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Foresight

Migration and Global Environmental Change

PD1: Improving urban living conditions in Kuyasa (Cape Town) through energy-efficiency retrofits: the impact on low-income communities

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Figure 1: Typical RDP house in Kuyasa

Executive summary

The percentage of global population living in urban areas is expected to increase, with notable growth in sub-Saharan Africa. South Africa is no exception. Migration is largely driven by poverty. Those seeking access to the economic opportunities that cities provide will often be forced to live in informal settlements.

This places a significant burden on the local municipalities, and service delivery is often compromised as the informal settlements grow. The South African government has attempted to address the formal housing shortage through its Reconstruction and Development Programme (RDP) but many of the houses built have lacked basic thermal efficiency design. This has resulted in thousands of poor households spending much of their limited funds on energy, while suffering a disproportionate health burden.

Kuyasa is a low-income community in Cape Town. The particular area within Kuyasa which is the focus of this report comprises 2,300 low-income RDP households. The Kuyasa Clean Development Mechanism (CDM) project was developed to address the inefficient design of the houses, with a particular aim of improving the quality of life of the Kuyasa residents and reducing the required monthly expenditure on energy sources. The successful implementation of this project required finance, buy-in and support from many different parties, notably the UNFCCC, private sector, as well as national, provincial and local government.

The project's main interventions were the installation of solar water heaters (SWHs), thermal insulating ceilings, energy-efficient lighting and improved wiring. Some houses also received 'hotboxes' (thermal insulation cooking devices), which help to reduce the cost of cooking. One of the project's key aims was to support local job creation and skills development, and members of the community were trained and employed through the project to install the various technologies; this resulted in over 65,000 person-days of labour.

The main aim of this report is to identify the impact of the project on the community and the resulting reduction in demand on the local municipality's service delivery. The most notable effects of this project have been on the overall health status of the community, a reduction in energy expenditure and an improvement in the residents' quality of life. Two surveys were conducted within the community, one before installation, where 81% of households were

surveyed, and one after installation, where 31% of households were surveyed. These surveys aimed to provide insight into the energy and water consumption patterns of the community as well as to determine their frequency of respiratory illness. The surveys provide very detailed information on demographics, poverty levels, monthly expenditure on electricity and fuel and the type and frequency of respiratory illnesses experienced.

The survey results have been confirmed through informal interviews and focus group discussions. In many instances, the results are confirmed by those for another similar project in Cosmo City, Johannesburg, where quantitative data logging was done. This monitoring involved continuously recording electricity usage and indoor and outdoor temperatures in five houses with different orientations, room layouts and use patterns, before and after installations of SWHs and thermal insulating ceilings.

Improvement in health and safety

Respiratory illnesses are very common within low-income communities, and influenza, tuberculosis (TB) and asthma are common complaints. The ceiling installation was expected to reduce the frequency of illnesses within households, as the level of condensation and damp in winter months decreases as the thermal efficiency of the house improves.

The results confirmed this expectation. 81% of households indicated that there had been a decrease in the frequency of illness. Significantly, households experiencing illnesses twice or more a year dropped from 79% to 26%. Close to half (43%) of the respondents attributed their improved health to the ceilings or the warmth of the house. Positive health effects also resulted from less dust and sand in the house. Households in the Cosmo City project also reported a reduction of allergies and respiratory problems from no longer being exposed to fine dust particles from fibre cement roof sheeting.

As an added benefit, these health improvements decreased demands for health services, resulting in savings in treatment costs for the City of Cape Town. Residents also saved money and time from reducing expenditure for private medical consultation (in cases where households could not access free health clinics), medication and travel to facilities.

Figure 2 Locally manufactured SWH in Kuyasa

The Kuyasa project also led the way in improving the safety of low-pressure SWHs using evacuated tube technology, which can heat water to temperatures exceeding 90°C. Through engagement with local manufacturers and setting target standards for a switch to local supply, the project was instrumental in the development of a locally manufactured geyser that allows for balanced cold and hot pressure, automatic tempering of hot water to 55°C, and a design life span of more than 10 years. The last 600 SWHs installed are of this new, locally produced variety – providing additional local jobs and economic development.

Addressing energy poverty

Many low-income households in South Africa are unable to access energy to meet their basic requirements, due to a lack of either infrastructure or resources. A key project objective was to reduce household expenditure on energy services, through residents moving away from the common practice of using kettles and stoves for water heating and reducing their dependency on appliances for heating homes in winter.

The Kuyasa project has had an enormous impact on the financial stability of households, with a significant decrease in monthly electricity and fuel expenses within the more expensive brackets of R101–R200, R201–R300 and over R301. This is a substantial reduction, particularly when many households have less than R100 in monthly disposable income. As a result, households have more money available to spend on basic necessities such as food and clothing.

Monitoring household energy usage at Cosmo City also demonstrated similar reductions in energy expenditure. It was estimated through energy modelling that each household would save approximately R1,154.94 per year in electricity costs from the interventions, or a monthly average of R96.25.

49% of residents in the follow-up survey at Kuyasa identified that the house was warmer because of the ceiling. Respondents also identified that the SWHs saved them money, as they did not have to boil the kettle for as long or as often because the water was often already warm. Cosmo City monitoring also showed an increase in the minimum indoor temperatures in the houses in winter, and evidence of the ceilings storing heat.

What the Kuyasa project means for housing delivery in South Africa

The South African government plans to build 3 million RDP houses by 2025. This is a critical window for implementing sustainable energy design, increasing the energy resilience of communities and managing national energy demand.

The Kuyusa project, the first in South Africa to access the United Nation's CDM and the first in the world to be registered as a Gold Standard project, has demonstrated the multiple benefits from pursuing energy-efficient design in RDP housing.

The project has shown that improving access to clean and affordable energy is a key aspect in any policy or programme to uplift communities and build liveable human settlements. Providing energy-wasting 'free' government housing to millions of households in South Africa as a means to tackle widespread poverty, while at the same time increasing the economic burden for the poor through higher energy costs, only deepens poverty.

By building cheaper, energy-intensive homes a 'false economy' is also created where more money is spent by government in the longer term to provide energy services in the context of electricity price escalations and increasing peak demand. The ability of Eskom, the national electricity utility, to cater for peak demand has been seriously constrained in recent years and the importance of energy efficiency for managing this demand has been recognised. However, this recognition must now be translated into real, widespread changes in the design and delivery of the South African housing programme.

The savings in energy consumption from the rollout of retrofit projects similar to Kuyusa, as well as more efficient new-build homes, have very real macroeconomic implications for avoided new power capacity and distribution infrastructure. This, coupled with the considerable socioeconomic impact at local level, makes a strong argument in favour of replication of Kuyasa-type installations nationally and at scale.

In this regard, various interventions are required to make more sustainable housing delivery on a national scale a reality. These include:

- Incorporating an energy-efficiency component in the National Building Codes to enforce standards in all new buildings in the country, including low-income housing delivery
- Establishing a sustainable financing mechanism to cover additional costs per household based on one or more of the following:
    - avoided costs from a national perspective including health care costs and generation costs;
    - carbon credit mechanism based on electricity saved per household;
    - cross-financing in mixed-use developments.

This mechanism could be applied to both new build and retrofit projects.

Financing large-scale rollouts

Funding energy-efficiency retrofits in RDP housing remains a challenge. Options include accessing finance through the CDM, rebates on SWHs through Eskom's Integrated Demand Management Programme (IDM) and monthly payments from beneficiaries, amongst others. However, the CDM remains a long and complicated process, the future of Eskom rebates for low-pressure SWHs is uncertain and workable solutions for collecting monthly resident payments have yet to be implemented.

SouthSouthNorth (SSN) – the NGO responsible for the original Kuyasa CDM design – is pushing for innovative financial solutions for large-scale replication through the National Sustainable Settlements Facility (NSSF). The NSSF is currently busy validating a new CDM Programme of Activities and developing new methodologies for both thermal and energy-efficiency in subsidised housing. This includes the concept of 'suppressed demand', which assumes households would use more energy if they were able to afford it. If this CDM Programme of Activities methodology is accepted, it could have enormous implications for low-income communities, like Kuyasa, in developing nations in Africa and beyond.

Introduction: urban migration and the South African context

Urban migration is considered to be a normal element of population growth in many countries, as people are drawn to cities for the economic opportunities they provide. Global trends indicate that while developed areas such as Europe, North America and Australia are experiencing reduced rates of urbanisation, the rates in less developed regions are increasing drastically. In 1950 only 44% of the world's urban population resided in less developed regions, but this is expected to increase to 83% by 2050. Sub-Saharan Africa in particular is witnessing elevated levels of urban migration, with urban populations set to more than triple by 2050, compared to a modest 9% growth expected in Europe in the same period (UN, 2009). Migration is not the only cause of growth within urban areas, as the natural growth of current urban populations is expected to be a significant contributor to urban growth.

South African historical and anticipated urban migration rates, while not as high as the rest of sub-Saharan Africa, are still significant. The last national census, held in 2001, indicated that 56% of South Africa's population lived in urban areas. The legacy of apartheid is evident in the demographics of urban dwellers, as can be seen in Figure 3. While the majority of coloured, white and Indian/Asian populations live within urban areas, the proportion of urban black Africans is consistently below the national average.

The urban population of black Africans experienced hardly any growth between 1960 and 1985. This can be attributed to the notorious 'influx control' and 'pass law' restrictions imposed by the apartheid government. The last 20 years have seen an increase in the proportion of black Africans in urban areas, and it is expected that this trend will continue into the future (Kok and Collinson, 2006). Relative poverty levels in South Africa largely mirror racial identity, with black Africans at the bottom of the economic ladder. It is likely that as migration patterns correct the artificial imbalance of residential segregation, relatively larger numbers of poor black Africans will migrate to informal/shack housing in and around South Africa's major cities.

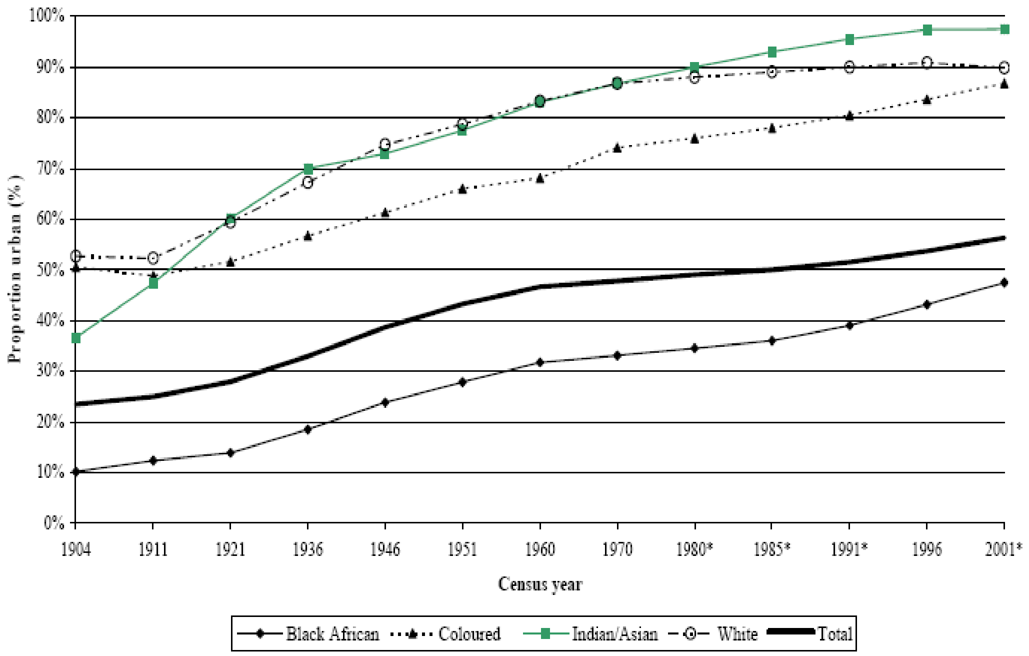

Figure 3 South Africa's historical urbanisation trends (Kok and Collinson, 2006

Note: The urbanisation figures for 1980, 1985 and 1991 were not derived from the censuses themselves but are interpolations. This was necessary because these censuses excluded those parts of the country that were covered by the former homelands of Transkei, Bophuthatswana and Venda (1980, 1985 and 1991) and also Ciskei (1985 and 1991) (Kok, 2006).

