who are unable to afford solar home systems, a few organisations have successfully implemented a rental model for solar lighting. An entrepreneur owns a kiosk where he/she charges the battery during the daytime. In the evening either the entrepreneur distributes the batteries to the consumer or the consumer visits the charging centre to rent it (Figures 12 and 13). Since lead acid batteries are heavy, transportation becomes a tiring process for both entrepreneur and consumer, making it unattractive especially for female entrepreneurs.[77] There is also an additional cost of operating a vehicle to transport the heavy batteries. These challenges can be overcome if the weight and volume of the battery were reduced.

Figure 13. **Fruit vendor using rented solar-charged batteries for evening lighting in Kundapur town, Karnataka**

Source: Arunabha Ghosh

Other technologies that are being experimented for grid storage include flow batteries, lithium ion, and sodium sulphur technologies. Flow batteries and sodium sulphur are being tested for large energy storage systems. It is estimated that the global market for advanced batteries would double each year for the next five years, reaching $7.6 billion by 2017 and revenues in the sector would increase to $29.8 billion by 2022.[78] For off-grid applications, lithium ion (Li-ion) batteries seem to be the best option as they have high energy density and are light in weight.

Until recently, R&D for Li-ion was focused on electrical vehicles and one of the priority areas was to reduce the weight and volume. Since both electrical vehicles and solar home systems (SHS) require daily charging and discharging, reduction in cost and weight of Li-ion batteries can greatly benefit the off-grid

[77] Interviews with rural entrepreneurs in Dakshin Kannada District, Karnataka State, 2 October 2012.

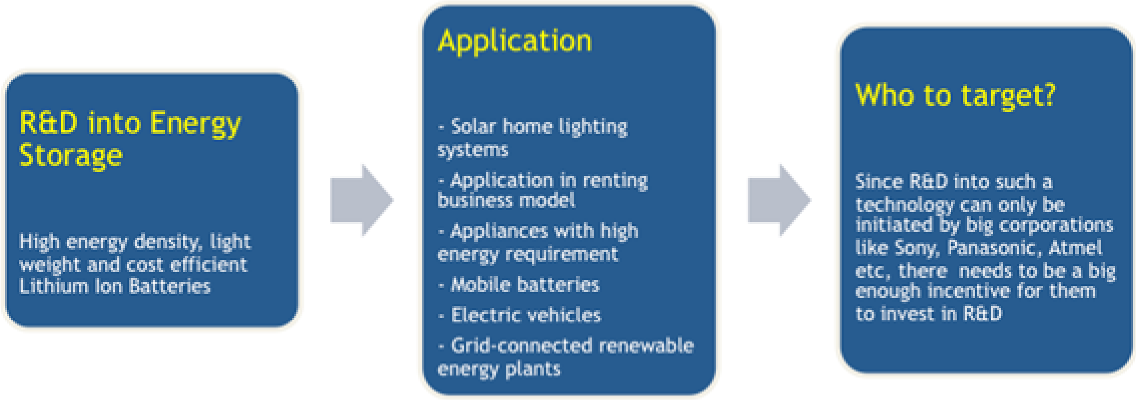
[78] Solar Thermal Magazine (2012) *Advanced Batteries for Energy Storage Will Represent a Market of Nearly $30 Billion by 2022*, August, accessible at http://goo.gl/mZ9lt

renewable electricity sector as well. Some industry predictions estimate that the prices of Li-ion batteries could fall from the present $500-$600/kWh to $200/kWh by 2020 and $160/kWh by 2025.[79]

In July 2012, Panasonic inaugurated a lithium-ion battery manufacturing unit in China, which would cater to the demand of renewable energy powered households in Europe. These cells would have a capacity of 1.35 kWh with a battery management system to control the charge and discharge of the batteries.[80] Panasonic aims to cut costs by increasing production ratio, procuring materials locally and reducing logistics cost.[81]

In India, R&D into Li-Ion batteries has been initiated by the National Centre for Photovoltaic Research and Education (NCPRE) at the Indian Institute of Technology, Bombay.[82] During the five-year project that started in 2009 NCPRE aims to increase the life cycles of the batteries and develop a prototype lithium-ion cell for high energy density applications. However, there has been no industry involvement in the project.[83]

Figure 14. **How R&D in energy storage could be applied – and who would do it**



Source: CEEW

Could RBF be used to incentivise research into low weight, high storage batteries in India? In principle, large prizes or other incentives could be used to drive innovation investment by large corporations (see figure 14). But innovation depends on a number of factors, not just the amount of funding available. Unless an innovation ecosystem exists, along with the necessary funding, human capital, institutional support, regulatory environment, and commercial opportunities, it would be difficult to deliver results.[84]

[79] McKinsey Quarterly (2012) *Battery technology charges ahead*, July, accessible at http://goo.gl/XfXaj

[80] Environmental Expert (2012) *Panasonic to Begin Mass-production of Long-life Lithium-ion Battery System for Solar-powered Homes in Europe*, 4/6/2012, accessible at http://goo.gl/wJJVN

[81] Panasonic (2012) *Panasonic Inaugurates New Lithium-ion Battery Plant in China to Respond to Global Demand*, 17/7/2012, accessible at http://goo.gl/vLmji

[82] National Centre for Photovoltaic Research and Education (undated) *Solar PV Systems and Modules,* accessible at http://goo.gl/wCVDn

[83] Interview with researchers at NCPRE, October 2012.

[84] Ghosh, Arunabha (2012) *Innovation needs an ecosystem,* Sunday Business Standard, 26/2/2012.

4.1.2 Analysis of pre-conditions – (i) Upfront finance

For R&D in energy storage, the availability of upfront finance would be a major challenge. Although we could not find information on the amount of R&D investment in this area, our consultations with battery companies based in India revealed their reluctance to undertake what they felt would be very large investments. In fact, none had analysed whether there was a scope for devoting resources towards R&D. Large companies with established markets and high financial turnover have little incentive to invest in developing batteries targeted at small, rural consumers.[85] The amount of payment within an RBF scheme would need to be large enough (although unspecified) to incentivise the largest market players to enter the fray. Meanwhile, small social entrepreneurs do not have the technical base or innovation systems to develop improved batteries.[86]

4.1.3 Analysis of pre-conditions – (ii) Institutional capacity

In terms of institutional capacity, various government ministries could be tasked with implementing such a programme. For example, Ministry of Finance, Ministry of Science and Technology, Ministry of Micro Small and Medium Enterprises, or the Ministry of New and Renewable Energy (MNRE). However, none of them has a specific mandate or the budget to administer large investments into R&D in batteries.

4.1.4 Analysis of pre-conditions – (iii) Measurable and controllable outputs

Since batteries have wide applicability (lighting systems, rental models, mobile use, electric vehicles, and so on), it is likely that private consumers and entrepreneurs, including rural or urban poor, would come forward if batteries were efficient, light and durable. Thus, it might be relatively easier to structure an RBF with observable targets in the form of decrease in battery weight or increase in battery storage efficiency.

4.1.5 Conclusion

R&D in battery technologies is a promising area of innovation, which could yield concrete results. The challenge is that the institutional capacity (both public and private) as well as the large upfront investment needed towards this end are missing. Existing market conditions in India do not seem to be suited to an RBF approach, especially since the size of the investment itself is unclear. Nevertheless, if innovation could be triggered in other countries, the resulting products could be valuable for deploying in India as well.

[85] Interviews with Exide, Luminous, Hyderabad Batteries Limited, and Amar Raja Batteries during October 2012.

[86] Interview with Selco Foundation Lab, 2 October 2012.

4.2 An RBF intervention for R&D in energy efficient appliances?

4.2.1 Introduction

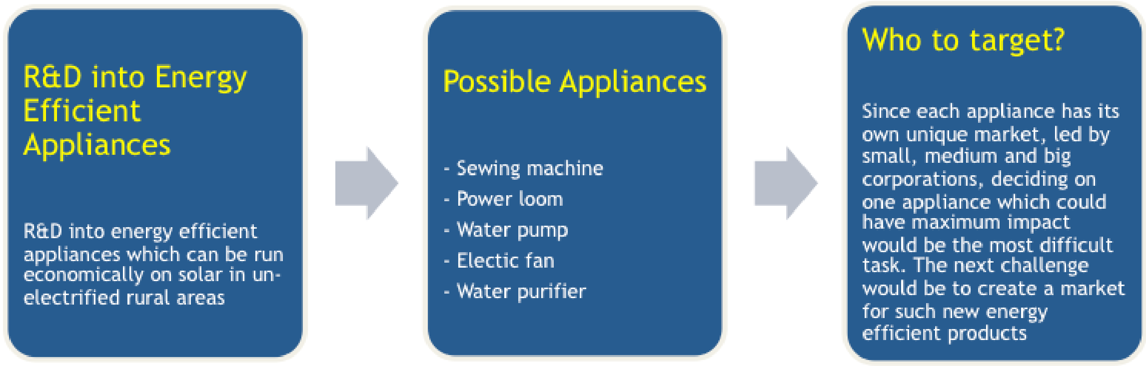
Innovation in the energy efficiency of appliances can be considered in a holistic way, integrating considerations about renewable energy, energy efficiency and livelihood generation. For instance, income generating appliances such as power looms, water pumps or sewing machines have high power requirements, which require a large amount of energy to operate and, in turn, a large amount of investment in the solar home system. But such appliances, by offering solutions beyond merely lighting, offer opportunities to raise incomes and broaden the economic and social impact in rural communities (say, by allowing women entrepreneurs to establish small home-based businesses).

A sewing machine may consume 150 W (watts) whereas the power consumption of power looms and water pumps may vary from 1 HP (746 W) to 3 HP (2238 W). A small enterprise running five sewing machines for 8 hours/day may require energy worth 6000 Watt-hours/day. The cost of powering such a system net of government subsidies with one-day battery backup would be Rs.290,000 (approx. USD 5,300). This cost, however, could be reduced significantly if the sewing machines were made more energy efficient. A sewing machine with a more efficient power consumption of 75 W may only require Rs.140,000 (approx. USD 2,600) worth of investment in a solar home system.

Based on the high capital cost of installing a solar system to run a small rural enterprise, this option is often not financially feasible for rural households. CEEW's discussions with sewing machine companies in India revealed that they did not have a specific R&D department to improve power efficiency. They already enjoy deep market penetration and have little incentive to expand into new areas, such as servicing small rural businesses. Moreover, most of the machines sold are currently imported rather than manufactured in India, so the R&D capacity is also limited.[87] Also, since the demand for such machines would be low as compared to existing alternating current (AC) machines, companies are unlikely to invest in developing a small, niche product. If R&D were incentivised *and* coupled with public procurement, then companies within or outside India might assume the task of manufacturing newer, energy efficient models of various appliances.

[87] The views expressed indicate the sentiments of one of two major market players that were interviewed by CEEW. Numerous attempts to get details from the other major company did not yield any results.

