Measures for low income households

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Brazil

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Energy Efficiency Programs targeted to low-income households within the Brazilian Electricity Public Benefits Fund

Context

► General context for energy efficiency activities in Brazil

For a long time, **access to modern energy services** to the entire Brazilian population has been a key element in this country's public policy. For example, since the 1960's a great deal of efforts have been done in order to create a market of LPG to replace fuel wood cooking as the main energy source for this purpose (Lucon, Coelho et al. 2004).

Since 1985, **energy efficiency activities** have also been developed, especially labeling schemes, by the public electricity holding company (**Eletrobràs**)[1] through **PROCEL** (National Electricity Conservation Program). "*During the period 1986-1998, total expenditures in energy efficiency initiatives amounted to $260 million resulting in cumulative savings of 5.3 TWh/year as of 1998, equivalent to 1.8 percent of electricity use in the country*" (Jannuzzi 2000) referring to (Geller, de Almeida et al. 2000).

Since 1995, Brazil has undertaken a major **reform** in its electric sector (privatization and de-verticalization of utilities). Public-interest programs, which once were carried out by state-owned utilities, have had to find their place in this new open market. In particular, alarms have been rising to continue to promote energy efficiency and electricity services to low-income households.

As a result, a regulatory agency (–**ANEEL**, Agência Nacional de Energia Elétrica), was created in 1996 (and really operational from 1998) to assume a supervising role. Among its functions, the agency assures the continuity of funding and incentives towards energy conservation and efficiency. **Privatized distribution utilities have then been obliged by law since 1998 to invest 1 percent of their annual net revenues in energy efficiency and R&D activities**. The shares of this funding between energy efficiency programs managed by the utilities, R&D activities and public energy efficiency policies have changed significantly over time. "*The 2007 law passed by Congress reinstates the energy efficiency allocation to 0.50 percent, half of which must be spent on energy efficiency measures targeted at low-income households*" (Taylor, Govindarajalu et al. 2008, p.236).

"*It is (ANEEL's) understanding that **utilities have a better knowledge of customers behavior** and more capable to design programs and what is best to achieve in their respective markets*" (Jannuzzi 2000).

However, "*utilities use DSM[2] primarily to solve very specific problems and not as a tool to obtain demand-side resources that could be an alternative to supply-side resources in the scope of an IRP process*"(Pinto Junior 2007, slide). Among these specific problems, securing electricity supply, reducing power theft and unpaid bills are reasons inducing utilities to implement programs towards low income households.

[1] with the technological support from the research centre CEPEL.
[2] Demand-Side Management
[3] This definition is national, but the rates still vary from a utility to another.
[4] For example due to "unformal" business or small commercial activities made at home (e.g., bars, laundries).
[5] This represents around 18 million consumers.

► **Low income households and energy consumption in Brazil**

In order to improve the access of electricity for all Brazilian, utilities have by law since 2002 the obligation to achieve progressively a **100% electricity coverage** in their service areas. Moreover, ANEEL has set a cap on recovery through ratepayers of technical and non-technical (e.g., power theft) losses. These both regulatory conditions created clear incentives for utilities to provide better services to low income households, especially to ensure higher rates of bills collection, if they want these conditions to become revenues' opportunities and not only expenses.

In parallel, ANEEL also defined in 2002 a national frame for a **social tariff**. Such subsidies existed beforehand, but were not proposed by all utilities and were quite different from one utility to another. Even the definition of the eligible households varied: "*the former Electricity Regulatory Agency, DNAEE, defined low-income consumers for each one of the electricity utilities of Brazil by the Act 437/95. The definition was based on criteria informed by the utilities that differed from each other. Low-income consumers are benefited with lower energy rates and, in some utilities, the municipalities pay their energy bills as a social help program. So, in most cases, the criteria used by the utilities to define low-income consumers were based more in political than technical terms*" (da Cunha 1999).

Now, the households who can benefit from the social tariff set in 2002 are defined as followed[3]: either "*all households supplied with monophase power supply whose average monthly consumption ranges between 0 – 80 kWh based on the previous 12 months, without exceeding 220 kWh more than one time within this period*" or "*all households supplied with monophase power supply whose average monthly consumption ranges between 80 – 220 kWh based on the previous 12 months, in addition to be registered in the National Unified Register for Social Programs of the Central Government, or benefiting from the programs School Bursary (Bolsa Escola) or Food Allowance*".
"*The **criteria required to define a low-income consumer**, relying heavily on **consumption levels and connection type**, often are not adequate and may include consumers with higher income also having monophase connections to the grid. Nevertheless, there is also a large part of the population that is, despite being clearly considered low income, unable to receive a benefit from the subsidized tariff because of their high consumption[4]; this has resulted in high rates of unpaid bills*."
"***Around 37% of the Brazilian residential consumers**[5] are qualified and benefit from the Social Tariff, which is about 50% of the residential tariff. Particularly in the Northeast region of the country, the figure reaches 66% of consumers. Even though their electricity consumption is low, on average 65 kWh per month, and the electric bill is on average R$ 9[6], the total amount of subsidies have been rising and currently reaches annually R$ 1.4 billion[6]*" (Jannuzzi 2007b).

In order to better target the use of these subsidies and to limit their increase, ANEEL has **strengthened the parameters** for classifying low-income customers, especially by restricting the social tariff to households also registered to other social programs (e.g., to exclude second home). As a consequence, the number of households having access to the social tariff has steadily declined. On top of having poor electrical installation and obsolete equipments, the removal of the subsidy and the lack of information from the utilities part have led to an increasing energy bill.

"*It is desirable to develop a strategy to phase out subsidies without negatively*

[3] This definition is national, but the rates still vary from a utility to another.
[4] For example due to "unformal" business or small commercial activities made at home (e.g., bars, laundries).
[5] This represents around 18 million consumers.
[6] Respectively around US$4.2 and US$650 million.

impacting the ability to pay of the consumers provided with the Social Tariff. ***Energy efficiency can be part of this strategy****, unburdening those consumers who are actually subsidizing the inefficient electricity use by obsolete appliances found in low-income households*" (Jannuzzi 2007b).
Society as a whole and the power sector utilities could greatly benefit from energy efficiency programs directed to low-income households. As a result of such programs, the economical burden for sustaining these social tariffs or subsidies would be reduced for taxpayers, non-payment of electrical bills would be cut down, and the energy saved could be delivered to other customers or for other end-uses, postponing the need for new capacity on the distribution power network systems.

One of the key objectives for the utilities is also to **reduce the commercial losses** due to illegal connections[7]. These are also responsible of short circuits and fires, damaging equipments and housings.

Moreover, several utilities have performed field studies, which indicate a **major waste of electricity** in low-income households. Among the most important reasons, they found: lack of information about its rational use, leading to waste; precarious electrical installation; use of inefficient refrigerators; and buildings without ventilation and natural lighting.

"*The residential sector is responsible for about 20- 35% of the evening peak demand across typical Brazilian utilities*" (Jannuzzi, dos Santos et al. 1997). "***Refrigerators represent 70% of the total low-income household's electricity consumption, whilst lighting accounts for 20%***"[8] (Jannuzzi 2007b). That's why these end-uses were the priority targets of energy efficiency programs.

Other reasons support also this choice. For refrigerators: "*high participation on the residential energy consumption (70%); high appliance dissemination among low-income households (96%); most of low-income have refrigerators more than 10 years old (less efficient); and the energy consumption should be higher in such households due to the precarious electrical installations which reduce the performance of the appliance*" (Jannuzzi 2007b)(2). The same analyses apply for replacing incandescent lamps by CFLs: "*incandescent lighting represents about 95% of the lighting electricity use in 1993*" (Jannuzzi, dos Santos et al. 1997).

The above has largely marked Brazil's strategy on dealing with energy efficiency towards low-income households. As will be develop further down, most strategies have concentrated in refrigerators replacement, low consumption lighting, replacing electric showers and improving the overall electric installation of households.

Objectives

► General objectives

- Improving life conditions of the low income households (especially these living in the slums or *favelas*), and favoring their integration into the society;
- Reducing the subsidies due to the social tariff while empowering low-income households to cover their electricity bills, by reducing their energy consumption levels thanks to energy efficiency improvements;
- Reducing illegal connections, both for improving housings' safety

[7] The Brazilian Association of the Electricity Distribution Utilities has estimated in 2004 that these energy losses amounted nationally to around 17% of the electricity sales for residential customers (UNFCCC 2006). "*Power theft consumes as much as 25 percent of all energy produced in some regions in the northeast*" (Palmigiani 2009)
[8] This was measured in the Northeast region, which has the highest share of low income households. In other Brazilian regions, the use of electric showerheads may change these consumption shares.

(households' side) and for decreasing commercial losses (utilities' side);

- Reducing collection expenses (due to unpaid bills, disconnection, etc.), increasing revenues (thanks to new "legal" and paying customers) while meeting the regulatory requirements (e.g., 100% electricity coverage);

- Improving the reliability of electricity supply, by reducing peak load demand.

► Operational objectives / targets

- improving the overall electrical installation (rewiring);
- replacing old inefficient refrigerators by new efficient ones;
- replacing incandescent light bulbs by CFL;
- replacing inefficient electric showerheads by more efficient ones or by solar water heaters;
- education and information (especially about a safe and regular use of electricity).

Program description

Motivation

The documents analyzed show that the main motivations of distribution utilities to carry out energy-efficiency programs in low-income households are economical reasons (unpaid bills, collection expenses, commercial losses, etc.) and obligations set by ANEEL.

The economical reasons could change significantly the results of a cost-benefit analysis. However, such benefits have not often been assessed (Jannuzzi 2007a) (see below the case of Paraisopolis).

Therefore, even if programs targeted at low income households were implemented before, the obligations have proven to be more effective in terms of inducing utilities to invest in these programs; and since no specific actions are mandatory, economic thinking usually still takes over programs design.

To a lesser extent, energy efficiency programs in low-income households have been carried out to study the market response to less consuming technologies, as well as to test different dissemination mechanisms for such technologies.

Finally, there may also be a motivation to get international funding to implement such programs (e.g., support from the US AID, United States Agency for International Development) or as a result of the programs (e.g., through the Clean Development Mechanism framework). See for example the two concrete cases presented in the "Results" section below.

Main characteristics

► The general frame

By law, all distribution utilities must invest 0.5%[9] of their annual revenues in energy end-use efficiency programs, **of which 50% in end-use efficiency in low-income households** (since 2005). As a result of these compulsory energy efficiency programs, a total of US$ 80 million[10] are being invested annually in

[9] This is the current rate. It has changed over time in the past (see above the description of the context).
[10] For comparison, the average annual whole expenditure on energy efficiency programs led by PROCEL in the period 1994-2003 was around US$ 14 million.

low income households programs (Jannuzzi, da Silva, Ana Lucia Rodrigues et al. 2009), most of them directed to lighting, refrigerators, rewiring and solar water heating.

ANEEL has published in 2005 a **guidebook**[11] setting the requirements that the utilities have to comply with when submitting a program to the ANEEL's agreement before its implementation. There is therefore an **ex-ante validation** of the programs. But the utilities remain in charge of designing and implementing them. They can also subcontract ESCos[12] to do so.

► The programs targeted to low income households

Since low-income households often have old, less efficient appliances, substitution programs are created to **replace** such appliances for newer, more efficient ones. All cases studied targeted highly spread appliances. It is common practice to **identify one single target at a time** and to create one strategy that can be recreated in other cities and regions.

As mentioned above, the mechanisms for identifying households eligible for these programs are usually based on energy consumption level and connection type. However there is a common agreement in that such **classification parameters** may not be always relevant or reliable, because it may include non-low-income households, as well as exclude those households that consume too much because of inefficient appliances, informal or small commercial activities, etc. So usually, **the utilities target their efforts to specific areas like favelas, with high commercial losses** (power theft/non-paying consumers).

Different **delivery mechanisms** are proposed. Some programs work in a give-away basis, in which the utility takes charge of the whole cost of the replacement. In other cases, the user is involved paying a part, or the whole of the investment. In such situations, various scenarios are present in current practice, including rebates and monthly payment integrated to the electrical bill.

Give away programs often include a technician that goes from household to household to install and inform about the modes of use. Programs that include a **user's contribution** often involve coupons send to the user by post or included in the energy bill.

Moreover, "***educational and cultural actions*** *are carried out often as part of the above mentioned interventions and frequently involve the so-called community agents, select dwellers of the community hired to perform visits to households. During these visits they provide information about safe and rational use of electricity*" (Jannuzzi, da Silva, Ana Lucia Rodrigues et al. 2009).

Most often, the beneficiaries from a program also have to commit themselves to keep a legal connection and pay their future bills. Similarly commitments are sometimes used so that a sample of households accepts meters in their dwelling for measurement and evaluation purposes. In practice, this is subject to negotiations between the utility and the dwellers. And accessing the dwellings is not always easy for the evaluation team (see "evaluation issues" below).

Concrete examples/Impact/evaluation

Concrete examples

Public documentation is seldom available about utilities' programs (even more in English). But two programs get an international recognition and are therefore documented in English:

[11] ANEEL, 2005. Manual para Elaboração do Programa de Eficiência Energética (ciclo 2005/2006). Brasília, ANEEL: 121.
[12] Energy Services Companies

- the **COELBA Agent Project** for the low income communities of Salvador (Bahia's state capital) ;
- the US AID – ICA – AES Eletropaulo project for **slum electrification and loss reduction in Paraisopolis** (a favela of São Paulo).

► The COELBA Agent Project in Salvador de Bahia

This project was led by a Brazilian utility, **COELBA**, having 63% of its residential clients being classified low-income consumers. It includes rewiring, CFL donations, refrigerators replacements, information activities and commercial assistance.
From an energy point of view, the main target was the refrigerator replacement. From July 2006 to early 2008, **17 000 refrigerators**[13] were thus replaced on a **donation basis**. The budget for this project (entirely funded by COELBA) was initially assessed around US$ 9.4 million, for expected electricity savings of around 19 GWh/year, representing 1 500 tCO_2e avoided/year (UNFCCC 2006).
To increase the number of replacements[14], COELBA is now considering providing its customers with a **subsidy** representing 60% of the appliance price together with free CFLs. The customers would cover the rest through scheduled payments financed by the Brazilian Popular Bank. A **43% reduction of the electricity consumption** was observed on a sample of 37 consumers, representing savings of 53 kWh/month[15]/household (Mascarenhas 2009).

This project was nominated in 2009 for the International Star for Energy Efficiency Award delivered by the Alliance to Save Energy[16]. It also received a Montreal Protocol Exemplary Project Recognition (Pinhel 2009), for its efforts to collect the CFC-R12 gas and the choice of an environment-friendly device for the new refrigerators. Indeed, the **recycling** of the old fridges has made possible to collect 400 kg of CFC-R12 gas and also to raise money which was used for **community projects**.

Pinhel (Pinhel 2009) reported the following overall results (mainly qualitatively):
- economic results: postponed investments, collection rate increase, and commercial losses reduction for the utility ; reduction in electricity cost up to 75% for the participants ;
- environmental results: CFC-R12 recycled, energy savings and avoided CO2 emissions ;
- market transformation: prices lowered and new models proposed ;
- replication of this project by other Brazilian utilities.

Finally, this COELBA project was also submitted in 2007 to the **Clean Development Mechanism** (CDM) framework, in order to get additional revenues from the project (valuing the avoided GHG emissions). This income would be used as extra funding for future similar projects (UNFCCC 2006).

► Slum Electrification and Loss Reduction Project in São Paulo

The second project was implemented within the **Slum Electrification and Loss Reduction Program** (SLER) launched in 2005 by the U.S. Agency for International Development (US AID), in cooperation with the International Copper Association (ICA). "*The primary objective is to develop, test and evaluate customized approaches to improve electricity access and normalize services in slum areas for wide-scale implementation. Program activities include developing and designing pilot projects with local stakeholders in India and Brazil to develop customized approaches that can be replicated in these and other countries*" (Nexant Inc. 2005).

[13] Together with around 90 000 CFLs.
[14] Considering that COELBA has more than 2 million low-income consumers, whose at least 40% are assessed to have very inefficient refrigerators.
[15] The refrigerator consumption changes significantly over the year in that region, due to temperature variations.
[16] See http://ase.org/content/article/detail/5686#istar

The first pilot of this program was the project implemented from 2006 in **Paraisopolis**, second largest *favela* of São Paulo (about 80 000 inhabitants[17]). As it was experimental, this project was restricted to a target area representing 4 365 households whose the vast majority had illegal connections or were legally connected but not paying.

It involved the following partnership:

- "***AES-Eletropaulo***[18] [the local utility] *picked up the bulk of the project costs, including the* ***distribution network upgrades, metering, consumer registration, and new refrigerators*** *(with ICA);*
- ***ICA***[19] *paid for the* ***efficient transformers, rewiring of households****, and* ***preparation of a financial model****;*
- ***USAID*** *covered the* ***community campaign costs, audits*** *of each household and selected commercial customers,* ***purchase of CFLs*** *(with AES-Eletropaulo),* ***post-project survey****, and efficiency recommendations to targeted commercial customers.*

Total project costs were $2.52 million" (Lawaetz 2009).

As the main objective of the project is the regularization of the households' connection ("*transforming electricity consumers into customers*"), large efforts were done in improving the primary and secondary distribution systems, together with the transformers and the meters.

However, "*as the Pilot area's consumers were not paying for service, they did not efficiently manage their electricity consumption, and many appliances were old and poorly maintained. Consequently, electricity consumption was very high (around 250 kWh per consumer* [per month]*). It was clear at the outset that, even with the subsidized tariff for low-income households, residential consumers, once regularized, would find it very difficult to pay for such a high level of use*" (Nexant Inc., Smyser Associates 2009).

So achieving the objective was also depending on both the **willingness and ability of the "new" customers to pay** for their consumption.

Several factors were supporting changes in **willingness to become legal customers**[20]:

- illegal connections are **unsafe** and have frequently caused **incidents** resulting in fires, damages or even deaths;

- the city of São Paulo has started in 2000 the **Legal Neighborhood Program** to "*determine land ownership as the vast majority of the inhabitants do not own the land that their house was built on*", which was completed from 2005 by a more comprehensive program aiming at "*improving roads, drainage, flood control, public lighting, sewer system and water supply*" (ibid., p.18): **when public services come to the neighborhood, its inhabitants feel more like regular citizens**;

- AES-Eletropaulo has developed a "**passport to citizenship**" approach: "*the consumer poll recorded that nearly 90% of regularized consumers saw benefits from regularization such as having proof of residency and easier access to credit and being able to register for assistance programs for low income people*[21]" (ibid., p.51).

[17] São Paulo population is around 19 million.
[18] The project proposed by AES-Eletropaulo was selected out of five projects submitted by five Brazilian utilities to the SELR program. In terms of billing, AES Eletropaulo is the largest distributor of electricity in Latin America, as it covers the most important socioeconomic region of Brazil.
[19] Through its Brazilian affiliate Procobre.
[20] Other regularization projects were intended before this one, but without success.
[21] Indeed, "*the UN Habitat report cited research done in Rio de Janeiro that showed that living in a slum is considered a greater barrier to obtaining employment than racial or gender barriers*" (ibid. p.13).

For the **ability to pay**, two main drivers are to be considered: behaviors and appliances. The project included the following **activities to help the "new" customers**:

- "*with the approval of the regulator, free meter, service drop and grounding (normally the consumer is required by law to pay for these)* [**4 365 new meters installed**]*;*

- *assistance to heads of household to* ***prove eligibility to receive the low income tariff****;*
- ***capping of billed consumption*** *at 150 kWh for a minimum of 3 months (…): this would help transition customers into paying for their service and, as the bills showed what their actual consumption was and what they would have paid for it, would educate them on the extent to which they would need to reduce their consumption once their bill was uncapped;*

- ***mini-audits*** *of households to identify energy efficiency opportunities, particularly assessing the need to replace inefficient refrigerators and unsafe internal wiring* [2 598 mini audits]*;*

- *the replacement of up to three incandescent bulbs with efficient compact fluorescent bulbs (…)* [**9 588 CFL installed in total**]*;*

- *the* ***replacement of refrigerators*** *in bad condition for* ***496*** *residential customers with the least ability to pay their bills (…);*

- *inefficient individual lights installed on the exterior of houses for security purposes were eliminated and* ***public lighting*** *installed*" (ibid., pp.25-26); moreover, the public lighting made also inhabitants feel more secure.

Social cutting was also experimented: "*social cutting is limiting the amount of kWhs that a customer can consume but not disconnecting the customer, in the case of non-payment. It is called social cutting because the technique allows the customer to keep on receiving a minimum amount of power, even if in arrears, up to a preset limit*" (ibid., p.22).

About the **results** at the **utility level**, the final conclusions emphasized that "*after project implementation, AES-Eletropaulo began to collect a significant amount of new revenue from consumers who had not previously paid for their electricity consumption.* ***Annual billing is expected to reach over $920,000****; currently, the bad debt rate is about 35%. This bad debt rate is relatively high and is due to the large number of commercial customers*[22] *with high consumption levels that are unable or unwilling to pay*" (Lawaetz 2009). Indeed, the non-payment rate decreased from 98% before the project to 32% after the project. In other words, this means that **the number of paying customers was multiplied by 34**!

However, "*about 46% of the new customers paid their bills on time or were only one month behind, even after the cap was lifted*" (ibid., p.44), meaning the remaining customers may cause **collection expenses**. Moreover, delay in payments and unpaid bills significantly increased once customers have to pay their actual consumption: "*customers found it more difficult to pay their bills after the cap was removed and that more customers will pay their bills if they are a smaller proportion of their total monthly budget*" (ibid., p.44.).

Even taking into account possible debt rate, the new billing revenue (including the subsidy for the social tariff) together with avoided costs (of purchasing

[22] One explanation for this can be the following: "*some problems arose with commercial customer registration and metering. Commercial operations are only eligible for the commercial tariff if they are formally registered with the government as a business. As many have not done this, they were assigned the low income tariff based on their consumption levels*" (Nexant Inc., Smyser Associates 2009).

electricity for non-paying consumers, and of avoided consumption due to energy savings) and resale benefits (saved kWh can be sold to other customers, potentially with higher rates) make a **positive cost-benefit analysis**: **the simple payback on the investment was assessed around 1.4 years**. This confirmed that this kind of project can be highly beneficial for the utilities, even from a financial point of view. Moreover, a sensitivity analysis also showed that this result remains positive even in the most pessimistic case tested (e.g., with less favorable regulatory conditions). However, the simple payback may increase significantly (up to 10 years in the scenarios tested).

The best proof that the project was successful for the utility is that AES installed a **local office in the neighborhood**. "*The company's permanent presence in the community will substantially improve its image, create a favorable impression for the community and make it easier for new customers to solve their problems locally. The company was also expanding its regularization effort, based on the results of the pilot and its experience in other areas already regularized, to aggressively reach all of its low income neighborhoods requiring regularization within the next several years*" (ibid., p.57).

At the **household level**, results were the following:

- **electricity consumption** of all households within the pilot area were metered[23] before and after the actions: the average consumption before the regularization was 250 kWh/per month, then dropped to 190 kWh/per month after the regularization but before the energy efficiency actions, and finally decrease to around 150 kWh/per month → "*together the actions taken in the pilot achieved a **40% reduction in consumption with roughly half coming from the regularization effect[24] and half from the efficiency measures***" (Nexant Inc., Smyser Associates 2009) ;

- in billing terms, the average annual bill before the project would have been around $354, while it was around $213 after the project (not taking into account the cap used during the transition period): however this reduction may not be sufficient as 45% of the customers surveyed after the project said that it was difficult or very difficult for them to pay their bills ;

- the replacement of refrigerators made possible for the corresponding households to beneficiate from the **social tariff**, by reducing their consumption level (as this is a key eligibility criteria): however as they were also the poorest households, they still declare larger **difficulties to pay** their bills than other customer groups of the pilot test ;

- **75%** of surveyed customers were **highly satisfied** with the project (score of 8 to 10/10), the satisfaction being higher among the customers having benefited from more actions (especially refrigerator replacement and rewiring);

- "*the top six spontaneous citations of why those polled would recommend regularization to their neighbors and the top advantages of the pilot project included the reduction in the number of appliances burning out, the 'improved potency' of the appliances, reduced variation in the power received and not having power outages anymore (…) the elimination of the risk of fires due to short circuits and accidents with electrical shocks or electrocution[25]*" (ibid., p.50): **improvement in the reliability and safety of electricity service is a key factor to involve inhabitants in the project**;

[23] However, the measurement period and the metering frequency is not indicated in the report. For example, we do not know whether the consumption are subject to seasonal variations.
[24] "*that is, the effect on consumption of the new anti-theft measures, the 'price signal' sent by now billing for electricity service and changes in consumer behavior as a result of the community campaign*" (Ibid, p.40)
[25] Indeed, while 57 incidents were recorded during the 6 months prior to the project, only 6 occurred in the 6 months after the project.