Almost all of the growth that will unfold in African cities will take the form of slum growth (Pieterse, 2009). According to the most recent State of the World's Cities Report, 'sub-Saharan Africa has the largest slum population where 199.5 million (or 61.7%) of its urban population live in such areas' (UN Habitat, 2010).

The increase in urban migration rates within South Africa is largely motivated by the apparent economic opportunities that cities provide as 'migration results when the individual's expected urban wage exceeds that for the rural sector' (Cornwell and Inder, 2004). Degradation of natural environments within rural areas and political instability both locally and across national borders can also lead to increased urbanisation rates. South African urban areas are to become home to a predicted 45 million people by 2050, an increase of 14 million (UN, 2009).

The scale of urbanisation occurring within South African cities and towns includes several undesirable consequences, for both migrants and local governments. While many migrants seek employment within urban areas, the extent of migration has led to a surplus in local labour, resulting in increased levels of unemployment. The extent of poverty and unemployment within informal settlements often leads to elevated levels of crime and insecurity.

The demand for housing has far exceeded supply, causing the expansion of informal settlements. When it came to power in 1994, the South African government's attempt to address the ever-increasing housing backlog within cities was the RDP. This programme has seen the construction of millions of homes for residents previously living in informal settlements. Unfortunate legacies of this programme are the resulting urban sprawl, poor amenities and long commutes faced by many people aiming to access more central urban areas. The lack of effective densification and the little regard shown for energy efficiency or quality of life design parameters in the programme have resulted in a large stock of poorly built housing.

While more recent housing policy has sought to improve basic standards for subsidised housing, most notably through the Breaking New Ground (BNG) programme from 2004 and the inclusion of ceilings in developments in the high-condensation zone of the South Eastern Cape from 2009, South Africa is still left with the legacy of over 2 million housing units that subject their occupants to a disproportionate health, energy and poverty burden, exacerbating an already fragile social structure.

Those within formal housing are of course better off than informal shack dwellers. Service delivery within informal settlements is for the most part insufficient, and many urban migrants live without adequate access to electricity, water and sanitation. The further development of basic infrastructure, such as transportation links and health and education facilities, struggles to keep pace with the rapid expansion of the informal settlements. The necessity for the delivery of basic services places a significant burden on local governments with already limited resources.

While migrants may find that urban areas offer more economic opportunities than their rural counterpart, the quality of life may not offer much improvement. Many migrants experience energy poverty, being unable to access their basic energy requirements, due to a lack of infrastructure or because of the high costs of purchasing energy.

The current unemployment level in South Africa is 25.3% and the unemployment level of black Africans is 29.8% (Stats SA, 2010). The number of jobs is therefore limited and many of the jobs available to unskilled urban migrants pay low wages. Unemployment, financial concerns, health problems, fear of crime and substandard housing all contribute to the state of mind of residents within low-income communities (van Heyningen and Lund, 2011), and it is estimated that approximately 16.5% of South Africans suffered from a common mental disorder, such as depression or anxiety, in 2007 (Lund *et al.*, 2008).

The level of depression measured by Lund in mothers attending antenatal facilities in Khayelitsha, a low-income settlement in Cape Town, was a staggering 32%. This level of mental illness is attributable to the burden of life and does not bode well for social resilience or immunity to common diseases, to which these residents are already vulnerable.

It is clear that the rapid growth of the low-income and informal sector in South African cities is posing significant challenges for the country, and will require focussed management strategies and solutions from government and society at large to ensure a humane and equitable existence for these communities.

A look at the Kuyasa community within the context of urban migration

Kuyasa is a low-income community located south-east of Cape Town city centre, within a township settlement called Khayelitsha. The exact population of Khayelitsha is unknown, due to the informal nature of much of the housing; an estimate is thought to be 400,000 people, of which approximately 128,000 (32%) live in informal shacks. The community of Kuyasa is made up of approximately 2,200 standalone units of formal cement block and some brick housing. It was one of the first communities in Cape Town to receive formal housing through the state-subsidised RDP rollout.

While the Kuyasa community is living in better conditions than the informal population of Khayelitsha, the overarching problems faced by the community are not dissimilar. The housing provided was poorly designed, with no thought given to basic 'passive efficiency' design criteria such as orientation or window placement, or to thermal efficiency, for example the sealing of windows and doors. Kuyasa is typical of most housing delivery in the country at that time. These households, built with hollow cement blocks or single-skin brick walls and without ceilings, result in thermally uncomfortable living spaces, with associated increased energy costs and health implications. Kuyasa is representative of many other such communities across South Africa and as such it is a highly relevant area for research and the implementation of problem-addressing interventions.

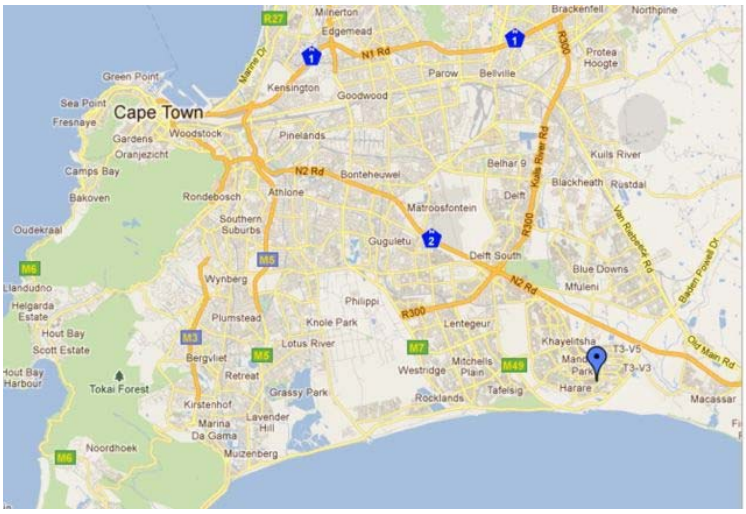

Figure 4 Map of Cape Town, locating Kuyasa

To this end, a baseline study of the Kuyasa community was conducted by the Kuyasa CDM Project in 2008 (referred to hereafter as Survey 1)[1]. The aim of the study was to provide insight

[1] Survey 1 was a baseline survey of approximately 1,700 residents conducted in June 2008 and Survey 2 was a follow-up survey in June 2009 of approximately 680 residents (after the retrofit of the energy efficiency interventions). The survey was drawn up by Esteve Corbera, Carl Wesselink and Holle Wlokas, and data gathering was arranged by Fikiswa Mahote. The data are owned by the Kuyasa CDM project and analysis was done by the authors of this paper.

into the energy and water consumption patterns of the Kuyasa community, as well as to determine their level of health. A sample size of more than 80% of all houses in Kuyasa was taken. As a result of this extensive survey, reliable data were obtained around demographics, poverty levels, the amount of electricity and liquid fuels consumed, the level of monthly expenditure made by each household on energy, hot water and overall water consumption levels, and the degree to which each household suffers from respiratory illnesses. A further study by the University of Cape Town within the community has also given valuable insight into the state of mind of the Kuyasa residents.

Demographics

The baseline survey conducted canvassed 1,791 households, which were homes for 7,173 people, and provided very detailed information about the demographic makeup of the Kuyasa community. The average RDP house of size 30 m^2 houses four people, with some houses providing homes for up to 16 people. 39% of all residents are children, and the average household cares for 1.56 children. Some houses have up to nine children living under one roof, many of whom are orphaned or are being raised by someone other than their parents. The age of the head of the household varies dramatically from 18 to 76 years old. The average head of house, however, is 40 years old. The split by gender for the head of house is fairly even, with marginally more households having a female head of house (55%). The ethnic descent of Kuyasa residents mirrors that of the greater Khayelitsha community, and the majority, if not all, of Kuyasa comprises black Africans.

Location

Cape Town, like all South African cities, is still faced with the problems created through apartheid planning. South Africa has a ‘legacy of transport networks that are poorly integrated and where the majority of citizens live far from places of work’ (Department of Environmental Affairs, 2010). Kuyasa is located 30 km outside of the city centre, and access to public transport is limited. Cape Town’s railway infrastructure is ageing, and there is a heavy dependence on the services of minibus taxis. The remoteness of the Kuyasa community makes commuting to the city centre in the pursuit of employment expensive and the cost of transportation can be prohibitive. Kuyasa is also isolated from community orientated facilities such as libraries and clinics, and residents seeking to benefit from library resources or looking for medical assistance are required to travel to other sections of Khayelitsha, which takes time and costs money.

Health burden

Kuyasa is located within an area particularly vulnerable to the elements, known as the Cape Flats. This area experiences very cold and wet conditions in winter and very hot and windy summers. The area is prone to floods during heavy rain storms, and the ground is covered in sand, which gets blown everywhere in periods of high winds. Khayelitsha, and therefore Kuyasa, has the highest PM10[2] count in Cape Town, largely due to the fine sand particles picked up by the wind, but also to the particles released or exhausted by the heavy traffic flow along the adjacent N2 national highway.

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[2] PM10 are particles of 10 µm or less, which are easily inhaled. These particles can cause respiratory illnesses, or can increase a person’s susceptibility to an illness.

Cape Town, and Khayelitsha in particular, is faced with a very high prevalence of HIV/AIDS, which is compounded by the co-prevalence of TB. The severity of TB can be exacerbated by poor living conditions, particularly within dusty, cold or damp households. The Kuyasa community is therefore faced with elevated levels of illnesses including influenza and asthma. As reflected in Table 1, 79% of households surveyed before initiation of the project reported suffering from respiratory illnesses twice or more every year.

Table 1: Respiratory illnesses identified from 1,791 households surveyed prior to project implementation

	Number of households affected	Frequency				
		Hardly ever	Not a lot (once/ year)	Often (twice/ year)	Very often (3 or more times/ year)	Undefined
TOTA (out of 1,791 households surveyed)	1,566	49	89	761	652	15
Percentage of households	87%	2.7%	5%	42.5%	36.4%	1%

Poverty/access to income

Kuyasa is a low-income community, and like other low-income communities in South Africa, it is burdened with high levels of unemployment and many residents live below the poverty line. Only 76% of households generate income from employment of some variety. 35% of households depend on government grants, and other forms of income are generated through small business or come from pensions. 4% of households have no stable income whatsoever and half of these households have electricity expenses during the winter months exceeding R100 per month (Survey 1).