Figure 15. **How R&D in energy efficient appliances could be applied – and who would do it**



Source: CEEW

4.2.2 Measurable and controllable outputs

An RBF mechanism focusing on R&D to redesign appliances to make them more energy efficient could lead to a reduction in the investment for solar systems for homes and small enterprises. It could also create new opportunities for livelihoods and employment for poor households unconnected to the electricity grid. However, the RBF mechanism would only work if specific appliances were targeted for increased R&D spending (Figure 15). Unlike batteries, which have wide application, the types of appliances demanded by different rural entrepreneurs would vary from place to place. There are multiple potential consumers for multiple appliances and the decision to choose one appliance to focus R&D efforts would be difficult. Alternatively, the target could be a consumer appliance, like efficient fans, which have wide demand but its income generation potential would be low. Moreover, as in the battery example, the RBF instrument would need to be large and attractive enough to incentivise the biggest market players (of the selected appliance) to increase R&D spending in developing products that would be both more efficient and run on direct current (DC) for sale to a niche market.

4.2.3 Up-front finance and institutional capacity

Given the difficulties in choosing one particular appliance to target incentives at, the questions of upfront finance and institutional capacity becomes even harder to deal with.

A large part of our field visits were associated with understanding the needs of entrepreneurs or local vendors who had a sense of the demand for lighter or more efficient products. As a result, we have been able to illustrate the nature of R&D requirements, the range of applications and the potential target beneficiaries for an incentive scheme. But small-scale operators or social entrepreneurs cannot perform the type of innovation required. There is a need to incentivise large companies to undertake such R&D operations. Having contacted large manufacturers, we neither found much enthusiasm about undertaking such operations, nor any idea whether they had the in-house financial ability or inclination to kick-start R&D in such areas.

4.2.4 Conclusion

Since the case fails to meet the three necessary preconditions for an RBF intervention to be viable, we decided not proceed with designing an RBF mechanism for R&D in efficient appliances. Note that we have not dismissed the potential for R&D in these cases. But the nature of the challenges facing R&D in products have kept us one step short of developing the RBF mechanism design for R&D in energy storage or energy efficient appliances in India. If the conditions were appropriate elsewhere (or at the global level), then perhaps innovation prizes could be used to stimulate research and product development.

It is also possible that there may be other hardware innovations worthy or an RBF-like incentive. The reason we focused on batteries and appliances is because in all our conversations with field-level NGOs, social entrepreneurs, or vendors, these two were the ones that were most frequently cited. The same stakeholders mentioned why it was difficult to stimulate innovation in these technologies under present circumstances.

4.3 An RBF intervention to support innovation in energy access business models?

An RBF mechanism may be effective at supporting the roll-out of promising new energy access business models

4.3.1 Introduction

In India, although there is a case for improving battery or appliance technology, the highest urgency of innovation lies in filling prominent gaps in servicing, maintenance and financing of off-grid renewable energy systems. The evidence suggests that, in order to access reliable and affordable energy technologies, poorer households need innovations not just in products but also in the finance available to buy SHS. They also need better servicing and maintenance of the SHS component installed in their homes.[88] Currently, it is difficult to find innovations targeted at the needs of poor households for two main reasons:

1. *Financial Risk:* Large and small financial institutions are unable to visualise the long-term benefits in investments in off-grid solar. This results in fewer financial innovations that make such systems more accessible to rural and poor households.[89]
2. *Lack of Commitment:* Manufacturers try to sell products designed for the developed markets rather than to the 'Bottom of the Pyramid' (BOP). Most organisations do not consider innovations for the BOP market a main priority for the company's business. As a result, adequate management and technical resources are not allocated nor research budgets earmarked for low-cost innovations. Rural markets for off-grid electricity are challenging since profit expectations are low. Potential market participants are hesitant to invest resources to innovate products targeted at poor households. Moreover, they are unable to judge the needs of the end-users in rural areas due to a lack of capacity to serve these regions. Ultimately, the number of service providers catering to the needs of the non-electrified households in rural areas remains low. [90]

CEEW has identified two specific innovation needs in service and finance that could potentially be targeted with an RBF mechanism.

Servicing and maintenance of off-grid energy access technologies

One of the main problems facing customers of solar home systems (SHS) is poor after-sales servicing and maintenance. Entrepreneurs hoping to serve off-grid energy solutions face a vicious cycle of bad history, lack of trust, and insufficient finance. In the past, the government has heavily subsidised or distributed free

[88] See generally, Selco (undated) *Need for Innovations*, accessible at http://goo.gl/vN3jV
[89] *Ibid*
[90] *Ibid*

solar lights in non-electrified villages.[91] However, poor quality systems, lack of after sales service and poor maintenance have created a lack of trust among customers.[92] In turn, households have been unwilling to pay for the systems when there are few guarantees for the quality of the product or the efficiency of the after-sales service. A small customer base, small deal sizes and lack of information about renewable technologies are reasons why banks are averse to giving upfront finance to entrepreneurs. There is, then, a need to incentivise better service provision by vendors, such that customers are satisfied with the product and do not default on their loan repayments. Over time, this could revive confidence among financial institutions to consider financing off-grid renewable energy projects.

Payment processes for energy access technologies

The second issue concerns the ability of customers to pay for the SHS. With the off-grid sector mostly comprising poor households, there is a need for innovation in the financing options available to such households to adopt new energy access technologies.

An example of a company developing solutions to overcome shortcomings in servicing and finance is Simpa Networks.[93] It has developed a solar home system that runs on the 'pay as you go' prepaid model. The customer purchases credits in advance and the system automatically shuts down once the credits are exhausted. The battery powering the system is locked in a box onto which a 'smart meter' is installed. The meter is responsible for regulating electricity use. One major concern is that the system could be tampered with. Simpa is trying to mitigate this problem by selecting its customers carefully. This time-consuming process will become harder to sustain as soon as the company tries to scale up its operations and expand its customer base.[94]

The above example highlights how some vendors are trying to ease financing hurdles by offering households a more flexible choice for making payments. The customer does not necessarily have to make monthly interest payments to banks or other financial institutions, nor be burdened by a loan for the capital cost of the system. In turn, the prepaid nature of the service allows the household to design expenditures on electricity according to expected and actual financial flows. Moreover, since the customers would purchase units in advance only if they are sure that the system would work, the servicing of the system is automatically part of the contract with the vendor.

The use of SHS is likely to become widespread only if both the system *and* after-sales service are of high quality, and if people are satisfied enough with the system to be willing to pay for the electricity generated. Thus, innovative business models based on 'flexible payments' could help to increase the uptake for SHS on two fronts: first, by lowering the upfront costs for customers by giving them flexible payment options, and secondly, by tying payment to better servicing, the risk of systems failing is borne by the vendor instead of

[91] The Times of India (2011) *HC order govt to arrest 233 mukhiyas*, 25/8/2012, accessible at http://goo.gl/ohuJ0

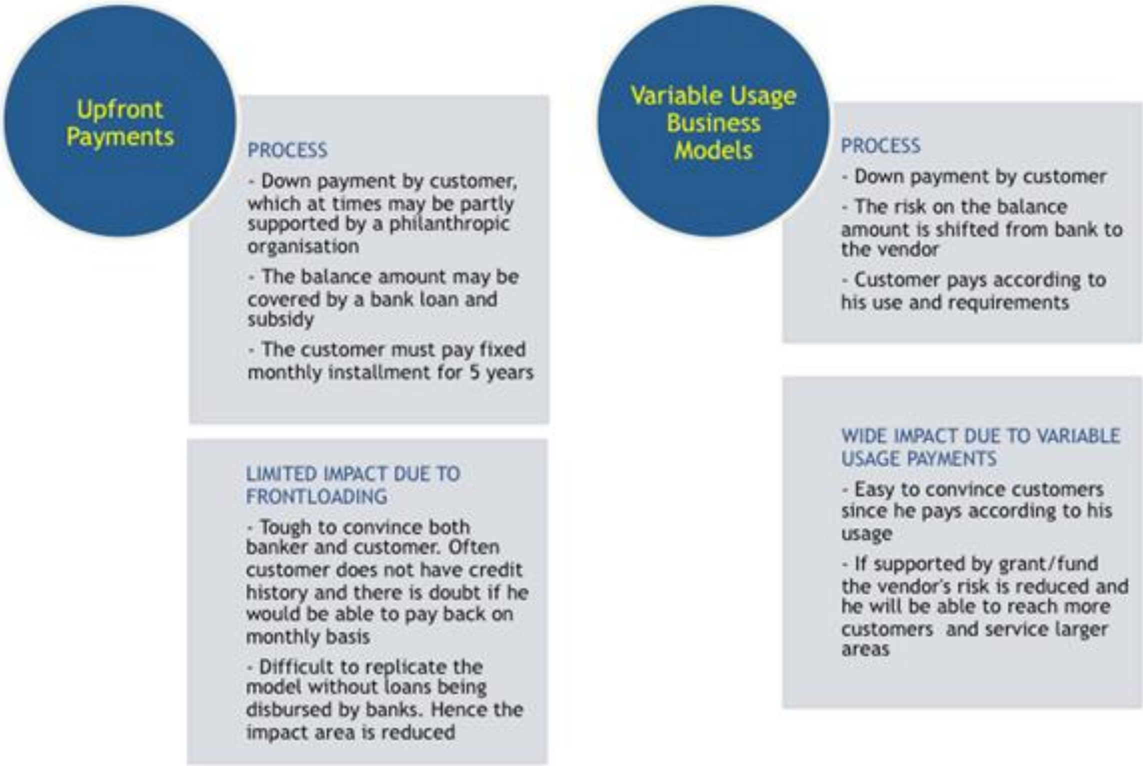
[92] CEEW discussions with rural and urban poor consumers in Karnataka, 1 and 2 October 2012; also see PV Magazine (2010) *I came, I installed…I left*, November 2010, accessible at http://goo.gl/72TiS

[93] See generally, http://simpanetworks.com/

[94] This example has been offered not to make it central to the case study or to support Simpa *per se* as a company. Instead, the aim is to illustrate how entrepreneurs offering off-grid energy solutions based on more reasonable payment structures for customers are encumbered by the need to restrict or slow down the scale of operations.

the customer (see Figure 16figure 16 for a comparison of business models based on upfront and variable usage payments).