- however, "*only 87% of those surveyed were aware of the project despite the numerous outreach events and door-to-door visits*": this may be explained because "*regularization was seen by the vast majority of those polled to be inevitable and essentially fairer than the prior system*" (ibid., p.51), so inhabitants may have thought this was only regulatory activities, and moreover, "*when asked about who benefits from the regularization, many mentioned that it is the electricity company that benefits the most*[26]".

From an energy point of view, "*the largest individual savings were from refrigerator exchange at 576 kWh or $73 per year for those who got them, but the greatest overall impact on electricity savings in the pilot area was from light replacements (around 70% of the total household savings achieved)*" (ibid., p.41).

One of the main problems encountered in this pilot test was the share of "commercial" customers (having small shops or other activities). Most of them are informal, and so are considered as residential customers. Besides, their high consumption level prevents them from beneficiating from the social tariff. So they have often high electricity bills. Two results appear from the pilot test:
- the electricity savings potential was assessed to be high for most of these "commercial" customers, but this is more difficult to achieve than for households, as the actions to implement are more specific;
- these businesses represent local employments, and there is therefore a social risk when these customers can not afford their energy bills if they have to close their activities.

Finally one key point of this pilot test is the **added value of the evaluation efforts** (e.g., monitoring of the consumption, ex-post participants' survey, financial analysis). "*Although AES had undertaken electricity 'regularization' programs in the past with varying degrees of success, they had not examined and conducted analysis on which program elements would be critical to achieving sustainability, which might be optional and which could be eliminated*" (ibid., p.18). At the contrary, this pilot test was examined under several points of view (utility, participants, community, ratepayer) offering rich conclusions (see "conclusions" section below).

Global results

Analyzing the Brazilian Electricity Public Benefits fund, Jannuzzi (Jannuzzi 2006) reported the following results for the period 1998-2004[27], based on ANEEL and utilities data, including all utilities programs, i.e. not making a difference whether they were targeted to low income households: around US$400 million invested in energy end-use efficiency, 3,7 TWh saved and 1,1 GW avoided. However, Jannuzzi highlighted that "*a major criticism of this program [the Public Benefits Fund] is that while there is substantial ex-ante evaluation of projects by the regulator, there is little if any systematic verification of the results*". Therefore, the estimated results should be considered with caution.

Looking more specifically at programs targeted to low income households, Leonelli (2008) reported the following results based on ANEEL data, for the cycle 2005/2006[28], covering all utilities:
- around **US$80 million invested** in these programs ;
- **2.9 million CFL**, **34 000 efficient refrigerators** and **18 000 solar water heaters** installed ;
- **upgrade of the existing electrical installation of 130 000 dwellings**.

Jannuzzi et al. (Jannuzzi, da Silva, Ana Lucia Rodrigues et al. 2009) reported more recent results: 5 million of CFL and 60 000 efficient refrigerators distributed during 2005-2007.

[26] which is not completely false when looking at the financial analysis.
[27] So this was before the obligation set in 2005 for the utilities to spend 50% of their energy efficiency investments into programs targeted to low income households.
[28] The Public Benefits Fund is not administrated according to calendar years, but to annual cycle.

Leonelli reported also **unitary results** from field assessments of refrigerator replacements made by several utilities. The average unitary savings were around 750 kWh/year (i.e. refrigerator consumption reduced by around 70%). But **results vary significantly** from one field test to another (standard deviation of 390 kWh/year, i.e. +/- 50%). And when compared to the average electricity consumption of Brazilian low income households (780 kWh/year[29]), this result raises questions (e.g., sample sizes, measurement periods).

Jannuzzi et al. (Jannuzzi, da Silva, Ana Lucia Rodrigues et al. 2009) reported the results from a detailed ex-post evaluation on a sample of 385 households who beneficiated from a utility's program replacing incandescent bulbs by CFL in Rio de Janeiro. Load demand and electricity consumption were compared before and after these replacements, using measurements from the transformers. Energy savings were around 35 MWh/month, representing a consumption reduction of 22.7%. The peak demand also decreased by 15 to 20%.

This evaluation at the transformer level was complemented by field surveys in a smaller sample to monitor changes in consumption patterns. Lighting demand and consumption were then metered at the end-use level. The observed reduction for both, peak load and lighting consumption, was around 75%.

Jannuzzi (Jannuzzi 2007a) has proposed a **methodology for cost-benefit analysis** of programs for low income households. But no results from real cases have been published yet.

Evaluation issues

Most programs include now an evaluation methodology and a monitoring plan, as this is required by ANEEL since 2007. However, ex-post evaluation practices have been so far quite limited.

For example, although a qualitative and non-economical analysis is often suggested, common practice is to only take into account economical factors and cost-benefit analysis for the ex-ante validation. Unfortunately, real ex-post evaluations are seldom performed.

And this is even more critical for programs for low income households. Jannuzzi et al. (Jannuzzi, da Silva, Ana Lucia Rodrigues et al. 2009) analyzed the difficulties of evaluating such programs based on a case study in Rio de Janeiro: "*within the **challenges and specificities** which characterize low-income energy efficient projects, the authors highlight the inaccurate or lack of information about the dwellings and consumers, the difficulty of collecting field data and access to the slums, the metering reliability in distribution transformers, high levels of commercial losses and transformers replacement*" (ibid., p.522). Then the authors proposed a **detailed methodology** to face these issues and evaluate these programs. This includes the following components: "*1-analysis of the electrical and physical characteristics of the low-income community, (…) 2-installation of meters at selected transformers which provide electricity to the households, (…) 3-survey of household appliance ownership and consumption patterns, (…) 4-end use metering, (…) 5-consumer satisfaction survey*" (ibid., p.525).

The feedback from this case study is that "*the methodology has to be robust enough in order to take care of the following issues:*
*a) the **physical access to the local community**, which imposes challenges of time and costs surveys and measurements;*
*b) **poor quality of the existing data**;*
*c) **disseminated practice of illegal connections***" (ibid., p.526).

The exchanges between the evaluation team and the utility also led to improvements in the practices of data collection, which are a key factor to make

[29] See (Jannuzzi 2007b) for a detailed analysis of low income households' consumption.

evaluations possible and successful.

Unfortunately, Jannuzzi et al. did not give information about the costs of this evaluation, and whether it would be feasible that such evaluations become common practices.

Problems / adaptations

As mentioned above, no specific targeting obligation from the regulatory side prevented the investments to be used in the most profitable way from the utilities' standpoint, instead of taking account of the social point of view (i.e. the public interest). This can be reflected by the implementation of mostly small scale programs. On top of this, almost none of such programs have been properly documented. This makes extremely difficult to evaluate and provide secure guidelines or best practices examples for coming projects. These issues (targeting and evaluation) have been addressed in recent updates of the regulatory framework, however it is too early to know whether these changes have induced concrete changes in utilities' practices.

A major problem when evaluating the pertinence of an energy efficiency program directed to low-income households comes when having to choose an Internal Rate of Return (IRR) to evaluate the economical viability of such programs. This factor is determinant since the amortization of the project depends on it. IRR values for this type of social directed projects are not clear. The value chosen can make a project viable or not, and will have a major influence on the choice of installed equipments (better quality-more expensive ones versus lower quality cheaper appliances).

One key issue for the design and success of programs targeted to low income households is the **level of subsidy** for the appliance replacement. It should be high enough to convince households to take part in the program, but most of all to ensure that the reminding part that they will have to reimburse will not make difficult for them to pay their future electricity bills. At the same time, too high subsidies will limit the number of appliance replacements for the same program budget (see (Jannuzzi 2007a) for more details, and see the example of the COELBA project in the Bahia state (Mascarenhas 2009)).

In addition, end-use efficiency programs tend to be more costly to operate in the poorest regions of the country, but could have greater societal benefits. This is not really taken into account so far in the regulatory rules applied by ANEEL.

Conclusions

► Conclusions about the Public Benefits Fund and the specific obligations related to low income households

There are clear evidences that the Brazilian Public Benefits Fund made possible **an increase of energy efficiency activities in terms of investments**, diffusion of efficient appliances, etc. **But the final impacts**, especially in terms of energy savings and peak load reductions, **are much less documented**, due to the lack of ex-post evaluations. However, several qualitative analysis of the Fund's functioning led already to positive changes in its designs and rules (for more details see (Jannuzzi 2006, Jannuzzi 2005)).

The main conclusion is that "*it is very unlikely that initiatives in energy efficiency and R&D would have taken place without the regulators' enforcement* (…) *However, provisions in legislation alone are not sufficient condition to ensure that resources are being used efficiently to maximize the public interest of energy-related services. Analysing the country's experience since 1998, an important* ***learning process*** *within the regulator and also amongst the utilities was observed*" (Jannuzzi 2005).

One disadvantage of making utilities responsible for the programs' design and implementation is that their activities are seldom coordinated at a wide level. This resulted in **numerous but small projects**.

These general conclusions also apply for programs targeting low income households. Therefore significant outputs have been achieved (see the "results" section above), but **the potential** of development for such programs **remains very high**, looking at the very challenging stakes: improving access to energy and housing conditions of millions of people, reducing illegal connections and commercial losses, reducing the around US$650 million of subsidies ensuring the social tariff for 18 million consumers.

A better coordination between the local utilities and the national public bodies (ANEEL, PROCEL, Ministry of Energy) could gather the following advantages:

- **keeping a local management of the operational activities** (here the utilities programs), making easier to create partnerships with key local stakeholders (community leaders, municipal services, NGO): such local involvements and supports are key success factors for programs targeted to low income households ;
- **setting a national supporting frame**, especially to define priority targets (according to public interest), to foster dissemination of experience feedback and to create a national consortium for favoring economies of scale and involving other key stakeholders: procurements of efficient appliances could be negotiated nationally with manufacturers, long term strategies could also be developed with manufacturers and retailers, partnerships could be created with banks for innovative financing mechanisms, evaluation studies could be pooled among several utilities, etc. ;

The creation in 2000 of the CTEnerg Fund[30] was a good step forward, but progress can still been achieved in these directions.

As well, improving evaluation practices would be a key to develop larger-scale programs and to disseminate successful programs. Since 2007, the regulatory agency ANEEL strengthened the evaluation requirements. In parallel, research work was done to propose more specific methodologies. These efforts have produced promising results that will be very interesting to follow.

► Conclusions about utilities' programs targeted to low income households

As for utilities' programs in general, few ex-post evaluations are available and documented. This is a key issue, as it prevents from really taking advantage of the experience accumulated over the years, especially in order to disseminate successful practices. However, the two concrete cases presented above already provide interesting conclusions.

The COELBA project gives a feedback from a real-size experience, while the Paraisopolis pilot test's objective was to be more focused (in size), but to make possible more comprehensive analysis.

Antonio Pinhel (Pinhel 2009), from COELBA, highlighted the following **key points from the utility side**:

- being allowed to use an energy efficiency fund;
- focusing on the demand side (end use & income profiles);
- involving the local community (here the use of recycling revenues to finance community projects was probably a key success factor);
- paying a lot of attention to planning, logistics and monitoring;
- taking advantage of the existence of labeling program (here from PROCEL) to select the efficient appliances and prove the results to the regulator;
- using the experience acquired to develop other similar projects (scalability).

He also pointed out the **next challenges**:

- continuation of monitoring and ex-post evaluation;

[30] This fund is not dedicated to programs for low income households, but to support energy efficiency activities and energy R&D which would not be considered by utilities or market agents. So its objectives are much wider, but it is a national stakeholder which could favor strategies as mentioned above (for more details about CTEnerg see (Jannuzzi 2005)).

- design of finance mechanism for leveraging the results;
- incentive design of new/efficient products and services for low income population.

The final report of the Paraisopolis pilot test (Nexant Inc., Smyser Associates 2009) identified complementary **lessons learned**, especially useful for project design and replication (see below).

"*The **difficulties and challenges of reaching low income consumers** in informal areas*" make it very time and resource consuming. This can be influenced also by the geographical conditions, the security level (or crime rate). On top of that, families regularly migrate in and out of the community making a longer term strategy difficult to implement.

Door-to-door visits are very effective but not sufficient to reach all households and, at a minimum, **community events** should be held in parallel. "*Paying greater attention to timing and sequencing issues could have improved the efficiency*". It should especially be taken into account that it is difficult to meet the households. So the number of contacts needed should be minimised (e.g., including the mini-audits in the pre-regularization visits). Similarly all **administrative process** (e.g., for refrigerator replacement) should be made as **streamlined** as possible, to minimise the corresponding delay and burden.

As for the COELBA project, it is clearly highlighted along the report the **importance of local partnerships** involving community leaders, municipal service providers, NGO, etc. and also of **coordinating with other activities on-going in the same area**.

In this pilot test, refrigerators were offered only to the poorest households. Utilities will not have the funding to fully finance refrigerator replacement for all their low income consumers. Experiences from other utilities and the ex-post survey show that consumers may accept to pay for a new efficient refrigerator when they learn how much it can reduce their electricity bill, provided they can beneficiate from a grant and/or a kind of leasing (scheduling the payments through their future energy bills).

Moreover, "*the financial sustainability of slum electrification efforts to the utility depends on the continued collection of several different post-pilot revenue sources. They included collections from customers, subsidies received from the government to make up for the loss to the company from the low-income tariff, cost savings from the regularization effect and energy efficiency measures, and gains from the sale of electricity that is no longer being stolen*".

Another key issue raised is the persistence of the energy savings. It is pointed out that refrigerators' efficiency may decrease after five years of use (due to degradations of insulation and door seals, and then of the thermostat and compressor). Likewise, CFL may be replaced by incandescent.

The final Paraisopolis report also highlighted the two following factors that may change the viability and effectiveness of **similar projects in other countries** than Brazil:

- **levels of power theft and of appliance ownership** should be considered when defining the technical targets, and they will influence the futures changes in revenues from electricity sales;

- **regulatory conditions** (tariffs, allowance for recovering investments, impacts on ratepayers or taxpayers) are decisive for the financial possibilities and the cost/benefit analysis (see section 3 of (Nexant Inc., Smyser Associates 2009) for examples of simulation of different conditions).

Finally, the approach used in Paraisopolis was supposed to be replicated in other

pilot tests in India and Liberia. Yet, it would be very interesting to follow at the Brazilian level the continuation of the first successful programs: are their results still effective and are the corresponding utilities expanding these activities in their service areas? do other utilities develop similar activities using this experience feedback?

Perspectives / recommendations

A new law has recently been voted (around January 2010) updating the rules for the social tariff, and also setting the share of utilities' investments in energy efficiency programs for low income households to 60% (of the 0.5% of their annual revenues they have to invest in energy end-use efficiency).

Based on the review of the documentation available (see the "references" section below) on the Brazilian Benefits Fund and on the two concrete cases presented above, the following recommendations have proved to be better adapted to the Brazilian reality and to bring better results:

- Programs developed through partnerships or in collaboration with social service agencies and community representatives (e.g., discussing with community leaders to see what would be the most effective contact means and timing, and more generally involving the communities from the design stage);
- Community service agencies which are directly responsible for the program's implementation, and considering hiring people from the communities to work with the utility staff (e.g., for the visits and events);;
- Programs aiming to improve home energy efficiency as a whole (and even at the neighborhood level) instead of a single end use (especially having in mind that the first motivation for the households is most often to improve the safety of their installations, before reducing their electricity bills: so any energy efficiency actions should come together with an upgrade of the distribution system and eventually rewiring of the individual installations);
- Programs using a relevant grant level (based on past experiences, grants high enough to be a real incentive for the households, but not too high so that it can be proposed to more households for the same budget);
- Consumer education as an integral part of the program;
- Programs' information materials are also distributed amongst the neighboring population (not necessarily low-income), increasing dissemination of information and spill-over;
- Programs where the utility continues local activities after the end of the project, making that the residents can feel they are treated as well as other customers;
- The cost effectiveness of programs is not the main objective and measure of success. Other indicators such as indoor health, safety and well-being of households are more relevant;
- Programs which are conceived taking into account clear evaluation methodologies (of impact and of process) and results monitoring.

A key issue for the future of such projects is how their results evolve over time. First ideas are provided in the Paraisopolis report (Nexant Inc., Smyser Associates 2009) : "***sustainability*** [of these projects] *depends primarily on three main factors:*

- *the ability of the company to* ***make a business case*** *for serving low income customers,*
- *the* ***affordability of electricity service*** *for consumers and their satisfaction with the service they are receiving*
- *the* ***willingness of the regulator*** *to consider and approve actions that the*

company proposes to find profitable ways to serve these customers while protecting other consumers from undue financial burden".

The two concrete cases analyzed also that even if the projects are implemented locally, involving local partnerships, they can profit from international supports, either directly through a global partnership (see case of Paraisopolis) or indirectly through the valuation of the results like for the CO2 avoided emissions and the CDM framework (see case of COELBA project).

These examples also remind us that access to energy is only one issue of the larger problem of urban poverty. As mentioned in the documents reviewed, the population of the communities covered by these projects was continuously changing. And more generally, the number of people living in slums is still significantly increasing (due to e.g., rural depopulation). So it may be a endless run, if solutions against poverty are not thought more globally.

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Southern Africa

Case study done by Jean-Sébastien Broc (Ecole des Mines de Nantes, France), mainly based on the materials of the ProBEC and GTZ website (www.probec.org and www.gtz.de).

ProBEC: Programme for Biomass Energy Conservation

Context

► **General context**

Balmer and Hancock (Balmer, Hancock 2009) give an interesting analysis of the energy context in the SADC[31] countries, while challenging the classical **opposition made between modern energy carriers** (electricity and natural gas) **and traditional fuels** (e.g., wood, crop residues).

This opposition implied that traditional fuels were inferior goods. The usual objectives and expectations are that an increase in households' incomes would lead to fuel switching towards modern energies and an abandonment of traditional energy sources. The level of use of modern energy was supposed to be an indicator of development. Therefore most of the efforts related to energy in the developing countries have been for many years focused on supplying "modern" sources of energy such as electricity and LPG. This vision was also supported by the increasing level of urbanization.

Based on their own work and on other papers, Balmer and Hancock show that **current trends give a rather different picture**, mainly due to the following reasons[32]:

1) continued use of biomass energy resources: more than 80% of the population in SADC countries still rely on biomass energy for the bulk of their energy requirements.
2) pressure on biomass resources: fuelwood is harder to collect and its price is rising while it was deemed free before ;
3) significant increase in the price of commercial energies (paraffin, gas and electricity) ;
4) lack of access to electricity remains: only 24% of the population in Sub-Saharan Africa have access to electricity and the generation capacity are stagnating while population is growing fast.

Balmer and Hancock (2009, p.12) then conclude that "***there is no alternative for most of the wood fuel dependant population***[33] *who continue to use ever scarcer and more expensive biomass*". And this affects in priority the poorest and the women (as they are most often in charge of the wood collection).

Moreover, even if the access to electricity were significantly improved, using electricity for heating or cooking would raise the individual electricity consumption beyond the payment capacities of most low income households.

Therefore, they argue that, instead of focusing only on the access to electricity, the solution lies in **two complementary pillars**:

1) **supporting the current development of new and more efficient appliances for thermal application using biomass** (e.g. efficient cook stoves) provided that the resource base is sustainably managed;

[31] Southern African Development Community, alliance of southern African states: Angola, Botswana, the Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe (www.sadc.int)

[32] For an interesting discussion about the use of fuel wood for cooking and the management of the biomass resource in Sub-Saharan Africa, see also (Hiemstra-van der Horst, Hovorka 2009).

[33] In Sub-Saharan Africa, more than 90% of the rural population (and almost 60% of the urban population) still relies on traditional fuels for cooking (IEA 2006).

2) **targeting electricity supply for non-thermal applications only**, also with new and more efficient solution (e.g. photovoltaic lighting with LED[34]).

This view is supported by the analysis of the United Nations Millennium Development Goals (MDG) defined in 2000. Modi et al. (Modi, McDade et al. 2005) showed how critical the energy issues, especially the promotion of more efficient cooking appliances, will be for the achievement of the MDG.

► From poverty alleviation to a business opportunity

The size of the challenge[35] raised the interest of universities (see e.g., the Score Stove project[36]) and also of large international companies (see e.g., Philips Woodstove or the Protos stove of Bosch and Siemens).

Indeed, Balmer and Hancock (2009, p.12) refer to Prahalad (Prahalad 2009) who "*theorised that the approximate 4 billion people living on less than $2 per day are not an economic lost case but present tremendous benefits to multi-national companies who choose to serve these markets in ways responsive to their needs*". However, Balmer and Hancock then highlight[37] that the poor should not only been seen as consumers but also as producers and entrepreneurs, in order to **create business opportunities while really alleviating poverty**. This is actually one of the key principles of the program presented below.

In addition, this argues for a **multilevel partnership with a strong involvement of local populations**, bringing together international R&D, development programs, national policies and local networks.

Balmer and Hancock think as well that **carbon instruments** may create incentives for private companies. So far, the potential mostly lies in the voluntary carbon market, as cook stoves programs are mainly small-scale projects, for which CDM (Clean Development Mechanisms) certification costs would be too expensive. But the experience gained and the scaling up of these projects as well as the availability of new carbon instruments, for example programmatic carbon, may change these conditions.

However, the authors also indicate that **public support** will remain a key for the success of any initiative. Past results proved that a better co-operation between public institutions is needed to improve aid cost-effectiveness. And new forms of public-private partnerships could be a way forward.

► Low income households and energy needs in Southern Africa

"***Biomass is the primary source of basic energy for up to 80 percent of total energy consumption for families and small businesses in most Southern African countries****. An average rural family needs roughly two tons of firewood a year to cook just one meal a day.* ***One billion tons of firewood is burned for cooking every year****. Industrial exploitation and uncontrolled logging, farmland gained through slash and burn, and cooking with wood continue to destroy the world's forests at a rate of 15 million hectares per annum.*

In the past, chopping down trees for firewood was the poor person's safety net; however, forests are diminishing faster than they grow. Deforestation, rapidly rising prices, the use of wood for charcoal aimed at urban markets all deplete

[34] See e.g., (Adkins, Eapen et al. 2010)
[35] It is estimated that around two billion people in developing countries are still living in rural or peri-urban areas and depend on biomass energy such as fuelwood, charcoal, etc. for their daily needs (GTZ 2004)
[36] Developed by UK universities, the Score Stove is at once a cooker, a fridge and a generator, at a total cost of around $50 per appliance (see www.score.uk.com).
[37] Quoting Karnani (Karnani 2006) and Simanis and Hart (Simanis, Hart et al. 2008).

wood reserves[38]*. The cost of grid electrification is prohibitive, and there is huge deficit in power generation capacity in the Southern African Development Community (SADC) region.* ***Basic energy solutions can save a lot of firewood****. (…)*

Research has shown that the use of biomass continues alongside electrification. As the cost of producing electricity continues to increase in this region, it is envisaged that even more households in the foreseeable future will become dependent on biomass."[39]

The link between using fuel wood for basic energy needs and deforestation is challenged by Hiemstra-van der Horst and Hovorka (Hiemstra-van der Horst, Hovorka 2009), whose field survey showed that most of the biomass harvested for energy purpose is deadwood (as it is already dry, etc.). Their analyses also support the high interest of a more energy-efficient use of fuelwood, which would make possible to cover the energy needs of an increasing population with the same amount of resource.

These explanations provide the rationales for the choice of targeting the use of biomass for cooking. Moreover, studies have shown that among Southern African households, the lesser the income, the higher the use of fuelwood. Therefore it is implicitly assumed that **targeting the use of biomass for cooking in rural areas or urban slums is targeting low income households by itself**.

No real definition of "low income households" is given. Actually the actors used the definition of poverty as particular to each country, as there are significant differences between the SADC countries. Finally, it can be assumed that most of the beneficiaries of the program presented below have a revenue of less than $2 or even $1 a day. Here energy poverty means both a lack of access to energy resource (e.g. to electricity) and a difficulty to cover basic energy needs.

Objectives

► General objectives

"*The Programme for Basic Energy and Conservation (ProBEC) aims to ensure that low-income population groups satisfy their energy requirements in a socially and environmentally sustainable manner*" (www.probec.org).

Indeed, using traditional and inefficient wood burning systems (e.g., three-stone fire) induces high wood consumption, thereby increasing pressure on biomass resource and also the distance and time needed to collect the biomass. This keeps children away from school, then maintaining the poverty cycle.

Moreover, these kinds of bad combustion also create indoor air pollution, responsible of respiratory diseases[40].