While most of the households (73%) surveyed have sufficient money available for basic needs such as food, schooling or clothing, 6% of households often spend days without enough money for food and 15% have to borrow money from time to time. 59% of households do not pay their water bill, and the biggest reason for non-payment is insufficient funds (Survey 1). Figure 5 shows that 74% of households have less than R100 disposable income at the end of every month. This shows that most households are spending almost all their income on basic necessities and do not have sufficient money for any luxury items.

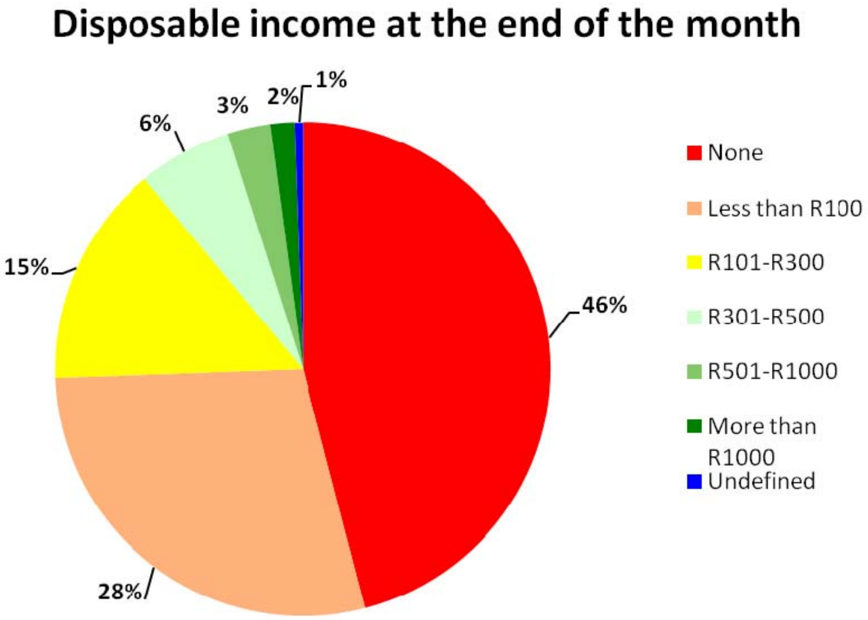


Figure 5: Disposable income at the end of the month (Survey 1)

Energy consumption in Kuyasa

In Kuyasa, as in most low-income communities, the majority of energy consumption requirements are met through the use of paraffin and electricity. Other fuels such as liquid petroleum gas and wood are used, but consumption of these fuels is minimal when compared to paraffin or electricity.

All households in Kuyasa are electrified, and pre-paid meters are installed in each home. Vendors within the community sell electricity vouchers with a 20-digit number that is then entered into the meters. Each month every household in Kuyasa is entitled to 50 kWhs of free electricity through the Free Basic Electricity programme, a government initiative aimed at bringing relief to low-income communities and which is funded through the national electricity basic support services tariff.

Even though all houses have access to electricity, paraffin is widely used in Kuyasa, particularly for space heating. Most houses (63%) have space heating in their homes, and the majority of these households use paraffin (see Figure 6), with electricity heaters being the second choice. Those relying on paraffin use either a paraffin flame stove or a dedicated paraffin heater. 1% of households use gas heaters.

Water is most often heated using an electric kettle; only 5% of households use electric heaters/cookers to heat water from time to time, with only 1% using paraffin only for water heating (see Figure 7).

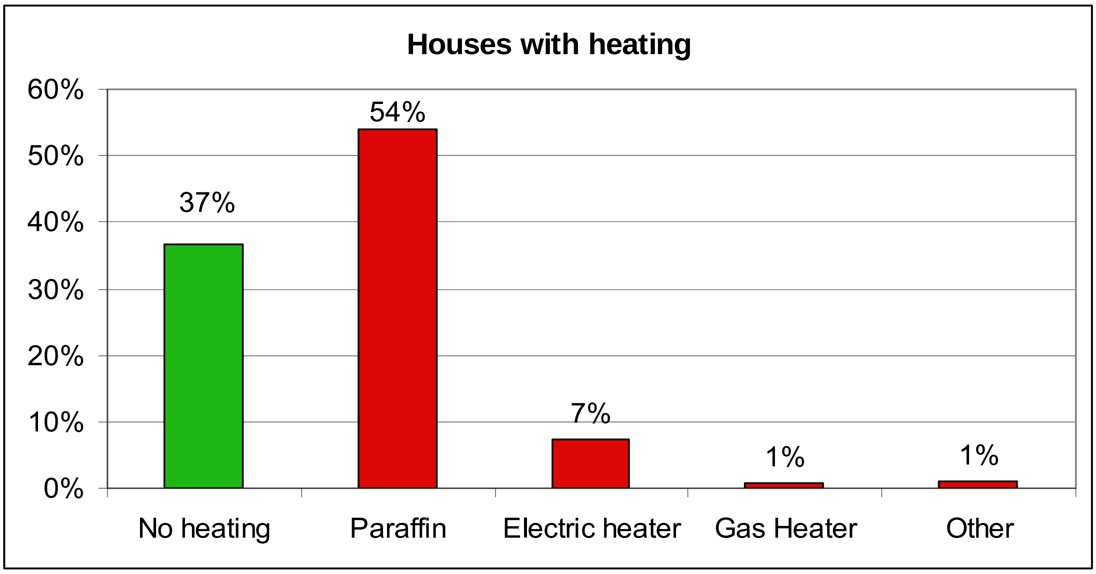


Figure 6: Space heating by energy source before interventions (Survey 1)

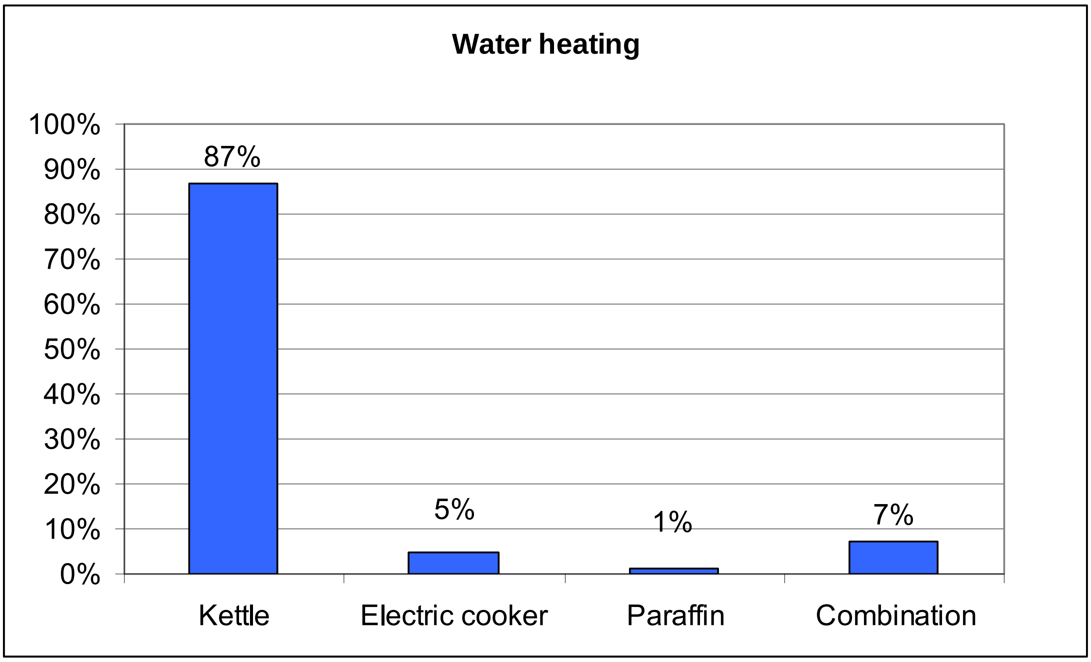


Figure 7: Method of heating water (Survey 1)

Ninety-five per cent of houses have at least one light bulb, with 63% of households having 1–3 light bulbs for the entire house. As a result of Eskom's Demand Side Management Programme (now IDM) rollout in 2007–8, more than half of the light bulbs already in use in households are

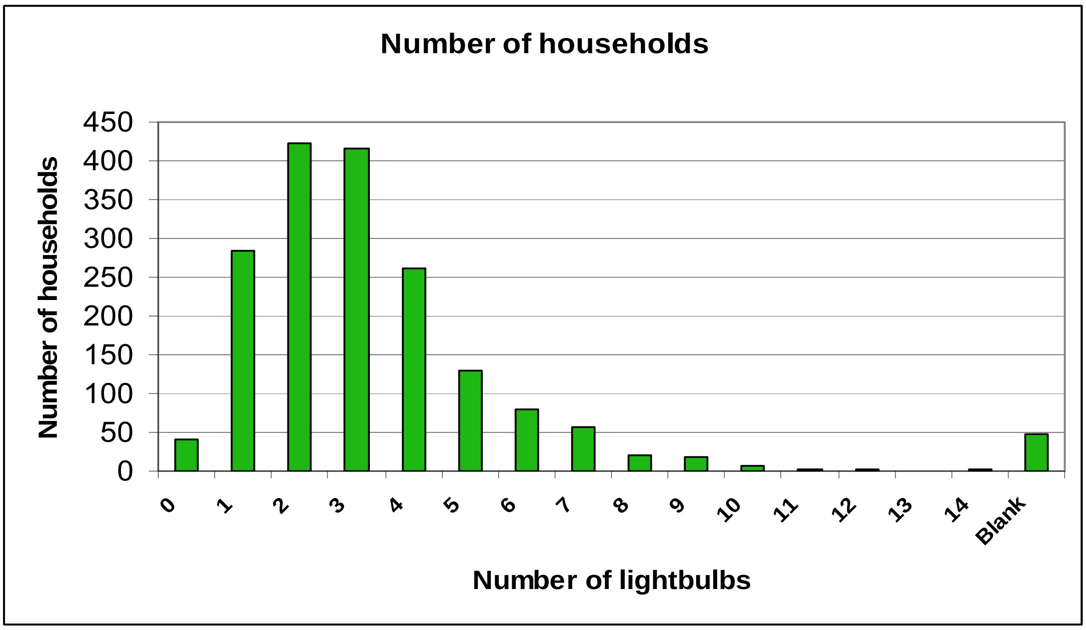


Figure 8: Distribution of light bulbs in 1,791 households (Survey 1)

CFLs. It is assumed that the remaining 41% are incandescent light bulbs (Survey 1). Other sources of light include candles and paraffin lamps (Cousins and Mohote, 2003).

State of mind

Much research has been done in South Africa and internationally into the link between poverty and mental health disorders, particularly within low-income communities. A study by the University of Cape Town's Centre for Public Mental Health is currently being conducted in the community of Kuyasa to identify the mental health status of residents. Mental health disorders such as depression and anxiety can be difficult to recognise but it is believed that the burdens placed on residents in Kuyasa, particularly because of poverty and unemployment levels, have had a significant impact on the mental well-being of individuals and the community as a whole.