Figure 16. **Upfront payments versus variable usage business models payments**



Source: CEEW

At the same time, such businesses have a limited window with privately raised equity investments to continue their pilot-testing phase. Financial requirements may vary from company to company. A small company comprising 3 to 4 employees with sales of Rs.200,000 to Rs.300,000 ($3700 to $5555) per month, would require approximately Rs.2,000,000 to Rs.2,500,000 ($37,000 to $46,300) for operating a single branch within a radius of 50 km. CEEW's discussions with one vendor suggests a need for additional sources of finance to continue operations.[95]

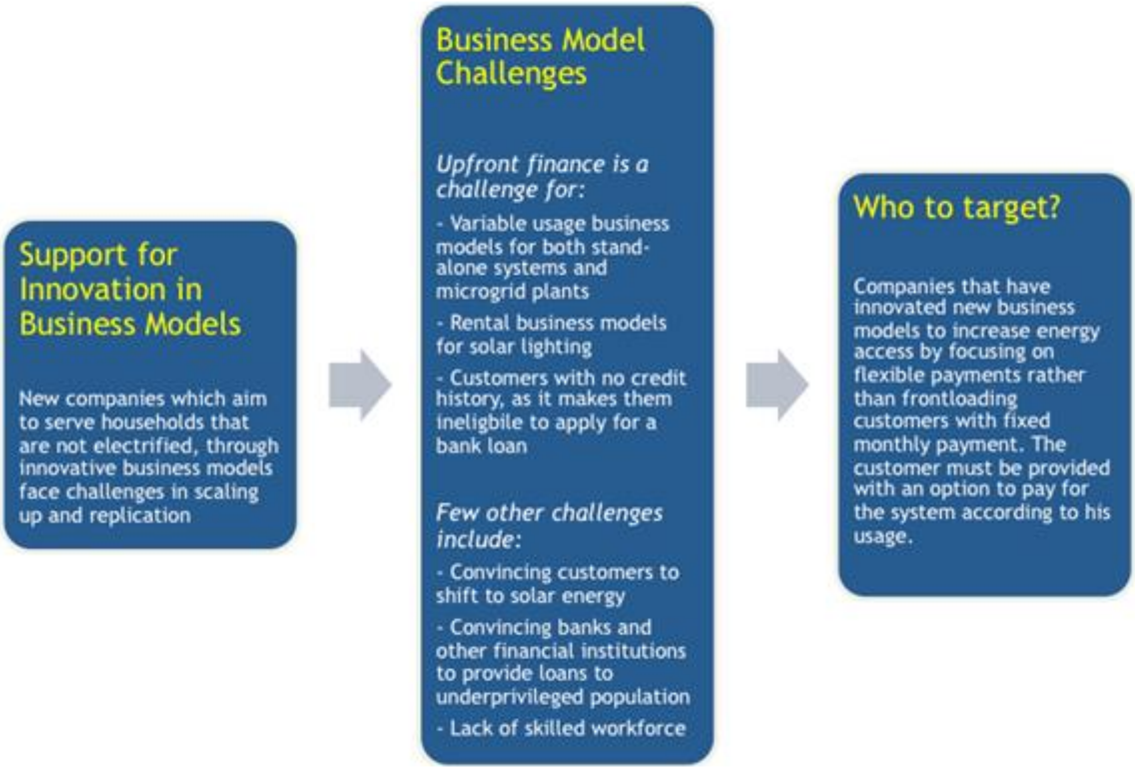
4.3.2 The case for using RBF to support business model innovation in energy access

Variable usage payment business models aim to widen the customer base and expand the scope of the energy technologies by offering better servicing and maintenance and pay-per-use options to the customer. Thus, they offer both quality assurance and ease a customer's upfront financial burden to take up off-grid energy applications.

[95] Stakeholder discussion with Bangalore based vendor on 26 September 2012

An RBF intervention could, thus, be used to promote innovation in financing options that creates new business models for existing off-grid products (Figure 17). For instance, there are gains from innovation in variable usage business models as these have the potential to target two challenges: (a) aversion to take large loans for the capital cost; and (b) concerns about system quality and poor past experience with lack of after-sales service.

Figure 17. **How innovation in business models could be applied – and who would do it**



Source: CEEW

However, the RBF mechanism would also have to be structured in a manner that eases some of the risk for the vendor. Otherwise, the risk of upfront capital investment is shifted entirely on to the vendor, the main reason why these businesses are carefully selecting consumers and limiting their operations. This is the case not only with companies like Simpa, which are relatively better known, but also with smaller or potential entrepreneurs who are planning to set up businesses offering solar lighting on a rental basis.[96] An RBF intervention that promotes variable usage business models (to benefit consumers) would also have to help potential entrepreneurs with support in the form of working capital.

[96] CEEW discussions with potential entrepreneurs in Udupi city slum and Dharmasthala village, Karnataka, 1 and 2 October 2012.

4.3.3 The case for choosing RBF – (i) necessary pre-conditions

Here, we discuss the design of an RBF mechanism for encouraging variable payment business models. Similar to the approach followed in the previous case study, we first examine whether the three necessary preconditions for using RBF instruments are fulfilled:

1) Sufficient access to upfront finance
2) Sufficient institutional capacity
3) Measurable and controllable outputs

A major part of the discussion on upfront finance and institutional capacity mirrors the discussion in the previous case for an RBF mechanism for SHW systems in India. There are multiple agencies and government ministries that could be tasked with providing finance to and implementing a new RBF scheme. However, no one particular institution can be identified that has a mandate to advance the objectives proposed by the RBF scheme. We will, however, attempt to highlight some other factors that could help iron out issues of upfront finance and institutional capacity.

Upfront finance: In addition to the existing market capital of companies, different financial packages in the form of solar loans are available through banking or micro-finance institutions.

Recently, the World Bank Group's *infoDev* has proposed an India Climate Innovation Centre (CIC), which aims to be a holistic country-driven approach to accelerate the development, deployment and transfer of climate technologies. It is being piloted as a mechanism to support innovation by offering a full suite of services to address locally relevant barriers to climate technology commercialisation. In addition to supporting promising new technologies and ventures, the CIC could also provide access to finance, equipment and facilities, market information, policy advocacy and technical assistance, as well as facilitate national and international collaboration.[97]

The mission of the CIC is to create, leverage and aggregate a holistic portfolio of programmes, services and financing in India that bridge local market gaps and support the accelerated growth of innovative climate technology ventures. Its core goals consist of filling market gaps by:

- Giving access to flexible finance at a number of strategic levels.
- Building capacity of new and existing enterprises and facilitating the interaction of innovative enterprises with large industry.
- Enabling collaboration and supporting an ecosystem that aggregates existing partners.
- Creating regional clusters of innovation to leverage existing resources and infrastructure.
- Providing a hub for building international partnerships that can facilitate technology transfer and collaborative R&D, as well as business-to-business linkages.[98]

An important consideration, therefore, would be whether the CIC could be relied upon to provide additional finance to spur innovation in the identified areas. That said, the CIC need not be the only funding source.

[97] India Climate Innovation Centre (CIC) – Business Plan at p.11, available at: http://www.infodev.org/en/Project.127.html
[98] *Ibid* at p.7

The challenge is to create a financing ecosystem for renewable energy, in general, and for off-grid applications and business models, in particular. There are early-stage attempts underway to create networks of financiers, technology developers, government institutions and other stakeholders, which could potentially promote innovative business models and small-scale entrepreneurs.[99] It is too early to comment on the success of these efforts.

Institutional capacity: The institutional capacities of the agents and principal are seemingly in place. There are numerous schemes through which external donors and public agencies within India channel funds to non-governmental (for-profit or not-for-profit) organisations to deliver services.

However, if a new agency, such as CIC or NCEF, is tasked with the RBF instrument then there may be insufficient institutional capacity to achieve the desired results. This is because the CIC is at the pre-implementation stage, with only a business plan for the financing and implementation of CIC in India. However, the structure of CIC indicates that it would provide a range of services such as finance, capacity building, ecosystem development and innovation cells. Such an enterprise could help drive small innovators who offer new payment processes and better servicing by creating a new self-sustaining business model.

Similarly, as the case study on solar water heating illustrated, the NCEF's mandate has not been finalised and, to the extent some guidelines exist, they are not being followed. Moreover, if the NCEF becomes one of the new agencies through which funds are channelled, then its capacity would have to be strengthened.

Measurable and controllable outputs: The task of determining the measurable and controllable outputs would be challenging but manageable. For instance, the kind of payment processes that would qualify as 'variable payments' would have to be determined upfront. In addition, the contracts would have to define the metrics for pay-outs: whether selling off-grid solutions to single households or small businesses, or entire communities, or even a larger scale of deployment.

4.3.4 The case for choosing RBF – (ii) The risk-incentive trade off

In order for RBF to be preferred over conventional instruments such as an upfront grant, the gains from stronger incentives should outweigh the cost increase from the risk transfer to the vendors.

a. Is the result under the control of the agent?

Yes, the result is mostly under the control of the agent as they are in charge of increasing the number of SHS by offering more flexible payment options to the customers. The more they ease the upfront cost burden of the customer, the greater the numbers they should manage to sell (so long as vendors have the working capital to cover the capital costs in advance).

b. Is there a clear line of sight for the principal to the result against which the result-based payment is being made?

[99] CEEW will be leading work in this area over the coming months, but at this stage there are no operational networks that could be referenced.

Yes possibly. The principal would have to judge the result based on specific metrics against which the payment is being made. These metrics would largely depend on deciding what are counted as ‘variable usage’ business models and on the scale of deployment. As long as the principal is clear on these criteria, it should be easy to define whether the results have been achieved.

c. Does the RBF mechanism stretch the balance sheet of the agent?

It depends. RBF would stretch the balance sheet of the agent compared to a business model where the customer assumes the burden of upfront down payment and/or a bank loan. However, if the aim were to win more customers by offering ‘variable usage payment’ schemes, then the RBF mechanism would ease the balance sheet of the agent by giving it a portion of the working capital it would need to cover capital costs. In the absence of the RBF intervention, the agent could recover its costs over the payback period, but would have to bear the entire risk of capital investment in the interim.

Could the agent hedge some of the risks by relying on alternative revenue streams? Yes, if the agent were a large firm with a range of energy products and services in its portfolio. In that case, variable usage payment models would be only a new type of service offering and the agent could, in fact, draw on its trust and credibility in existing markets, as well as any working capital, to win new customers. But, as the problem has been described here, the challenge is faced mostly by small social entrepreneurs without other sources of revenue. To the extent such vendors break into new rather than existing markets, their scale of operations is limited by access to capital and concerns about whether customers will eventually pay or not. Such small vendors would rely on an RBF-type instrument to cover some of the risk of initial capital investment.

d. Is the cost base largely variable?

The cost base of the agent responding to the RBF intervention is variable. The payment would only come through if all relevant stakeholders had agreed to deploy a system based on variable usage payments. These stakeholders would include both the vendor and the customer (household) but also potentially the local bank (say, to guarantee the customer’s contract with the agent).

Note that here the bank’s role is not to offer a loan. Instead, the bank could simply vouch for the customer if, say, she/he had an account. In one city slum, CEEW researchers found that a local bank had agreed to lend to one SHS customer, only when all other households in the slum had opened bank accounts in the local branch.[100] This way of establishing and leveraging social capital could be even more effective for variable usage payment businesses, since the upfront investment would be low for the customers. In the case of variable usage business models, so long as a household opens a bank account, local banks could be willing to offer a statement in favour of the household. The costs for the agent would be directly linked to the number of systems so installed.

e. What is the time horizon of the RBF intervention?

As with the SHW case study, the time horizon is unclear at the moment. It would depend on how long the entire scheme runs. However, a part of the pay-out must be given upfront as long as the household agrees to

[100] Field visit to Udupi city slum, Karnataka, 1 October 2012.

the installation and a local bank vouches for the customer. The RBF scheme should run at least for the length of the payback period for recovering costs via a ‘variable usage payment’ scheme. In this way, the vendor could use revenues earned during this period to support investments among new consumers.

4.3.5 The case for choosing RBF – (iii) Positive spill-over effects

Some of the positive spill-over effects of a successfully designed RBF intervention for variable usage business models are highlighted below:

- Access to electricity for households not eligible for loans. Availability of electricity could potentially lead to an increase in productive activities and raise the income of a household. A few examples of such activities are: studying for longer hours, rolling *bidis* at night, and engaging in small trades such as selling fruits and vegetables after sunset, or stitching clothes at night to generate an extra income.[101]
- Reduction in burns and injuries due to use of kerosene lamps.
- Reduced indoor air pollution.
- Reduction in travel time to purchase fuel.