► Operational objectives / targets

The operational objectives of the ProBEC activities are:
- to develop the expertise about biomass energy of public institutions and private sector in the SADC region ;
- to ensure that affordable energy-efficient technologies and techniques are commercially available and widely used in the region.

[38] Another important contributing factor is the lack of a coordinated management approach towards forest resource management (personal communication with Marlett Balmer).
[39] http://www.gtz.de/en/weltweit/afrika/24644.htm ; see also (Inglesi and Pouris 2010) for a discussion about electricity prices and demand forecasts.
[40] In the cases where households purchase fuelwood and charcoal, energy efficient devices can result in significant monetary savings and households reported between 49% and 60% savings on biomass energy expenditure per month when using an improved stove (personal communication with Marlett Balmer, based on the 2010 ProBEC Progress Report).

Concrete objectives in terms of efficient stoves production were defined (see the "results" section below).

The target groups are low income rural and urban households as well as small business and public institutions using biomass energy (fuelwood, agriculture residues) for cooking, baking, heating and other thermal processes.

Program description

Motivation

It is expected that the programme will bring multiple and long-lasting benefits (environmental, economic, and social):
- at local level: e.g., improving life conditions for families and supporting the development of small businesses;
- at national level: e.g., savings of foreign exchange for energy imports, increase in the expertise of biomass energy;
- and at global level: e.g., use of biofuels instead of fossil fuels, reducing net GHG emissions, optimizing the use of the biomass resource.

Moreover ProBEC is also in line with the Millennium Development Goals:
- goal 1: reducing the number of people whose income is less than 1 $ a day → creation of jobs in the informal sector for the production and marketing of improved technologies (mainly efficient stoves) ;
- goal 3 : promoting gender equality and empowering women → women are primarily targeted in trainings and extension services ;
- goal 5 : reducing of child mortality → smoke reduction thanks to efficient stoves has been proven to reduce respiratory diseases by 50% both for women and children ;
- goal 7 : contributing to environmental sustainability → the use of more energy efficient devices helps reducing fuelwood consumption.

Main characteristics

► Program history[41]

ProBEC (Programme for Biomass Energy Conservation) is multinational programme initiated by the **Southern African Development Community** (**SADC**), which commissioned the **Deutsche Gesellschaft für Technische Zusammenarbeit** (**GTZ**) GmbH as implementing agent.

Started in 1998, the programme initially aimed at the promotion of commercial supply and demand systems for **efficient biomass-using technologies** for three target groups in rural areas: low-income households, social institutions and small and medium-size enterprises (SMEs). ProBEC principles are to promote improved energy solutions through **market development and policy support**.

The first implementation phase (1998-2001) delivered the foundations of the programme in the partner countries (e.g., national steering committees, workshops, demonstration projects).

During the second phase (2002-2005), Biomass Energy Conservation (BEC) strategies were further developed at a national level (e.g., selection and adaptation of improved BEC technologies, improved BEC options, training of BEC technology producers on technical and business skills and monitoring and evaluation of projects). Indeed, larger scale implementation activities could occur as additional funding became available (see figures below).

In parallel, efforts were started to find a sustainable model for BEC

[41] For more details, see http://www.probec.org/displaysection.php?czacc=&zSelectedSectionID=sec1193995383

interventions, in order to **secure a long term activity**. Likewise, the programme has been extended to new partner countries.

In the third phase (2006-2010), the programme scope was broadened: the objective is now to cover also urban low-income populations (who do not rely solely on fuelwood).

Initially, there were six partner countries (Lesotho, Malawi, Mozambique, Namibia[42], South Africa, Zimbabwe[43]). The partnership includes currently **ten countries** (new countries are Botswana, Swaziland, Tanzania and Zambia).

The total institutional funding for 1998-2008 was around **10 million euros**, coming from the following sources:
- 4,4 million euros from the German Ministry of Economic Co-operation for the period 1998-2008 ;
- 6,0 million euros from the Dutch Directorate General for International Cooperation for the period 2002-2008.

Moreover, the funding initially allocated by the European Commission (1,6 million euros) for the period 1998-2001 was finally not distributed, due to contractual problems[44].

► Program components and working scheme

ProBEC operates at both, **regional and national level**. ProBEC operates in member countries by appointing a **National Coordinator** (NC) and setting up a **National Advisory Group** (NAG). The NAGs include energy and forestry ministries and other key energy role players, especially these who may be involved in the future market developments. The NC is ideally located or embedded in a local organisation or structure which could carry out ProBEC-like activities once the programme cease to exist. Where a suitable local organisation is not available, ProBEC establishes a local office, but with the firm view of working towards a situation where the local country structure can be incorporated into an existing organisation. ProBEC as a SADC project maintains a close relationship with the SADC secretariat in Gaborone, Botswana. The programme is advised on a regional level by the **Programme Steering Committee** (PSC), chaired by the SADC secretariat and consisting of member states and ProBEC. Finally, a **coordination office** in Johannesburg provides support to national programmes in each partner country.

Then **preliminary studies** are performed to analyze the context in each country: national overview of energy demand and supply, fuelwood consumption, fuelwood supply potential, technical and economical analyses of possible cook stove options, identifying local know-how, etc. (see e.g. (Kaale 2005) for Tanzania ; (Chirwa, Ham et al. 2008) for South Africa).

These studies provide the background:
- to choose the best way to manufacture energy efficient devices, taking account of local habits, and especially looking for solutions that can be produced locally (to ensure that the devices will be affordable and to develop the local economy) ;
- and to select a local Non-Governmental Organisation (NGO): the NGOs are thus the national or local implementing partners, with a support from ProBEC for training, marketing and lobbying.

Then public actors, NGOs and other involved stakeholders (e.g. research organizations) are trained to support the private sector with training, awareness campaigns, monitoring, etc. This way, local private entrepreneurs (formal and informal sector) are trained to produce and market the chosen efficient stoves.

[42] The programme in Namibia was not active during the 3rd phase of ProBEC.
[43] The programme in Zimbabwe was suspended due to the political situation.
[44] Personal communication with Marlett Balmer.

This is the **"commercial" approach** which constitutes the core of ProBEC (see below).

In parallel, ProBEC also aims at providing **policy support**, for example through a platform for awareness raising and lobbying on the importance of biomass energy in the region. ProBEC also facilitated the formulation of Biomass Energy Access Strategies in countries. Draft strategies have been completed in Lesotho, Malawi, Botswana and Swaziland, with the process underway in Mozambique, Zambia and Tanzania. ProBEC also facilitated the formulation of the recently adopted "SADC Regional Energy Access Strategy". A Programme Steering Committee was formed of representatives from SADC and national governments, in order to review and provide guidance on the overall ProBEC implementation and to facilitate regional integration and coordination.

Finally, ProBEC provides the following outputs:

- **diffusion of more efficient energy devices** (promotion, accreditation, manufacture, retail, installation), together with training on efficient use of these devices and field inspection to monitor stoves maintenance, persistence effect and wood savings ;
- **policy advice**, especially to the SADC secretariat but also to national ministries ;
- **development of new knowledge** on biofuel and use of biomass resource.

► A specific approach based on market development/transformation

"*ProBEC, unlike older non-profit organisations and NGOs, places emphasis on the **commercial distribution** of the products that it actively promotes within the relevant markets. Commercial distribution allows products to enter the markets and be competitive rather than rely on subsidies that do not always last. In this sense, ProBEC promotes **self-sufficiency** and creates a subsequent market edge for the various cooking devices it promotes. ProBEC's target market presents a huge demand for energy-saving cooking devices that are inexpensive*"[45].

Indeed, donor support for ProBEC is supposed to end in 2010. So it should now becomes a **self-supportive initiative** (see section "Problems / adaptation" below). Activities will go on in the two fields of promoting national markets for basic energy efficiency products and services and supporting the improvement of national policies and strategies related to basic energy for low-income populations.

Moreover, one of the key principles of ProBEC is that the **local implementers** (most often NGOs) aim at developing **small local businesses** (production and/or sale of efficient stoves) which should be self-profitable and further expand. These efforts are mainly based on **training** and awareness campaign.

ProBEC is also working on securing the supply chain in the SDAC region for improved energy devices that cannot be produced locally, especially encouraging the partner countries and their importers to group their orders.

[45] http://www.probec.org/displaysection.php?czacc=&zSelectedSectionID=sec1194855430

Concrete examples/Impact/evaluation

Results

► **Global Results reported on the ProBEC website**:

Quantitative results:

"*ProBEC is credited with saving 1,781 ha of forest,* ***82,000 t CO_2 and 220,000 kg CH_4***" (Kölling 2009)[46].

Other quantitative results[47]:

- sales of improved energy devices:

	As of May 2008	From 1 June 2008 to 31 December 2009
households stoves	**97 000**	**120 000**
institutional stoves	1 322	4 179
SME devices	193	478

- an average **50% decrease in use of firewood** and therefore in fuel costs, but with a **wide dispersion** (20 to 80%) due to diverse levels of awareness and practices (Brinkmann, Klingshim 2005);

- correct use of improved devices (checked by on-site surveys): 40% in May 2008, 50% in December 2009 ;

- 40% of women involved increase their disposable income by 10% through the sale and use of energy efficient stoves from September 2005 to December 2009 ;

- "*up to 30% of monthly income* [savings] *when fuel is bought and time savings of between 10–20 hours weekly, allowing women to engage in productive labour*" (GTZ 2004).

- **a target of around 127.000 efficient cook stoves** have been set for the year **2010**, distributed among Botswana (1.000), Lesotho (100), Malawi (30.000), Mozambique (49.000), Swaziland (1.040), Tanzania (26.000), and Zambia (20.000).

From a financial point of view, "*GTZ's role at ProBEC is catalytic as it has not only unlocked additional funding for biomass energy activities in the region, it has mobilised lobbying for the recognition of the importance of biomass energy as the main energy source used by poor people in the region.* ***For every one Euro spent, GTZ has raised an additional three Euros*** *in co-funding from the Netherlands, Australia, Norway and the European Union*."[48]

In addition, the following qualitative outputs/results have been reported at the national levels (GTZ 2005):
- improved technical, organizational and management **skills and know-how** in all countries ;
- **increased awareness** about biomass energy among decision makers at the national and SADC level ;
- **experience feedback** and experience sharing.

Other significant sociocultural impacts were reported at the local level:
- maintaining an improved stove was perceived as an indicator of modernity and progress, therefore giving a higher status to its owner, and this also improved the **gender relations** (e.g., husbands considering helping their

[46] These figures are based on the interim evaluation of ProBEC. This evaluation is not available online, and we could not contact GTZ to get a copy of it within this study.
[47] based on http://www.probec.org/displaysection.php?czacc=&zSelectedSectionID=sec1194005813 , except when others sources mentioned.
[48] http://www.gtz.de/en/themen/24644.htm

wives in housekeeping or cooking tasks) ;
- women involved in stove production gained in **self-confidence** and were more active and respected in their communities ;
- children from households using more efficient cook stoves get a better attention from their parents, and had a **better school attendance** ;
- local conflicts about biomass resource were reduced ;
- increased interest in environmental issues, especially at school or on radio programmes or public theatre sketches.

About health impact, as mentioned before, indoor air quality is improved when using more efficient stoves. For example, CO and particles emissions are reduced by at least 30%. Moreover fire or burn incidents are reduced as new stoves are safer. These improvements were strongly mentioned as positive impacts by the stoves' users. And women also beneficiate that they have much less to carry heavy loads over long distances.

ProBEC's objectives also explicitly include the mitigation of the HIV/AID pandemic. The contribution of the program is mainly indirect, by making easier to supply the energy needs (for cooking, for several end-uses of local medical centres, etc.). But a more direct effect was also reported: "*because they require less fuel, women are no longer at such risk of having to offer themselves to forest officials or be raped by them in order to gain access to wood resources. This also reduces the risk of HIV infection*" (Kölling 2009).

About environmental impacts, the surveyed people mentioned an increased awareness about deforestation and other related impacts. Using improved stoves was recognized as an effective means of reducing these impacts. However this was not a key reason of involvement in the projects.

► National results from the "household stove user" and "producers" impact assessment surveys[47]:

For **Tanzania**:
- stoves produced for the period June 2008 – December 2009: around 26.400 (mainly Rocket Stoves[49], a wood combusting stove for cooking);
- high using rate (90% of daily use for cooking) ;
- 70% of the inspected stoves were in good conditions (most of the damages were due to incorrect use, like using charcoal instead of firewood);
- no quantitative assessment on fuel cost savings, but around 94% of households report fuel savings as the most important advantage ;
- most households buy woods from vendors ;
- most of stove producers increased their incomes (also most of them had other activities before).

For **Zambia**:
- stoves produced for the period June 2008 – December 2009: around 24.800 (mainly "Pulumusa" charcoal stove);
- high using rate (80% of daily use) but also supplemented by the use of less efficient devices (for around 70% of the households surveyed) ;
- 80% of the surveyed households fulfilled 4 of the 6 criteria defining correct use of the stoves ;
- 81% of the users reported they reduced their fuel expenses, and the fuel costs were evaluated to be divided by two, the same for the charcoal consumption ;
- 40% of the women involved have increased their disposable income ;
- good multiplier effect leading to a high demand for the efficient stoves, that actually can not be met by the production of stoves ;
- the stove business is just starting, but seems to be on the right track: 58% of the producers trained are still producing efficient stoves, and 83% reported that they invest their benefits in their business.

[49] For more details see http://www.probec.org/displaysection.php?czacc=&zSelectedSectionID=sec1203365406

For **Malawi**:
- stoves produced for the period June 2008 – December 2009: around 31.300 (mainly clay and fixed stoves "Changu" and "Esperanza");
- high using rates (around 80% of daily use for cooking for the rural households), but still complemented by other ways (like the three-stone fire) ;
- wood costs were assessed to be divided up to 2.5, and the firewood collection was reduced by around 36% ;
- stove businesses are mainly managed by women and correspond to a part-time activity, but with a potential for scaling up, as it already represented a significant share of their income ;
- in parallel, local stove producers are willing to take charge of the marketing of their stoves too, and ProBEC was about to provide them "seller" trainings in addition to the "producers" trainings.

For **Mozambique**:
- stoves produced for the period June 2008 – December 2009: around 27.000 (mainly clay and mud stoves) ;
- raise in the production and diffusion of efficient stoves thanks to community based activists promoting the scheme and training new producers, but this remains a self-help approach as 55% of the stoves were given, 30% were self-made and only 15% were sold/bought ;
- more than 50% of the surveyed households fulfilled 3 of the 6 criteria defining correct use of the stoves ;
- wood costs were assessed to be divided by around 2, as well as the frequency and time for collecting wood.

Evaluation issues

One of the key to improve the effectiveness of development aid is to integrate monitoring and evaluation into the programme management. This approach is fully endorsed for ProBEC[50].

For the **monitoring**, all countries (except Lesotho) have **dedicated officers** who submit monthly stove production figures to the central office in Johannesburg.

Annual user and producer impact assessment surveys are conducted to measure the impact of its activities, to assess if the stoves are being used correctly, the extent to which they are being used, user satisfaction with the stoves, the amount of time, money and fuel saved with the stoves, as well as the income generation prospects of energy efficient device production for producers, and analysis of the market support they need.

In parallel, the surveys also collect information about the other socio-economical impacts (e.g., health, gender specific questions).

Such an approach is not easy to implement, as reported on the website[50]:
"*In many cases, there are **no specific figures on how much money is saved** through fuelwood savings since there was no information on how much wood costs provided in the surveys*."
"*The impact assessment survey process of 2009 revealed that **the research skills level in each country differs significantly**, with only Malawi staff being able to compile information at the required level. To a lesser extent the Zambian reports provided more comprehensive information. In the rest of the countries, data analysis had to be outsourced to university-based consultants, and even then, the resulting reports were weak. Nonetheless, conducting the impact assessment surveys was a **valuable capacity building exercise** and revealed some interesting as well as unexpected results. Some M&E officers will receive training in M&E research methods is a priority for 2010*."

[50] Its monitoring and evaluation policy is in fact clearly presented on its website: http://www.probec.org/displaysection.php?czacc=&zSelectedSectionID=sec1194005813

Significant efforts are made to continuously improve the monitoring and evaluation of the programme, especially the data collection. This is also to **comply with the requirements of carbon reporting and verification** (e.g., introduction of receipt books in order to formalise sales and to track stove users more accurately), as carbon markets are assessed to be an important source of funding for the continuation of the programme (see also below).

Three additional evaluation reports are available from the ProBEC website:
- an impact assessment at local level (based on the case of the Mulanje District in Malawi) (Brinkmann 2005);
- the feedback from the participatory impact assessment involving stove producers (Brinkmann, Klingshim 2005);
- the cross-section evaluation of GTZ programmes in the thematic priority area of Renewable Energies and Energy Efficiency (Kölling 2009).

Problems / adaptations

► Being specific to be effective and sustainable; but then different contexts leads to different histories

One of the problems faced by ProBEC is linked with one of its key factor of success: the programme is based on a multilevel coordination making it possible to promote solutions specific to each country. But then, the success of the projects is also **dependent on the local context**. Strong dynamics can be achieved in certain places, while weak support and adoption will be encountered in others.

"*Stove adoption was recognised as highly dependent on the village set-up. The major influential factor is the motivation and empowerment potential of the stove promoters and producers. (…) This commercial production has more potential for the sustainability of stove implementation as there is a simultaneous economic improvement. Income generation through stove production is motivating to maintain this technology. (…) The acceptance of the stove also depends very much on the quality of stoves. (…) Another relevant influencing factor is the traditional leadership of a village.(…) the frequency of training and visits by project staff, extensionists or other villagers was highly influencing the activities. (…) Another critical factor is the firewood availability. The more firewood – as the main fuel – is available, the less effort is put into energy conservation methods.*" (Brinkmann 2005) Likewise, main advantages reported by the stoves' users are(by order of importance): fuel saving, time saving and then heating in cold season and easy cooking. Main reasons reported by non-users or not-replacing are other priorities (garden, church, etc.) and the easy breaking of the stoves.

► Establishing a framework built on independent revenue streams

Another major challenge of the programme is to **find a sustainable model to continue after the end of the international aid**: "*the exit strategy hinges on the **establishment of a carbon facility*** [the SADC Regional Carbon Facility] *to commercialise the savings generated through its activities. This entails setting up a **basket- or pool fund** at the Southern African Development Community's Secretariat level to ensure a potential funding stream for biomass energy-orientated projects, embedding programme activities in local organisations and partners, and the establishment of a Sustainable Energy Technology Testing and Research Centre*."[51]

[51] http://www.gtz.de/en/weltweit/afrika/24644.htm

Conclusions / Success factors

ProBEC appears to be a **successful programme**. Indeed, together with the Aprovecho Research Centre, it was granted an Ashden Award for Sustainable Energy[52].

The **multilevel framework** made possible a **change of scale**, from individual projects to integrated national and regional technical cooperation programmes with a focus on commercialisation to foster long-term sustainability.

One of the key factors is also the training scheme ("**training of trainers**"). This is possible due to the choice of promoting devices **taking into account the local resources and skills**. This approach strengthens the **involvement** of national stakeholders and supports the **empowerment** of the local populations. At the end, they should be the core actors of the projects. Moreover, by increasing local knowledge and skills, this creates more opportunities for snowball effects.

"*In most cases stove implementation was recognised as part of the village development. Particularly the experienced and identified impacts of energy saving stoves gave **evidence of improvements** of households within the rural area. The establishment of stove committees and the involvement of the village leadership (chief, VDC, etc.) strengthened the work of stove promoters and at the same time this demonstrates that the contribution of improved stoves to the **development of the village** was realised. (…) This involvement of stove producers in training and exposure visits is **encouraging and empowering**. At the same time it creates ownership, so that stove production, marketing and adoption gets handed over to the stove producers. Through commitment, ownership and a good network the improvement and implementation of stoves has the chance to be sustained*" (Brinkmann 2005).

Another very interesting principle of this programme is that it aims at **lasting results**. It takes time to launch the dynamic (doing the preliminary studies, involving the actors, etc.), but then it is a "living" initiative. The main proof of this success is that the SADC decided to pursue the programme after the international aids ended.

But this does not mean that once a project has been done in a district, no more actions are needed. Actually, the field surveys showed that **regular actions** (e.g., training, awareness activities) **are necessary to maintain and/or develop the results. But this can be managed by national or local teams**.

Key interesting points of this programme are:
- objectives really in line with sustainable development: not only energy and GHG savings, but gender equality, empowerment, etc.;
- a multilevel coordination, with a common resource centre (for research, evaluation, etc.) but national and local involvements making possible to develop strategies specific to national and local contexts;
- combining the development of field projects together with activities for policy support, in order to achieve results at local and national/regional levels: at local level, concrete dissemination of improved cook stoves, and at national/regional level, development of biomass strategies or policies;
- using local materials, producing locally, then generating local economical activities and above all developing a self-sustainable business model.

Another success factor was **to group ProBEC with other programs** (e.g., in Malawi with the IFSP, Integrated Food Security Programme). Likewise, the operational objectives of ProBEC were not restricted to the sole diffusion of efficient cook stoves. It was combined with several trainings about stove production and maintenance, "kitchen management" (reduced time, better ventilation), etc.

At the **local level**, a **key success factor for the adoption of the stoves** is to

[52] http://www.ashdenawards.org/media/international_photos/2006

demonstrate its advantages, for example by directly comparing it with a traditional inefficient system. More generally, stove adoption and implementation mainly depends on the following:
"*1. Education and knowledge within the village & Awareness about general resource (wood) availability & Time it requires for internalisation of changes*
2. Involvement and support of traditional leadership (…)
3. Skills, know-how and motivation of promoters and producers
4. Quality of stoves – clay source, clay storage and preparation, technology transfer and proper kiln firing & Acceptance of stoves and estimation of their value, influenced by the previous self-help approach
5. Frequency and regularity of village-visits and training" (Brinkmann 2005).

Perspectives / recommendations

► The coming future of ProBEC

As mentioned above, "*SADC member states, through the SADC secretariat, indicated that they would like to retain ProBEC as a regional programme even after the German exit. Member states further committed to direct financial support of national biomass programmes and this commitment was confirmed at the SADC Energy Ministers Meeting held in Maputo in April 2009. However, apart from Swaziland who applied to the Treasury for 30 000 euro for ProBEC activities, little other support has been committed*."[53]

So if the willingness to go on the programme is clear, there are still uncertainties about its financial scheme. As indicated above, a Carbon Facility was created to take over the GTZ-ProBEC programmatic CDM project in order to beneficiate from carbon funding. Cooperations were also undertaken with the European Union through the EUEI-PDF[54], which resulted in significant policy outputs, both at a regional and national level.

Meanwhile, it appears from the experience gained by GTZ in this programme and similar initiatives that considering developing micro-financing opportunities could be an interesting solution to increase the number of stove producers and the dissemination of improved stoves.

Another key point for the continuation of the programme is to ensure that structures will be able to handle further activities in each country. Therefore "local champions" have been identified for this purpose.

► One key for further developments: the participatory monitoring

The first attempt made to involve the stove producers in the monitoring and evaluation of the programme was very encouraging (Brinkmann, Klingshim 2005): "*it can be expected, that if this kind of participatory monitoring is part of the regular training program of stove producers and promoters, this will increase their quality awareness, motivate them to improve the quality of their products, increase their reputation and marketing skills and thus access to customers. The stove producers, builders and promoters considered this assessment as outstanding and so important, that they passed a resolution asking for training in monitoring and impact assessment as part of their regular training program*."

And the authors also highlighted that making this participatory monitoring a regular practice "*will be especially important in the future, as widespread dissemination is envisaged and monitoring by the project* [i.e. at the national or SADC level] *can no longer suffice*". Moreover, such an approach provides a better understanding of the schemes and what could be improved.

In parallel, the available surveys tend to prove that most of the improved

[53] http://www.probec.org/displaysection.php?czacc=&zSelectedSectionID=sec1271252165
[54] Partnership Dialogue Facility (PDF) of the EU Energy Initiative (EUEI), see http://www.euei-pdf.org

stoves' users are highly satisfied with their new devices. So in order to reach more participants, one key issue is now to better understand reasons for non-users or non-adopters.

Finally, one key issue will be how to improve the data on the final impacts (i.e. effective energy savings, health improvements, etc.). Current reporting is indeed focused on the number of stove producers trained or improved stoves disseminated, while few information is available on final impacts. This is due to the difficulties first to measure these impacts, and then to collect the corresponding data.