Financial concerns seem to be the leading cause of anxiety, which is not just common in South Africa, but is endemic in countries with high levels unemployment or poverty. Another clear message from the University of Cape Town study is that a sense of community in Kuyasa is missing. While many Kuyasa residents were pleased with the improvement in the quality of their homes, they indicated that the lack of a sense of community can lead to them feeling isolated and cut off, and that while their standard of living may have improved, the structured and formal set-up in Kuyasa is much less personal than the organic communities that develop in the informal settlements. The houses are assigned to people on a waiting list, and so it is often the case that new home owners are moved very quickly from their informal housing to a neighbourhood full of strangers. This can be quite difficult to adjust to. Kuyasa has a noticeable absence of common spaces, such as parks, libraries and community halls. The result is that unemployed individuals feel cut off and isolated, which can lead to despondency. Many people in Kuyasa belong to a religious body, like a church, which provides comfort and support. While exceptions do of course exist, it is felt that women often have easier access to support services than men.

Depression and anxiety manifest in many ways depending on the individual, but somatisation, which is the physical manifestation of psychological symptoms in the body, is very common, especially where people don't have a language for what they are experiencing. People commonly experience headaches, stomach aches and chronic pain. There are also negative feelings, including helplessness, hopelessness and worthlessness. Individuals may have difficulty in solving basic day-to-day problems, and substance abuse is often connected to depression and anxiety, as people try to self-medicate.

There are many layers and things that need to happen together to overcome the burden of life experienced by many low-income communities. Education and skills development are required to nurture self-efficacy in order to give people a sense of mastery over their own existence. This is often missing with depression, and the sense of helplessness can be draining. People who are depressed or anxious don't eat properly or may have trouble sleeping (van Heyningen and Lund, 2011) and it is likely that 'poverty and common mental disorders interact with one another in setting up, in vulnerable individuals, a vicious cycle of poverty and mental illness' (Patel and Kleinman, 2003).

A move towards sustainable low-income communities: the Kuyasa project

The concept of sustainable low-income communities

Various projects around the country have been embarked upon with the intention of understanding and tackling the challenges facing low-income communities. These projects aim to determine the impact that different interventions may have on the communities under consideration, with the expectation that they will inform policy and implementation approaches into the future. It is within this context that the Kuyasa CDM project was initiated.

The Kuyasa CDM project is limited to addressing some key issues relating to formal housing, and this paper therefore sidesteps the larger (and arguably more difficult) question of informal housing. The same issues highlighted by Kuyasa are, however, prevalent in slums – only in greater intensity. The lessons learned from this project are therefore more broadly relevant and underline the need for practical interventions at the level of informal housing. Government endorsement for such interventions requires – as a first step – the acknowledgement that informal housing is part of our long-term future. Thereafter, the possibility exists to encourage government subsidisation for informal building materials that address thermal efficiency concerns, as part of its larger subsidised housing programme. Current government policy is reflected in its intention to address the housing backlog by 2030. While this is still the stated intention – an objective that we are almost certainly unable to achieve – it is likely that we will miss the opportunity to invest in improving the quality of housing for large numbers of people who will continue to occupy informal shacks.

The Kuyasa CDM project was born out of the groundbreaking work done by Steve Thorne of SSN. SSN, in collaboration with the City of Cape Town, designed and developed the Kuyasa project as Africa's first CDM project and the world's first Gold Standard project. According to Thorne, the principal rationale behind the project was to pilot the application of his seminal thinking on 'suppressed demand' and thereby provide an illustration of how the CDM might be applied to help address energy poverty in South Africa's subsidised housing programme. In Thorne's words: 'why wait until poor people become major consumers of dirty energy before trying to improve/clean their energy usage, when we can supply energy and thermal efficiency alternatives and create an immediate socioeconomic and environmental impact'[3].

By validating a 'suppressed demand' interpretation of an existing methodology, the Kuyasa CDM project is able to earn Carbon Emission Reduction certificates (CERs) using an assumed baseline of energy consumption that is higher than the actual consumption and closer to the consumption that would have been if those households were not constrained in their use of electricity by virtue of poverty.

Institutional arrangements

Five years after the successful validation of the project and registration with the UNFCCC, finance for its implementation was arranged by the South African Export Development Fund (SAEDF), a private sector trust. The then Department of Environmental Affairs and Tourism (DEAT), through its Social Responsibility Programme, financed by the government's Expanded Public Works Programme, committed the bulk of the finance (approximately R27 million). Provincial government, through the Department of Housing, provided a further approximately R5 million. The SAEDF underwrote the budget and took on the role of implementer. The City of Cape Town, through its Environmental Resource Management Unit and Urban Renewal Programme provided coordination and facilitated oversight.

Implementation was done in close consultation with the community of Kuyasa and through a localised job and skills development programme. To keep costs low and promote community ownership, implementation proceeded through direct labour agreements and without any professional/commercial subcontractors. The project generated over 65,000 person-days of labour within the target community. The job scales and number of people employed are shown in Table 2.

Table 2: Job scales and number of people employed (unaudited figures)

Category	Rate	Person-days × rate	No. of people	Total person-days
Clerical	193	R206,896	2	1,072
Labourer	100	R3,235,000	2,175	32,350
Semi-skilled	132	R2,940,168	152	22,274
Skilled	213	R1,857,573	19	8,721
Supervisor	230	R231,610	2	1,007
Total		R8,471,247	2,350	65,424

[3] Dr Steve Thorne, interview.

Interventions and intended impacts

This project aimed to improve the thermal performance and efficiency of households, improve water heating efficiency and provide improved lighting quality. The main desired outcomes of these improvements were an improvement in the quality of life and a reduction in energy consumption, which would ease the financial burden on low-income communities struggling to afford their energy sources. This consumption reduction would also have an impact on the CO_2 emissions from the community, and the installations of the interventions detailed below were expected to result in significant amounts of avoided CO_2 emissions per household. Thus the overall goals of this project were the alleviation of energy poverty and CO_2 emission mitigation.

Insulated ceilings

The RDP houses in Kuyasa were built with no ceilings. The biggest single intervention for increasing the thermal efficiency of these houses was to install an insulated ceiling. The benefits of ceilings are numerous, and the effect on the residents' quality of life and energy consumption was expected to be significant. Houses without ceilings or adequate thermal insulation are hot in summer and cold in winter. Good insulation helps cut down on heating from paraffin, helps prevent damp and mould from forming, and has excellent associated health benefits. The house also becomes less vulnerable to wind, and less dust and fine particles are able to make their way in during Cape Town's hot and dry summers, providing further relief to household members suffering from asthma or other respiratory conditions.

Keeping the houses warmer in winter means that less fuel is consumed to keep the residents warm, which leads to a decrease in household expenditure. The number of open flames required is also reduced, helping to improve the indoor air quality and exposing the household to less risk of destructive fires. Ceilings also have an aesthetic value, improving the appearance of the living space.

Solar water heaters

Under this project, each household received a low-pressure 100 litre evacuated tube SWH. These were each mounted on stands to ensure an optimal position relative to the sun. The SWHs displaced the need for heating of bath and washing water using electric kettles, the most widely used method of heating water in Kuyasa. 92% of households surveyed before the installation of SWHs used kettles to heat their water, and a reduction in electricity demand, and associated CO_2 emissions, were expected to result after installation. Therefore the biggest

Figure 9: Insulated ceiling installation

Figure 10: SWH installation

benefit expected of an SWH installation to the residents of a low-income community is the potential cost saving that it provides. Other benefits expected are time saved, through not waiting for a kettle to boil, and improved air quality in the households through a reduced dependency on paraffin.

Energy-efficient lighting and improvements to household wiring

This intervention provided wiring 'for four lights, two double plug points as well as energy efficient light bulbs and fittings in the bathroom, living space, sleeping space and outside the door' (UNDP and Goldman, 2009/10).

Kuyasa households were initially built with no light or plug fittings except for a double plug point on the pre-paid electricity meter. In order to use electrical appliances in the rest of the house, many households had dangerous makeshift connections, often exposing live wires. Connections were often made by residents themselves using cheap flex cabling and exposing them to risks. The wiring improvements in the households allow for more electrical appliances to be connected, with safe plug points throughout the house. This discourages residents from consuming electricity through dangerous connections.

The move from incandescent light bulbs to compact fluorescent light bulbs (CFLs) was expected to have an impact on the electricity consumption in the home, as CFLs use approximately 18% of the electricity consumed by an incandescent bulb. The CFLs also have a longer lifetime, and while they may cost more up front, the savings over their life cycle are significant.

Hotboxes

Besides the three main interventions, the project also distributed approximately 800 hotboxes. A hotbox is a cover or insulator into which a pot of (boiling) food is placed. The insulation helps the food to retain its heat, and the food continues to cook without any external energy source. The food simmers, saving electricity and preventing the food from burning. The hotboxes were given to people who specifically asked for them, and training was provided as to how to use them. This intervention was expected to help save electricity and paraffin, thereby saving households money.

Implementation

As intimated above, implementation of the project was largely managed from within the community. A site office and storage facility was established, from where teams of labourers were deployed. In addition to public meetings and extensive consultation with the local leadership, a team of facilitators went door to door to provide information and answer questions about the installation process. Each household was invited to facilitated training sessions, which included a training video about the project and installed technologies.

Local labour applicants were identified through community leadership structures and appointed after a selection process run by the SAEDF. A concerted effort was made to employ youth, women and disabled persons. The breakdown of employment is set out in Table 3.

Table 3: Breakdown of employment by gender and age and the number of disabled persons employed

Category	Male	Female	Youth	Adult	Disabled
Clerical	1	1	1	1	0
Labourer	7	10	12	5	0
Managerial					
Semi-skilled	36	19	35	20	3
Skilled	13	0	4	9	0
Supervisor	1	1	2	0	0
Subtotal	58	31	54	35	3
Total		89		89	3

Informal and on-the-job training was supplemented by formal training at a local college and each of the approximately 100 installers attended a month of full-time accredited training. Training data are summarised in Table 4.

Table 4: Number of people receiving training, specifically women and youth (PTD = people training days)

Accredited training course name	Total no. of people trained		Women		Youth	
	No. of people	PTD	No. of people	PTD	No. of people	PTD
Heavy current electrical	14	288	5	108	7	132
Carpentry	31	661	5	84	14	302
Plumbing	15	338	4	99	9	200
Totals	**60**	**1287**	**14**	**291**	**30**	**634**

The accredited training and on-the-job experience helped a few of the temporary project staff find permanent employment outside of the project or continue their own small businesses. This was not formally tracked after project completion and it is not possible to establish exact numbers but it is probably in the region of three to five persons. A small team of four have been retained on a long-term basis to provide for on-going monitoring and maintenance of the project. In total then, an estimated 10% of the total labour force has gained long-term employment.

Analysis of the impact of the Kuyasa project

The majority of the information covered in this section is drawn from a survey that was conducted after the completion of the Kuyasa project (hereafter referred to as Survey 2). This survey canvassed 680 households (30% of all 2,309 households) and asked many of the same questions as the baseline survey conducted before installation. This allowed for a direct comparison to be made between the energy picture, the average household expenditure and the health profile of the community before and after the project. Besides this information, the survey also provided feedback from the Kuyasa residents on their satisfaction with the interventions and the extent to which residents made use of the new technologies. This section also draws on an assessment that was done on 10 households who formed part of a demonstration project in 2003, which formed a baseline study for the extended rollout of the interventions to all approximately 2,200 households.