4.3.6 Designing RBF interventions relevant to the problem

In designing the RBF based on the analytical framework, we will detail the following: eligibility, conditionality or trigger for paying out the RBF, structure of the pay-out, and the role of the principal.

4.3.7 Designing RBF interventions relevant to the problem – (i) Eligibility

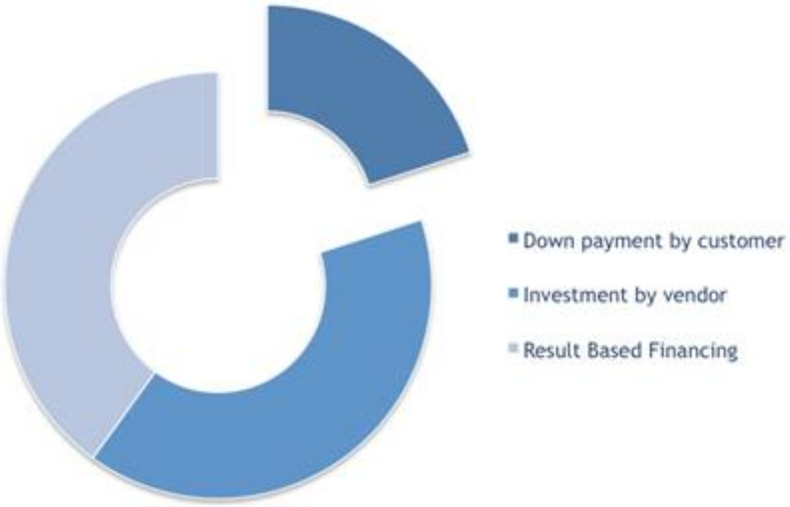
The RBF mechanism would be aimed at companies that create new business models by offering variable usage payment options to customers, thereby increasing the uptake of SHS. The eligibility could be based on certain additional criteria such as minimum numbers of households serviced or a threshold number of households that have agreed to have the SHS installed in a particular target area.

4.3.8 Designing RBF interventions relevant to the problem – (ii) Conditionality

The RBF intervention would be paid as an upfront amount as soon as the household agrees to install the system. The RBF intervention, in essence, would supplement the investment made by the investor in order to dilute his risks. For example, as illustrated in figure 18, if a portion of the cost is paid by the customer as down payment (a sum much smaller than if the customer had to cover upfront capital costs of the system), then the RBF mechanism could be set at half of the remaining cost of the system.

[101] Observations during CEEW field visits, October 2012.

Figure 18. **Breaking down the total cost of SHS under the proposed RBF mechanism**



Source: CEEW

Our suggestion is that a part of the payment incentives should be linked to after-sales service, for example, half-yearly or annual maintenance visits. Is there a possible inconsistency between our stress on the need for after-sales support and the RBF mechanism, which is designed to ensure that the vendor does not have to bear the entire burden in terms of continued use of the system? Not really. This is because while the RBF reduces the vendor's payback period, she/he would still bear most of the cost for the system. The return on investment would continue to remain contingent on the continued use of the system, which would ensure a steady revenue stream. This would not happen unless the after-sales service is of high quality and the system retains its integrity in terms of power output.

4.3.9 Designing RBF interventions relevant to the problem – (iii) Pay-out structure

The aim here is to incentivise entrepreneurs who, in turn, target customers through variable usage payment options. An entrepreneur may provide services either through standalone systems or through micro grids. Often potential customers are not eligible for bank loans due to absence of credit history or required documentation. To service these customers vendors have to bear the risk of non-payment. An RBF can assist the vendors by covering a part of the risk by providing assistance in form of an interest free loan. Once recovered it may be utilised for the next cycle of assistance on discretion of the lender.

Since the RBF payment would be made upfront to the vendor, it should not be mistaken as a subsidy. Rather, it could be considered as a result-based incentive through an interest-free loan. The costs recovered by the vendor from the customer over the stipulated time period should help him to pay back the RBF amount to the principal. This is a response to the absence of bank financing for such risky business models illustrated earlier. Alternatively, the principal could also allow the money to be reinvested into another cycle of system installation. This is why we recommend that the RBF programme should run for at least the length of one payback period. In turn, this could make the business model a self-sustaining success story.

Entrepreneurs operating micro grids often service areas where population density and electricity requirements are low to medium. Hence, large investments are required for setting up and operating micro grid plants. There may be a possibility that customers may not be willing to pay the amount desired by the developer. Hence, for micro grids the assistance may be in the form of the difference between the amount per unit desired by the developer (to generate a positive net present value with a discount rate greater than or equal to the cost of capital or the required internal rate of return) and the amount the customer is willing to pay.

4.3.10 Designing RBF interventions relevant to the problem – (iv) Role of the principal

The main role of the principal in this case would be to help facilitate the shift from frontloading investments on customers to creating a more sustainable ecosystem for the market players to branch out into newer areas with their innovative payment structures. The principal may also conduct monitoring and third party verification from time to time, in order to ensure that the installed systems are functioning well. In this case, however, the customers would be the best verifiers, as they are unlikely to pre-pay for electricity if the systems are not well maintained or serviced.

4.3.11 Designing RBF interventions relevant to the problem – (v) Exit strategy

The proposed RBF mechanism in this case study is designed to encourage innovation in business models. The ultimate objective would be to create a self-sustaining market for these new business models. According to the main report, this would benefit from a phased exit strategy.

The principal should ideally look to reduce RBF payments after a stipulated minimum period by which time the market has reached the point of self-sufficiency. In this case, the main challenge for variable usage payment models is not the cost of the system itself but the ability of vendors to assume the upfront costs *and* the risk of supplying electricity or other services to unknown customers. The RBF intervention serves as a way to cover a portion of those upfront costs and reduces the payback period for the vendor, thereby allowing the vendor to reach out to a wider customer base.

If one round of funding were successful and it resulted in regular customer usage and per-use payments for the service delivered, the recovered funds could be reinvested in a second round of installations or could be returned to the RBF principal. The principal, in turn, could use the funds to stimulate similar business models in other areas or with new vendors. Or, if the funds were limited and available only for the duration of one payback period for a particular business model, the programme could be shut down subsequently. Either way, the risk for the RBF principal is low.

4.4 Conclusions

The main premise of this case study was to analyse the scope of facilitating R&D for the wider application of renewable energy technologies, which go beyond home lighting and into more productive uses. There was a case for R&D in energy storage by making batteries more efficient, light and durable. However, this case failed to meet the necessary preconditions for RBF to be viable. A similar case was made for R&D into energy efficient productive (income-generating) appliances, but it too failed to meet the necessary criteria for the application of an RBF mechanism. There remained the case for innovation in business models, whereby an RBF intervention was proposed to encourage new and innovative business models that offer variable usage payment options to customers.

The prices of solar lighting systems have decreased in recent years making it comparable to the conventional electricity generation systems. However, upfront finance remains a major challenge among rural households. Recently a small number of entrepreneurs and vendors have tried to overcome this barrier by providing the end user with the option of variable usage payments. A business model that customises the payment structure based on customer needs could potentially increase the demand for these systems. The risk of non-payment, however, still lies with the entrepreneur. The proposed RBF scheme is, thus, designed in the form of an interest free loan that could help the entrepreneur reduce the risks as well as offer high-quality service to a larger number of customers than would otherwise have been possible.

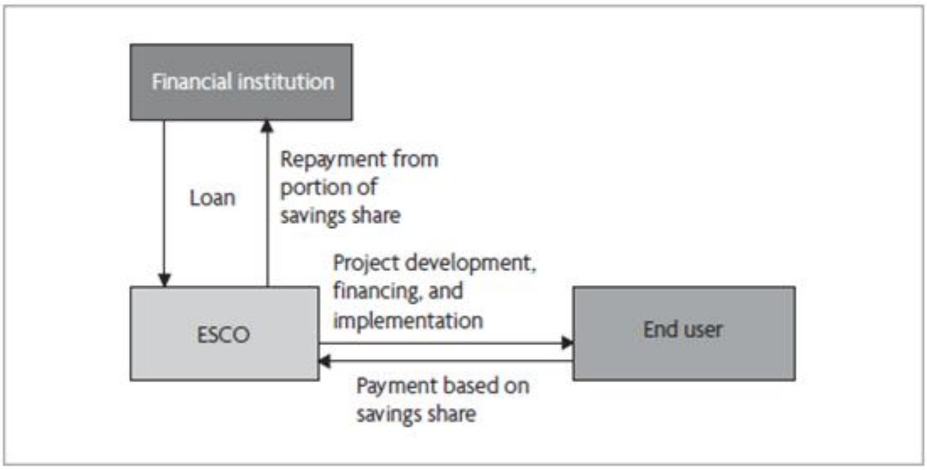
5 Energy efficiency in multi-family buildings

Encouraging energy efficiency through RBF

Section Contents:

Energy efficiency holds a vast potential of untapped opportunities, though these are notoriously difficult to realise. Improvements in energy efficiency allow countries to do three things at once: strengthen energy security, reduce costs, and cut greenhouse gas (GHG) emissions, largely at negative abatement costs. RBF schemes may be an option for unlocking a substantial part of this potential. This case study considers the more challenging case of multi-family building retrofits.

Figure 19. **RBF may be able to promote ESCOs**



Source: Langenheld (2012). Available at http://goo.gl/2igDw

5.1 Introduction

Improvements in energy efficiency[102] (EE) enable countries to achieve three objectives simultaneously:[103] to strengthen energy security, improve competitiveness, and reduce GHG emissions.

As regards climate change mitigation, improved EE is one of the cheapest options for GHG abatement;[104] indeed a number of EE opportunities are characterized by a negative abatement cost (the financial net present value of such investments is positive over a certain time-horizon), making GHG abatement a free co-benefit of improved EE. Deployment of energy efficiency investments, however, is not happening at scale due to a range of barriers, which are different in terms of type and impact depending on each market segment.

One of the most important segments of the energy efficiency market relates to improving the energy efficiency of residential buildings. Buildings account for about 40 per cent of final energy demand in the world,[105] and residential buildings for about 25 per cent.[106] As observed by McKinsey: 'The residential sector is not only the largest single energy end-use sector; it is also where the largest energy productivity opportunities are waiting to be seized'.[107]

The sub-sector of *multi-family buildings*, especially the retrofitting of older buildings, is notoriously complex and is characterized by under-investment due to a number of barriers, discussed below. Around 50 per cent of residential buildings are multi-family buildings in China, Europe, and India, with a lower proportion in Brazil, and the United States.

In non-OECD countries renewable energy, particularly traditional biomass, remains the largest source of energy consumption for the residential sector. In Russia, many Central and Eastern European countries, Ukraine, and Kazakhstan, district heating remains important in this sector.