► Comparison with other similar programmes

The meta-evaluation of similar GTZ programmes (Kölling 2009) raised the issue of the dissemination approach, looking at what approach would be the most effective. However, the author mentioned that the available evaluation reports did not make it possible to really compare the programmes on that matter. However, from his analysis, it seems that another programme in Uganda (EAP, Energy Advisory Project) would have lead to significantly higher results, while using a different approach from the ProBEC one.
ProBEC is using a "commercial" approach, with the assumption that training local stove producers is the best way to ensure a sustainable and lasting model. The EAP principle is quite different as it relies on disseminating the skills to build improved stoves to everybody so that they can build their own stoves, with the assumption that this way will make the improved stoves more affordable for the population and will also increase the empowerment. But at the same time, experience feedback from ProBEC showed that training stove producers ensures a better quality of the stoves, compared to self-built stoves.

Both approaches aim at "snowball" effects. But not enough information is available to say which one would be more efficient. Actually, some of the projects implemented within ProBEC have also used the same approach than in the EAP.

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United Kingdom

Case study performed by Luca LO RE and Jean-Sébastien BROC (Ecole des Mines de Nantes), mainly based on the 7th Annual Progress Report of the UK Department of Energy and Climate Change (DECC 2009), documents from the House of Commons (House of Commons 2010; Bolton 2010) and papers from the scientific literature (see reference section).

Energy Efficiency Programs targeted to low-income households within the UK Fuel Poverty Strategy

Context

►General context for fuel poverty activities in the UK

Fuel poverty started to be officially recognized as a specific public issue in the mid-1990's, as explained in (EPEE 2008a, p.2 of Appendix 5): "*prior to the 1996 English House Condition Survey*[55]*, data collection was limited and did not allow identification of fuel-poor households*".

However, the issue was already identified for years and assessed to be critical, as highlighted in the review of the book of Boardman (1991) by Taylor (1993): "*Boardman attributes the scale of fuel poverty in the UK to the failure of successive governments to address the issue of warmth: she argues that housing and energy policies have instead emphasized the amount of space provided and the provision of delivered energy. Consequently,* ***the average thermal efficiency of UK housing is the lowest in northern Europe****".*

Indeed, until the 2000's and the UK Fuel Poverty Strategy (see below), fuel poverty was not addressed as such, but as a part of general poverty. Then, very few budget was dedicated to energy efficiency activities, while large amounts of money were needed to help consumers to pay their heating bills[56].

Nowadays, the picture is completely different: UK is known to have the largest experience among European countries in producing statistics on fuel poverty, as well as in developing specific policies and programs to tackle this issue[57].

It is likely that fuel poverty has become a politically-sensitive issue in the UK at from the early '90s, as one result of the opening of the electricity & gas markets (started in 1989). Indeed this market opening has created a situation where the energy prices were much more likely to fluctuate. The poorest layers of the UK society were not really protected by any sort of legislation regarding fuel prices increases in particular, and this aggravated their economical situation even more.

►Current definition and measurement of fuel poverty in the UK

"*A household is said to be in fuel poverty if it needs to spend* ***more than 10% of its income*** *on fuel to* ***maintain a satisfactory heating regime****. This is*

[55] "*The English House Condition Survey collects data on household income, required expenditure on all energy sources, the heating and insulation properties of the dwelling and the characteristics of the household occupants. This survey is the key source for data on fuel poverty in England based on the universally accepted definition of the need to spend more than 10% of household income in order to achieve an indoor temperature conducive to health and comfort. (…) In the absence of reliable data, fuel poverty campaigners used a series of proxy indicators to attempt to quantify the scale of the problem*" (ibid.).

[56] "*Many Local Authorities do, however, have energy efficiency retrofitting programmes which are limited only by the amount of funding available. Earlier this year* [1993]*, the DoE [English Department of Energy] announced a fund of £10 million specifically for such initiatives in England: within 6 weeks Local Authorities had submitted claims for £195 million (…) Unfortunately, the traditional way of addressing fuel poverty has been to concentrate on the symptoms rather than on the causes, by providing Heating Additions to Supplementary Benefit (SB) payments. By 1987 a total of £3.4 billion had been paid out*" (Taylor 1993).

[57] See for example the cross-countries comparisons made within the European project EPEE (European fuel Poverty and Energy Efficiency): www.fuel-poverty.org

considered to be 21°C for the main living area and 18°C for other occupied rooms during daytime hours. Besides space heating, fuel costs also include spending on energy for water heating, lights and appliances and cooking. Fuel poverty is therefore not based on what a household actually spends on fuel. If this were the case then the measure would exclude households that needed to spend more than 10% of their income on fuel, but cut back on heating etc. to reduce costs. (…) For the purpose of fuel poverty measurement and targets a ***'vulnerable' household*** *is one containing* ***elderly or disabled people***, ***children*** *or the* ***long-term sick****. It is these groups who are likely to be more vulnerable to cold-related ill health*.

As fuel poverty is a measure of what a household needs to spend on energy rather than what it actually spends, ***total energy needs are modelled****. In each of the home countries this is based on findings from* ***surveys of households and the housing stock****. This takes various factors into account including the size and energy efficiency of the property, household size, household type and type of heating. The modelled energy needs are then multiplied by appropriate fuel prices to reach a figure for total fuel costs*" (Bolton, 2010, pp.2-3).

It has to be noticed that there still are debates about the way "fuel poverty" is defined and how the statistics are built[58]. This is especially of importance for the monitoring and targeting of the related public policies. In fact, most fuel poverty data simply give the number and proportion of households in or out of fuel poverty. "*The 10% cut-off point places households who need to pay much more than 10% with those who just fall in this category. Similarly, households who need to pay just less than 10% and who may struggle to keep their houses warm are grouped with those who need to spend a very small proportion of their income on energy* (…) *In 2007, there were half a million households (…) who needed to spend more than 20% of their income on energy to maintain a satisfactory heating regime – in so-called 'extreme fuel poverty'* " (Bolton, 2010, pp.5-6).

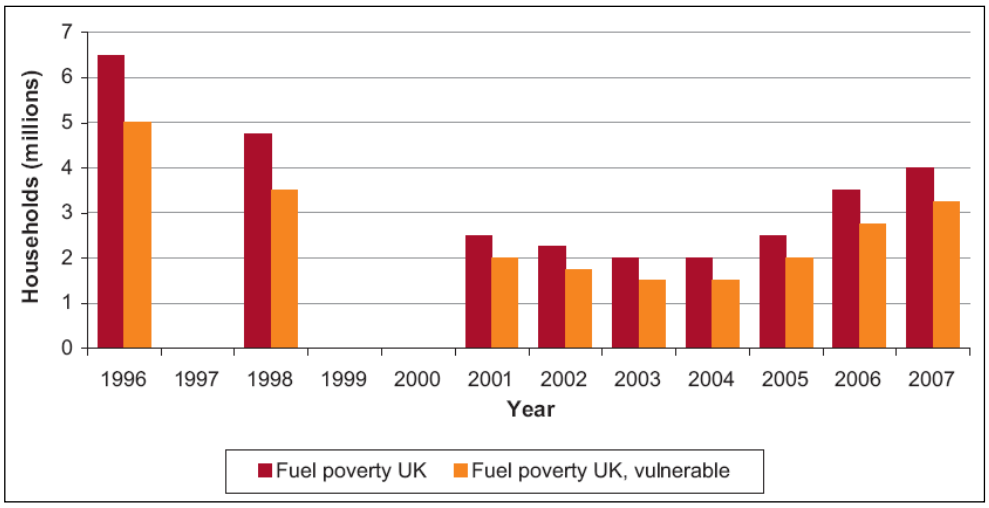
►General statistics on fuel poverty in the UK

"*Measuring fuel poverty on a UK wide basis is complex as figures are estimated on a country by country basis to different timescales and slightly different definitions. Nonetheless, the latest estimates indicate that in 2007, there were* ***approximately 4 million households in fuel poverty in the UK.*** *This represents an increase of around 2 million households since 2004, or half a million since 2006. Around 3.25 million of these were vulnerable households, an increase of around half a million since 2006. The increase reflects the impact of energy price rises in recent years on the number of households in fuel poverty.*" (DECC 2009, p.7).

It has to be noticed that **"vulnerable" households represent more than 80% of the fuel poor**, and almost 100% of the increase in the number of fuel poor between 2006 and 2007.

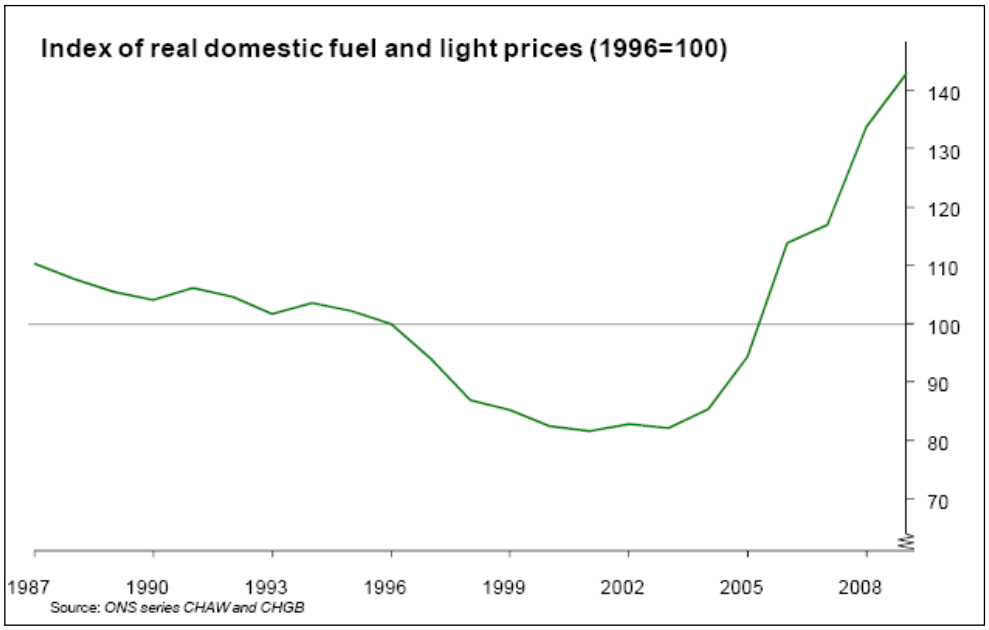
Figure 1 below illustrates the estimated evolutions of the number of fuel poor and vulnerable households in UK from 1996 to 2007. It clearly shows a significant decrease until 2001 (-60% between 1996 and 2001), then stabilizing until 2004 before growing again since 2004 (the number of fuel poor doubled between 2004 and 2007).

[58] For more details see e.g., (Ravetz 2008 ; Healy and Clinch 2004). Chesshire & ?? (2006) report on the Fuel Poverty Methodology is key



(Source: DECC 2009, p.7)

Figure 1. Fuel poverty in the UK, all and vulnerable households, 1996-2007.



(Source: Bolton 2010, p.4 referring to ONS series CHAW and CHGB)

Figure 2. Index of real domestic fuel and light prices.

As emphasised by Bolton (2010, p.3), "*energy prices are currently the main driver of changes in fuel poverty. [Figure 2] shows trends in annual domestic fuel and power prices. Domestic prices of fuel fell by 17% in real terms between 1996 and 2003, but increased by 42% between 2003 and 2007 and in total by 74% between 2003 and 2009. Such large price increases can only be partially offset by increases in income and energy efficiency improvements*".

► The UK strategy to alleviate fuel poverty

Three factors are identified to be the main causes of fuel poverty: **household energy efficiency**, **energy prices** and **household incomes**. The UK Government has **launched in 2001** its **UK Fuel Poverty Strategy,** structured according to these three factors: "*at the outset this package included Warm Front, the Carbon Emissions Reduction Target*[59] *and the Decent Homes Programme primarily addressing the* ***energy efficiency*** *of households, a robust*

[59] Initially this scheme was named EEC, Energy Efficiency Commitment.

*system of **regulation** aiming to protect all consumers, and Winter Fuel and Cold Weather Payments alongside the wider tax and benefit system to increase **household incomes***" (DECC, 2009, p.2).

"*The Government has spent **more than £20 billion** on measures to reduce fuel poverty **over the period 2000-08**. The majority of this has been in **Winter Fuel Payments** which are worth around **£2 billion a year** at present. The other main measures are heating and insulation for the social rented sector through the wider **Decent Homes programme (£4 billion)** and grants for energy efficiency improvements paid through the **Warm Front** (and predecessor) scheme in England (**1.6 billion**)*" (Bolton 2010, p.9).

The components of this strategy dedicated to improve household energy efficiency are described further in the part "Program description" below. We briefly remind here key information related to the two other factors (energy markets, and household incomes).

► Energy Retail Markets

As highlighted above, "*energy prices are a key driver of fuel poverty. **Increases in gas and electricity prices** have been the largest factors in the rise in fuel poverty numbers in recent years*[60]*.* (…) *The **regulator Ofgem** carried out a retail markets probe in 2008. Subsequently Ofgem has developed a number of remedies to address problems identified by the probe. These remedies include licence conditions to **prevent unfair discrimination** between customer groups, and **improvements in customer protection** relating to direct selling*." (DECC 2009, pp.4-5).

In parallel, suppliers signed in 2008 a **voluntary agreement** on programmes of social assistance for vulnerable customers. "***Suppliers' social programmes** can include social and discounted tariffs for vulnerable customers, trust funds and debt write-off schemes, rebates, partnership agreements and benefit entitlement checks*" (DECC 2009, p.21). During 2008/09, the six major energy suppliers collectively spent **£157.3million** for these programs, mainly to provide **over one million customers** a **social tariff**. Based on this, the Government has currently the "*aim of placing social price support on a statutory footing when the current voluntary agreement ends in March 2011*" (DECC 2009, p.5).

Moreover, in 2009, "*Ofgem and Consumer Focus [have carried] out two joint reviews on energy supplier practice to investigate how effectively they are protecting vulnerable consumers and helping customers with **debt problems***" (DECC 2009, p.20).

► Household incomes

The issue of low income and vulnerable situations is first tackled as a general poverty issue, through diverse social measures like Pension Credit for the older people, or the Disability and Carers Service.

Then three additional supports are provided to specifically tackle energy poverty:

- the **Winter Fuel Payments**: "***tax free lump sum payments**, with all households with people aged 60-79 receiving £250, and those with pensioners aged 80 and over receiving £400. **£2.7 billion** of payments were made in 2008/09*" (House of Commons 2010, p.6), and this represents

[60] Additionally, costs of environmental commitments and network charges, have also risen significantly (DECC 2009, p.19).

over 12.3 million beneficiaries (DECC 2009) ;

- the **Cold weather payments**: these are "*payable by the Government to poorer pensioner and other eligible*[61] *households in weeks of extremely cold weather. For the 5 years up to 2007/08 the number of annual payments made averaged around* ***£500,000*** *and the payment was £8.50*" (DECC 2009, p.23);

- **Benefit entitlement checks**: "*the Department for Work and Pensions has calculated, for example, that at least a third of people eligible for pension credit did not claim it in 2006-07. The [Warm Front] Scheme has tried to account for this effect through offering a benefit entitlement check to all applicants, to determine whether they are eligible for additional benefits they are not currently claiming, which may make them eligible for the Scheme*" (House of Commons 2010, p.11).

These measures "*make an important contribution to tackling fuel poverty and were responsible for taking around 100,000 households out of fuel poverty in England in 2007 (and around 200,000 in the UK as a whole)*". (DECC 2009, p.9)

Objectives

►General objectives

The overall aim of the UK Government and the Devolved Administrations through the UK Fuel Poverty Strategy is the **eradication of fuel poverty in the UK by 2016**.

Separate targets exist in England and each of the Devolved Administrations (DECC 2009, p.6):

- **England**: end of fuel poverty for "vulnerable" households by 2010, and then all households by the end of November 2016;
- **Scotland**: elimination of fuel poverty by November 2016;
- **Wales**: end of fuel poverty for "vulnerable" households by 2010, then for no non-vulnerable households in social housing by 2012, and finally for all households by 2018;
- **Northern Ireland**: elimination of fuel poverty for "vulnerable" households by 2010, and for all households by 2016.

As explained in the "Motivation" section below, the energy efficiency activities also hold related objectives: reducing carbon emissions, improving the health conditions of the UK housing stock, and creating jobs.

► Operational objectives / targets

In concrete terms, the energy efficiency activities mainly aim at **improving the overall energy efficiency of the dwellings**, resulting in improving the occupants' comfort and/or in reducing the energy bills.

In its new Strategy for Household Energy Management set in 2009, the UK Government established the target to **insulate 6 million dwellings by the end of 2011**.

Most common actions are the installation of **cavity wall and loft insulation**, **draught proofing**, installation or replacement of the **central heating system** (together with smoke alarms and security measures)[62].

[61] "*people in receipt of Pension Credit or income-related Employment and Support Allowance that includes a work-related activity or support component; those in receipt of Income Support, Income-based Jobseeker's Allowance or income-related Employment and Support Allowance in the assessment phase if they have a pensioner or disability premium included in their benefit or if they have a child who is disabled or under the age of five*" (House of Commons 2010, p.9)

[62] These are termed the 'cost-effective measures' defining cost-effective on a short-term payback rather than a lifetime payback. This means that over 30% of the UK housing stock is not addressed by these measures

In a lesser extent, the programmes may cover **lighting and appliances**.

Moreover, in order to support and induce the installation of energy efficiency measures, complementary activities are develop to provide consumers with **energy efficiency advice**.

Program description

Motivation

The documents analyzed show that the main motivations of the UK Government to carry out energy-efficiency programmes in low-income households are the commitment to citizens, commitment to the environment, an indirect action to prevent further costs on the UK health system, and the creation of jobs.

The **commitment to citizens** regarding fuel poverty is part of a welfare policy carried on by the UK Government in the last decades. Under the UK Fuel Poverty programmes is clearly stated the intention to improve the living conditions of the fuel poor households by **guarantying a minimum standard of thermal comfort**. The World Health Organization (WHO) defines this as 21°C in the living room and 18° in the other occupied rooms ((Burns, 2007) referring to (DBERR, 2001)).

Concerning the **commitment to environment**, the UK Government is committed to become a low carbon country. This process must be carried out gradually, and the transition is described in the paper "**UK Low Carbon Transition Plan**" published by the DECC in 2009. The main goals are cutting emissions, maintaining secure energy supplies, maximizing economic opportunities and protecting the most vulnerable. One of the actions that will be taken under this plan is to insulate 6 million households by the end of 2011. This commitment is being delivered through a number of schemes, primarily Warm Front, the CERT and Decent Homes Programme (see descriptions below) (DECC, 2009).

On the other hand, the links between cold, damp homes and poor health have long been recognised (Healy and Clinch 2002 ; Liddell and Morris 2010) and fuel poverty presents a serious **risk to the health and well being** of thousands of people[63]. "*Fuel poverty damages people's quality of life and imposes wider costs on the community, through increased health service use*[63]" ((Burns, 2007) referring to (Evans et al, 2000)).

Finally, the need for improving the energy performance of a large share of the building stock means also a significant increase in the corresponding activities, especially insulation works. The UK Government is actually expecting that its new Strategy for Household Energy Management would create **up to 65,000 jobs in the so-called "green homes industry"** for installing and manufacturing energy saving measures or providing home energy advice.

Main characteristics

► The general frame

The UK Fuel Poverty Strategy aims at tackling fuel poverty acting directly on what is identified to be the main causes of it. Therefore, actions are taken in

because they cannot take cavity wall insulation (solid or other type of walls), they are not on the gas network so cannot improve their gas central heating or they do not have a loft with a gap that can be insulated. This problem has been underestimated in the global strategy until 2009 (Pett, 2010). See e.g., (Pett, 2002) and (Ramsay and Pett, 2003) on 'hard to treat' homes. Furthermore, an ACE report (ACE, 2010) showed that now 50% of the fuel poor live in this category of dwelling.

[63] "*Every degree fall in average winter temperature causes an additional 8,000 deaths*". More generally, fuel poverty is assessed to cause health damages representing £1 billion in costs to the National Health Service each year. See e.g., http://www2.warwick.ac.uk/fac/soc/law/events/past/2003/healthyhousing/papers/shentonj.pdf

terms of **energy efficiency and heating**, **energy markets** (i.e. energy prices) and **household incomes**. According to Bolton (2010, p.9), "*of the three main factors that affect fuel poverty rates –income, energy prices and energy efficiency- **it is energy efficiency that government policy can have the greatest impact on***". Moreover, "*improving the energy efficiency of homes is the **most effective long-term means of alleviating fuel poverty**. Incomes and, especially, fuel prices may fluctuate; however, if a home is made energy efficient its fuel consumption will be reduced in the long-term and its occupants are less likely to be in fuel poverty*" (House of Commons 2010, p.17).

"*Measures aimed at combating fuel poverty are **a mixture of direct expenditure by the public sector and legal obligations on energy suppliers** to provide free or cut price energy efficiency measures*" (ibid., p.9). Hereafter are presented three major "energy efficiency" components of this strategy:

- the **Warm Front scheme** (England[64], from 2000 on): programme providing **grants** targeted to the **private housing sector** to help low income households improving their dwelling's energy efficiency ;

- the **Carbon Emission Reduction Target** (CERT) (Great Britain, from 2002 on): **obligations on energy suppliers** to achieve energy savings and reductions of carbon emissions in the domestic sector ;

- the **Decent Homes Standard** (England, from 2001 on), the Scottish Housing Quality Standard (from 2004 on) and the Welsh Housing Quality Standard (from 2002 on): **requirements on minimum energy performance** (among others) for **social housing**.

This is complemented by **area based programmes** (Community Energy Saving Programme[65] in Great Britain, Community Energy Efficiency Fund in England, Low Carbon Buildings Programme in England and Wales, Warm Zones in England). Moreover, these activities are reinforced by **information campaigns** (e.g., "Keep Warm Keep Well") and **stakeholders actions** (e.g., "Energy Efficiency Partnership for Homes"). All these are not covered by this case study, but are detailed in (DECC 2009).

It has to be noticed that the strategy is organized on three levels:
- at the **UK level**: general objectives, global monitoring, coordination ;
- at the **national level**: operational objectives, national programmes[66], networks of actors ;
- at the **local level** : community-based projects, specific partnerships, implementation of the actions.

The local dimension of the strategy is recently getting a bigger importance. Started in September 2009, "*the **Community Energy Saving Programme** (CESP) places a new obligation on energy suppliers and generators to deliver approximately £350 million worth of energy efficiency measures, targeted at the country's poorest communities. It is envisaged that around 100 new schemes might be created, with community partnerships between local authorities, energy companies and community groups helping to deliver measures to around 90,000 households, using a street by street approach*" (DECC 2009, p.16). Likewise, the **Community Energy Efficiency Fund** (CEEF) launched in June 2007 supports area-based initiatives to produce targeted, tailor-made advice and to favour immediate actions, targeting the most

[64] Home Energy Efficiency Scheme in Wales, Energy Assistance Package in Scotland, Warm Homes and Warm Homes Plus Schemes in Northern Ireland are equivalent programmes to Warm Front in England for the other parts of UK.
[65] This is a pilot scheme introduced in 2009 to see if it will address hard to treat homes learning from previous Warm Zone programmes (Pett, 2010).
[66] All the national programmes rely heavily on links with local authorities in order to promote the programmes and in many cases fund the local authority programme or operate through referral from local authority schemes (Pett, 2010).

vulnerable households.

The main principle is to **target specific areas of "low income neighbourhood"**, where households are likely to have a greater than average propensity to be in fuel poverty. Indeed, in parallel, the public authorities aim at establishing fuel poverty maps. Moreover, the other principle is to encourage a **complete energy efficiency improvement** of the dwellings treated, rather than separate actions (e.g. double glazing only), having in mind that there are very few chances for a dwelling to be upgraded several times. So there should be **no "lost opportunities"**[67].

Managing the energy efficiency actions at the local level is also the best way to get **more coordination between the key stakeholders, here mainly the local authorities and the energy suppliers**. This is actually required by the **Household Energy Management Strategy** recently established by the UK Government. And this was expected by the House of Commons (2010, p.3): "*we want to see energy efficiency measures delivered on a comprehensive, street-by-street basis*".

Finally, while the official public documents focus on the role of public organisations and energy suppliers, it has to be noticed that **associations and NGOs** are also very active and essential actors in the fight against fuel poverty. The main ones are the **National Energy Action** and the **Centre for Sustainable Energy** (EPEE 2008b).