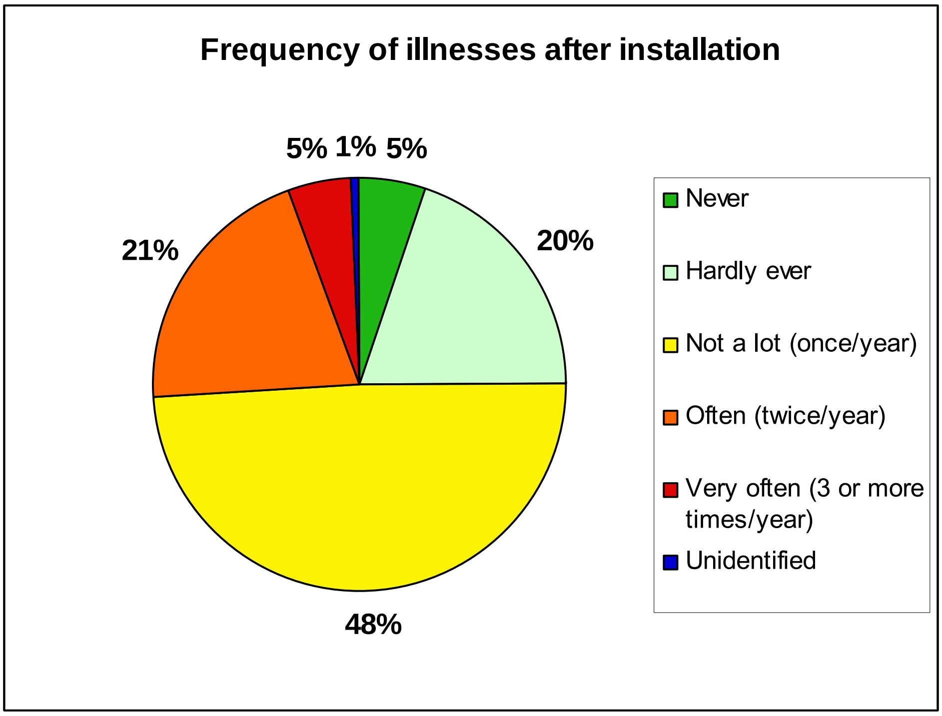
Health and safety

The health benefits associated with the installation of technologies that promote thermal efficiency were expected to have the most impact on the community. Kuyasa residents experienced an incredibly high frequency of illnesses, with 87% of households surveyed complaining of illnesses, and 90% of these households falling ill twice or more every year (79% of all households surveyed). 70% of households complained of flu alone, but other associated illnesses and symptoms included TB, sinusitis, asthma and coughing. 48% of households attributed the high frequency of illnesses to the cold temperatures in the house, and 28% to the cold and wet climate. The Kuyasa project therefore had high expectations that improving the thermal efficiency in the RDP houses would have a marked impact on the health of the community.

The survey conducted after the installation of ceilings identified a significant drop in the incidence of respiratory illnesses. 81% of households indicated that there had been a decrease in the frequency of illnesses. 16% of households stated that the frequency had remained the same, with 2% indicating an increase. A significant indicator of the effect of the ceilings is that prior to the installation of ceilings, 79% of households experienced illnesses twice or more a year, while after the installation this figure dropped to 26%. The other 74% of households experience illnesses once a year, hardly ever or never (see Figure 12). 43% of respondents from the follow-up survey identified the ceilings or the warmth of the house as the cause of their improved health, one of whom stated: ‘My life has changed because I don't get sick anymore. The children are not suffering of the cold’ and ‘[it has] changed [my] life, the house is warm, no more sickness as before’. The severity of illnesses has also diminished, and people are able to overcome their periods of sickness faster, as was identified by Mrs Thabalaza, who heads one of the 10 households included in the demonstration project. ‘In the winter before the ceiling was installed, she would get sick with the ’flu for weeks at a time. However, because it is warmer in the house, a ’flu lasts only for a few days’ (Cousins and Mohote, 2003).

The ceilings also had a very noticeable effect on the amount of dust in the house. 15% of households mentioned that there was less dust and sand in the house after the installation of the ceilings. This has an effect on the overall health of the household as dust exacerbates respiratory illnesses.

'I can speak about the ceiling. At home we are asthmatic and have chest problems. Her illness is a real problem, because of the asbestos. You see the asbestos has a problem of becoming moist but ever since the ceiling was installed things are much better' – Youth, Kuyasa (van Heyningen and Lund, 2011).



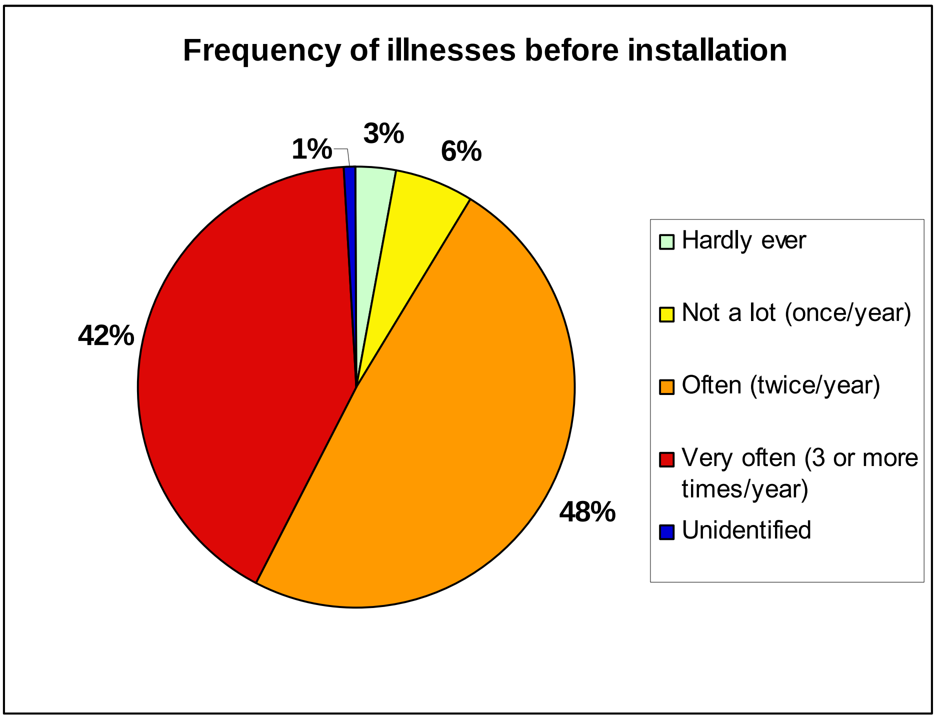


Figure 12: Frequency of respiratory illnesses before and after installation of energy-efficient technologies (Surveys 1 and 2)

Paraffin is a highly toxic and highly flammable substance. Many households use litres of paraffin every week, and it is often contained in reusable plastic containers, which are not well signed and are stored within the home. Young children are at risk of paraffin ingestion and poisoning, as it is possible for them to mistake it for a drink. Paraffin stoves or heaters can result in devastating fires if misused or knocked over. While there are no qualitative data to support this, it is hoped that the reduction in paraffin consumption through this project will lead to a reduction in the cases of paraffin-related poisonings and burns.

There is a concern that low-pressure SWHs using evacuated tube technology can lead to water temperatures exceeding 90°C. This can lead to burns if the hot water is not suitably mixed with cold water. At inception, there were no locally manufactured SWHs that could compare with Chinese imports for price. The imported products, while inexpensive, have serious drawbacks – overheated water being one. One household surveyed after the installations indicated that they had experienced a burn from the SWH, but no further information was given on the details of the incident. The same household indicated that they were happy with the installation and maintenance of the SWH. Potential burns are a point of concern, and the project provided an innovative solution. Through engagement with local manufacturers and by setting target standards for a switch to local supply, the project was instrumental in the development of a locally manufactured geyser that allows for balanced cold and hot pressure, automatic tempering of hot water to 55°C and (very importantly) a design life span of more than 10 years. The last 800 geysers installed by the project were sourced locally and came with improved specifications, more appropriate for local conditions.

An added benefit expected as a result of the installation of ceilings is a reduction in demand on health services. 45% of households surveyed before the interventions sought treatment for their illnesses twice or more every year, and 46% of households rely on the community health clinics for their treatment. Further treatments are sought from hospitals, pharmacies, private doctors and traditional healers. Community health clinics and hospitals provide free medical assistance, but the cost of treating every household even once a year is significant for the City of Cape Town. This significant reduction in the frequency of illnesses would have a dramatic effect on the local health facilities. The households also bear the cost of obtaining medication from pharmacies and from seeking advice from private doctors and traditional healers. Reducing the frequency of visits to the clinic helps to save residents time and money spent on travel.

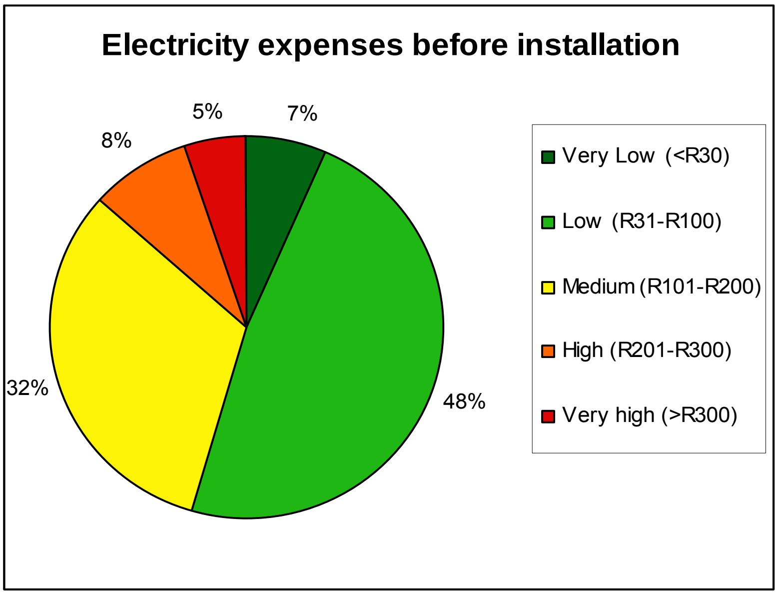
Energy poverty

Energy poverty is experienced when an individual or community is not able to access energy sources for basic requirements such as cooking or washing. This could be because of a lack of infrastructure to provide the energy or a lack of resources with which to purchase the required energy. It is closely linked to the overall poverty of the community.

One of the main motivators for this project was that one of the impacts of the interventions would be a reduction in the amount spent every month by the households on meeting their energy requirements. Figure 13 and Figure 14 both show a significant decrease in electricity and fuel expenses falling within the more expensive R101–R200, R201–R300 and over R301 brackets. This shift towards the lower end of the energy expenditure range indicates that residents were able to save significant amounts of money every month through the interventions which were undertaken as part of the Kuyasa project. This has an enormous impact on the financial stability of a household. As mentioned previously, most households had less than R100 in disposable income at the end of each month before these interventions took place. A shift in energy expenditure, for both electricity and fuel, from R200 or more to less than R100 helps to make money available to the households for use on other items. This provides relief for households that are struggling to afford food, clothing or other necessities.

