Synergies between Energy Efficiency and Energy Access Policies and Strategies

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Abstract

Policies to improve energy access and energy efficiency are often discussed, designed and assessed in isolation from each other. In this paper, we highlight possible synergies in these two domains of policy making by looking specifically at some key household end uses that are the first to be met once improved access has been provided. By building in efficiency considerations at the very inception of activities aimed at improving access, effective energy supply available is potentially increased, the level of energy services that can be provided by the existing capacity and infrastructure or from existing budgets available is also enhanced, and the potential for reducing the cost for those populations for which cost has the highest consideration is also improved. In particular, we recommend two areas where policy maybe leveraged to benefit both access and efficiency objectives, first in the setting of standards, labels and codes and second coupling energy subsidies for access with rebates or grants for more efficient end use devices.

Policy implications

- Pursuing energy access and efficiency policies in tandem can help realize substantial synergies by potentially increasing the level of energy services that can be provided by existing infrastructure, reducing energy costs, and avoiding lock in into inefficient technologies and practices.
- Providing increasing energy access more efficiently is likely to benefit from a reorientation of subsidy policies from subsidies on energy alone to grants, rebates or easy credit for efficient end use equipment as well.
- The use of appliance standards and labels coupled with financing schemes for efficient equipment purchases can be an effective means to diffuse more efficient appliances even among the poorest and reduce the overall amount of energy needed to meet growing energy service demands.
- Building codes and regulations can be an effective means of attaining desired levels of thermal comfort while reducing the energy needed for using heating and cooling equipment.

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Introduction

Two standard recommendations made in practically all policy documents relating to the future sustainability of the energy system relate to the need for improving energy efficiency and increasing energy access for populations that are denied this. The United Nations (UN) Secretary-General's Advisory Group on Energy and Climate Change (AGECC) has also chosen two specific areas that present immediately actionable opportunities with many cobenefits: energy access and energy efficiency (AGECC, 2010). However, policies and programs for energy efficiency and energy access have historically not always been pursued in tandem. The two issues have been often discussed and assessed in isolation from each other, and often efficiency is perceived as a secondary policy priority to be addressed after having met primary access goals. This is despite general consensus that providing additional energy access in an effective and efficient manner is desirable. Consequently, discussions of the possibility of synergies in policies for addressing both objectives simultaneously are limited. If such synergies are identified and consciously forged, access maybe enhanced, efficiency improved, and other potential ancillary co benefits may be realized as well (such as better health and safety). The purpose of this paper, therefore, is to map the potential interactions between the two domains of enquiry and policy making, identify synergies and how these might advance both policy fields.

The paper consolidates and systemizes the relevant findings and background research conducted under the framework of the Global Energy Assessment (GEA, forthcoming). It starts with mapping the various routes through which the two fields interact by presenting a brief taxonomy of these and assessing the synergies in concrete end uses most important for low energy consumers. The paper focuses only on consumptive household uses, including lighting, cooking, thermal comfort (cooling and heating) and household appliances. This is followed in section three by a discussion of the general policy implications drawn from the assessment of potential synergies for each of the major end uses. The paper concludes with a few concrete recommendations on how the synergies maybe leveraged in the future.

Taxonomy of interactions between access and efficiency policies

While energy efficiency is often not considered a policy goal in itself, but a means to achieve other targets, it can be a least cost vehicle to help attain many energy related goals, including natural resource conservation, improving energy security and sovereignty (Tirado Herrero, Urge-Vorsatz et al., 2011), reducing environmental emissions (Novikova and Ürge-Vorsatz, 2009; LaBelle, in press), and other socioeconomic goals (Korytarova and Ürge-Vorsatz 2010; Tirado-Herrero and Ürge-Vorsatz, in process). The paper argues that access can also be enhanced by considering energy efficiency objectives during implementing access policies.

In practice, all access policies do in fact lead to efficiency gains as they replace less efficient fuels and/or end use devices with more efficient ones. However, the net benefits in terms of the gains in efficiency are often obscured by the fact that the data on traditional fuel use and spending or expenditures to purchase traditional fuels is either missing or incomplete (due to its non commercial nature) (Pachauri et al., 2004; Pachauri, 2007). National statistics, therefore, tend to only reveal the increases in commercial fuels and fossil energy use without the corresponding decrease in traditional solid fuel use, or human and animal power expanded for economic activities and subsistence. Despite the central role of biomass energy in many developing countries, both for meeting household thermal needs and in small scale commercial and industrial enterprises, facts and figures concerning biomass energy use are often inaccurate or undocumented. The home grown nature of biomass and the complexity (and sometimes illegality) of production and marketing networks makes supply and demand much more difficult to measure than for fossil fuels or electricity. Institutions responsible for biomass energy data gathering also often lack financial and human resources and play a marginal role in government policy making.