The IEA has highlighted the contrasting policy challenges facing OECD and economies in transition (EITs) on the one hand, and developing countries on the other in this area: 'OECD countries, and EITs to a lesser

[102] Energy efficiency is defined as the energy services provided per unit of energy input. This contrasts with energy conservation, which 'is typically defined as a reduction in the total amount of energy consumed. Thus, energy conservation may or may not be associated with an increase in energy efficiency, depending on how energy services change. That is, energy consumption may be reduced with or without an increase in energy efficiency, and energy consumption may increase alongside an increase in energy efficiency'. (Gillingham et al., 2009).

'Technically,"energy efficiency" means using less energy inputs while maintaining an equivalent level of economic activity or service; 'energy saving' is a broader concept that also includes consumption reduction through behaviour change or decreased economic activity. In practice the two are difficult to disentangle and the terms are often used interchangeably.' (European Commission, 2011.)

[103] Although each of these objectives might be worthwhile pursuing separately and are indeed not given equal priority by governments (for example, a number of transition and developing countries are more preoccupied by energy security than by climate change mitigation).

[104] IEA (2008) Energy Technology Perspectives, Scenarios and Strategies to 2050

[105] World Business Council on Sustainable Development (2009) *Energy efficiency in buildings – Transforming the market*

[106] The residential sector accounts for about 70% (1,941Mtoe) of total building consumption of 2759 Mtoe (in 2007). IEA (2010) *Energy Technology Perspectives*

[107] McKinsey Global Institute (2007) *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity*

extent, are characterised by a large stock of residential buildings that is not growing quickly and that will be retired only slowly. So most of the CO_2 reduction potential is in the current stock of buildings. OECD countries and EITs also have significant heating loads, as does China'.[108] Consequently, to achieve significant reductions in the heating loads in existing buildings in these countries, insulation and heating system retrofit packages will be essential. Outside of OECD countries, China and the EITs are the main target regions for this type of measure, given their climate characteristics and the high proportion of multi-family buildings in their total building stock.

In multi-family buildings, the best EE results are achieved by *a full renovation* encompassing the modernization of the building envelope or shell (insulation and windows) and replacement of heating and air conditioning systems. Efficiency improvements of 50-75 per cent have been documented, and 30 per cent is usual.[109]

The IEA estimates that improvements in building shells (including the external walls, floors, roofs, ceilings, windows and doors) could account for just over half of the incremental investments required in the residential sector to attain the BLUE scenario[110] targets (7.9 trillion in constant 2007 USD, that is, 60 per cent of the total incremental investment in the building sector).[111]

Although most of these investments yield net cost savings and are thus overall cost-effective, the refurbishment of building shells 'will only be economic when major scheduled refurbishments are undertaken, typically every 20 to 30 years, but sometimes after much longer periods', however 'retrofitting high-rise residential buildings with energy efficiency improvements when they are refurbished can yield energy savings of up to 80% and negative life-cycle costs'.[112]

This case study investigates whether results-based financing (RBF) could help overcome some of the barriers that hinder EE investment in the segment of multi-family building retrofits, drawing on examples from around the world, but particularly OECD, China and EITs.

[108] IEA (2010) *Energy Technology Perspectives*

[109] World Business Council on Sustainable Development (2009) *Energy efficiency in buildings – Transforming the market*

[110] The BLUE scenarios assume that global energy-related CO_2 emissions are reduced to half their current levels by 2050 (a division by four of the forecast BAU level). The BLUE scenarios are consistent with a long-term global rise in temperatures of 2º to 3º Celsius, but only if the reduction in energy-related CO_2 emissions is combined with deep cuts in other greenhouse-gas emission. IEA (2010) *Energy Technology Perspectives*

[111] IEA (2010) *Energy Technology Perspectives*

[112] Ibid.

5.2 Policy objective and challenges

5.2.1 Policy objective

The policy objective is to stimulate energy efficiency investments in the multi-family housing stock. This case study looks at three potential RBF instruments to meet this objective. However, in each of the three cases there are significant challenges that can hold back the efficacy of any intervention aimed at achieving high (technically feasible and economically justified) levels of EE.

The three cases considered are as follows:

i. Stimulate EE performance in existing multi-family buildings (retrofitting of apartment blocks, including social housing).
ii. Stimulate the demand for Energy Service Companies (ESCOs) (or equivalent public private partnership arrangements) services to implement EE investment projects in existing multi-family buildings.
iii. Stimulate the provision of commercial bank loans to implement EE investment projects in existing multi-family buildings.

5.2.2 Barriers and rationale for public sector intervention

In each of the three cases above, significant barriers are inhibiting or hindering investments. Below we investigate these barriers case by case.

Barriers and rationale for intervention (i) – investments to retrofit existing multi-family buildings.

Three types of considerations (which could be cumulative) could justify a public intervention in the form of a subsidy:

- The project is not cost-effective financially (or over a 'bankable' horizon, say 20 years) (case of retrofits involving the building shell) but has significant *positive externalities*, for example in terms of carbon abatement, as highlighted by the IEA.[113]
- Regardless of whether a project is cost-effective, the full cost cannot be borne by lower-income households.
- The project is cost-effective but there exist a series of barriers. The main types of these market imperfections include: (i) the principal/agent issue when energy users are not those who take and finance capital investment decisions (see box 9); (ii) the lack of information; for example, in many countries (EITs, China, some OECD) energy (and water) consumption in apartment blocks is metered at the building level but not at the level of each apartment, and is invoiced to each apartment owner or tenant on the basis of floor space; (iii) access to capital constraints, particularly in developing countries; (iv) the high upfront (or first) cost and long pay-back of refurbishments involving the building shell, (v) the complexity of decision-making within home-owner associations (when they exist), and (vi) the complex technical nature of these investments.

[113] Ibid.

Box 9. **Specific barriers to energy efficiency in the building stock**

'One significant barrier common to all building types that are not directly owned is known as the *split incentive*. It applies to both residential and commercial buildings and means that the benefit of energy savings does not go to the person making the investment. For example, the owner is likely to be responsible for making energy efficiency investments, but the occupier may receive the benefit of lower energy bills.

This means the owner has no direct incentive to invest (although landlords may benefit from higher rents). On the other hand, if the landlord is responsible for the energy bills, the tenant has no direct incentive to save energy. Landlord/tenant relationships are also complicated by *billing practices* that can mean tenants do not pay specifically for the energy they use. Many apartments and offices in multi-occupied blocks do not have individual heating systems or meters to measure consumption. Heating costs may be included in the rent or charged to tenants based on criteria such as floor space; so the tenant will have no incentive to save energy. When tenants are billed for actual consumption, energy use for heating typically drops by 10 to 20 per cent%.'[114]

*Source***:** *World Business Council on Sustainable Development (2009)* Energy efficiency in buildings – Transforming the market

Barriers and rationale for intervention (ii) –ESCO (or equivalent public private partnership arrangements) services to implement EE investments in existing multi-family buildings

There is no standard definition of ESCOs,[115] but they are broadly understood as being private or public[116] companies specialising in identifying energy saving opportunities (through energy audits), and designing, implementing and possibly financing the resulting EE investment projects. Representing a form of out-sourcing, ESCOs bundle services that their clients could procure separately, and, as such, offer a one-stop shop, turnkey service. They generally take on the project performance risk through a shared saving contract or the guarantee of a minimum level of energy savings – see box 10.

Box 10. **Typical ESCO contracts**

[114] In China, 'most urban dwellers with central heat supply are also not responsible for paying their own heat bills – this is still typically the responsibility of employers or local government'. World Bank (2005) *Project Appraisal Document on a Proposed Grant in the amount of US$5.5 million to the Socialist Republic of Vietnam for a Demand-Side Management and Energy Efficiency Project*

[115] The EU Directive 2006/32/EC on 'energy end-use efficiency and energy services' (Energy Services Directive) defines an ESCO as 'a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria'.

[116] UkrEsco in Ukraine is a state-owned ESCO.

The typical ESCO contract is called an energy performance contract (EPC) or energy saving performance contract (ESPC), conveying the idea that the ESCO's remuneration is tied to its performance in saving energy at its clients' facilities. The EU Directive 2006/32/EC on 'energy end-use efficiency and energy services' (Energy Services Directive) defines 'energy performance contracting' as 'a contractual arrangement between the beneficiary and the provider (normally an ESCO) of an energy efficiency improvement measure, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement'.

There are two main EPC models. Under the '**shared savings**' model, the ESCO normally finances the project, and shares the savings with the client on a pre-determined basis. In the '**guaranteed savings**' model, a third party such as a commercial bank finances the project and the ESCO guarantees a certain level of energy savings to the customer: this model is advantageous when interest rates are usually lower as, for example, in the US where municipalities can issue tax-exempt bonds, and thus have a lower cost of debt than ESCOs (as long as their overall indebtedness remains within reasonable limits). By contrast, in the shared savings model, the ESCO assumes both the performance risk *and* the credit risk of the facility owner (the risk that it may not be able to meet its financial obligations to the ESCO). Note that the liability incurred by the facility owner under a 'shared savings' contract does not qualify as debt. It is an off-balance sheet financing method. This makes ESCOs attractive to clients starved of capital but it requires ESCOs that are well capitalized and have good access to finance in the form of bank loans, forfeiting, or leasing.

ESCOs are generally more suited to EE improvements in the building stock than in industry where the complexity of some (proprietary) processes makes the involvement of a third party more difficult and sometimes undesirable.

ESCOs predominantly operate in the more mature markets, with the notable exception of China, where a homegrown brand of ESCOs has developed since the mid-1990s, in part under the impetus of World Bank projects such as the first Energy Conservation Project I starting in the late 1990s.

Barriers to ESCO projects are manifold, however. They are especially acute in the multi-family housing sector, where they combine with the intrinsic complexity of this end-use segment (see above). Even in the US – the largest ESCO market in the world – the residential sector only accounted for 9 per cent of total 2008 ESCO revenues[117] and it is likely to be much lower in most economies in transition where ESCOs of any form are rare. For instance Marino et al., report no ESCOs in Belarus, Albania, and Bosnia-Herzegovina, Moldova and Montenegro; only one in the Former Yugoslav Republic of Macedonia, and a couple in Croatia and Estonia.[118] According to a report by the World Energy Council and ADEME: 'major barriers in the residential sector are the high relative transaction costs, the low level of information and lack of interest about this mechanism among building owners as well as the complexity of the decision process. They

[117] The Federal government and the 'MUSH' sector (municipal and state government, universities, schools and hospitals) accounted for 69% of ESCO revenues. Satchwell, A., Goldman, C., Larsen, P., Gilligan, D., and Singer, T. (2010) *A Survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011*

[118] Marino, A., Bertoldi, P., Rezessy, S. (2010) *Energy Service Companies Market in Europe - Status Report 2010*

prevent almost every ESCO activity in this sector, although saving potentials would be easier to realize than in other sectors'.[119]

In many countries, mistrust on the part of potential ESCO clients is a key barrier to entering into EPC contracts. In their 2010 survey of the ESCO market in Europe, Marino et al. underscore the 'high level of mistrust in the ESCO model both from customers and from financing institutions. The lack of standardization is perceived as the most important motive for this mistrust. In addition (and partly related to the lack of standardization) the following issues have been identified as reasons for mistrust: different ESCO offers by different companies, which makes standardization of contracts difficult; a lack of competition in some market segments; a lack of experience of clients, ESCOs and financial institutions; the absence of widely disseminated best practices with a clear client focus; unclear definitions and failed contracts; lack of standardized measurement and verification of project savings; and complex contracts'.[120]

Barriers and rationale for intervention (iii) – The provision of loans for EE investments in existing multi-family buildings

It is well documented that commercial banks under-invest in EE due to several barriers, ranging from lack of experience/expertise in appraising these projects, risk perceptions and, not least, the fact that EE is a notion which does not fit well into banks' traditional business sector and product lines, with EE being embedded in general renovation or modernization investment plans without being a focus of attention as such. This explains why EE finance is, unlike renewable energy, under-recorded and under-reported in statistics and the literature on sustainable energy finance flows.[121]

SMEs and households are 'affected much more by the "disconnect" between the financing needs and the lending practices of LFIs (local financial institutions) than large industrial firms with substantial balance sheets that can borrow funds with fewer restrictions'.[122] Regarding the former, banks are very strict on security (collateral) requirements, sometimes as a result of their own regulator or central bank (for example, Uzbekistan).