Electricity and fuel expenditure

Respondents identified that the SWHs save them money, as they do not have to boil the kettle for as long or as often because the water is often already warm. Others noticed that their electricity consumption has reduced because of the ceiling, as they now ‘spend less on [the] electric heater’ (Survey 2).



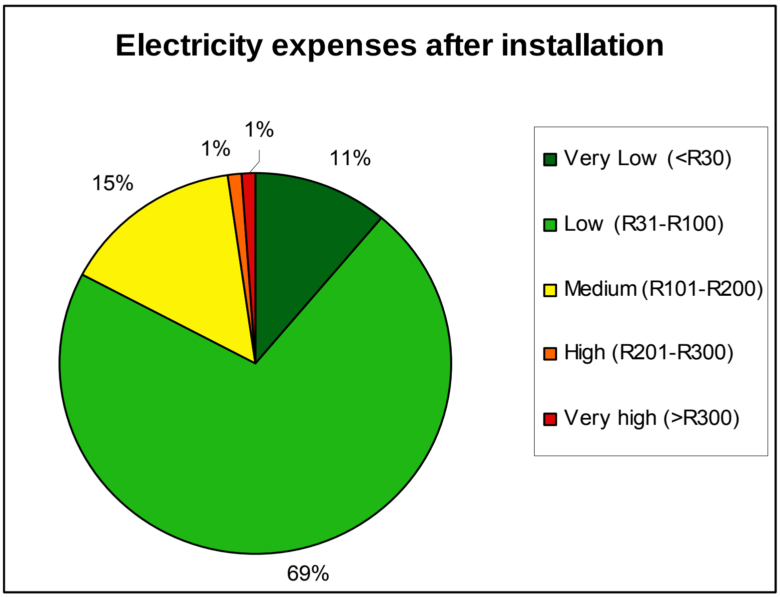
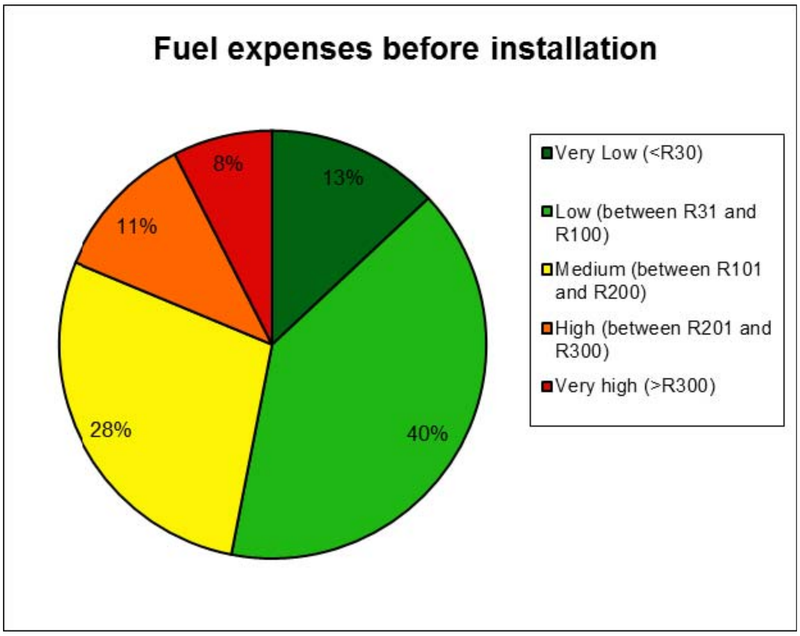


Figure 13: Expenditure on electricity before and after installation (Surveys 1 and 2)

‘Another role of the geyser, yes Kuyasa is windy therefore there is always electrical black out. If electricity blocked out on Sunday, the geyser and the hot box, and you hadn’t cooked yet or you did cook and your food looks like it is going bad, you have to take these hot boxes and put in your food. And the geyser, in the morning you don't have anything that you are going switch on the stove with such paraffin or electricity, all you have to do is to open the tap and hot water would come out' – woman (van Heyningen and Lund, 2011).

The number of households using space heating has not changed significantly (63% before installation and 62% afterwards) and 83% of these households use paraffin-based heaters to do so. However, the dependency on these heating appliances to keep the house warm has declined. 49% of residents in the follow-up survey identified that the house was warmer because of the ceiling: 'The house is warm so I don't buy the litres of paraffin as I use to' (Survey 2).



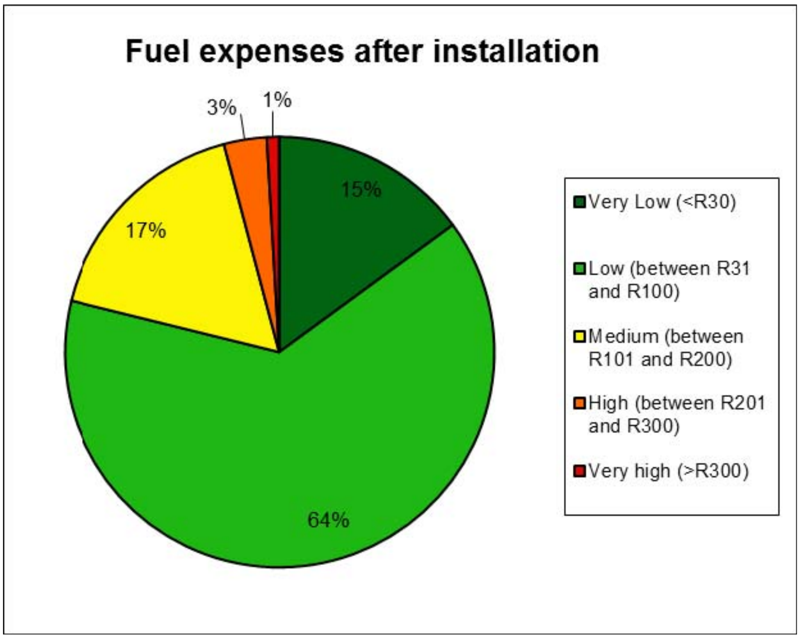


Figure 14: Expenditure on fuel before and after installation (Surveys 1 and 2)

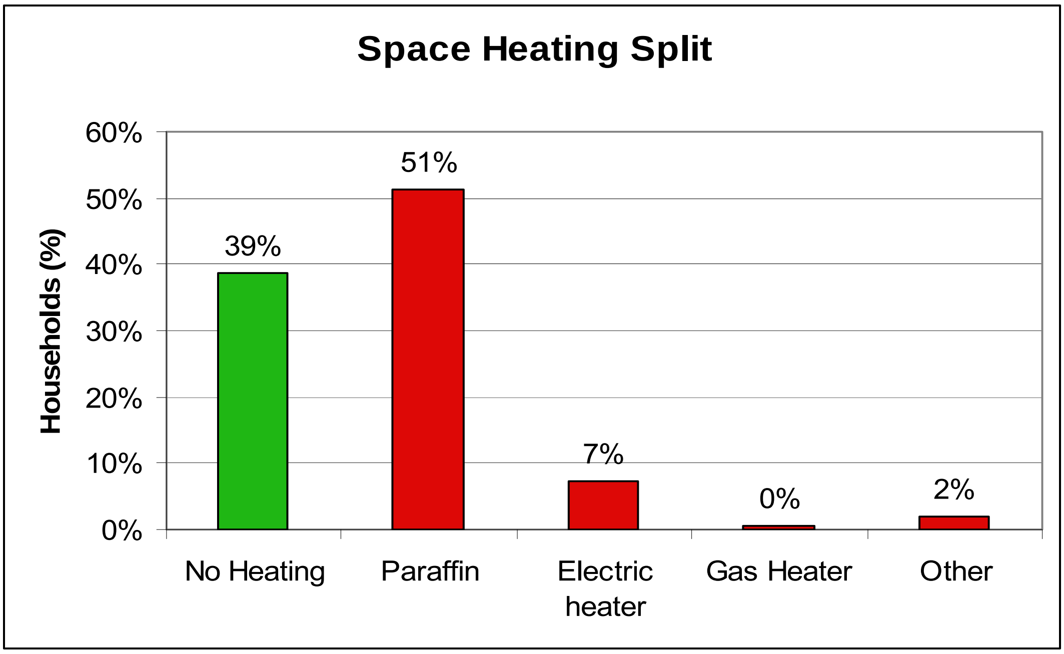


Figure 15: Space heating by fuel source after interventions (Survey 2)

It was also noticed through the quantitative assessment of the 10 demonstration houses that the ceiling helps to hold in ambient heat generated through simple body warmth and activities such as showering or making tea or coffee.

The CFL installation has had some measure of success in converting residents to the technology. The high price of the bulbs might turn some individuals off purchasing CFLs, as of the 2,865 bulbs identified during the follow-up survey, only 71% were CFLs. When questioned about which technology residents would chose were their CFLs to fail, only 65% said they would choose the CFL over a traditional light bulb. Only one household mentioned the CFLs as contributing to their electricity savings. Two households also mentioned that the CFLs are not as hot as incandescent bulbs. This makes them easier to handle, but an added benefit seems to be that insects are not as attracted to them (Cousins and Mohote, 2003).

Hotboxes

Of the 680 households surveyed after the completion of the project, 148 had received hotboxes. Of these households, 123 made use of the hotboxes, most commonly for cooking samp and rice. The hotboxes are also used for cooking pap (maize), meat and vegetables. The savings attributed to the hotbox vary significantly, but those using it on a regular basis have positive feedback:

'Works well, I don't spend time watching a pot' – Dumisani Mathabeni (Survey 2).

'It's safe, you can leave the pot in the hotbox, and you don't have to worry that it will burn' – Bulelwa Zicina (Survey 2).

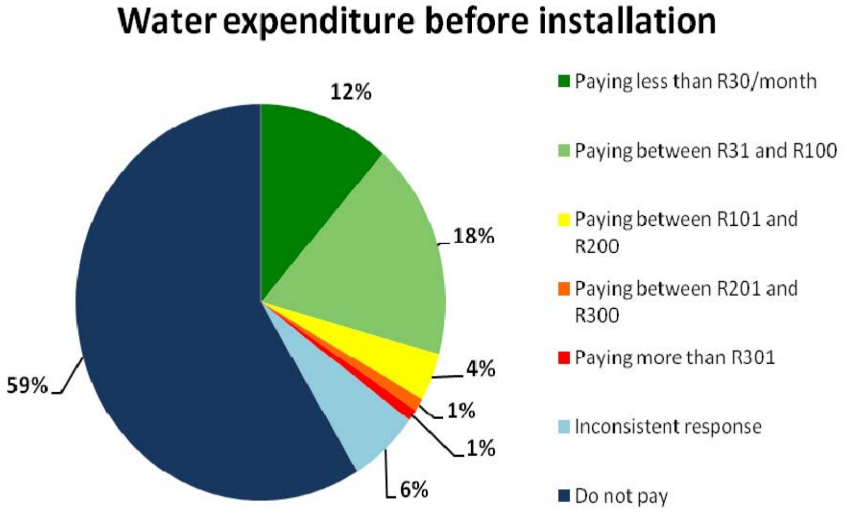
'I don't use as much electricity; I use my hot box to cook most things' – Mlindeli Kohlela (Survey 2).