► The Warm Front scheme

History, objectives and working scheme

*"The Warm Front scheme, **launched in 2000**, is a key programme of the **Department of Energy and Climate Change** (DECC) and previously the Department for the Environment, Food and Rural Affairs to tackle fuel poverty in England. The Scheme was developed from the Home Energy Efficiency Scheme (which began in 1991), to reduce CO_2 emissions. The UK Fuel Poverty Strategy, published in November 2001, identified the Scheme as a key programme in tackling fuel poverty because it addresses poor energy efficiency and therefore reduces household energy bills. In 2006 the Department reported that the Scheme was its third most effective programme for cutting CO_2 emissions" (NAO, 2009, p.9).*

*"The Department relies upon **a contractor, Eaga**[68], to administer the Warm Front scheme on its behalf and to manage the 139 contractors, including seven wholly owned subsidiaries, responsible for the installation of heating and insulation measures" (ibid., p.4).*

*"The Scheme provides a **grant** of up to £2,700, or £4,000*[69] *if an oil central heating system is required, to pay the installation cost of heating and insulation measures in **vulnerable private sector households.** Vulnerable households are those with low incomes containing older people, families with children, or those who are disabled or have a long-term illness" (ibid., p.9).*

Together with the grants, the other key components of the Warm From scheme are to provide the consumers with a technical survey (**free energy audit**) before implementing the actions, and then with a **quality inspection and "aftercare"** once the works done. These are essential to ensure the quality of

[67] Other stakeholders would appreciate recognition of the Warm Zone pilot which then became Warm Zones Ltd as the demonstration that this approach was more effective than other policies (Pett, 2010).
[68] Eaga gained the contract for all regions in the mid-term bidding round, it didn't have them all before hand and has lost one in the latest round of negotiations (Pett, 2010).
[69] In year 2010, the UK Government has announced it will increase the grants to £3,500 and £6,000 respectively (DECC, 2009). These grant maxima and the inclusion of a higher grant for most costly work for off-gas properties have only recently been introduced (Pett, 2010).

the interventions.

Eligibility issues

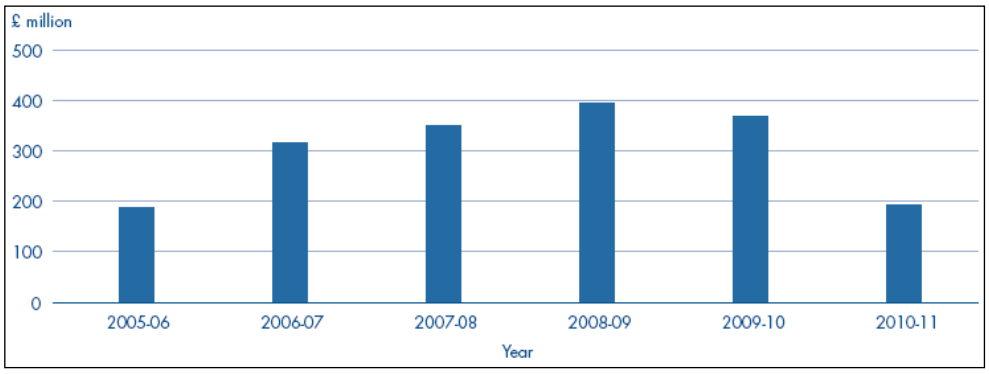
These conditions (i.e. being a vulnerable households) are verified based on general ID documents and different kind of "social" certificates[70] forming the so-called "passport" benefit. This is supposed to make the administrative process easier, however "***such eligibility criteria do not guarantee that the recipient is actually in fuel poverty***, *with the consequence that a significant proportion of the resources earmarked for the alleviation of fuel poverty are used to provide support or benefits for people who are not fuel poor (…)* ***Conversely, many people who are fuel poor are not eligible for or do not claim the "passport" benefits*** *which would allow them to access measures designed to assist those in fuel poverty. The NAO's analysis of the 2006 English House Condition Survey indicated the [Warm Front] Scheme is only available to approximately 43 per cent of vulnerable households (classified as families with children, the elderly or occupants in long-term ill health) in fuel poverty, and 35 per cent of all households in fuel poverty*" (House of Commons, 2010, pp.10-11).

Indeed, one of the main reasons is that many eligible people do not claim for the benefits for the support they could get[71]. Hence a service of benefit entitlement check was recently established by the social services (see above).

Budget and households contribution

It was estimated that the budget of the Warm Front scheme (and predecessor) amounted to **around £1.6 billion for the period 2000-2008** (Bolton 2010, p.9).

For the period **2008-2011**, "*spending on Warm Front is planned to be* ***£874 million****. The original level of Warm Front Spending for this period was £800 million. The increase announced by the Prime Minister as part of the Home Energy Saving Programme would still mean annual spending of around £290 million per year in 2008-11 compared to £320 million in 2006-07 and £350 million in 2007-08*." (Bolton 2010, p.10)



(Source: NAO 2009, p.11)

Figure 3. Warm Front Scheme funding 2005-06 to 2010-11.

The Warm Front scheme remains one of the main energy efficiency programmes against fuel poverty, but the decrease in its funding is regretted by the House of

[70] Documents proving that the household/person is actually a beneficiary from another social support / programme. For more details, see (House of Commons, 2010, pp.9-10).

[71] "*Analysis of the English House Condition Survey 2006 indicates that 57 per cent of vulnerable households in fuel poverty do not claim the relevant benefits to qualify for the Scheme. Yet nearly 75 per cent of households who would qualify were not necessarily in fuel poverty. In practice, a large number of these households may have otherwise fallen into fuel poverty or be 'near' fuel poverty as a result of reported fuel price increases in 2007 and 2008, though prices appear to be easing*" (NAO 2009, p.5).

Commons (2010, p.22): "***despite extremely high levels of demand for Warm Front services, the Scheme's budget is reducing****, albeit not so dramatically as originally envisaged*".

"*When the grant does not cover the costs of work and alternative sources of funding, such as assistance from local authorities, cannot be found, applicants are required to pay the difference (…)* ***The average contribution required in 2007-08 was £581****, and* ***nearly 25 per cent of applicants that year were asked to contribute to the cost of the work required****. (…) Over 129,000 households between June 2005 and October 2008 have agreed to pay the difference, but 6,076 households withdrew from the Scheme and a further 14,326 households (as at October 2008) had not progressed their application*" (NAO 2009, p.5).

Evolutions

Even if considered as successful, the Warm Front scheme was assessed to be perfectible. And therefore, several improvements were recently implemented, especially to improve the quality of customer service and the cost-effectiveness of the actions (DECC 2009, p.11):

- "*increased competition in the supply chain and for work between installers;*
- *introduction of a new computerised surveying process which will provide a much clearer picture of the system to be installed in the applicant's house;*
- *an improved inspection process with workforce trained to an advanced level of technical qualification;*
- *improvements in customer service with tighter quality controls on installers' performance*."

► The Carbon Emission Reduction Target (CERT)

History, objectives and working scheme

In April 2008, the CERT replaced the Energy Efficiency Commitment which was started in 2002. This scheme has set obligations on energy suppliers in Great Britain, based on three-year cycles. While its primary focus is on reducing carbon emissions in the domestic sector, it has also a social dimension, as 40%[72] of the corresponding energy reduction target has to be met among a so-called "priority group" which includes low income and elderly (70 and over) households.

The CERT obligation on energy suppliers has recently been increased by 20% from 154 million lifetime tonnes of CO2 to 185 million tonnes, meaning **annual savings of over 5.6MtCO2 by 2011**. "*The effect of this increase will be that an extra £600million is likely to be invested by energy suppliers in helping households install energy efficiency measures, bringing total support under the programme between 2008 and 2011 to an estimated £3.2 billion. Of this, we* [DECC staff] *estimate* ***around £1.9 billion will be directed at vulnerable households in the Priority Group***". (DECC 2009, pp.13-14).

In comparison, "*energy suppliers spent 55% of their direct costs for energy efficiency measures on this group (£178M during EEC1 [2002-2005]) and the priority group contributed £26 million*" (Lees 2006, p.32).

The working of EEC/CERT is not detailed further, as this kind of scheme is the topic of another WEC case study.

Targeting issues

Looking at the "social" specificity of EEC/CERT, it has to be noticed that the energy suppliers have reported **difficulties in being able to identify and**

[72] This share was of 50% for the Energy Efficiency Commitment period (2002-2008).

prove whether the beneficiaries of their actions were in Priority Group or not.

Then it is also interesting to see that most of the energy suppliers developed **partnerships or other forms of collaboration with local authorities and social housing associations** in order to be more efficient in their Priority Group actions.

It was reported that the actions thus led within the Warm Front scheme (i.e. private housing sector) were faster implemented than the ones done within the social housing sector.

This may explains the following observation made by NAO (2009, p.5) when reviewing the Warm Front scheme: "*eaga [the Warm Front contractor] has delivered cost savings to the Scheme, and approximately £45 million of income through the Carbon Emissions Reductions Target (CERT), whereby utility companies pay eaga to install insulation measures on their behalf*".

► The Decent Homes and other Standards

"*Since 2001 the Government has been committed to **ensuring that all social rented housing in England meets the Decent Homes Standard**. The Standard has a thermal comfort element that requires the presence of efficient heating and effective insulation in homes (…) In the 2009 Budget the Government allocated **£84 million** to help social landlords in England to insulate hard to treat cavity walls that would not otherwise be filled under the Decent Homes Programme. The **Social Housing Energy Saving Programme** will fund the insulation of up to **130,000 wall cavities** in social rented homes; enabling **savings of £120 per year on bills and 800 Kg CO2 a year** on emissions for each house treated; and will support **2,500 jobs***" (DECC 2009, p.14)

Similar standards also apply in Wales (WHQS, Welsh Housing Quality Standard, from 2002) and Scotland (SHQS, Scottish Housing Quality Standard, from 2004), while the Decent Homes Standard is also used in Northern Ireland.

These standards are often based on existing rating systems for housing performance like the HHSRS (Housing Health and Safety Rating System) or the SAP (Standard Assessment Procedure, related to energy performance).

In each case, objectives are set in terms of percentage of the social housing complying with the standard by given deadlines. The corresponding investment programmes involve the national (English, Scottish or Welsh) governments, the local authorities and the social housing associations. "*Expenditure on energy efficiency as part of the Decent Homes programme is expected to be **£2.2 billion over the period 2008-11***" (Bolton 2010, p.10). For comparison, it was assessed to be **£4 billion for the period 2000-2008**.

Concrete examples/Impact/evaluation

Results

► Warm Front Scheme

"*Warm Front remains the Government's flagship scheme, assisting **over 2 million households** since its inception in June 2000. This includes half a million households in the last two years alone. (…) The Government estimates that **without Warm Front and the wider package** of measures aimed at tackling fuel poverty **the number of fuel poor households would have been around 400,000-800,000 higher in England in 2008***." (DECC 2009, p.2)

The corresponding results in energy terms have been "*producing an **average***

annual fuel bill reductions of between £360 and £400 *and increasing the average Standard Assessment Procedure (SAP) rating of households which have received assistance from the scheme from 38 to 62*" (House of Commons, p.6). Moreover, "*Warm Front has also reduced* ***CO2 emissions*** *by an estimated total* ***annual saving of 1.4 tonnes for the average household*** *improved each and every year for the next 20 years*" (DECC 2009, p.11).

Applying this average result to the number of households assisted would lead to around 2.8 million tonnes of CO2 emissions avoided each year. But this is a rough estimate which would need to be verified.

Table 1. Detailed outputs of the Warm Front scheme from 2006/07 to 2008/09.

Heating period	2006/07	2007/08	2008/09
Budget	£320 million	£350 million	£359 million
Number of households assisted	250,000	270,000	233,594
New gas central heating system	24,000	100,000	14,000
Boiler replacement	54,000		80,000
Cavity wall insulation	36,000	30,000	27,000
Loft insulation	60,000	58,000	57,000

(Source: corresponding annual progress report for the UK fuel poverty strategy published by the DECC and previously the DEFRA).

In addition to the monitoring of the number of actions implemented, the National Audit Office surveyed the working of the Scheme and the satisfaction of the beneficiaries, showing a high satisfaction rate (NAO 2009, p.13): "***86 per cent of customers were satisfied with the work carried out*** *including 75 per cent who were highly satisfied, with five per cent of customers being dissatisfied. Eighty-nine per cent of customers were satisfied or highly satisfied with the overall quality of workmanship and* ***84 per cent would recommend the service to a close friend or relative***".

These results proved among other the **effectiveness of the global support provided** together with the installations of the energy efficiency measures (i.e. the pre-technical survey and the post-quality inspection and aftercare).

► EEC/CERT results

"*Through CERT and its predecessor EEC, some 6 million households have benefited from subsidised or free insulation since 2002, 1 million of these in the first year of CERT alone*" (DECC 2009, p.14).

"*Some* ***23.7 million CFLs*** *were delivered to priority households in the* ***EEC1*** *period [2002-2005] along with over* ***1.2 million appliances*** *and* ***0.23 million cavity wall insulations****. Assuming four CFLs per priority group household, it is likely that two out of three priority group households will have benefited directly from EEC1 mainly through free CFLs"* (Lees 2006, p.31).
The corresponding results in energy terms were estimated to be *"lifetime discounted energy benefits of* ***22 (EEC1) TWh of electricity*** *and* ***30 (EEC1) TWh of fossil fuel****. Using the 2004 price of electricity and gas to the residential sector as 6.68 and 1.66p/kWh, then the present value of the electricity benefits are £1.5 billion and the present value of the fossil benefits are £0.5 billion*" (ibid.).

The distribution of the savings according to the type of measures was around 22 TWh for insulation measures, around 15 TWh for CFL and the remaining being heating systems and appliances (according to the EEC Update, Issue 13 of August 2005 published by Ofgem).

During **EEC2** (2005-2008), it was assessed that **82 TWh were saved** (lifetime savings) among the Priority Group, representing around 44% of the total

savings of EEC2. Moreover, around **85%** of these 82 TWh were achieved through **insulation measures**, the second main measure being CFL (Bolton 2010; and EEC Update, Issue 24 of May 2008).

During the first seven quarters of CERT (April 2008 – January 2010), around 43 Mt CO2 emissions reductions have been achieved among the Priority Group, representing around 44% of the total achievements. Around 30 Mt CO2 comes from insulation measures, 12 Mt from lighting, and the remaining being heating systems and appliances (CERT Update, Issue 7 of February 2010).

► Decent Home and other Standards

"*Since 2001 there has been **a 36% reduction in the number of social sector homes failing on the thermal comfort criterion**. The number of social dwellings with a SAP of 30 or less has been substantially reduced since 1996, from over 14% of the stock to less than 4% in 2007. In 2007 the social sector housing stock had an average SAP rating of 58, compared to only 48 in the private sector. The social sector has improved more than the private sector since 1996, rising 11 points up the index compared to seven points in the private sector over the same period.*
*In the local authority sector landlords report that between 2000/01 and 2007/08 **over 1 million council houses have had new doubled glazed windows, at a cost of over £2.5 billion; over 1 million have had new central heating at a cost of over £2.7 billion and over 820,000 have had improvements to their insulation at cost of almost £375 million**.*
*The Decent Homes Programme has already resulted in an **estimated average reduction in tenant's fuel bills of £152 a year** (2008 prices) between 1996 and 2006.*" (DECC 2009, p.14).

Evaluation issues

► The official monitoring and evaluation scheme

As a major public policy, the UK Fuel Poverty Strategy is **continuously monitored**. The DECC (Department of Energy and Climate Change)[73] is in charge of the supervision of the whole strategy and therefore publishes yearly an **Annual Progress Report** (see e.g., DECC 2009).

This monitoring is based on the reporting of each of the programmes (Warm Front scheme, CERT, etc.), and looks especially at the **corresponding budgets / expenses, the number of households having received an assistance, and the number of implemented actions**. This comes on top of the statistics registered on fuel poverty (see "Context" part above).

Additionally, **complementary evaluations** of the programmes are periodically ordered (see e.g., the survey of the Warm Front scheme by the National Audit Office (NAO 2009) or the evaluation of EEC1 by Eoin Lees (Lees 2006)). These reports are especially used for the regular **review of this policy by the House of Commons** (see e.g., House of Commons 2010). The latter is also based on interviewing the main concerned stakeholders, especially associations representing different household categories or NGOs.

These practices have induced **regular improvements** of the programmes. But not all of the suggestions made are implemented, either due to budget restrictions or to opposite suggestions (see the section below).

Actually, a larger review of the whole strategy has begun last year: "*With the creation of the Department of Energy and Climate Change last year, and the bringing together of energy and climate change policies in a single department, it was a timely opportunity to review progress towards our fuel poverty goals. A fuel poverty review was announced, to examine whether existing measures to*

[73] Previously the DEFRA (Department for Environment, Food and Rural Affairs).

tackle fuel poverty could be made more effective, and whether new policies should be introduced to help us make further progress towards our goals. The initial findings of the review were announced in the UK Low Carbon Transition Plan published on 15th July this year, but work will continue to see what more can be done to make our policies more effective." (DECC 2009, p.3)

Finally, it has to be noticed that while the working process of the programmes and the corresponding outputs (in terms of households assisted and actions implemented) are well documented, there are **much fewer information on the final impacts** especially in terms of energy savings, health impacts or other potential co-benefits. These would need to be better documented if a comprehensive cost-benefit analysis were to be performed.

► Research works

In parallel to this official monitoring scheme, the issue of fuel poverty has also been a topic of interest for the researchers. Within this case study, we couldn't make an exhaustive of the whole corresponding literature, especially because the number of publications on the matter is recently increasing significantly.

It is likely that one of the "historical" works on fuel poverty in the UK is the PhD thesis of Boardman (1991).

Then this topic is really multidisciplinary, and many aspects of it have been investigated, particularly:

- analysing the perception of fuel poverty by the households and the related explaining factors (e.g., Healy and Clinch 2004) ;
- how to improve the identification of the fuel poor (see e.g., Hutchinson et al. 2006) ;
- the effective achievements in terms of comfort improvements and internal temperature increases (see e.g., Hong et al. 2009 ; Burholt and Windle 2006 ; Gilbertson et al. 2006 ; Milne and Boardman 2000) ;
- the effective achievements in terms of heating savings (see e.g., Hong et al. 2006)
- relation between fuel poverty and health (see e.g., Liddell and Morris 2010);
- what would be the most efficient strategy (see e.g., Jenkins 2010).

These studies are especially interesting to better understand the **real impacts** of the actions implemented, and also to have assessments on the corresponding **co-benefits**. This was highlighted in the presentation of Dr. Christine Liddell at the final conference of the EPEE project[74]. She explained that based on the scientific literature it was possible to assess that **for every euro invested in tackling fuel poverty, 42 cents is returned in savings from health expenditure** on all householders (whose 12 cents for the children), **the rest being returned by savings and carbon reduction**.

Based on these evidences, she emphasised that the actions against fuel poverty were then **cost-neutral interventions**.

Problems / adaptations

► Eligibility and targeting

As observed in the previous sections, the definition of fuel poverty and consequently of the eligibility criteria for the corresponding programmes have been actively discussed and debated. This has actually raised another debate on whether or not constituting a specific database on fuel poverty parameters (especially the energy performance of the dwellings)[75].

[74] EPEE (European fuel Poverty and Energy Efficiency) ; see the corresponding slides at : http://www.fuel-poverty.org/files/EPEE_EuropeanConference_20091008.pdf

[75] "*One of the difficulties faced by the Government in targeting help at the fuel poor is that it does not know who they are. In addition to information about energy prices, the Minister put it to us that "to be completely effective at hitting the targets I have got...I would need real-time information about household make-up, their*

Certain stakeholders did support this initiative, arguing that it would considerably help improving the targeting of the money spent, ensuring it comes first to the most vulnerable households.

But this proposal has faced several critics:
- the required data sharing between involved administrations and stakeholders has already failed in the past, while significant efforts has been tempted ;
- documenting such a database would be very costly, and money should be first dedicated to concrete actions ;
- it could create a negative signal by making people more aware of the problems of their dwelling while not necessarily offering them the required support to improve it ;
- it could create "privacy" issues with a kind of "big brother" effect

That's why the House of Commons (2010, p.12) finally concluded: "*Using benefits as a proxy for fuel poverty is a rough-and-ready approach which means that some people in genuine fuel poverty do not receive assistance, and others who are not in fuel poverty do receive help. This is inefficient and inequitable. However, there are significant logistical and bureaucratic obstacles to the establishment of the kind of detailed domestic energy efficiency database which would allow more accurate targeting of resources*" (House of Commons, p.12).

► Coordination, strategy and efficiency of the money spent

"*While there is widespread agreement about the importance of energy efficiency, the adequacy of current measures has been criticised. NEA* [National Energy Action]*, although noting the "significant" support for energy efficiency programmes provided directly by the Government and suppliers, said that 'the current structure of domestic energy efficiency programmes makes them unfit for purpose in terms of eradicating fuel poverty. A* ***fragmented approach*** *in which individual households make* ***individual applications*** *for assistance followed by individual assessment and installation work represents grossly* ***sub-optimal use of resources****'. The Fuel Poverty Advisory Group agreed, telling us "there is no doubt that the schemes we currently have, bearing in mind the task that we face, are unfit for purpose and, therefore we do need to have a radical rethink*". (House of Commons 2010, p.18).

Answers have started to be developed in the **Strategy for Household Energy Management**[76], with the main ideas being:
- **more coordination** between suppliers and local authorities;
- encouraging **comprehensive** interventions rather than individual actions;
- **ambitious objectives** in terms of number of dwellings insulated (6 million homes by the end of 2011).

Moreover, the UK Government has taken the following measures (DECC 2009, pp.33-34):

- *"announced major improvements to the* ***Warm Front delivery contract****. These changes will open the Scheme up to* ***greater competition*** *to provide best value for money and improved customer service;*

- *announced* ***increases to the grant limits*** *for eligible households under the Warm Front Scheme. The grant increases of £3,500 (or £6,000 where oil or a new low carbon technology is recommended) will mean that* ***the vast majority of households will not have to contribute payment*** *towards their measures (…);*

income and the consumption of energy and the condition of the property, and I do not have any of those details in that form at all at the present time". In the absence of this information, the Government has to use criteria such as age and receipt of benefits as proxies for fuel poverty" (House of Commons 2010, p.9).

[76] See http://www.decc.gov.uk/en/content/cms/what_we_do/consumers/saving_energy/hem/hem.aspx

- *changed the law to enable the launch of the **Community Energy Saving Programme** (CESP) from September 2009. This programme is designed to apply entirely in **areas of low income**, where households are likely to have a greater than average propensity to be in fuel poverty. This new £350 million programme will improve energy efficiency and lower household fuel bills, and the **partnership approach** with local authorities and other community representative organisations should help to **reach more of the most vulnerable households**;*

- *made changes to the Carbon Emissions Reduction Target (**CERT**) – an obligation on energy suppliers – so that from August 2009, an estimated **£1.9 billion will be directed at energy savings amongst a priority group** of low income and elderly households in the period to 2011. For the extension period of CERT to the end of 2012, the Government has also announced that it will be exploring how best to provide help to more of the most vulnerable households within the Priority Group."*

In parallel, at the other end of the public organisations, "*there is **pressure on local authority officers** to develop programmes that maximise the amount of carbon emissions that can be saved for every pound of public money invested. However, due to their statutory powers on social well-being, authorities still need to address fuel poverty. Some concerns arose about a **conflict of interest** between the two types of programmes, mainly on the magnitude of **rebound effects***" (Pett 2009, p.1676).
"*For those developing these programmes, there is uncertainty as to whether focus on one will also bring benefits in another, or whether they will conflict*" (ibid. p.1675).

Pett answered to these concerns and showed that the two programmes are not incompatible at all. On the contrary, **the amount of carbon saved through the measures taken under the Warm Front scheme was at least as good as that assumed for non-fuel poor households from the Government calculations for the energy suppliers' Carbon Emission Reduction Target programme**.

Finally, Jenkins (2010, p.832) argued that "*the aim is (…) not to look at modest carbon savings per house over the entire building stock, but rather **ambitious carbon savings across a specific section of the stock**, namely fuel poor social housing*."

► Households off the grid: the forgotten side of fuel poverty?

Several evidences tended to prove that households off the gas grid and in non-cavity wall dwellings were **more likely to be in fuel poverty**, while most of the actions are targeted on dwellings having gas-fuelled heating systems. Hence the following observation made by the House of Commons (2010, p.3): "*Households not connected to the gas grid have to pay more for their fuel and a high percentage of them are in fuel poverty. We call on the Government to report progress on trials of technology which could help such households as soon as possible and we also urge the Government to review urgently the case for regulating the market for fuels bought by people off the gas grid*".

Conclusions

► General conclusions related to the objectives of fuel poverty eradication

There is evidence in literature (Hutchinson, 2006; Burns, 2007; Hong et al., 2009; Jenkins, 2009; Pett, 2009) that the **UK Fuel Poverty Strategy** is an **effective** plan for increasing the energy efficiency and heating system of fuel poor households.

However, after a first decrease between 1996 and 2003, the number of fuel poor households in the UK has been increasing again since 2004, due to **fuel price fluctuations** and then the 2008-09 **global economic crisis**[77].