Some RBF instruments have been used to encourage banks to allocate more attention and resources to small energy efficiency projects. For example, some of EBRD's dedicated energy efficiency and renewable energy credit lines include an RBF-type incentive to local banks. The EBRD loans to local banks are priced at normal market terms (however with a longer tenor), but banks receive a fee of 1-2 per cent of the value of each loan they make to eligible borrowers. This enables banks to earn a higher return in areas where they perceive risks or have little experience. The purpose of the RBF fee is to buy down the cost of building expertise, allocating resources, and even creating a new banking product, up to the point when the 'market' is established.

[119] World Energy Council and ADEME (2007) *An Assessment of on Energy Service Companies (ESCOs) Worldwide*

[120] Marino, A., Bertoldi, P., Rezessy, S. (2010) *Energy Service Companies Market in Europe - Status Report 2010*

[121] The UNEP publication 'Global Trends' has discontinued tracking EE investments since its 2011 edition.

[122] IEA (2011) *Joint Public-Private Approaches for Energy Efficiency Finance*

5.3 Application of the framework, part 1

RBF may be an option to deliver more energy efficiency

Having established that all three situations are faced with market barriers, which provide sufficient justification for public intervention, this case study then applies the conceptual framework developed in the conceptual paper, starting with part 1 here.

Can RBF instruments be considered?

There is a range of different policy instruments that are available to principals to correct the type of market failures described in the previous section. These include setting of minimum performance/quality standards, mandating certain forms of activities, taxing activities, allowing patents, as well as subsidising activities. In cases where a principal decides to introduce a subsidy then this may be structured as an RBF instrument.

In the following discussion, it is assumed that energy prices are set at a cost-reflective level (long-term marginal cost), but that they do not take into account the cost of externalities such as climate change.[123] In this context, an RBF instrument would not be used to offset the negative impact of subsidized energy prices on the uptake of EE measures. Fossil energy prices are still significantly subsidized in former Soviet Union countries, particularly in Central Asia.

An additional characteristic of buildings is the very different economic life spans of the buildings and the different energy-consuming systems and devices inside them that determine total building energy consumption. While the residential building stock has a long economic life and very low retirement rate, energy-consuming technologies and appliances are changed much more frequently. Heating, ventilation and air-conditioning (HVAC) systems are generally changed every 15 to 20 years. Roofs, facades and windows need renovation periodically. Household appliances are changed every 5 to 15 years, and consumables such as light bulbs are changed in generally shorter timeframes.

In this context, a subsidy structured in the form of an RBF instrument could make sense to encourage measures which affect the building envelope/shell because of their high upfront costs, longer pay-backs, and intrinsic complexity for multi-family housing (requiring that at least a majority of owners agree to undertake the works, and so on)[124] Such a subsidy could also help to make such investments (more) attractive to the private sector in a situation in which increases in energy prices to take account of carbon externalities will remain politically infeasible in the near-medium term.

[123] The EU Emission Trading Scheme is putting a carbon price on electricity generation, but this price is currently and is likely to remain very low.

[124] The EU building directive (2010/31/EU) sets MEPS for existing buildings that undergo a major renovation. Member states are also to set MEPS for renovation of technical building systems (large ventilation, cooling, hot water, heating, AC) for new built and replacement, and for renovation of building elements (walls, roofs, and so on) if technically, functionally and economically feasible.

By contrast, for equipment with short time-frames and consumables, where the pay-back to any energy-efficiency investment/activity is much shorter, performance mandates (or minimum energy performance standards) such as those existing in many OECD countries for electrical appliances and (mostly new and existing public) buildings, or even an outright ban (such as for incandescent light bulbs in the EU from 2013) may be more appropriate.

As regards ESCOs, a policy mandating their use could be viewed as discriminating against other types of EE retrofits, and encouraging inefficient take up of ESCO activity.

The justification of an RBF instrument encouraging the financing of EE retrofits by local Banks would be to compensate the banks for the additional efforts (training, new hires, and so on) to address the lack of information and risk perception (both derived mostly from a lack of experience with these projects) they have historically claimed as being the key factors holding back greater engagement in this sector. Experience from the World Bank Group (Energy Conservation Programmes I and II; IFC's CHUEE), KfW and AFD projects in China suggests that capacity building, partial loan guarantees and concessional funding from these Development Finance Institutions (which reduces the cost of resource; hence increases the profitability of these operations) have had a positive impact in overcoming these barriers. However an RBF instrument could arguably have a stronger impact as the benefit (an increase in bank's remuneration) would be provided directly.

5.4 Application of the framework, part 2

Is RBF more appropriate than conventional subsidies?

5.4.1 Necessary preconditions

Three necessary conditions have to be fulfilled in order for an RBF scheme to be viable – see Table 16 below:

Table 16. **Preconditions for the use of an RBF scheme**

Model	Access to upfront finance	Sufficient institutional capacity	Measurable and controllable outputs
I. Stimulate investments in EE retrofits of multi-family buildings	Variable, depends on geography and total cost, and other factors	Variable	Yes: completion of physical investments
II. Stimulate consumer demand (contracting of) for ESCOs for retrofits of multi-family buildings	Variable, depends on geography and total cost	Variable	Yes: signing of an EPC (in line with agreed best practice/template)
III. Stimulate supply of bank loans for EE retrofits of multi-family buildings	Banks will not grant a loan if project is not fully financed	Variable	Yes: signing of a loan (in line with agreed best practice/template)

Source: Climate and Energy Solutions

First, there must be *sufficient access to upfront finance* relative to the needs of the project; if the capital available is insufficient, or so scarce as to be prohibitively expensive, then an RBF scheme is not viable.

Access to upfront finance is the most significant challenge in the case of Model I. In this case, access to upfront finance is likely to be an issue if: (i) the *investment (or 'first') cost* of the EE retrofit is high, as it will be in the case of a full renovation;[125] (ii) the *ownership* and *governance* of the building is complex (multiple owners; lack of strong, legally empowered, home-owner associations able to enter into contracts and borrow money); (iii) *owners' incomes* are uneven and low on average, raising an issue of affordability; and not least (iv) *banks* are reluctant to finance these types of project under the set of circumstances described in (i) through (iii). The retrofit of multi-family buildings has been and remains especially challenging in EITs because of difficulties arising at every node, for example, under (ii), no decision could be made on matters of collective interest in Romania until very recently because of the absence of condominiums or home-owner associations. Given these problems, for multi-family buildings with fragmented ownership (the norm except for social housing), it is very unlikely that the equity contribution (own contribution of owners) can be much

[125] An estimate of the average comprehensive refurbishment cost per dwelling for France is $30,000 (€23,000). ICE (2011) *Energy Performance Contract in Social Housing, European Handbook*

more than notional, and will fall short of the level of 20-30 per cent of total funding requirements that is common in project finance. The bulk of the finance would have to be provided by bank loans and grants, or an ESCO (raising most of its funding from banks through loans or forfeiting[126]). Banks and ESCOs may be unwilling to take on a high share of project costs if owners do not contribute a minimum proportion upfront. In this case, and building on the discussion in the conceptual framework, the RBF instrument could be structured as a 'hybrid', a first instalment being paid in lieu of owners' equity or as a complement to owners' equity upon some milestone such as the decision to enter into a contract with a general contractor for the refurbishment works. Part of a bank loan could consist of a bridge loan, which would be repaid with the second instalment of the RBF payment, paid upon investment completion.

In terms of Model II, in circumstances where ESCOs finance EE investment projects (under the 'shared savings' model), access to capital is a constraint for smaller, thinly capitalised ESCOs.[127] The World Bank has noted that in the Chinese context: 'Raising capital for investment is difficult for the small companies that dominate the ESCO industry, and these companies can quickly reach loan and equity financing ceilings, hampering their ability to grow strongly while they await repayment proceeds'.[128] This issue is likely to be encountered in all countries where ESCO penetration is low (most EITs with the exception of Hungary).

Under Model III, access to capital for banks is generally not an issue as EE still represents a minor proportion of their portfolio (although no data is available – see earlier remark on the absence of measurements and tracking of EE finance flows).

Second, both principal and agent must possess *sufficient institutional capacity* in order for an RBF scheme to be viable. Since RBF works by transferring risk from principals to agents, it is only viable if the principal is capable of designing the RBF instrument and if the agent is capable both of managing the increased risk, and of responding to the new incentive structure.

Fulfilment of this precondition will depend strongly on the specific situation and country. However, as the 'output' that needs to be monitored is a one-off, straightforward step (see below), this should not be beyond the capacity of the counterparts. In the case of I, where the agent would typically be the homeowner association, some verifiable proof of investment completion will need to be produced, and an on-site completion verification mechanism as exists under several EBRD credit lines (Sustainable Energy Financing Facilities) in EITs could be set up.

Third, there must be some *measurable and controllable outputs* that correspond to the desired outcome. An RBF scheme is impracticable in the absence of a measure against which to disburse it; equally, if the outcome is measurable but not controllable, the agent will be unwilling to assume the risk.

[126] The sale of receivables from an EPC contract.

[127] This was a key consideration behind the World Bank's Second Energy Conservation Project of 2002, which included a major loan guarantee program backstopped with GEF funds to facilitate access by ESCOS (EMS) to bank loans.

[128] Taylor, R., Govindarajalu, C., Levin, J., Meyer, A.S., Ward, W.A. (2008) *Financing energy efficiency: lessons from Brazil, China, India, and beyond*

As discussed further below, it is suggested that the most plausible 'result' against which RBF payments would be made should not be the energy savings themselves, but rather an event which is a prelude and a pre-requisite, but not in itself a guarantee, of subsequent energy savings. Specifically, the recommended result would be the *completion of an investment project* improving EE in a multi-family building.

If some kind of incentive would be required at the contract stage, one could also disburse the RBF payment in *two stages*, one at contract signing and another one when investments are realized. This contract would be (i) under Model I, the building renovation contract[129] (ii) under Model II, some form of Energy Performance Contract between a facility owner and an ESCO to implement an EE retrofit project in a multi-family building and (iii) under Model III, a loan agreement between a commercial bank and a facility owner or ESCO to loan finance an EE retrofit project in a multi-family building.