Table 5: Estimated monthly savings from the use of hotboxes (Survey 2)

Monthly savings	Number of households
Nothing	4
Less than R10	29
Between R10 and R20	22
Between R20 and R30	12
Between R30 and R40	3
Between R40 and R50	7
More than R50	6
Uncertain	40
Estimated amount saved by 83 households:	
R1,525	

Water expenditure

Cape Town is a water-scarce city, and an expected effect of climate change is that water is to become even scarcer as rainfall patterns change (CCT, 2006). Water wastage is therefore of concern in Cape Town. What emerged from both surveys conducted with the Kuyasa community was that the majority of households do not pay their water bills. The level of non-payment actually increased after the installation of SWHs. 59% of households admitted to not paying their water bills before the project started, and this increased to 71% after installation was complete. Figure 16 shows comparative expenditure on water in winter before and after installation.



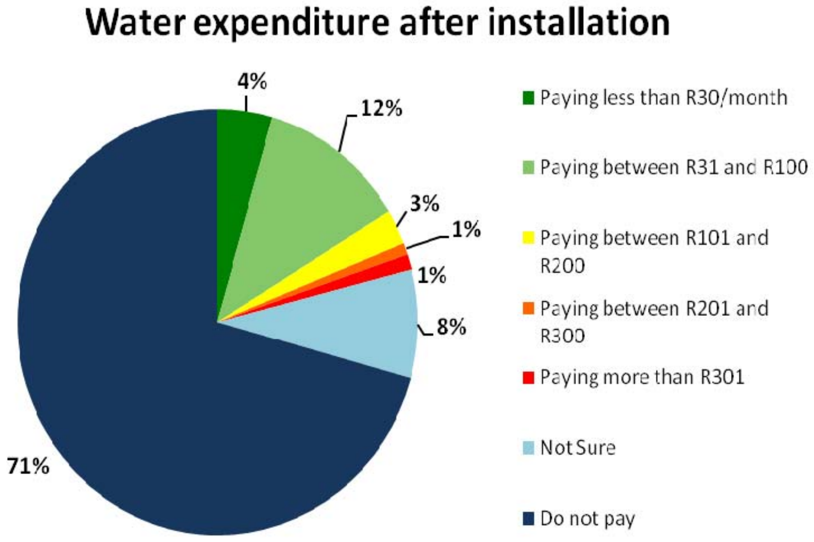


Figure 16: Water expenditure before and after installation (Surveys 1 and 2)

14% of households have noticed that they spend more on water than before the installation. The most common reason given for the increase in water consumption is that people wash more than before because of the SWH. Another reason identified is that while previously residents would fill a kettle to boil water, they now have to wait for the hot water to reach the tap from the SWH, which wastes water. 'We have to open a tap long time before the hot water from geyser comes' – Nobuntu Zondani (Survey 2).

While one of the aims of the SWHs was to give households easy and affordable access to hot water, an unfortunate result of the installation is an increase in water consumption. In a water-scarce city, and a water-scarce country, this is something of concern, especially as the City of Cape Town plans to roll out 120,000 units to low-income communities and 300,000 units to mid–high-income communities over the course of the next four years, and the national government has set a target of installing 1 million units across the country by 2014.

In order to address water wastage and non-payment of water services, the City of Cape Town has recently developed a policy whereby water management devices are installed in prioritised indigent households. The City has extended the free basic service to provide an extra (free) 4.5 kl to the existing 6 kl of free water every month. Households qualify for this scheme on condition that a water management device is installed. This device limits the daily water allowance for each household. 'The number of indigent households qualifying for the Indigent grant on a property value less than R300,000 are 211,879 currently, while another 3,044 qualify for the grant based on income level'[4].

This helps the municipality to identify leaks faster, as the household is likely to notice if their free water is being used faster than normal. As the identification and rectification of water leaks is a priority in Cape Town, previous water debts are written off with the installation of the water management device. These are being installed across the city in a range of income groups and 45,000 had been installed at the end of 2010 (CCT, 2011).

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[4] WATER SERVICES DEVELOPMENT PLAN (WSDP) FOR CITY OF CAPE TOWN 2011/12 – 2015/16, Executive Summary, Draft 2.4.

The most common reason assumed for using more water is that the project is addressing the 'suppressed demand'. Residents now have more hot water available in which to bathe more comfortably. It should be noted that an estimated 95% of residents in Kuyasa do not have installed baths or showers and 'bucket-bath' in approximately 5 litres of water. The other contributing factor is that residents may waste more water waiting for the supply to 'run hot'. There is a lag of 3–5 m for hot water from the SWH to reach the tap. 42% of households use much more water than before and 14% of households say that they spend more on water. However, of the 42% using more water than before, 95% are satisfied with the installation of the SWH. This is perhaps because there has been no implication to non-payment for water services. Since the follow-up survey was conducted, water management devices have been installed in some indigent homes where households were struggling to pay for the water services (see above).

Level of satisfaction with the installation

The feedback received after the completion of the project was overwhelmingly positive. 84% of households surveyed after the installation was complete were satisfied with the outcome of the project. Only 2% of residents were unsatisfied (see Figure 17). The main complaint among unsatisfied residents was due to the installation of the ceiling, with complaints ranging from the noise that the ceiling makes, to the look of the ceiling, to concern that the ceiling is flammable. Others were upset that life had not seemed to change after the interventions were completed or that the SWHs were very weather-dependent.

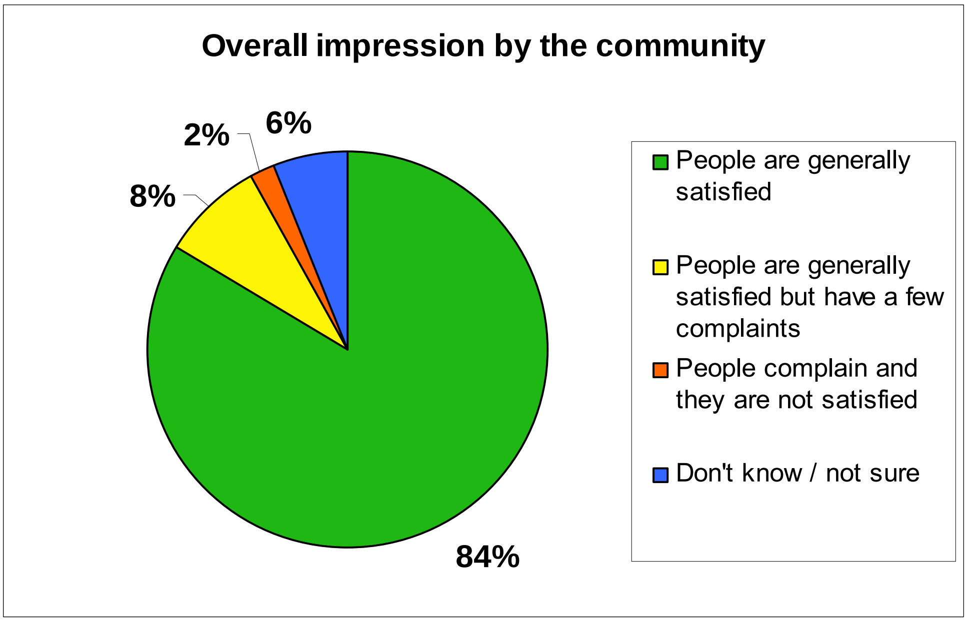

Figure 17: Level of satisfaction with the interventions (Survey 2)

A clear benefit identified by residents was the opportunities created for the community by the project through job creation and skills development. 82% of households listed employment and skills development as a benefit of the project, in addition to the energy-efficiency and health benefits.

From the study being done by the University of Cape Town, it has been seen that there are clear benefits that the community has identified as resulting from this project. The focus group made up of youths between 18 and 24 years old identified that there was a connection between the interventions and their mental health, and that there was less stress in the household around energy consumption. Individuals expressed that prior to the interventions they were often shouted at for boiling water unnecessarily. However, while various small sources of stress may have been removed from day-to-day life, the overarching cause of mental health disorders is poverty, or the level of unemployment which results in the poverty of the community. The interventions undertaken have helped to reduce expenditure in the household, but if there is no income within the household then any expenditure on energy is still a source of stress (van Heyningen and Lund, 2011).

Many people (33%) have indicated that this project has made their life ‘easier’. This has been attributed to an improvement in health, a warm and cleaner house and a reduction in energy expenditure.

Out of 680 households surveyed there have been 145 households (20%) that have needed some maintenance work done. Most of these incidents were because of leaking SWHs, unfinished ceiling installations or wiring problems. Of the 127 incidents that have been reported, half were fixed, most of them in less than five days. The other half were yet to be fixed at the time that the survey was conducted.

88% of households are satisfied with the wiring work done on their house and 90% of households are making use of the plug points installed.

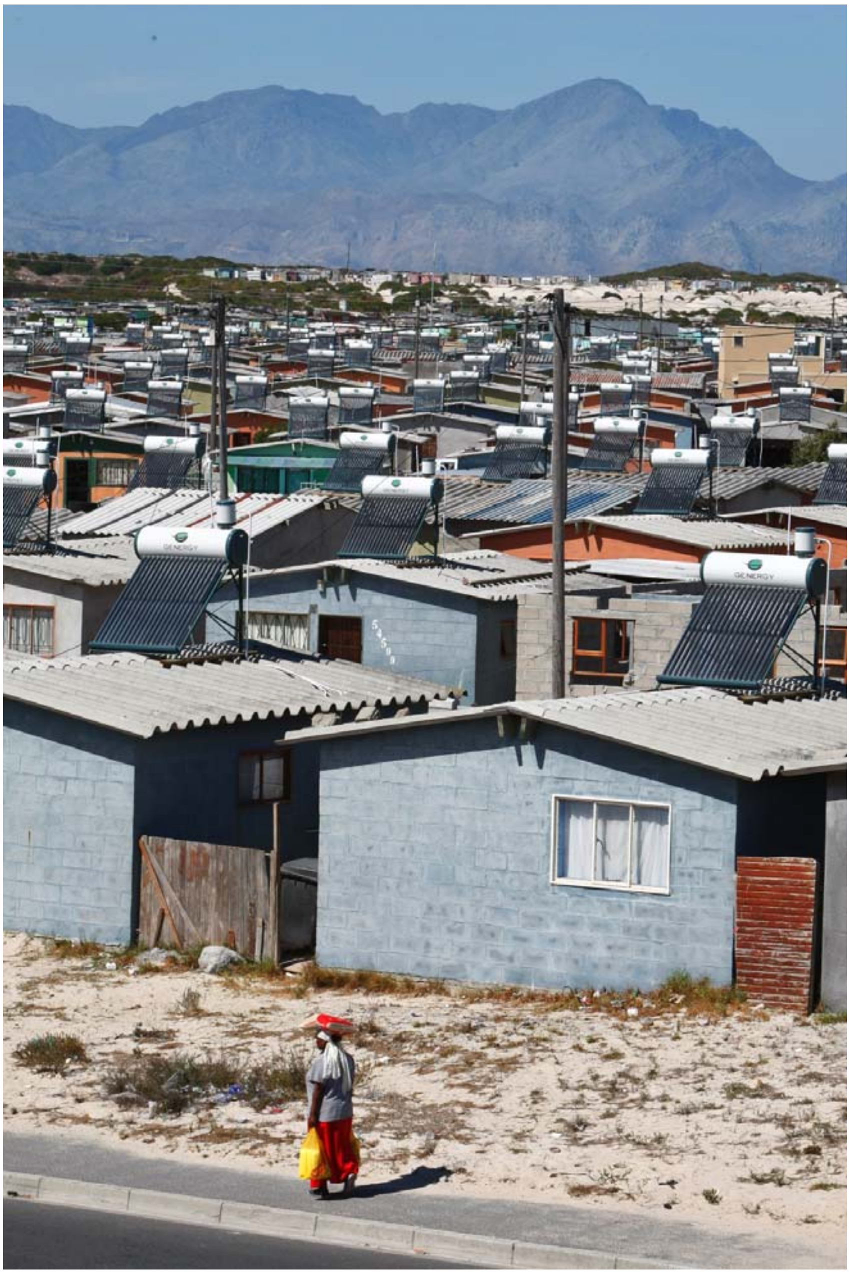

Figure 18: The community of Kuyasa after project completion

Lessons learnt and improvements to be made

Widespread poverty and unemployment remain a source of major stress and anxiety for residents, and a multifaceted approach, providing education, employment, community spaces and sustainable resources, is required to uplift the community fully. This project has however made many valuable contributions to the Kuyasa community and it has assisted in alleviating some concerns and helped to reduce the burden faced on a day-to-day basis. This project was the first in South Africa to access the United Nation's CDM and was the first in the world to be registered as a Gold Standard project. The Kuyasa project has been the focus of much interest, both locally and internationally, and is a good example of the potential that energy-efficiency projects have within low-income communities.