Indeed, the **first milestone** of having no vulnerable households in fuel poverty anymore by the end of 2010 will be **missed**. However, the UK Government and the involved stakeholders still hold the next objective of eradicating fuel poverty by the end of 2016.

Beyond the reality of the energy prices' fluctuations, another explanation is that the main factors causing fuel poverty vary according to different temporality:

- **energy prices and household incomes** may follow **short-term** dynamics with potentially high fluctuations ;

- the **energy efficiency** level of the housing stock is a **long-term** variable: the energy performance of a given dwelling may be improved in a few weeks, but achieving this for millions of dwellings require big investments, numerous and qualified manpower, etc. (Preston et al. 2008).

Consequently, even if effective on a longer run, the energy efficiency improvements were not spread enough to mitigate the strong increases in energy prices cumulated with the economic crisis. This diagnosis is shared by all the concerned stakeholders, who actually asked the UK Government to define a specific **roadmap** in order to define intermediate objectives and ensure that the public support will be strong enough (Boardman 2010).

However this proposal was so far refused by the DECC, which considers that it will not be realistic to define objectives being highly dependant on uncontrolled parameters such as energy prices. By the way, it is interesting to see that the same argument could be used to question the liberalisation of the energy markets.

At the same time, there is a concern that increasing significantly the expenses of energy suppliers for energy efficiency would lead to increase the energy prices (as these expenses are "compensated" on the energy tariffs).

► Conclusions on the energy efficiency programmes

Compared to the practices in the 1990's, the programmes implemented in the 2000's represent a **significant change of scale**: millions of households have been assisted, million of dwellings were insulated, etc.

This was made possible by **mobilizing both, public** (State and local authorities) **and private** (energy suppliers) **funding**. And in parallel, the economic sectors of insulation works and heating systems have been considerably developed, compared to previous years.

First evidences of positive impacts on comfort, energy bills and health conditions have been analysed. But it came out also that **the improvements were not always enough** to change cold dwellings in warm homes. It would be very interesting to investigate whether these "failure" situations remain seldom or are the rule[78].

[77] Hence the statement made by David Kidney the Parliamentary Under-Secretary of the DECC (Department for Energy and Climate Change) (DECC 2009, p.3): "*Our fuel poverty strategy was launched in 2001 when our policies and stable energy prices meant that good progress was made in reducing the number of households in fuel poverty. However, significant price rises since 2004 have seen the downward trend in fuel poverty numbers reverse in recent years. (…) The increase in the number of fuel poor households does not mean less has been done. Significant steps have been taken (…), but we cannot escape the fact that rising energy prices and the current economic climate have made the challenge much more difficult*."

[78] Such evidences or studies may exist, but were not found during this case study.

Moreover, the other limit of the programmes was highlighted above: **actions were managed as a sum of individual interventions** (a given number of cavity wall insulation, a given number of heating system replacements, etc.). If this may be the most effective way to reach the largest number of households in the shortest delay, this appears not to be the most effective way to achieve the strongest energy efficiency improvements.

First, because, despite setting eligibility criteria, the **targeting of the assistance proposed was not optimal**: households not being fuel poor received benefits from the programmes, while a significant share of the fuel poor did not claim for the support they could be given → this may be addressed by **using an area-based instead of a global approach**. Experience showed that the local authorities have a good knowledge of their territories. They can identify what neighbourhoods should be priority targets. This could also be done through GIS (Geographic Information System) approach using the currently developed database on housing energy efficiency.

Second, because **changing only one separate component of a dwelling can be counterproductive**. For example, it can be partially inefficient to upgrade the heating system of a dwelling having a poor insulation. Moreover, it is unlikely that a household having made a change in its dwelling (e.g., double glazing) will quickly make another improvement. This leads to the so-called "lost opportunities" → this may be addressed by **encouraging comprehensive interventions**, i.e. treating the dwelling only once, but treating it fully.

Finally, the failure in reaching the eradication of fuel poverty among the vulnerable households by the end of 2010 raises the following question:

- **what level of investments** would be required to improve sufficiently the whole building stock so that all households be sustainably away from fuel poverty conditions? And could these investments induce additional increases in the energy prices?

- **will the required "strike force"** (i.e. numerous and qualified manpower) **be available**? will massive training be necessary?

- **can energy efficiency improvements be sufficient alone** on the long term? (i.e. would a stronger action on energy market regulation and/or initiatives to develop alternate energy sources required anyway?)

Perspectives / recommendations

"*The Committee on Climate Change modelled the impact on fuel poverty of the measures needed to meet the carbon budgets it proposed by the Government. Under their reference scenario, the number of households in fuel poverty in the UK falls from 3.5 million in 2006 to 2.1 million in 2022. The possible increases in gas and electricity prices over this period needed to meet the carbon budgets would increase the number of households in fuel poverty in 2022 to 3.8 million. The cost of offsetting these price increases for all fuel poor households was estimated at £500 million. The improvements in energy efficiency needed to meet the carbon budgets would cut the number in 2022 to 3.5 million. However, funding further energy efficiency improvements through the Supplier Obligation would increase prices further and raise the total number of fuel poor households in 2022 to 3.9 million. The CCC adds that income transfers and/or social tariffs would be needed to offset these impacts*". (Bolton, 2010).

This modelling exercise shows how complicated the issue of tackling fuel poverty is, as most of the influencing parameters are interrelated.

Another example of this is the recent consultation on setting minimum standards of energy efficiency for rented accommodation. This may first seem to be a strong incentive for the private renting sector to improve their housing stock. However, several associations or NGOs remain sceptical about this initiative, as they estimate based on their field knowledge that it could lead to

landlords taking their "indecent" properties off the market, and not improving them.

However, as started in the early 2000's, the UK Fuel Poverty Strategy holds now a significant experience. And valuable lessons can be drawn from the available feedback:

- a good **coordination between the national level (for the funding scheme) and the local level (for the intervention scheme)** is the key to achieve a large number of actions implemented ;

- **targeting** the most vulnerable households by using "social" criteria based on households characteristics and eligibility to other assistance/social programmes may result in being non effective: using an **area-based approach taking into account the specificities and the knowledge of the territories** appears to be more efficient ;

- developing **local partnerships between local authorities, energy suppliers and community groups** is very effective in putting together the required forces to face the colossal challenge of alleviating fuel poverty while energy prices are increasing and household incomes decreasing due to the economic crisis ;

- experience showed that it is more efficient to **encourage comprehensive interventions** treating the whole energy performance of the dwellings rather than developing a sum of individual actions which may only partially solve the problems ;

- likewise, it may first seem attractive to use an approach replicating standardised and straightforward solutions to a vast number of households then minimizing the "administrative" costs, but this is a short-term view: this can work for simple end-use (e.g., for lighting with CFL), but appears not to adapted for improving the energy efficiency of a dwelling, where a pre-energy audit will bring a real added value by proposing solutions specific to the dwellings → **a good compromise between the minimisation of the administrative costs and the proposal of tailor-made solutions can be to use building typologies to develop a "good practices" database** ;

- **innovative funding scheme** would have to be investigated in order to ensure a sufficient support to the households, while public budgets are facing strong restrictions and that private expenses from the energy suppliers will directly or indirectly be passed on the energy tariffs.

Finally, innovative solutions should also be investigated, especially looking at how to combine actions on the demand (improving the energy efficiency) and on the supply side (developing alternate energy sources, especially for these households off the gas grid). Illsley et al. (2007) presented a very interesting initiative in Scotland. They analysed the feasibility of the **promotion of an indigenous pellet-based wood fuel market** by extending the principles of industrial symbiosis from a site-specific to a regional scale. They conclude that current market barriers would prevent such an opportunity. But that ways to overcome these barriers should be further investigated, as this initiative appears to be promising.

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United States

Case study done by Jean-Sébastien Broc (Ecole des Mines de Nantes, France), mainly based on the presentation of the Weatherization Assistance Program made by John P. Millhone ((Millhone 2009a) and (Millhone 2009b)), the LIHEAP Home Energy Notebook (HHS 2009a) and ORNL studies[79].

WAP: Weatherization Assistance Program

Context

► General context

The issue of high energy burden for US low-income households first arose in the field of public policies in the **mid-1970's**, due to the **oil crisis**.

"*States enacted a mixed array of laws to soften the impact of soaring fuel price on low-income homeowners. In response, President Ford proposed and Congress recognized the **need for a common, national plan** and several energy efficiency initiatives to promote conservation. One of the programs[80] was the **Weatherization Assistance Program**—designed to help low-income families reduce their home heating fuel use*" (Millhone 2009a).

Nowadays, the situation is unfortunately still critical as observed in (Millhone 2009a): "*The rising energy prices fall particularly hard on low-income families. **The average residential energy burden for low-income households rose from 12.6 percent to 14.6 percent of income from 2001 to 2005**, the most recent year for which data is available. The average energy burden for non-low-income families remained unchanged at about 3.2 percent of income*"[81].

► Official definitions: low income and vulnerable households

The official definitions on this topic are established by HSS (the US Department of Health and Human Services Department) (HHS 2009a):

- **low income households:** "*households with incomes at or below 150 percent of HHS' poverty guidelines*".
- **vulnerable households[82]**: "*households with at least one member that is a young child, an individual with disabilities, or a frail older individual) as one of two groups of households having the highest home energy needs*".

There are currently **two main sources of estimates** for the number of low income and vulnerable households:

- **ACF** (U.S. Department of Health and Human Services' Administration for Children and Families);
- **CPS ASEC** (Current Population Survey Annual Social and Economic Supplement).

"*The ACS and CPS ASEC[83] differ in their measurement of income and disability, and despite the fact that both use the same Census definition of a household, the ACS data yield a lower estimate of the total number of households in the*

[79] See http://weatherization.ornl.gov

[80] For example, fuel purchase was made alternate (i.e. allowed the even days for the even numbered license plates, and reciprocally for odd plates). The main campaign used the slogan "Don't be fuelish" (see (Millhone 2009a)).

[81] Large (double digit %) rate increases have been authorized by regulatory bodies over the past 5 to 10 years. All were deferred to future time, which will be namely now. As such, low-income programs are popular again. This is because the energy burden is likely to rise above the 15% indicated here due to slow income growth, on-going recession, job outsourcing, loss of blue collar jobs, etc. (Monte de Ramos, 2010).

[82] "*The [available] statistics suggest that targeting households with a members who is elderly, disabled, or a young child is appropriate because these individuals are more susceptible to the health problems—and even mortality—caused by a home temperature that is too hot or cold. The household's susceptibility is increased if these households also have high home energy burdens*" (HHS 2009a).

[83] Actually ACF derives its eligible population estimates from CPS as well. They do not have any independent survey arm (Eisenberg, 2010).

United States than do the CPS ASEC data" (HHS 2009a).

Distinct estimates are also made according to the threshold used as "low income limit":

- **Federal Maximum Income Standard**: the greater of 60 percent of State median income estimates or 150 percent of the HHS Poverty Guidelines;
- **State Maximum Income Standard**: State income guidelines can vary from 110 percent of the HHS Poverty Guidelines up to the Federal maximum LIHEAP income standard.

Table 2 presents the corresponding data, crossing the two sets of options (ACS or CPS ASEC, and types of "low income limit").

	Total number of low-income HH	**whose HH[84] at least 1 person 60+**	**whose HH at least 1 child less than 6**	**whose HH at least 1 person with a disability**	**Whose no vulnerable HH**
Case 1	33.8	13.7	6.5	9.0	9.6
Case 2	24.6	9.5	5.0	7.0	6.8
Case 3	31.9	11.7	6.3	10.0	10.3
Case 4	23.9	8.5	4.9	7.9	7.5
	Total number of low-income HH	**at or below PG[85]**	**>100%-125% PG**	**>125%-150% PG**	**over 150% PG**
Case 1	33.8	12.7	5.3	5.3	10.5
Case 2	24.6	12.7	4.9	3.6	3.3
Case 3	31.9	13.0	5.0	4.9	8.9
Case 4	23.9	13.0	4.7	3.4	2.8

Case 1= CPS ASEC estimates + Federal Maximum Income Standard
Case 2 = CPS ASEC estimates + State Maximum Income Standard
Case 3 = ACS estimates + Federal Maximum Income Standard
Case 4 = ACS estimates + State Maximum Income Standard
(based on (HHS 2009a)*)*

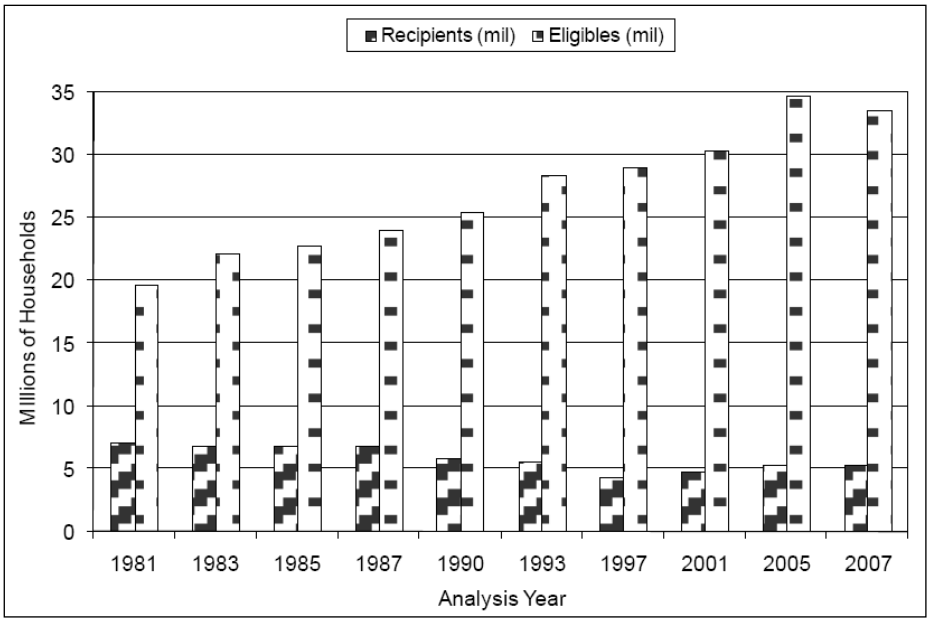
Table 2. Estimates of the number of low-income households (in millions) by vulnerability category and by HHS poverty intervals[86].

Therefore, **low income** households represent **between 23 and 34 million** households, whose **between 16 and 24** are considered "**vulnerable**", i.e. around **70% of the low income households**.

Since 1981, the first support offered to low income households is a direct financial assistance through LIHEAP (see details below). This programme induced to register the number of eligible households (= low-income households) and the number of assistance recipients.

"*Between 1981 and 2007 (…) the number of income eligible households has risen more than 70 percent. (…) Also during this period, the percentage of income eligible households receiving heating and/or winter crisis assistance has declined sharply from 30 percent in 1981 to 16 percent in 2007*" (HHS 2009a)[87]. This illustrated by Figure 4 below.

[84] households
[85] HHS poverty guidelines
[86] Average of 2006, 2007, and 2008 State-level estimates for CPS ASEC estimates, and average of 2005, 2006, and 2007 State-level estimates for ACS.
[87] It has to be noted that most of these programs are over-subscribed, meaning not enough monies to go around (Monte de Ramos, 2010).



*(*Source: (HHS 2009a))

Figure 4. Number of LIHEAP income eligible and heating and/or winter crisis assistance recipient households from 1981 to 2007.

► Energy-related statistics for low-income households

Detailed statistics are available about energy related data for households (see the presentation of LIHEAP below). The latest ones present the 2007 situation (HHS 2009a), then updating the data used by Millhone.

In average, low income households have a 17% lower energy consumption than non low-income households, representing also a 19.5% lower annual energy bill. But these lower energy expenditures create a mean individual burden almost twice higher on the low-income households compared to the non low-income households (due to the differences in their incomes).

	All households	Non low-income households	Low income households
Fuel consumption (mmBTUs[88])	95.8	101.9	84.4
Fuel consumption (kWh/year)	28069	29856	24729
Fuel expenditures ($/year)	1,986	2,132	1,715
Mean individual burden	7.0%	3.6%	13.5%
Median individual burden	4.2%	3.1%	9.3%
Mean group burden	3.0%	2.5%	9.9%

(based on (HHS 2009a)*)*

Table 3. Average annual household consumption, expenditures, and burden by all, non low income and low income households, United States, FY 2007.

The difference in the global energy consumption between both groups may explain the **higher share for space heating and smaller share for appliances** in the consumption per end-use for low income households compared to non low income households.

[88] 1 mmBTU <> 293 kWh

End Use	All households	Non low income households	Low income households
Space heating	28%	27%	31%
Space cooling	13%	13%	12%
Water heating	15%	15%	16%
Refrigeration	8%	8%	8%
Appliances	36%	37%	33%
All uses	100%	100%	100%

(Source: (HHS 2009a)*)*

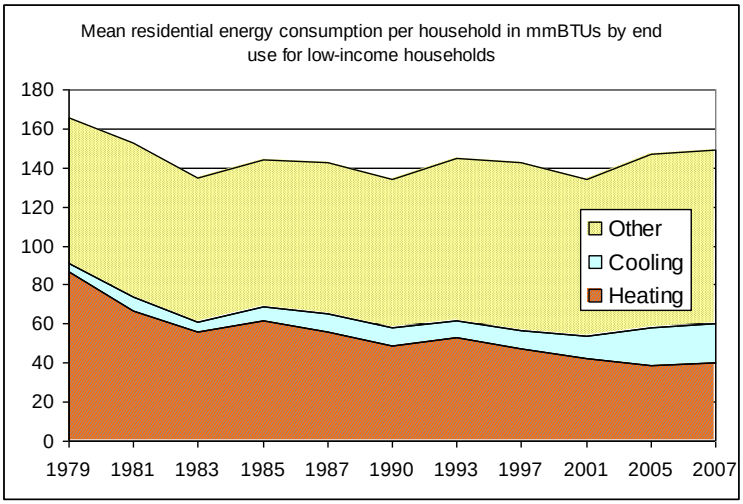
Table 4. Percent of residential energy expenditures for each of the major end uses by all, non low income and low income households, United States, Fiscal Year 2007.

It has to be noticed that the **"thermal" end-uses** (space heating, space cooling and water heating) represent **59% of the energy consumption for low income households**. This supports the priority targets of the weatherization programs.

Figure 5 below presents the **trends** for the mean energy consumption per household for low income households **between 1979 and 2007**. During this period, the **total mean consumption has been reduced by around 11%**, but with very different trends according to the end-uses: average **heating** consumption have **decreased by 54%** (with the main decrease occurring between 1979 and 1983), while **cooling** consumption have been **multiplied by 4** and **other** consumption have **increased by around 19%**.

In parallel, Figure 6 shows the same trends for the mean energy expenditures per household. During this period, the **total mean expenditures** have considerably **increased by 172%**, the opposite of the reduction observed in the energy consumption. This is mainly explained by **fuel prices increases**.

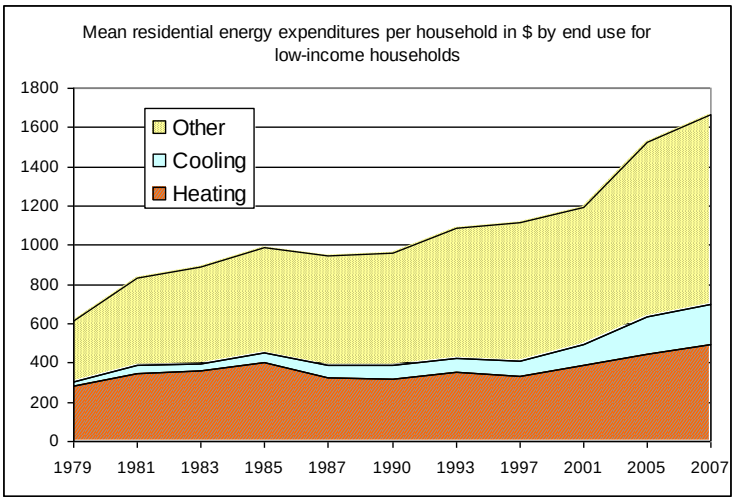
Finally, Figure 7 emphasises the trends for the **mean group energy burden**. It has first **decreased from 15.6% in 1979 to 10.7% in 2001**, before **increasing again from 2001 to reach 13.1% in 2007**. This situation is likely to get further worse due the economic crisis currently ongoing[89].



*(*Source: (HHS 2009a))

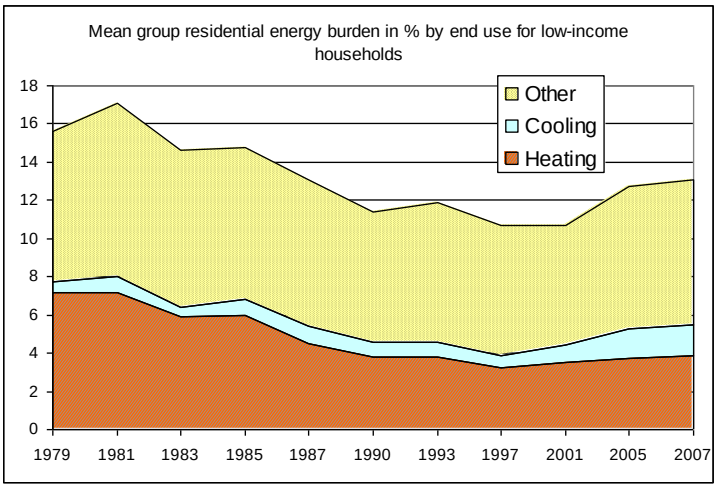
Figure 5. Mean residential energy consumption per household in mmBTUs by end use for low-income households from 1979 to 2007 in the US.

[89] The mean group burden may have actually dropped because of a decline in energy prices. The number of people in trouble has gone up because of the economic crisis but the burden itself is probably stable (Eisenberg, 2010).



(Source: (HHS 2009a))

Figure 6. Mean residential energy expenditures per household in $ by end use for low-income households from 1979 to 2007 in the US.



(Source: (HHS 2009a))

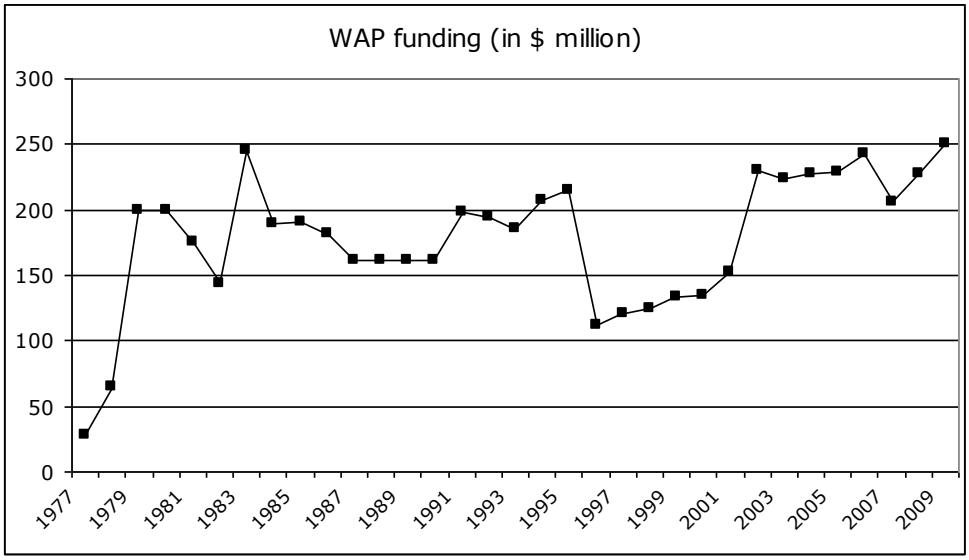
Figure 7. Mean group residential energy burden by end use in % by end use for low-income households from 1979 to 2007 in the US.

► Political support and budget fluctuations over time

"The initial appropriation [1976] *was $26 million (…) The popularity of the program accelerated rapidly during those energy crisis years, which also saw the* ***creation of the U.S. Department of Energy*** *in 1977. The annual funding for Weatherization more than doubled to $65 million that year, tripled to $199 million the next two years before easing down to $175 million the following year"* (Millhone 2009a).

Millhone analyzed the history of the WAP and highlighted that the program has always been subject to fluctuating attention from the successive US administration, sometimes supported as a major policy, sometimes depreciated (especially when time was to restrict public expenses). This is illustrated by Figure 8 giving the annual WAP funding from 1977 to 2009. Millhone noticed a pattern where WAP funding is expanded during the first term of a President, while being reduced during his second term (independently of being Republican or Democrat). This was especially true for George W. Bush who increased the funding at its highest level during his first term, before proposing to reduce it dramatically during his second term, even proposing to cut it completely during his last year of mandate.

Despite these variations, a global amount of around $6 billion was dedicated to the WAP over a 30-year period (1977-2009).