In each of these cases, the corresponding outputs (investment completion, EPC contract signed, loan agreement signed) are easy to measure and control.

In conclusion, all three necessary criteria for an RBF scheme to be viable can be met except in countries and situations where access to finance is compromised because of a combination of adverse circumstances, ranging from first cost to the banks' attitude. As indicated in the analytical framework, an 'upstream' RBF instrument could address the issue of banks' negative attitude to financing multifamily building retrofit. One such 'upstream' RBF measure is discussed below.

5.4.2 Risk-incentive trade off

The main factor driving the choice between RBF and conventional finance (that is, other types of subsidies that are not tied to results or performance) being the allocation of risk between principal and agent, we need to consider the balance between the expected gains from stronger incentives and the expected costs increase (cost of capital) from risk transfer.

The conceptual framework identifies three crucial factors that will help make RBF preferable to conventional finance by increasing the power of the incentive while imposing relatively small amounts of additional risk/cost on the agent:

- Controllability of the results by the agent.
- Clear line of sight to the results for both principal and agent.
- Relatively short period of time before results payments are made.

Insofar as the results against which the payments are made are not the savings themselves but rather the prior event necessary for the savings to be realized (investment, ESCO contract signature and loan agreement), as discussed further below, then all of these factors would be met.

There are then three additional factors in the conceptual framework that are noted as important:

- The extent to which costs vary with the quantum of the results delivered.

[129] With a contractor or an ESCO. In this latter case, payments under two RBF schemes would be made to the building owner.

- The extent to which delivery of the results will entail a significant proportion of the resources of the agent.
- The extent to which it is hoped that success on the initial project will have a demonstration impact.

The first two determine the extent to which RBF increases the risk placed on the agent; the third determines the value associated with the greater likelihood of success resulting from RBF.

In terms of Model I, the costs of undertaking refurbishment largely scale with the number of refurbishments undertaken. In other words, the cost base is largely variable which would support the use of RBF. However, as explained above, the resources that the agents would need to commit in order to deliver the results would likely represent a very substantial proportion of the spare resources of the housing association or other (that is, pre-financing of the improvement would stretch the balance sheet of the members of these organisations substantially). To mitigate this problem, the hybrid approach outlined above is proposed (that is, a first instalment of the RBF payment made at the time a decision is made on whether to proceed with a retrofit or a contract is signed with a contractor) but it may not be sufficient in all cases, if banks are unwilling to provide bridge financing at all or beyond a certain amount.

Furthermore, it is likely that the RBF intervention may have a wider demonstration impact beyond supported projects. Currently, few of these projects happen because stakeholders, whether home-owner associations, contractors, ESCOs, or banks, are inhibited by the complexity and perceived risks of these operations, and these risks mutually reinforce each other. A critical mass of successful operations triggered by the use of RBF could demonstrate that these retrofits are feasible, even though there will be a lag before energy savings materialise.

In terms of Model II (use of ESCOs), the same consideration on costs and demonstration impact as for Model I applies. However, unlike in the model where the building owner raises all the finance on its own books, engaging an ESCO under the ‘shared savings’ model transfers most of this role and risk onto the ESCO, particularly if payments to the ESCO are tied to future savings.

In terms of Model III, the banks’ costs will also scale with the number of projects and volume of investments financed with loans, although banks may need to invest in training and staff at the outset of a programme (this is more complex than conventional mortgage lending). This may warrant a larger RBF payment at the outset (per unit of loan awarded). Embarking on a new lending activity will not overly stretch banks’ balance sheets, despite the loans spanning a long period, especially in light of the fact that future cash flows from savings can be predicted with a high confidence interval and some measures can be taken to ensure repayments are made (for example, in some countries EE loans are tied to the building not to the owner so that when a dwelling is sold the liability remains attached to the dwelling). For banks, even more than for building owners, the success of an initial sample of projects would have high demonstration impact as commercial banks are typically large organisations and word of success (or failure) will spread out quickly throughout the organisation.

5.5 Application of the framework, part 3

Designing an appropriate RBF intervention

RBF approaches can be analysed in terms of six components:

- eligibility: which agents are eligible to receive this particular RBF intervention?
- conditionality: what is the condition (result) that, if met, either once or on a repeated basis, triggers the payment?
- pay-out structure: what pay-out will occur if the RBF mechanism's conditions are met?
- pay-out size: how will the pay-out size be determined?
- principal's role: does the principal directly procure the good or service in question, or does he or she intervene in alternative ways?
- duration of the RBF intervention and exit strategy.

For each of the three models, Table 17 below shows answers to the questions above. More details on each of the six dimensions are given in the text following the table.

Table 17. **Design of the RBF schemes**

Design dimensions	**I. Stimulate investments in EE retrofits of multi-family buildings**	**II. Stimulate consumer demand (contracting of) for ESCOs for retrofits of multi-family buildings**	**III. Stimulate supply of banks loans for EE retrofits of multi-family buildings**
Eligible agents	Building owner (for example, home-owner association) of building with EE performance below a certain threshold (or over for example, 30 years)	As for I.	Banks
Conditionality/ trigger of disbursements	Completion of investment (with possibly a first instalment for example, at start of works)	Completion of investment (with possibly a first instalment upon signing a contract (EPC) with an ESCO	Completion of investment (with possibly a first instalment upon signing a loan agreement with a bank
Structure of pay-out	Lump-sum (possibly in two instalments)	Lump-sum	Lump-sum
Pay-out size	Up to [20]% of total retrofit cost (possibly based on pre-RBB project IRR)	Combination of a fixed and variable fee (percentage of ESCO contract value)	Combination of a fixed and variable fee (for example, 1-2 per cent of loan amount depending on loan size) with a cap initially

Design dimensions	**I. Stimulate investments in EE retrofits of multi-family buildings**	**II. Stimulate consumer demand (contracting of) for ESCOs for retrofits of multi-family buildings**	**III. Stimulate supply of banks loans for EE retrofits of multi-family buildings**
Role of the principal	Intervention in market	Intervention in market **or** procurement	Intervention in market
Duration of RBF intervention / Exit strategy	Depends on how quickly this intervention can lower barriers and investment costs, and whether other policy measures can address externalities and equity issues	A few years	A few years

Source: Climate and Energy Solutions

5.5.1 RBF design – (i) Eligibility

For Models I and II, the agent would be the building owners, no matter what their legal status as long as they are constituted as legal entities vested with the power to enter into contract and able (in the case of home-owner associations) to enforce some decisions (for example, servicing a loan) upon their members.

For Model III, the agent would be the banks participating in the scheme. One condition for participating in the scheme could be, for example, the adoption of a banking product targeting multi-family building retrofits, or of a target for increased lending in this area (against an agreed baseline).

5.5.2 RBF design – (ii) Conditionality

As indicated before, the rationale for a pay-out linked to an actual physical investment (and possibly signing a contract under Models II and III) as opposed to the delivery of energy savings is:

For Model I: the homeowner association or building owner may not have full control over energy consumption (and hence savings), and the baseline itself may be tricky to establish. For these projects, however, completion of the investments is almost as good as actual savings (only poor maintenance could lead to energy savings falling below the projected level, but then one can assume that HOAs or single owners will act rationally and take measures to correct the situation). Furthermore comprehensive refurbishments – which also yield the largest amount of savings – entail high first (upfront) costs, which a subsidy can help defray. As noted in the conceptual framework, a long lag between when the investment costs are incurred and when the RBF payments are received can diminish the ‘power’ of the RBF incentive. By linking the payment to investment completion, this problem can be reduced. In addition to this, as noted before, a hybrid RBF instrument with some proportion of the payment made upfront upon contract signing is suggested to reduce the risk borne by the agent.

For Model II: the barrier to be addressed is mistrust on the part of potential ESCO customers. The RBF scheme could be aimed at overcoming this intangible barrier, and assuming that parties to a contract will find advantages in executing it, the conditionality should logically be the signing of an EPC contract (at least for a first instalment).[130]

For Model III: the barrier to be addressed is the extra cost of appraising and processing, and the risk perception associated with EE projects stemming from the various factors identified earlier in this case study. Although a bank might not disburse a loan that it has signed (but then it would need to have good reasons, and using a certain loan template could be a condition for the RBF payment), the signing of a loan agreement appears to constitute an appropriate conditionality (at least for a first instalment).

Additional conditionalities could be added in light of local circumstances. For examples, payments of the RBF instrument to the building owners could be tied to adoption of consumption-based billing (EITs, China.)

5.5.3 RBF design – (iii) Structure and level of the RBF pay-out

The question of the *level* of these pay-outs cannot be discussed independently of specific country or programme circumstances. While precise numbers cannot be provided, orders of magnitude could be as follows:

For Model I: Up to 20 per cent of total project costs (investment value). This reflects the high first cost of a comprehensive retrofit, and the difficulty to raise finance for these complex projects (multiple owners, long pay-backs, etc.), but also high social returns in terms of reduced GHG emissions, which building owners are currently unable to monetise under any system.[131] The actual percentage would vary as a function of the project IRR prior to the RBF intervention.

For Model II: A combination of a fixed and variable fee is proposed so that an inflated project cost amount (hence of the ESCO investment commitment under the EPC) does not create a perverse incentive, with a cap in absolute terms for the larger contracts, as the barrier to be tackled is mostly of a behavioural nature (mistrust) and is not a function of (EPC) contract value.

For Model III: A combination of a fixed and variable fee is also proposed here, up to 2 per cent of the loan value amount, with also perhaps a cap in absolute terms on the loan size if the subject of barriers is more about lack of familiarity and experience with appraisal of EE projects than about risk perceptions. In case of the latter, a significant proportion of the RBF incentive could be based on the loan amount. As banks participating in the scheme would have to build capacity at the outset of the programme, a higher initial RBF amount could be justified. If a programme following this approach were implemented, a reverse auction mechanism could be used in order to avoid windfall profits.

[130] A similar scheme was implemented by the World Bank (IDA) with GEF funding in Vietnam to promote small EE investments in the commercial or industrial sectors by ESCO-type companies. An 'investment bonus grant' of up to US$30,000 could be allocated to an EE project upon independently verified completion. The purpose of these grants (together with grants buying down the cost of energy audits) was to 'to stimulate the market for EE services by overcoming market barriers such as high project development costs from initial audits, scepticism of customers to actual investment opportunities, limited credibility of project agents to prepare and implement EE projects, and perceived risks associated with committing to EE investments'. World Bank (2003) *Project Appraisal Document on a Proposed Grant in the amount of US$5.5 million to the Socialist Republic of Vietnam for a Demand-Side Management and Energy Efficiency Project*

[131] White certificates systems could partially remedy that.

In each of these cases, the practical circumstances dictate that the pay-out would be a lump-sum amount paid on satisfactory delivery of the (single) outcome rather than linked to market values like prices or quantities.

5.5.4 RBF design – (iv) Funding the RBF scheme(s)

An RBF scheme of the Model I type could be very expensive. In EITs and China, donor funds for that purpose are likely to be scarce or non-existent (except in EU countries where substantial funds from the Cohesion and Structural funds are now ear-marked for EE in building).