There have been very clear indications that the interventions chosen in this project have resulted in notable reductions in energy consumption. The shift in energy expenditure has been significant, and the community has recognised that the interventions have saved it money. The community has also acknowledged the contribution the project has made towards improving the health of household members, giving the community jobs and training opportunities and improving the wiring in the households.

Kuyasa is a good example of other low-income communities in South Africa, and the replicability of this project provides a good opportunity for other project developers to learn from experiences in Kuyasa in order to roll out other successful projects nationwide. The modular design of the low-income communities of RDP houses means that rollouts of energy-efficient interventions can be done systematically, and by focusing the rollout of projects in designated areas, the rollouts can be done efficiently and with speed. All RDP houses are more or less the same in design and construction, certainly those within a designated area such as Kuyasa, and it is therefore possible to predict the costs of the project with some accuracy.

The savings in energy consumption – specifically given the numbers of RDP houses (2.5 million) built since 1994, with another 3 million houses planned by 2025 – have very real macroeconomic implications for avoided new power capacity and distribution infrastructure. This, coupled with the considerable socioeconomic impact at local level, makes a strong argument in favour of replication of Kuyasa-type installations nationally and at scale.

Incorporating energy efficiency into the initial construction of the house is much cheaper than the cost of retrofitting. It is therefore possible to promote energy efficiency more effectively by incorporating ceilings, solar water heating and more efficiency lighting into the initial design of the RDP houses. This will also help to ensure that new houses are efficient from the outset, which has implications on the amount of unnecessary energy consumed and will help to improve quality of life for the residents. The key factor to be addressed if these improvements are going to become standard on all new-built housing is finance. There is very little (if any) incentive for housing developers to include thermal and energy-efficient specifications, and in the absence of regulation and/or sustainable finance (see proposed NSSF below) it is unlikely that these important interventions will become standard.

Limiting factors and recommendations

There are various items that needed to be addressed with the implementation of this project, and it is foreseen that these will also be a factor in future projects. The lead time for this type of project is long, as project managers need to consult, often extensively, with stakeholders, most importantly with government, the community in question and extended communities.

It is important to identify the most suitable community for the installation of the retrofit, and to do this a clear and sound methodology is required. Kuyasa was one of the first communities to receive formal housing through the RDP rollout, and as such the houses were the oldest, and were identified as those most needing of the interventions. The economic status of the community, the number of disabled persons living in the community or the number of child-headed households could also be selection criteria. This helps to generate community buy-in and to reduce the amount of resistance from other communities also interested in receiving the installations.

This project took many years to move from a conceptual phase to implementation. There were problems with accessing finance and with institutional resistance within local and provincial government. The CDM is complicated, with an unsure future, and it is a long and difficult process accessing financing through it. The current rebates for SWHs and the Standard Offer offered by Eskom, through their IDM, reward energy-efficiency interventions, and have roles to play in financing further energy-efficiency projects.

The Eskom rebate is currently under revision and the future subsidy for low-pressure SWHs is uncertain. Other developing countries may be without these incentives, and therefore without a source of finance currently available to South African initiatives. Even within South Africa, the Eskom IDM funding is considered to be a short-term response to a shortage of electricity supply. It is therefore anticipated that funding these projects will remain a challenge, and potential funding gaps need to be addressed if energy solutions are to be distributed to those most in need. The role of government is also critical, and projects such as these require inter-departmental coordination as well as effective public–private interaction and cooperation. It is important for the project concept to fit within the relevant regulatory framework in order to facilitate progress.

This project aimed to collect a monthly payment from the beneficiaries of the interventions, to generate a sense of ownership and accountability. The issue of collection of this monthly payment has been problematic, and as yet no workable solution has been identified. It was easy to secure commitment from residents to a monthly contribution – particularly after the direct financial savings became evident – but an institutional collection mechanism was required to achieve the actual collection.

The concept of residents forfeiting all or part of their free 50 kWh (basic energy grant) every month to the project implementer as payment for the retrofits has been considered. This too has proved to be problematic as it involves decisions at multiple levels of government, and given the multiple institutional blockages, it proved impossible to secure the necessary official support for a pilot solution in Kuyasa.

There are enormous concerns around the safety and security of collecting these monthly payments manually, a problem which would be common in most low-income communities, as, apart from the logistical barriers, the collector would be required to carry large amounts of cash.

Where to from here?

The NGO SSN – responsible for the original Kuyasa CDM design – has recently entered into a partnership with the Development Bank of South Africa to support the development of an NSSF. Borrowing heavily from the Kuyasa experience, the NSSF is currently busy validating a new CDM Programme of Activities and developing new methodologies for both thermal and energy efficiency in subsidised housing. The NSSF is also developing the financial modelling through which the necessary additional ties can be financed. Carbon finance and carbon credits, cleared at scale, are a key component of this modelling. The NSSF represents arguably the best Nationally Appropriate Mitigation Action (NAMA) for South Africa.

The new methodology proposed by the NSSF programme includes the concept of 'suppressed demand', whereby households would use more energy if they were able to afford it. 'Bringing down the emissions and demand trajectories of developing countries will only be possible, if the expected and hoped for increase in economic activity uses high-efficiency, lower emissions technologies and builds on current energy management behaviour' (Thorne, 2010). This may result in an overall increase in energy consumption, but there would be a marked reduction in consumption against an expected consumption level had the energy-efficient interventions not taken place. If this CDM Programme of Activities methodology is accepted, it could have enormous implications for low-income communities, like Kuyasa, in developing nations in Africa and beyond.

It is hoped, given the critical political imperative of visible service delivery, job creation and poverty alleviation and South Africa's commitments to reducing its greenhouse gas emissions, that the innovative solutions proposed by the NSSF will find the necessary political support – prompting the kind of innovative decision-making that will enable the large-scale replication of the Kuyasa model on a national scale.

An institutionalised process to incorporate these ideas into national housing delivery is then the natural next step, realising ideas such as the NSSF and linking them to national cost–benefit analyses showing the value of such interventions to the country from an economic, social and environmental perspective, as well as to innovative financial models based on cross-subsidising in mixed-use developments. An example of how this can work was demonstrated in 2009, when it was established that the health impact (particularly on TB) of not having ceilings in the condensation-heavy region of the South Eastern Cape was costing the country enormously. Policy was implemented on the strength of this information, and from then on all new government subsidy houses in the region have been required to have a ceiling.

Amending the National Building Regulations to include an energy-efficiency component will also assist in making the proposed interventions a reality, giving policy makers a secure framework from which to act. The regulations will probably not include SWHs, but will require a thermally insulated building envelope, including floors, walls and ceilings, as well as efficient lighting. The additional funds generated through the institutionalised process alluded to above will have to be allocated to secure SWHs on these households.

References

Cornwell, K. and Inder, B. (2004) *Migration and Unemployment in South Africa: When Motivation Surpasses the Theory*. Clayton, Victoria, Australia: Department of Econometrics and Business Statistics, Monash University.

CCT (2006). *Framework for Adaptation to Climate Change in the City of Cape Town*. Cape Town, South Africa: Environmental Resource Management Department, City of Cape Town.

CCT (2011). *Water Services Development Plan (WSDP) for City of Cape Town 2011/12–2015/16, Executive Summary, Draft 2.4*. Cape Town, South Africa: Water and Sanitation Department, City of Cape Town.

Cousins, T. and Mohote, F. (2003). *Social Research for Kuyasa Pilot CDM Project Activity: Assessment of the Impact of Energy Efficiency Interventions in a Low-income Housing Settlement, Kuyasa, Khayelitsha*. Prepared for SouthSouthNorth, Cape Town, South Africa.

Department of Environmental Affairs (2010). *National Climate Change Response Green Paper 2010*. South Africa: The Government of the Republic of South Africa.

Kok, P. and Collinson, M. (2006). *Migration and Urbanisation in South Africa. Report 03-04-02*. Pretoria, South Africa: Statistics South Africa.

Lund, C., Kleintjes, S., Campbell-Hall, V., *et al.* (2008). *Mental Health Policy Development and Implementation in South Africa: a Situation Analysis, Phase 1. Country Report*. Cape Town, South Africa: Mental Health and Poverty Project.

Patel, V. and Kleinman, A. (2003). Poverty and common mental disorders in developing countries. *Bulletin of the World Health Organization* 81: 612.

Pieterse, E. (2009). African cities: grasping the unknowable. Inaugural lecture delivered at the University of Cape Town, 26 August.

Stats SA (2010). *Quarterly Labour Force Survey, Quarter 3, 2010*. Pretoria, South Africa: Statistics South Africa.

Thorne, S. (2010) National Sustainable Settlements Facility – opportunities to finance domestic energy service improvements through climate change mechanisms and Energy Efficiency and Demand Side Management (EEDSM) instruments. SouthSouthNorth Projects: *Human Settlement Review* 1(1).

UN (2009). *World Urbanization Prospects: The 2009 Revision; File 3; Urban Population by Major Area, Region and Country, 1950–2050 (thousands)*. United Nations (UN), Department of Economic and Social Affairs, Population Division. Available from: http://esa.un.org/unpd/wup/CD-ROM_2009/WUP2009-F03-Urban_Population.xls.

UNDP and Goldman, M. (2009/10). *Kuyasa CDM Project: Renewable Energy Efficient Technology for the Poor*. United Nations Development Programme.

UN Habitat (2010). *State of the World's Cities 2010/2011 – Cities for All: Bridging the Urban Divide*. United Nations Habitat.

van Heyningen, T. and Lund, C. (2011). Recorded interview conducted 7th January 2011 with Thandi van Heyningen: *Environmentally Sustainable Housing and Mental Health, a Qualitative Study in Khayelitsha*. Centre for Public Mental Health, University of Cape Town, Department of Psychiatry and Mental Health. (Final study write-up still to be completed.)

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