(Based on the figures provided in (Millhone 2009a)*)*

Figure 8. Annual funding for the WAP from 1977 to 2009.

In addition to the periodical restrictions in the public budgets, the uncertainties about policy support for WAP can also be explained by a **conflict in "corporate culture"**, as mentioned by (Millhone 2009a): "*the primary mission of EERE*[90]*, where the Weatherization program is located, is to conduct research and development (R&D) on new energy efficiency and renewable energy technologies. In this culture, Weatherization is an outsider—and a heavy one. Nearly 20 percent of EERE's budget is spent on the Weatherization program. The funds are a vulnerable target for researchers eager to explore advanced technologies.*
Indeed, the same tension was partially responsible for the large cut in Weatherization fund during the Clinton term. Ironically, the same connection between the building sciences and Weatherization that is fundamental to its successes is now threatening its survival".

► The complementary funding sources

The weatherization activities has also remained important thanks to non-DOE funding that was attracted due to the good recognition of the program and the active network of local agencies: other policy measures, actors (e.g. utilities) or funding source have relied on WAP to deliver cost-effective services and energy savings, which these actors accomplishing their own objectives.

These other funding sources were mainly the LIHEAP fund (see below), the Petroleum Violation Escrow (PVE) fund[91] and a mixture of utility and states program.

Reagan terms (1982-1989)	George Bush term (1990-1993)	Bill Clinton terms (1994-2001)	George W. Bush terms (2002-2009)
> $300 million/year	$400-450 million per year	from $200 million in 1994 to $500 million in 2001	Around $500 million per year until 2006

(Based on the information provided in (Millhone 2009a)*)*

Table 5. Non-DOE funding gained for the WAP from 1982 to 2009.

[90] Office of Energy Efficiency & Renewable Energy of the US DOE, see http://www.eere.energy.gov/
[91] The PVE funds were amounts paid by oil companies when judged to have practicing "price gouging" or overcharging (as oil prices were regulated from 1973 to 1981). (Millhone 2009a).

DOE	LIHEAP	PVE	Other	Total
238 *32,6%*	312 *42,7%*	2 *0,2%*	179 *24,5%*	731

(Source (Millhone 2009a)*)*

Table 6. Example of the distribution of WAP funding for the year 2006 (in $ million).

After reaching a record level of around $500 million per year for the period 2001-2006, the amount of future non-DOE funding has become uncertain, as analysed by Millhone (2009, p.12): "*The PVE funds are all spent. With lower requested funds for LIHEAP and high energy prices, states are likely to apply all available funds to direct financial assistance*"[92]. A similar situation applies to utilities funding.

► LIHEAP, Low Income Home Energy Assistance Program: the "curative" side of the supporting policies

"*LIHEAP, like the Weatherization program, was a response to the 1973 OPEC oil embargo. A pilot initiative, Project Fuel, was created in Maine in 1974 by the Office of Economic Opportunity to provide emergency assistance to low-income households facing sharply rising energy costs. A variety of assistance strategies, patterned after the Maine experiment, were tried until LIHEAP was created in 1982.*
The primary mission of LIHEAP is to provide for home heating, medically necessary home cooling and emergency assistance to low-income families[93]*.*
In its early years, it also supported minor weatherization efforts—weather-stripping, caulking, etc. LIHEAP then formalized these investments by ***allowing states to transfer up to 15 percent of their LIHEAP allocations to the DOE's Weatherization program***" (Millhone 2009a).

"*LIHEAP is administered by the* ***Department of Health and Human Services*** *(HHS). Through this program, HHS provides* ***funds to states to assist eligible households meet the costs of home energy****. (…) Levels of assistance provided to each household are determined by each state*" (Tonn, Schmoyer et al. 2003). The eligibility criteria are the same as for the WAP (see below), i.e. mainly based on income. However, states "*may give priority to those households with the highest home energy costs or needs in relation to income*"[94].

The Department of Health and Human Services manages two funds[94]:
- the **Block Grant**: the national funding distributed **regularly** to the states based on each State's weather and low income population ;
- **the Contingency Funds**: special funds decided by the President and released to assist with the home energy needs arising from an **emergency situation**, based on criteria appropriate to the nature of the emergency (e.g., extreme weather conditions or energy price increases).

The regular LIHEAP funding has recently considerably been increased from an average level of between $1 and $2 billion to $4,5 billion in 2009 and 2010 in order to help low-income households to face the consequences of both, the increases in energy prices and the economic crisis.

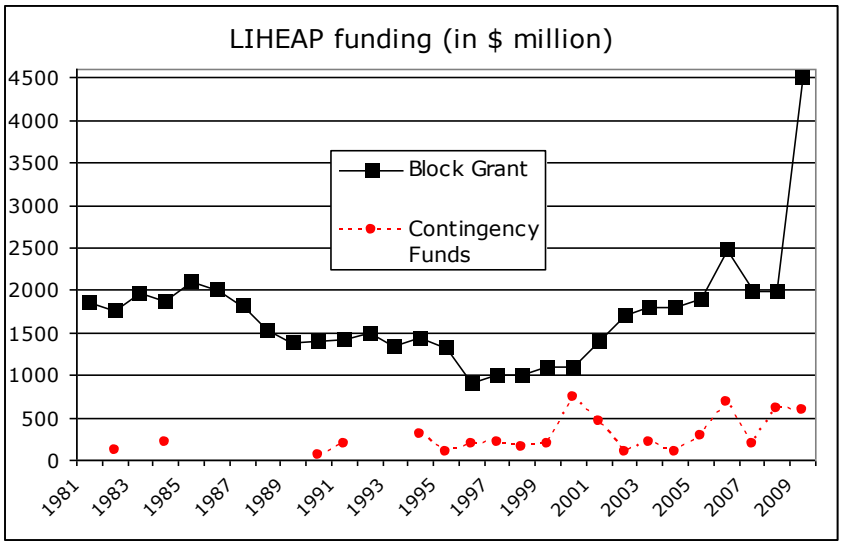
At the household level, "the percentage of the total home heating bill for LIHEAP income eligible households covered by LIHEAP heating and winter crisis benefits decreased from 23 percent in 1981 to 10 percent in 2007. The decrease resulted from the combination of higher home heating bills and a smaller per-

[92] Actually LIHEAP has been increased substantially from its old levels, and while there has been some modest pull back for transfers to WAP this has not been widespread (Eisenberg, 2010).
[93] For more details see http://www.acf.hhs.gov/programs/ocs/liheap
[94] http://www.acf.hhs.gov/programs/ocs/liheap/about/factsheet.html

household amount of assistance benefits" (HHS 2009a).

From 1981 to 2009 (see Figure 9 below), the whole LIHEAP funding has amounted to **around $55 billion**. This has to be compared to the around $6 billion dedicated to the WAP from 1977 to 2009. It is actually **more than 9 times the WAP funding**.

The comparison is even worth if we compare the **2009 appropriation**: $4,5 billion for the LIHEAP Block Grant against $250 million for the WAP. **The LIHEAP funding represents 18 times the WAP one**.
This stresses first the **clear priority to direct assistance for the period of crisis** (energy crisis and/or economic crisis), and second the **necessity for the WAP to be allowed to take advantage from a part of the LIHEAP funding** (as shown in Table 6 above, the LIHEAP source represented 42,7% of the whole funds for weatherization in 2006, against 32,6% for the DOE funding).



(Source: http://liheap.ncat.org/Funding/lhhist.htm)

Figure 9. Annual LIHEAP funding from 1981 to 2009.

It has to be noticed that the Office of Community Services, in charge of LIHEAP at the national level, also maintains **rich statistics**[95] on the LIHEAP programs that are to be reported by each state, such as uses of LIHEAP funds, average household benefits for fuel assistance. Likewise, HHS has funded energy assistance questions on the U.S. Information Energy Administration's **Residential Energy Consumption Survey** (RECS) based on US-representative samples of around 5000 households.

This makes it possible to publish yearly the LIHEAP Home Energy Notebook (HHS 2009a) included in the annual LIHEAP report to the Congress (HHS 2009b). This report details energy related data for low income households (see above), such as statistics on their energy expenditures, their heating and cooling consumption, the distribution of their energy consumption according to the main end-uses, etc.

Looking at the **implementation field**, Tonn et al. (Tonn, Schmoyer et al. 2003) analyzed the **interactions between both programs** (WAP and LIHEAP), and more specifically what impact weatherizing homes of LIHEAP recipients has on the level of need for LIHEAP assistance. This was made by comparing three treatment groups having received both weatherization and LIHEAP assistance with a control group having only received LIHEAP assistance.

[95] http://www.acf.hhs.gov/programs/ocs/liheap/program_statistics.html

"*The overall conclusions of this study are that **weatherization decreased the need for high-energy benefits but did not lead to low-income households relinquishing the need for standard LIHEAP benefits**. Although these results are not unexpected, this is the first study to quantitatively address this question. (…) **It was not possible to estimate a monetary benefit of the weatherization program to the LIHEAP program** for a couple of reasons. First, the level of LIHEAP benefits changes each year (…) thus, it was not possible to develop a baseline LIHEAP benefit. Second, it can be argued that the benefit of the weatherization program to LIHEAP is not a reduction in the number of households eligible for LIHEAP (because LIHEAP eligibility is solely based on income) but is actually related to how high-energy benefit funds could have been re-allocated to increase the average LIHEAP benefit per household over the entire program. Data were not available to this project to assess potential re-allocations of LIHEAP funds*" (Tonn, Schmoyer et al. 2003)[96].

Objectives

► General objectives

"*The **Weatherization Assistance Program** works to:*
- *Reduce energy costs and alleviate high energy burden for low-income families*
- *Decrease the nation's energy consumption and reduce dependence on imported oil*
- *Improve local air quality and avoid greenhouse gas emissions*
- *Provide economic boost in low-income communities*
- *Educate consumers in energy efficiency practices*" (DOE 2002).

► Operational objectives / targets

The main operational objective is to increase the energy efficiency of homes of low income households, by providing them with weatherization services (see below).

From a technical point of view, the priority target is heating (insulation and heating systems). But the WAP scope has been broadened over time to include cooling, appliances and lighting.

Program description

Motivation

As described in the "context" section above, the main motivation for WAP is the **alleviation of poverty**, and more specifically **ensuring that all households can afford a minimum level of heating** (and more generally of indoor comfort).

These direct stakes (in terms of energy expenditures and energy consumption) are detailed above.

Three additional motivations are also to be mentioned:
- **environmental concerns** at both, local (air quality) and global level (GHG emissions and resources exhaustion) ;
- **related economic impacts**, in terms of activities (insulation works, etc.) and job creations[97] ;

[96] Studies performed in the late 90s showed that comprehensive weatherization reduces utility arrears, improves payment compliance, and utility service continuity. These are the goals of LIHEAP. So each complements each other (Monte de Ramos, 2010).

[97] "*We're creating jobs immediately by … weatherizing 2 million American's homes, as was called for in the package. So that right there creates economic stimulus.… In the case of homeowners, they will see more money in their pockets, and we're reducing our dependence on foreign oil in the Middle East. Why wouldn't we want to make that kind of investment?*", President Obama, February 2009, quoted by (Millhone 2009b)

- **health impacts** (see below).

The importance of these non-energy benefits is increasing in public policies.

For example, the LIHEAP energy notebook (HHS 2009a) includes a review on the studies about health impacts and indoor comfort, especially to explain why it is important to target the assistance on the most vulnerable households:
"*The CDC [Centers for Disease Control] found that 49 percent of the hypothermia-related deaths in the U.S. during the period from 1999 to 2002 were individuals who were 65 or older. Moreover, a detailed study conducted in Alabama showed that the majority of deaths of elderly individuals were indoor deaths, compared to outdoor deaths associated more with individuals less than age 65.*
The CDC also reports that: infants, elderly persons, socially isolated persons, bedridden persons, and persons with certain mental and chronic illnesses are at highest risk for heat stroke. The elderly, especially those aged >80 years, are susceptible to heat-related illness because they are less able to adjust to physiologic changes (e.g., vasodilatation) that occur with exposure to excessive heat and are more likely to be taking medication for chronic illness (e.g., tranquilizers and anticholinergics) that increase the risk for heat-related illness. Infants also are sensitive to heat. Conditions such as mild fever can progress quickly to heatstroke if heat stress occurs.
Studies of heat waves in Chicago and Milwaukee report that elderly and disabled individuals accounted for the most deaths due to the heat wave of 1995".

Main characteristics

► General working scheme and eligibility conditions

The Weatherization Assistance Program (WAP) is a **federal program**: the US Department of Energy (DoE) provides funding and technical guidance to the states, which then define their own programs within the federal rules and regulations.

The **national funding** is **distributed to the states based on their potential beneficiaries**, using a formula which takes into account three factors: "*1) low-income population; 2) climatic conditions; and 3) residential energy expenditures by low-income households*" (Millhone 2009a). This formula has been actively debated (see section "Problems / adaptations" below).

From the start in the 1970's, each state has been free to define its own **implementation scheme**. "*States selected their **local service providers** who now make up a **nationwide network** of more than 900 agencies that cover all U.S. counties (…) The local agency networks were comprised of community action agencies, units of local government, and other nonprofit organizations that served the families in their communities*" (ibid.). Federal law requires the states to give preference to community action agencies in selecting their local providers (Eisenberg, 2010).

"*Low-income households who seek Weatherization services apply to their local agencies. **Eligibility depends primarily on income**. To be eligible, a household must have an income that falls **below 125 percent or 150 percent of the national poverty level**[98]. As an alternative, a state may set the income eligibility limit at 60 percent of its medium income, which often increases the number of eligible households. While the income eligibility limits vary among the states, they currently average about $32,000 for a family of four, drop to half that for a single person, and increase to $50,000 for a family of eight.*

[98] The eligibility for WAP is now 200 Percent of the federal poverty guidelines and the LIHEAP program eligibility is 150% of poverty or 60% of state median income, which is almost always higher (Eisenberg, 2010).

*DOE estimates that as many as **20 to 30 million families are eligible for Weatherization nationwide**[99]. Within this pool of eligible households, the program gives preference to people over 60 years of age, those with disabilities, families with children, and those with high energy use or with high energy costs*" (ibid., p.4).

► Weatherization services in concrete terms

The way weatherization is implemented in the field is described in three steps by (Millhone 2009b).

"***First**, an **energy auditor** visits the residence, uses a blower door to measure building tightness, identifies any health and safety problems, **prioritizes the energy-saving measures**, and interviews the client on the home's use, problems, and comfort. The auditor's report is passed to the installers*.
***Second**, **installers** make an appointment and visit the residence. They review the job plans with the owner or tenant, confirm the information in the audit, **complete the energy saving and health/safety measures**, confirm the results, and pass the record on to an inspector*.

***Third**, an **inspector** visits the dwelling, **verifies the work** of the installers, retests appliances, and sees that any problems are corrected. The inspector also **interviews the clients**, asks if they are satisfied, explains the improvements, and **educates them about the energy saving steps** they can take*[100]*. (…)*

► Type of measures implemented

"*From the start, Weatherization has focused on **selecting the most cost-effective mix of energy-saving measures for each home**. Initially, the focus was on the obvious measures—insulation, caulking and weather-stripping around doors and windows. The menu has grown to include a wide variety of measures encompassing the building envelope, its heating and cooling systems, electrical system and appliances.*

*From this growing list of Weatherization services, **the states submit their audit plans and priority measures to DOE** for review and approval. The state audit protocols must be updated at least every five years to ensure they include the latest technologies. **Steady pressure to use cost-effective measures is maintained by a DOE cap on the average expenditure** a state can spend to weatherize its dwellings.*" (Millhone 2009a).

More recently, to face the new challenges due to the energy prices increases and economic crisis, the limit was revised to be $3,055 in 2009, and now $6,500 under the provisions of the "economic stimulus act" formally known as the American Recovery and Reinvestment Act or ARRA. This aims at "*increasing the scope of the energy audit and the measure that can be included in the retrofit package*" (Millhone 2009b) (see also the "Perspectives" sections below about the future of WAP).

► Looking for using up-to-date technologies and solutions

As mentioned above, each state has to update its list of eligible measures every five years, taking into account both, the cost-effectiveness of the measures and **technological progress**.

[99] The current DOE figure is 38.7 million based on the RECS eligibility estimate (Eisenberg, 2010). Usually, around 20% of the households meet the income threshold (almost by definition). Therefore, it is likely that low income households could be much more, around 70 to 85 million (Monte de Ramos, 2010).
[100] It should also be noted the reliance on 'advanced diagnostics' which is critical factor (along with substantive Evaluation and Monitoring investments) for the success of the program. The feedback on WAP will not be so rich and detailed without this commitment (Monte de Ramos, 2010).

A specific structure, **WAPTAC**[101], was established to "*provide weatherization practitioners and other energy conservation professionals with information related to the Weatherization Assistance Program (WAP), its on-going operations, and its partnerships with stakeholders*"[101]. It gives the **technical support** to the local weatherization agencies in order to ensure a "***professional delivery system*** *to provide* ***quality*** *energy efficiency services and materials*" (DOE 2002).

In parallel, the Energy and Transportation Science Division of the **Oak Ridge National Laboratory** (ORNL, whose mission is to provide DOE with **R&D support**) is in charge of the **Weatherization Support Program**. Its "*activities include evaluations of the U.S. Department of Energy's (DOE) Weatherization Assistance Program (…), technical support for the Weatherization Assistant energy audit tool (NEAT and MHEA)* [see below]"[102].

Altogether, this has created the conditions for a **continuous improvement**.

► Maximizing the use of public funding by limiting the administrative costs

"*The final core feature of the new program provided for its administrative and training and technical assistance (T&TA) requirements*[103]*. The* ***administration costs are limited to 10 percent of the appropriated funds*** *and are divided between the states and the local service providers. The T&TA costs also are limited to 10 percent*[104] *with the bulk of the funds going to the states and local providers. While this may appear to be seen an administrative detail, the result has been the* ***creation of a national Weatherization network*** *that has* ***transformed the delivery of residential energy saving services*** *well beyond the originally targeted low-income homes. The trained retrofit providers and the graduates of the WAP program now provide retrofit services to all income classes*" (Millhone 2009a).

Concrete examples/Impact/evaluation

Results

► Official global results

The different websites and leaflets presenting the WAP insist on the success and the amplitude of the program:
"*During the past 33 years, WAP has provided* ***weatherization services to more than 6.4 million low-income households***"[105].

For example, more than 230,000 homes were weatherized in 2008.

Following results are announced on the WAPTAC website, based on ONRL studies[106].

[101] WAP Technical Assistance Center, see http://www.waptac.org/
[102] http://weatherization.ornl.gov/
[103] There once was also a minimum requirement of a percentage on materials but that no longer applies (Eisenberg, 2010).
[104] The T&TA level was raised to 20 percent under the ARRA (Eisenberg, 2010).
[105] http://www1.eere.energy.gov/wip/wap.html
[106] http://www.waptac.org/sp.asp?id=1437#Program%20Facts ; "*Short and Long-Term Perspectives: The Impact on Low-Income Consumers of Forecasted Energy Price Increases in 2008 and a Cap-and-Trade Carbon Policy in 2030*" ORNL/CON-503 , Oak Ridge National Laboratory, Oak Ridge,Tennessee, December - 2007; January, "*Estimating the National Effects of the U.S. Department of Energy's Weatherization Assistance Program with State-Level Data: A Metaevaluation Using Studies from 1993 to 2005*", ORNL/CON-493 , Oak Ridge National Laboratory, Oak Ridge, Tennessee, September, 2005.

- **Energy-related Impacts**

→ individual results
"Energy savings average 35% *of consumption for the typical low-income home. Weatherization saves an average of* ***32% in gas space heating****. This comprises a total* [primary heating] *fuel consumption reduction of 23%. Net savings for each home weatherized average* ***30.5 MBtu/year [i.e. 8900 kWh/year]"****.*

"Weatherization mitigates approximately ***2.65 metric tons of carbon dioxide per year****. Over the life of the measures, weatherization saves 53 metric tons of CO2 per house*".

→ global results
"Weatherization measures reduce national energy demand by the equivalent of ***24.1 million barrels of oil per year [i.e. 3.5 million toe/year[107] or 140*10[6] mmBtu]"****.*

- **Socio-economic Impacts**

→ individual results
"*Low income families will save* ***an average of $437 in reduced first-year energy costs****, at current prices*".

→ global results
"*In 2010, weatherized homes nationally will save* ***$2.1 billion for low-income families"****.*

→ cost-benefit analysis
"For ***every $1*** *invested in the Program, Weatherization* ***returns $2.51*** *to the household and society. This includes:*
- ***$1.80*** *returned in* ***reduced energy bills****;*
- ***$0.71*** *is returned to ratepayers, households, and communities through increased local employment, reduced uncollectible utility bills, improved housing quality, and better health and safety though the reduction of heat-related illness and death and risk of death from home fires due to utility disconnection".*

→ additional benefits
"Weatherization creates 52 direct jobs and 23 indirect jobs[108] for every $1 million invested". Current DOE funding supports about **8,000 jobs nationwide**. "*The number grows to an estimated 21,000 when you include the companies and services that provide the products and services to the program*" (Millhone 2009b).
In many cases, Weatherization is a first entry level experience with residential energy conservation. **Many jobs created by the program are in low-income areas**, where most needed (as reported in (DOE 2002)).

"Weatherization creates ***non-energy benefits*** *as well, including increased property value, reduced incidence of fire, reduced utility arrearages and bad debt, federal taxes generated from employment, income generated from indirect employment, avoided costs of unemployment benefits, and reduced pollution. Additional benefits that are more difficult to quantify include* ***improved health and safety conditions****, increased comfort for occupants, a reduction in homelessness and mobility, and extended lifetime of affordable housing"*.

This general review is completed by Millhone (Millhone 2009a):
- ***For every $1*** *invested by DOE, the Program* ***leverages an additional $3.39*** *from other federal, state, local and private sources. Agencies use*

[107] Tonne of oil equivalent: 3.5 million toe equals to 40 TWh (according to the IEA conversion coefficient).
[108] The source for these numbers is unclear, but this is a result commonly used by the experts of this program.

leveraged resources to weatherize more low income homes and to deliver more services

- "***Increased spending power**: the energy bills amount, on average, about 14 percent of low income families' gross income. Economists estimate more than 80 percent of these expenses leave the low-income community. Weatherization reduces this drain and keeps economic activity within those communities.*
- ***Affordable housing**: the upgrading of the energy systems in homes and apartment buildings in low-income communities increases their value and helps address the nationwide shortage of affordable housing*".

► Main results from the 1989 National Program Evaluation by ORNL[109]

"*In 1990, the U.S. Department of Energy sponsored a comprehensive evaluation of its Weatherization Assistance Program based mainly on data from the 1989 program year (supplemented by data from 1991-92)*" (ORNL, Brown et al. 1993). Actually, most of the results presented above are estimated based on the conclusions of this evaluation.

"*ORNL examined the program with an objective eye, finding it was **cost-effective, but not nearly as outstanding as its supporters had expected**. For each $1 spent, the **energy savings** at that time were found to be **$1.09**. The return was **$1.72** if you included **quantifiable non-energy benefits**, such as increased value of the home, increased employment, and more funds available to homeowners for other expenditures*. (…) *The program benefit/cost ratio compares the discounted value of energy savings to total program costs with an assumed **lifetime of 20 years** and a **discount rate of 4.7%***" (Millhone 2009a).

In addition to the quantification of the impacts and the cost-benefit analysis, this evaluation also looked at best practices to make recommendations.

Indeed, "*the evaluation found **big differences among local agencies**. 'Some agencies achieve savings of 30 to 40 percent of pre-weatherization consumption,' it reported. 'Others produce no measurable savings. Some agencies were found to employ state-of-the-art procedures, use a variety of funding and technical resources, and perform sophisticated self-examinations. Others followed the same procedures year after year, did not evaluate their impacts, and relied entirely on DOE for funding.'*
*There were **some surprises**. The weather-stripping of windows and doors had been seen widely as the most effective way to reduce convective air losses. Blower-door technologies found that **windows and doors contributed a relatively small share of these air losses**. The **serious leaks were found in attics and basements**"* (Millhone 2009a).

"*Many of the recommendations from the comprehensive evaluations were implemented, improving its performance; the DOE regulations expanded to embrace **cooling** efficiency measures; and the regulations broadened to give **more attention to health and safety issues***" (Millhone 2009a).

The recommendations made were also used to improve the WAP practices, especially by developing new audit tools and by proposing solutions specific to the dwellings.

"*DOE was able to say in 1996 that '**technical advances produced 80 percent higher energy savings per dwelling than had been achieved in 1989**.' The increases in savings were attributed to **improved training** for the agencies staffs, the use of NEAT [National Energy AudiT] and other advanced audit tools, and improvements in management practices*" (Millhone 2009a).