A possible (if only partial) source of funding could be the establishment of a surcharge on the local property tax levied on occupiers/owners of buildings (including co-owners of multifamily buildings) that do not meet a certain EE level of performance (in say kWh per m^2 per annum).[132] The surcharge would be lowered or lifted based on verified improvements in EE performance or upon completion of investments aimed at achieving certain improvements. The level of the surcharge should be calibrated to ensure acceptability, affordability and sufficiency of funding. This would operate at least to an extent as a a tax or user charge imposed by government that charges users of socially undesirable items (here the owners of buildings whose EE performance is below a certain threshold) and uses the proceeds for payments to users of socially desirable items (here the owners of buildings whose EE performance is at or above a certain threshold).

5.5.5 RBF design – (v) Role of the principal

In all three models, the *principal's role* would be to stimulate private (or public) sector participants, and a procurement approach would not work in any case given the type of asset considered. Taking into account the potential size of the market, the number of buildings involved and the type of countries where these RBF schemes would be deployed (EITs, China for the most part), the principal could be a central, regional/provincial, or local government, more exceptionally an NGO.

5.5.6 RBF design – (vi) Duration of the RBF scheme and exit strategy

As indicated in 5.2.2 above, three considerations could justify the use of subsidies to stimulate investments in this sector: positive environmental externalities;[133] market failures and other barriers; equity (lower-income households may not be able to finance the cost of retrofits even in the case NPV positive projects).

Some of these factors may endure, particularly if complementary policy reforms (some of which are outlined below) are not implemented in parallel.

In the long run, the first one (the carbon externality) can be addressed through some form of carbon pricing (which would make investments involving building shells NPV positive), and the third one through means-tested social benefits or tax breaks.

[132] A certificate on the EE performance of certain classes of buildings is already mandatory in many OECD countries. In the EU a system of letters using a scale from A (best) to G (worst) is used for that purpose.

[133] One could add jobs, energy security and the saved cost of avoided new generation capacity.

RBF schemes could help solve the second issue (market barriers) within a reasonably short time span (a few years or less, depending on jurisdiction), especially if accompanied by other policy measures. This is because a critical mass of positive experiments should eliminate these barriers (through learning, and so on) and drive down transaction costs. For example, once banks have financed a certain number of retrofit projects they will have built enough capacity, experience and comfort with this type of project and convinced themselves that they can earn a decent return from them (a credible expectation given the potential size of this market) so as to make an RBF scheme gradually redundant.

It is also quite possible that a significant number of retrofits (combined with higher energy prices in the future) will drive down unit investment cost through various channels, including new technologies, materials, and so on. This would potentially obviate the need to provide any kind of subsidy.

5.5.7 Additional observations on the use of RBF to promote EE in the multifamily housing sector

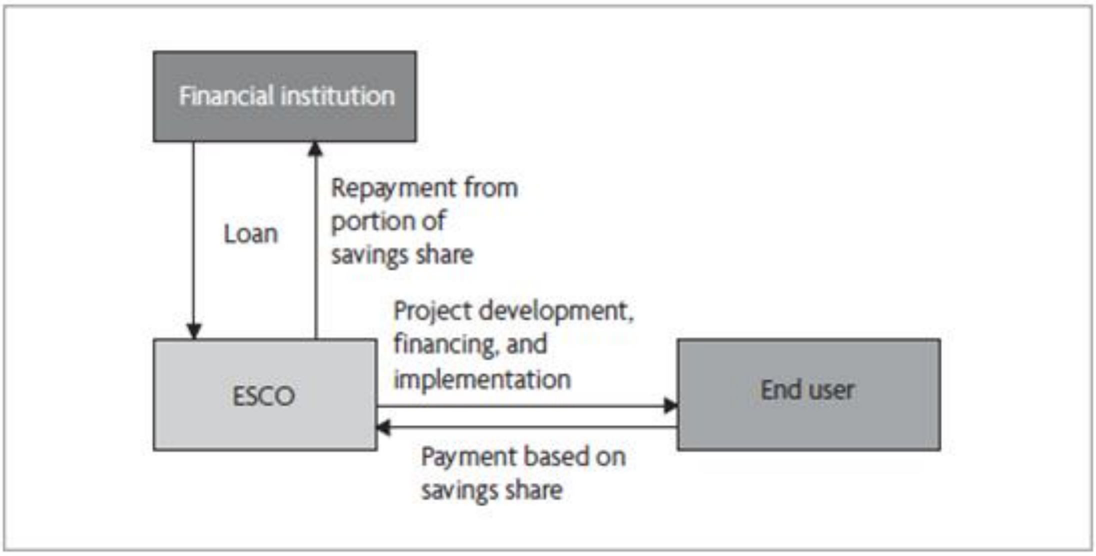
First, there is a case for combining the three RBF schemes (I, II and III) to maximise their impact on the promotion of EE retrofits in multi-family buildings.

Public policy aimed at stimulating EE investment in this sector would have much more impact if the RBF instruments discussed in these case studies were combined.

Involving an ESCO for retrofitting of multi-family residential sector would have several advantages. First, these projects are technically complex, encompassing multiple demand-side (building envelope, heating, ventilation, air conditioning (HVAC), double-glazed windows, etc.) and possibly supply-side measures (on-site cogeneration, and so on.). Second, an ESCO offers a one-stop shop that building owners need, given their lack of time and expertise. Third, ESCOs are strongly incentivised to hit or exceed their savings targets under the two classic models of EPC: ‘shared savings’ and ‘guaranteed savings’ (see figure 20 and figure 21, respectively). The RBF instrument would help alleviate the mistrust that building owners may have in relation to an ESCO (even in Western countries where ESCO penetration in this sector is very uneven outside of Austria and Germany) and/or cover the transaction costs associated with identifying, selecting and negotiating with an ESCO.

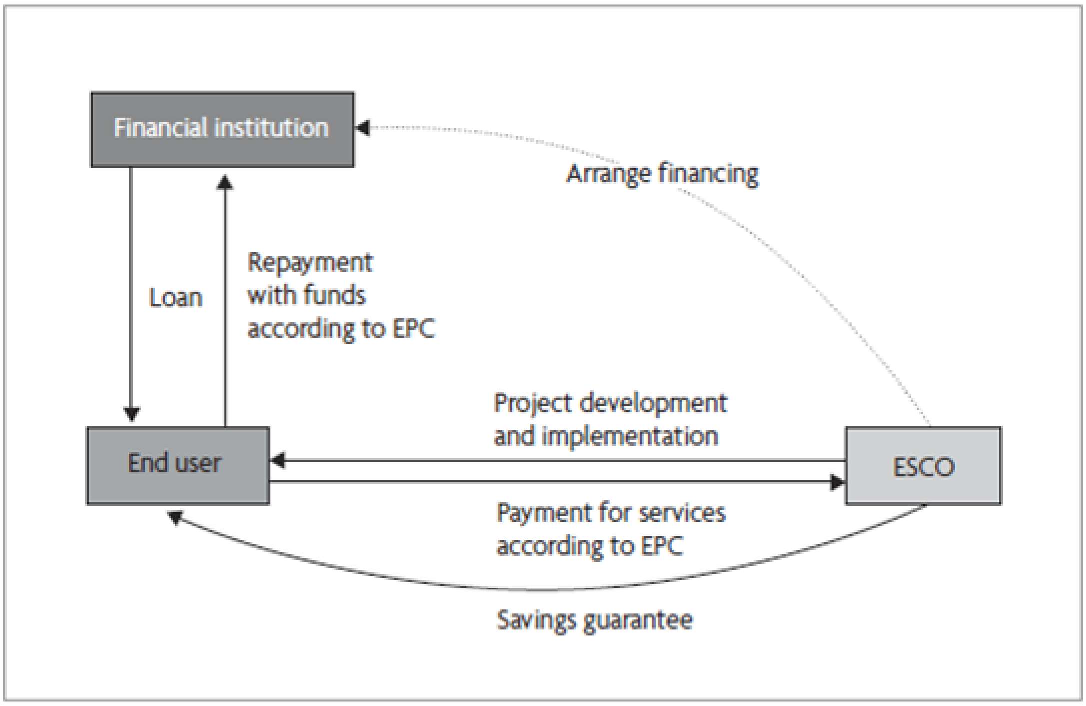
An RBF measure aimed at stimulating bank lending to this segment would be useful given the multiple constraints surrounding the bankability of these projects (see above), including in pure financial terms, the limited amount of equity (well short of what banks require in traditional project finance), and lack of adequate security – taking over / selling a building all or some of whose owners are late with, or in breach of, their payment obligations is not a (politically) realistic possibility. An RBF measure could help alleviate this reticence. Even if an ESCO is involved in providing a turnkey solution for the comprehensive EE retrofitting of a building, and its offer were to include financing, this ESCO may stumble in its quest for financing. In this case, an RBF instrument targeting banks would be useful.

Figure 20. **ESCO 'shared-savings' contract (building owner secures financing through the ESCO)**



Source: Langenheld (2012) Available at: http://goo.gl/2igDw

Figure 21. **ESCO guaranteed savings contract (building owner contracts financing directly from a bank)**



Source: Langenheld (2012) Available at http://goo.gl/2igDw

Second, RBF measures may not be sufficient on their own to unlock investments and decisions in this sector.

Given the number of barriers in this segment, it is likely to be necessary to complement the use of RBF instruments with other policy measures, such as:

(i) Stimulating the recourse to ESCOs:

- develop a certification system for ESCOs (to reduce the information and trust barrier);
- elaborate model contracts (to reduce transaction costs);
- elaborate methodologies for the establishment of energy consumption baselines (to reduce the risk of disputes down the line);
- provide negotiation support to building owners or organize a one-stop shop mechanism (this would be best organized at local government level, although this service could be contracted out to the private sector or NGO);
- establish simple, low-cost independent arbitration mechanisms in case of disputes.

(ii) Stimulating bank lending:

- RBF does not eliminate risk and apartment blocks do not provide adequate security; this may require establishing a specific loan guarantee scheme for this segment, funded through a surcharge on (fossil) energy utility prices.
- Banks may not be able to provide the required long-maturities that comprehensive EE retrofits require to more closely match debt service obligations (interest and principal repayment) with energy savings (30 years+). A specific ‘upstream’ RBF instrument could remedy this, if and when banks decide to roll over loans beyond their usual term. In essence, banks could receive a fee if they agree to roll over and thus extend the tenor of a loan.

5.6 Conclusion

This case study has investigated the use of three RBF instruments to stimulate EE investments in the multi-family buildings sector, which presents high potential for energy savings but suffers from under-investment due to an array of market imperfections and other barriers.

Four key conclusions emerged in the course of this case study. First, there is a robust rationale for public intervention in the form of subsidies to stimulate investments in the sector. Second, RBF instruments could be used to incentivise building owners in undertaking this investment (Model I), in using an ESCO to do this (Model II), and in incentivising banks to provide the necessary capital (Model III). Third, these RBF schemes would not be tied to a certain level of EE performance (energy savings versus baseline) but to a proxy: the completion of the physical retrofit, with possibly an initial instalment at the time of ESCO and loan contract signing. However, they all introduce a degree of contingency into the payments by the principal that requires the agent to deliver a result. Lastly, the use of these RBF instruments in combination rather than in isolation would maximize their impact, but this would require looking in more detail at the specific circumstances in each country or region.

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Company Profile

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