[109] The whole report (ORNL, Brown et al. 1993) is available on the ORNL website: http://weatherization.ornl.gov/Evaluations/ProgramEvaluation1989.htm

Evaluation issues

► An exemplary monitoring & evaluation scheme

WAP can be presented as a reference in terms of monitoring & evaluation scheme.

First, **states are required to report annually** on their expenses, number of homes weatherized and other performance data. This is favored by the use of a **web-based interface**[110], where state agencies can directly enter their data and also receive support (FAQ, etc.) for this purpose.

Second, as mentioned above, the **ORNL** is in charge of the **evaluation of the WAP at the national level**. They performed a comprehensive evaluation in the early 1990's (see below), and then have periodically produced meta-evaluation based on the reports done by the states.

Third, the studies can also use the **rich statistics on low income households** and energy consumption produced by the **LIHEAP agency** (see above).

► Evaluation approach

The individual impacts of the interventions are mainly assessed based on the **energy audits' data** and the **registered energy bills before and after** the implementation of the energy saving measures.

Then at the global level, the impacts are estimated based on **statistical approaches**, mainly by using regression or similar models like PRISM (Princeton Scorekeeping Method) to compare "treatment" and "control" groups.

For the meta-evaluations, a **survey of recent state level evaluations** provides a sample of results. This sample is then used to define a regression model. Taking the energy savings per household as the dependent variable, the statistical analysis showed that the only explanatory variable to be statistically significant was the pre-weatherization energy use per household.
The latest meta-evaluation published gave an estimate of 30.5 mmBTU (or around 9.000 kWh) for the average annual energy savings per gas-heated households[111], equaling to around **23% of pre-weatherization consumption of natural gas for all end-uses**, and around 32% of space heating consumption. "*This contrasts with the findings of the national [1990] evaluation, which reported per-household savings amounting to 13.0% of natural gas usage for all household purposes and 18.3% of space heating consumption*" (Schweitzer 2005).

The process evaluations use a classical approach combining performance indicators and surveys/interviews.

► Comprehensive Evaluation: time for an update?

"*The long-term direction of the Weatherization program was enhanced by a comprehensive evaluation by the Oak Ridge National Laboratory (ORNL), the DOE laboratory that provides scientific and technical support for the program. ORNL made an* ***intensive review of the 1989 Weatherization program****, including 368 of the local agencies and 14,971 of the Weatherized dwellings,* ***comparing the measures selected, the costs, and the energy savings****. From this* ***rich data base****, ORNL produced 12 final reports between 1990 and 1994 on ways to* ***improve the performance and cost-effectiveness of the program***" (Millhone 2009a).

[110] http://www.ecw.org/weatherization/index.php
[111] the number of data for electrically-heated homes and for electricity for non-heating was not sufficient to perform a significant statistical analysis.

"*For nearly 10 years, the program's leaders have recognized the **need for a second comprehensive evaluation** of the Weatherization program. (…) DOE announced plans for a new national evaluation in 2004 in its Weatherization Program Notice to the states. **The program has change greatly since 1989**. DOE pointed to several program changes: the expanded use of computerized dwelling audits, management changes stemming from the earlier evaluation, the adding of cooling and base load measures, new approaches for mobile homes, the expanded inclusion of multifamily buildings, increased flexibility to improve energy-related health and safety problems, and new opportunities to leverage Federal funds with utilities, other state programs and the owners of large multifamily buildings.*
*ORNL, which led the evaluation of the 1989 program, was asked by DOE to prepare a new evaluation plan using 2006 Weatherization data. ORNL issued a request for proposals and selected an independent contractor. Working with the states and local agencies, a 363-page **evaluation plan was drafted and presented to DOE in January 2007**. **Then nothing happened**. DOE apparently had changed its mind and was no longer interested in evaluating a program it was planning to kill [see "context" section]. For the reasons given by DOE in 2004, the evaluation of the Weatherization program as it exists now is an important step to identify the changes that will enable it to continue the program's successful service to low-income households."*[112] (Millhone 2009a).

The need of a new comprehensive evaluation is also supported by the observations made by Schweitzer (Schweitzer 2005): "*while the widespread adoption of advanced audits and the growing use of blowerdoor directed air sealing and high density wall insulation contributed to savings increases in gas-heated houses between the 1980s and mid 1990s, there have been no equally dramatic or widespread changes in Weatherization Program practices affecting heating energy consumption since that time*". In other terms, the recommendations from the 1990 national evaluation have led to major improvements. However since then, **the regular monitoring of the WAP has supported a continuous improvement, but no new breakthrough**.

Finally, Schweitzer highlighted as well the limitations of the meta-evaluations (using data from a sample of states which may not be fully representative):

- "*the current meta-evaluation is based on studies performed in only a third of the states, and those may **not be fully representative** of the entire Weatherization Program*"
- "***the value for pre-weatherization energy consumption,** which is a major input for the calculation of national savings, **is based on 1989 data***"
- "*few studies have been conducted on electrically-heated dwellings*"
- "***the biggest recent change** to the Weatherization Program – the addition of baseload measures such as highly efficient refrigerators, water heaters, and light bulbs – **has barely been addressed by state-level studies***".

► The NEBs (Non-Energy Benefits)

The NEBs (Non-Energy Benefits) are **one of the most difficult aspects to evaluate** when looking at programs targeted to low income households. And these are essential to quantify in order to be taken into account in the cost-benefit analysis[113].

[112] The ORNL now has funding to perform the National Evaluation of the Weatherization Assistance Program, both a retrospective evaluation of program years 2007, 2008 and of the Recovery Act Period, program years 2009, 2010,2011. The comprehensive evaluation plan is finally being implemented and the 2007-2008 evaluation is now underway, largely following the plan available on the ORNL website (Eisenberg, 2010).
[113] Only because it requires coordination with utilities, who may be reluctant to share this data in a contentious regulatory climate. In the past, data warehouses were built within a utility holding company that made this task easy. The results proved that weatherization works. Energy savings greater than 20% made utility service affordable (declining arrears, better payment performance, greater access to assistance funds, less terminations, etc.) (Monte de Ramos, 2010).

As mentioned above, in case of the WAP, the return for $1 invested was assessed in the 1990 evaluation to be to be $1.09. This would mean that, from a societal point of view, the program would have been cost-neutral, but not delivering significant benefits. But then, the return was $1.72 if quantifiable NEBs were taken into account. **This may change the appreciation of the added value of the program**. However this is not the only indicator to take into account when considering the usefulness of a public program[114].

Schweitzer and Tonn (Schweitzer, Tonn 2003) made a review of the available studies on NEBs from weatherization programs. They classified the NEBs in three categories, with their own sub-categories:

1) **ratepayer benefits** (payment-related benefits, and service-provision benefits);
2) **household benefits** (affordable housing, and safety - health – comfort);
3) **societal benefits** (environmental, social,or economic).

They found that the available literature tends to confirm that the NEBs are significant, being even slightly higher than the average value of energy savings, and substantially higher than the total cost per low-income weatherization.

Looking at the different categories, the societal benefits appear to be much larger than either ratepayer or household benefits.

However, it should be reminded that the range of values observed from a study to another can be large. Therefore, it remains difficult to define reference values.

Problems / adaptations

► The WAP formula

One of the most criticized points of the WAP is the way the national funding is distributed among the states.

One of the reproaches made was for example that until the 1990's, the funding was more oriented to Northern states having colder climate (and higher heating needs), than to Southern states having warmer climate (and higher cooling needs) (see also below). Consequently, most of the Southern states started to be really involved in weatherization programs later than the Northern ones. And this explains partly the difference of experience and practices between both groups of states (Monte de Ramos 2005).

We did not examine these discussions in this case study, but further details can be found in (Kaiser, Pulsipher 2004).

► Cooling (Southern states) and not only heating (Northern states)

"*The mid-1990s also saw Weatherization give more attention to low-income households in the south. The early program focused on lowering heating bills. By the late 1980s, there were news reports of low income elderly citizens dying from heat exposure in the south. Congress responded in 1990 by authorizing the expansion of Weatherization to encourage hot-climate states to include cooling efficiency measures in the program.*
DOE changed the program's regulations to permit the use cooling efficiency measures, such as air conditioner replacements, ventilation equipment, and sun screening and shading devices." (Millhone 2009a)

[114] The authors would like to highlight that the cost-benefit ratio is only one of the indicators to be used when considering the value of a program, especially for "low income" programs and from a societal point of view. Indeed, WAP is delivering an essential public service, whose true value can not be fully monetarized (e.g., what would be the value of avoiding new homeless people?).

► **The case of mobile homes**

*"Mobile homes are a special problem. They constituted **18 percent of the Weatherized households**; 23 percent in the southern states. They have **high owner occupancy**, 78 percent, by individuals with the **lowest incomes**. The [1990] evaluation found 'many are leaky, uncomfortable, and have high energy bills.' The past retrofits had included a high percentage of window and door measures—not nearly as cost-effective as other options. Nationally, Weatherization projects in mobile homes produced only about two-thirds the energy savings achieved in single-family detached dwellings. However, the study also identified an Indiana program that—against this pattern— used blower-door guided infiltration sealing and blown cellulose insulation between the belly board and floor of mobile homes to achieve a 32 percent savings, **providing a model for other mobile home retrofit projects**."* (Millhone 2009a).

► **The development of effective auditing tools**

One of the major improvements of WAP practices was the development in the 1990's of sophisticated, computer-based audit models that compute the cost-effectiveness of competing building envelope and heating and cooling equipment investments. This produced the **National Energy AudiT** (NEAT) tool which has been used nationwide since 2000.

"*To expand the audit option, DOE also developed a Manufactured Housing Energy Audit (MHEA) and approved the use of a multifamily audit option: Energy Audit—Queens Information Package (EA-Quip)*" (Millhone 2009a).

"*The combination of a **better trained workforce and advanced audits** led DOE to relax some of its project restrictions. The requirement that at least 40 percent of program funds be spent on materials could be waived in states that required the use of approved, advanced audits. Local agencies were given greater freedom to invest in improvements in heating and cooling equipment. Using advanced diagnostics and audits, agencies could install **cost-effective improvements tailored to particular dwellings** in specific climates*" (ibid.).
This is confirmed by the meta-evaluations done by ORNL(Schweitzer 2005): "*by 1995, weatherization measure selection was commonly guided by advanced computer audit tools or measure lists based on such tools. These customize recommended measure lists to optimize returns on a **house-by-house basis**. Advanced audits can be expected to produce **higher savings than the simple priority list approach** that had dominated measure selection in the 1980s, because priority lists assume that the same measure ranking will be equally suitable for all houses. Advanced audits, with their customized measure selection, were shown to **increase average savings by more than 10%** in two experimental field tests conducted in the 1990s*".

► **Conflict with other policies or programs**

When describing his arguments for the continuation of WAP, Millhone (Millhone 2009a) also give interesting insights about the conflict in "**corporate culture**" **between R&D and WAP missions** mentioned in the "context" section:
"*The DOE budget explains: "In FY 2009, Weatherization Assistance Funds are redirected to R&D programs which deliver greater benefits. EERE's Energy Efficiency portfolio has historically provided approximately 20 to 1 benefit to cost ratio. Weatherization has a benefit cost ratio of 1.55 to 1."*
*The benefit to cost ratio is a facile tool. The Weatherization ratio, as seen above, comes from actual energy savings in real dwellings. The R&D ratios come from the estimates of the research staff on what their efforts will achieve sometime in the future. This is not just an apples-oranges comparison; it's comparing an apple now and an imagined orange grove sometime in the future. A **fallacious comparison** is being used to justify ending a presidential commitment. Using the metric this way, there could never be a rationale for using federal funds to*

improve the energy efficiency and reduce the energy costs of low-income households.
The DOE budget message also risks collateral damage. As seen above, a noteworthy success of Weatherization, including its growth under President Bush's first term, is its attraction of non-DOE funds, particularly from the states and utilities. These sources look to DOE for the administrative and scientific services which assures them that their contributions to Weatherization will be used effectively.
The new DOE message — that the program fails to meet a cost-benefit hurdle — risks turning off these sources of non-DOE funds. Opponents of the state and utility programs will be able to argue: 'The U.S. Department of Energy is trying to kill its own funding of this program because it's not cost effective when compared with other energy programs. Why should we waste our money on it?' ".

► "Weatherization Plus"[115]

"*The late 1990s saw the emergence of "Weatherization Plus"—a* ***larger vision of the program*** *as a transforming agent within local communities that championed* ***increased utility funding***, ***whole house weatherization***, *and* ***growing attention to health and safety issues*** *(…) Service technicians focused on electric wiring that posed fire hazards. They identified old, faulty furnaces that were emitting poisonous carbon monoxide gases. Special measures were taken to avoid the health hazards of lead-based paint. The audits looked for water seeping into older homes that became a major cause of mold and mildew.*
These improvements attracted a ***rapid increase in non-DOE funding***, *increasing the size of the program to more than $500 million in 2001—one of the highest levels in the history of the program.*" (Millhone 2009a).

Indeed, "*In 1998, this network [of service providers] formed a Millennium Committee which a year later set forth its vision in 'Weatherization Plus; Opportunities for the 21st Century.'*
The committee published six white papers that describe the ***potential linkages between Weatherization and other building sector change agents****:*
- *Advanced technologies*
- *Partnership for Advanced Technologies in Housing (PATH)*
- *Climate Change*
- *Million Solar Roofs*
- *Community sustainability*
- *Electric industry restructuring*

Nearly a decade later, the hope survives. The DOE guidance to the states on November 8, 2007 (Weatherization Program Notice 08-1) promotes the evolution of the program to serve this larger mission and urges states to support plans to introduce Weatherization Plus in 2010. (…)
The Weatherization program is unique in providing a connection between grassroots community self-improvement efforts and the nation's leading scientific and technical resources in the buildings field*.*
The combination has indeed made it 'this country's longest running and perhaps most successful energy efficiency program.' With sustainable financing; an evaluation to update its services; and creative thinking about its larger, community role; the program will continue to play a leading role in a future, when affordable energy for low-income households is certain to be an even higher public priority" (ibid., p.13).

[115] Several utilities have programs that match the performance, but not the scope of WAP. It is important to mention that WAP PLUS is built on the Public-Private partnerships with utilities that are a natural beneficiary of these programs along with the participants (Monte de Ramos, 2010).

Conclusions

► A successful program

As highlighted by Millhone (Millhone 2009a), the comprehensive working scheme of the WAP has made it the "***country's longest running and perhaps most successful energy efficiency program***".

This success can seen in the following indicators:
- the program has been running for **more than 30 years**;
- it has reached a significant number of beneficiaries (**more than 6 million households** received weatherization services);
- it has **improved over time**, both by expanding the eligible types of measures and by increasing the quality of the services provided (e.g., enhanced audit tools);
- it has **gradually attracted more complementary funding**.

At the individual level, the average annual energy savings are about 30 MBtu/year per household, representing around 30% decrease and between $300 and $400 saved/year on their energy expenditures.

At the national level, the whole energy savings achieved through weatherization activities amount to **around 3.5 million toe/year** or $140*10^6$ mmBtu, representing global savings in energy costs of **$2.1 billion/year**.

From a societal point of view, the programs has also brought additional **non-energy benefits** in terms of local **employment** (a network of more than 900 local agencies representing 8000 jobs, plus around 13000 additional jobs e.g., building retrofit technicians and other private providers), **health** and **security**, **value of the housing stock**, etc.

Finally, the level of weatherization works generated is also a source of development for housing energy efficiency services in general (i.e. for all households)[116].

► Not enough?

The 6 million households having beneficiating from WAP can be compared to the 28 million households being eligible to WAP (latest DOE's estimate, (Millhone 2009b)), and even more to the 16 to 24 million vulnerable households, who face high energy burden compared to their income, and who may be strongly affected by energy prices increases. This is **already significant, but there is still much to do**.

Likewise, the 3.5 million toe saved by year can be compared to the around 60 million toe representing the total consumption of the 28 million households mentioned above. It makes around 6%. Again, this is already significant, but there is **still a high potential**.

A partial explanation is that **being an eligible households is not sufficient to get the home weatherized**: "*not all the households that meet the income requirement live in housing that meet other Weatherization requirements. Low-income housing often is unqualified because it needs major renovations beyond the scope of the energy-saving measures. Many low-income households rent from landlords who do not agree to the program requirement that rents remain at their current levels after the Weatherization improvements*

Still, the number of potential participants is huge when compared with the 6.2 million homes that have been Weatherized in the last 30 years. Since the qualified households greatly exceed the available funds, states and local centers have made little effort to publicize the program. Even so, ***many waiting lists***

[116] For example, "*historically, many of the technicians trained by DOE who begin their work in the weatherization centers move on to other jobs in the building energy efficiency field*" (Millhone 2009b).

run for three years or longer" (Millhone 2009b).

Moreover, it was not possible within this case study to find **follow-up results**[117], i.e. whether households having received weatherization services have faced again or not difficulties in affording a decent comfort in their homes. This is indeed the initial objective of the program.

This would be a very interesting result to know for example if households living in weatherized homes are sufficiently "protected" against the energy prices increases.

► Need for a new national evaluation

The current period is likely to be a **tipping point**. On the one hand, the recent economic crisis and energy prices increases have induced a new and considerable increase in the number households facing troubles with their energy expenditures. This means as well a large increase in the need for weatherization services. On the other hand, the continuation of the program was actively debated at the end of the G.W Bush's second term.

This situation creates a strong need for a new comprehensive evaluation in order to review the relevance of pursuing the program, and then to propose recommendations, either to launch a new program or to induce new breakthroughs to address the need for faster achievements.

Perspectives / recommendations

► Lessons learnt

1) The structure of the WAP can be taken as a reference, especially the organization on three levels.

→ at the **national level**:
- decision about the **core funding** → ensuring a high level of funding, minimizing costs for fund-raising and sending a clear signal to other stakeholders (leverage effect);
- **validation of the states' plans** & setting of requirements/specifications → ensuring practices are nationwide consistent, inducing cost-effectiveness;
- **technical assistance center** → ensuring practitioners use up-to-date solutions, providing them with training, disseminating quality process;

- **R&D support** → performing national or meta-evaluation, assisting the technical center in proposing new actions or tools.

→ at the **state level**:
- **implementation schemes** → taking account of local specificities and priorities;
- **network of local agencies** & **partnerships** → mobilizing the local "strengths" (community agencies, NGOs, utilities, etc.);
- **state level evaluation** → monitoring the activities and centralizing the data.

→ at the **local level**:
- **local agencies** → ensuring a proximity of service, creating local economic activity (and jobs);
- **weatherization services** → offering a professional service, supporting the development of local jobs (building retrofit technicians and other private providers), combining the field knowledge with the support provided by the

[117] However, some evidences exist and proved that the effects of weatherization did persist after 11 years without degradation (for the population, but large variance due to household changes). Still, this approach looked at the whole population of houses served and found low variance and no degradation (Monte de Ramos, 2010).

national technical center;
- **community involvement** → a local implementation scheme make it easir to involve community agents.

2) Continuous political support is needed.

Improving the energy efficiency of the housing stock is not a short term matter. It takes years. Then the continuity of the political support appears to be a necessity:
- to ensure a minimum level of funding so that activities (and jobs!) can be maintained, even in difficult periods;
- to avoid sending a wrong message to other stakeholders (if the government ends its support to weatherization, other stakeholders may think that it is not relevant anymore to bring additional funding).

3) A core public funding is a starting point. But involving other stakeholders and developing partnerships are key factors for program to grow sustainably.

"*By recognizing the need to fund the research, technical assistance, training, and administrative support for the new program, they [the WAP designers] created* ***a nationwide federal–state–and–local Weatherization network****. (…) The DOE funding continues to be the primary source of funding for the supporting infrastructure, not only the training and technical assistance and administrative costs mentioned above, but also health and safety protocols and quality controls.* ***With DOE covering these costs, LIHEAP and the "Others" were assured a big bang for their bucks***" (Millhone 2009b).

4) Technical support and training is vital to ensure there is a skilled and numerous enough workforce to deliver the weatherization service.

"*The training of energy auditors, installers, and inspectors is not a huge or time-consuming task, but it is absolutely critical to preserve the quality and cost-effectiveness of the Weatherization program*" (Millhone 2009b).

5) Inducing practitioners to review periodically their procedures and offers is a complementary way towards continuous improvement and market transformation.

The DOE requires that the states update periodically their plan, and also annually review the limit of expenses allowed by home weatherized, taking into account the latest good practices. These rules proved to be effective in favoring the dissemination of good practices.

In parallel, maximum thresholds are set for the administrative costs, so that the states and local agencies are also induced to look for improvements in their own practices.

6) Do not restrict too much the scope of the program.

As mentioned above, prioritizing and targeting the actions are key factors to reach the highest potentials. However, it should not be forgotten that improving energy efficiency is not only important for heating, but also for cooling, and increasingly for non-heating electricity (which represents a growing share of the energy consumption).

This is a long run, and program rules should be flexible enough to allow expanding the activities.

7) Specific advice deliver higher results than one-size-fits-all

Situations of low income households can be very diverse. WAP experience proved that using enhanced audit tools make it possible both, to take advantage

of past experiences and to take into account the specificities of each home.

8) Available statistics and continuous monitoring & evaluation are key factors to create the conditions for program improvements.

A good knowledge of the energy-related data leads to a better understanding of what actions are needed, and helps prioritizing the measures.

The monitoring & evaluation activities provide the feedback to detect factors of success and failures. Solutions are investigated at the national level and by examining further success stories or testing pilot projects, before being disseminated through the technical center (documentation and training).

9) Regular comprehensive review of the program and follow-up of the beneficiaries are the way to assess the relevance of the program.

Weatherization delivers direct improvements at the beneficiaries' level. But at the global level, energy efficiency activities are producing results over a long term dynamic.

In particular, periods with sharp increases in energy prices and/or economic crises could give the impression that these efforts were useless, as the number of households facing difficulties would grow considerably.

Therefore, national evaluations are needed to know what the global impacts of the program are. Likewise, a follow-up of the beneficiaries would bring additional insights about the true effectiveness of weatherization in the alleviation of poverty.

► Future of WAP

After a period of uncertainty about its continuation at the end of G.W. Bush's last mandate, the WAP is going to receive **more than a 20-fold increase in funding** (from $227 million to $5 billion) due to the "economic stimulus plan" decided by Obama's administration. The objective is to weatherize at least **1 million homes each year** for the next decade.

This is definitely a tipping point, having in mind that so far 30 years were needed to weatherize around 6 million homes. And as discussed by Millhone (Millhone 2009b) it raises the following question: "***Can this money be spent effectively or is this throwing money at a feel-good program?***".

"*The initial answer depends on an **accelerated delivery** of the expanded program—**training the energy retrofit technicians**, **marketing** the program to an enlarged number of recipients, and **streamlining its federal–state–local administration**. (…) The long-term success depends on constructing links with a broader movement for building energy efficiency, on playing a key role in revitalizing local communities, and on dramatizing the connection between building energy efficiency and climate change. In the end, success will depend on how success is defined—how we balance the urgent need to infuse spending and create jobs with our sustainable future energy, societal, and environmental goals*. (…)

The answer will depend on the ability to successfully complete three tasks:
*1. **Accelerate the administration of the program**, including bringing together a federal, state, local, and private sector implementation structure with transparent monitoring and verification of the results.*
*2. **Secure the support and participation of stakeholders** with an interest in the success of the program, not only because their support is essential, particularly in the southern states, but also to build confidence in the direction of the stimulus package.*
*3. **Translate the federal stimulus investment into a self-sustaining, ongoing activity** that relies on other funding sources and is recognized as*

vital in meeting long-term national goals" (Millhone 2009b).

And Millhone emphasizes that "***as with other programs, while these steps appear straightforward, the details get devilish***".

For example, states will face a considerable change in the funding available, and therefore in the efforts to attract eligible households. So far little promotion effort was required, as there was an even waiting list in many cases. Now, assuming the average grant per household would remain the same would mean reaching 20-fold more households.

For other details, see (Millhone 2009b).

► The utilities side

This case study focuses on the WAP as a federal program. However, depending on the states, utilities may also be key stakeholders in the energy efficiency programs for low-income households. About this, we strongly recommend the book by Monte de Ramos (Monte de Ramos 2005).

He developed the rationale for utilities to implement energy efficiency programs for low income households, not only for their corporate policies, but also (and even above all) for creating shareholder value and reaching their objectives.

His book is also a useful handbook for any actor which would like to develop such activities.

Likewise, we recommend the collection of success stories done by the ACEEE in 2005 (Kushler, York et al. 2005). They selected 24 utility-funded low-income energy efficiency programs to form a catalogue describing leading examples in the field.

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