Efficiency gains may also be obscured by the fact that as a result of adopting new types of energy carriers, people gain access to a much higher level of energy services. Similarly, household statistics only reveal the increases in expenditures on commercial fuels without revealing the savings to households (in terms of time or money) resulting from a shift away from traditional energy forms. Poorer households tend to spend a larger proportion of their budgets on energy, but they use some of the most inefficient technologies (Heltberg, 2003; Olivia and Gibson, 2008). Many access policies and projects in the past have focused on providing supply without any consideration of how efficiently the supply is provided or the ways the supplied energy is used. By building in efficiency considerations at the very inception of activities aimed at improving access, there is a real chance to increase the potential for increasing the effective energy supply available, advance the level of energy services that can be provided by the existing capacity and infrastructure or from existing budgets available, and potential for reducing the cost for those populations for which cost has the highest consideration.

The reverse also holds true in that most energy efficiency policies have the potential to improve energy access. Energy efficiency measures can shave off peak loads in a power system thereby minimizing the need for investments to meet peak demand, which lasts for only a few hours in a day. Efficiency improvements in energy using products and equipment can reduce final energy needs for meeting the same level of service, thus resulting in energy savings and possibly even in cost savings (through lower fuel costs). For populations that face constraints in the level of energy services they can afford, the same energy supply when used in more efficient end use devices could provide more energy services, either by providing access to a larger population, or access to more services to those already having access, or ideally both.

Taking account of efficiency considerations while implementing access policies is also important in order to prevent a lock in into inefficient technologies and the potential for perpetuating energy poverty (Urge-Vorsatz, Petrichenko et al., 2011; Ürge-Vorsatz and Tirado-Herrero, in process). Energy poverty, in this sense, implies a disproportionate financial burden for meeting energy needs that is either manifested in having to pay disproportionately higher energy bills compared to other households using a similar level of energy service, or by constraining the level of energy services used. This is often referred to as 'fuel poverty' when the energy service concerned is heating. It is most visible in the case of heating because of the long life of the associated equipment and wide range in efficiency of the related infrastructure, but it applies equally to other energy services. For instance, if highly subsidised energy prices are used as a tool to enhance access or to improve equity in access, consumers will have an economic incentive to acquire the cheapest and, thus typically, least efficient equipment (Boza-Kiss et al, 2009a). As a result, later when the subsidies are lowered or lifted, households are left with disproportionately higher energy costs than would be optimal based on a rational cost benefit analysis, made at the time of the equipment acquisition. Since energy using equipment may last many years, in some cases decades, this results in a lock in situation.

A prime example of the severe negative implications of such 'locked in energy poverty' is the case of the former communist countries (Ürge-Vorsatz et al, 2006). In these countries, energy was strongly subsidized in the 20th century, mainly on philosophical grounds. Since energy was considered a basic need, in many communist countries energy tariffs were symbolic, or at least highly subsidized (Ürge-Vorsatz et al, 2006; LaBelle and Kaderjak, 2008; LaBelle and Jankauskas, 2009). As a result, since the true cost of energy was hidden, it was not economic to develop and install energy efficient capital stock that had a cost premium since such investments did not pay back. This resulted in extremely wasteful infrastructure and equipment, as well as energy management practices and societal behaviour. Examples include the poor quality uninsulated building stock, wasteful district heating systems and poor distribution networks, very energy intensive industrial facilities, general lack of controls, switches and metering, and a society that had little, if at all any, awareness of opportunities for how to conserve energy. As a result, decades later, when energy subsidies were lifted or at least reduced after the fall of communism, the society and infrastructure were obsolete and extremely wasteful (Ürge-Vorsatz, Paizs et al., 2006). Since infrastructure and some energy using equipment have a long lifetime, and behaviour, culture and habits are slow to change, these inefficiencies were, or often still are, 'locked into' these societies even though consumers now pay high (energy) prices. The result is that consumers in these countries pay significantly more for the same energy service as compared to their western counterparts. For instance, specific heating energy consumption values in these nations are among the highest in the world, resulting in unusually high heating bills. Energy using habits and behaviour may take up to a generation to change. Consequently, residents in such countries are paying unnecessarily high energy costs without receiving a high level of service. This infrastructural and behavioural 'lock in' typically continues for many years, potentially decades, keeping people in (energy) poverty by forcing them to pay a disproportionally large share of their income for often disproportionally limited or obsolete energy services (Urge-Vorsatz et al, 2011).

Policies and programs aimed at improving access and accelerating the transition from the use of less efficient carriers to higher quality ones have traditionally focused on measures to reduce the costs of these carriers without focusing on the associated changes required in end use equipment purchases. However, for many households, the upfront costs associated with deposit fees and capital purchases needed to use new fuels poses a larger barrier to their adoption than the operating or recurrent fuel costs. In many cases, families lack the upfront capital to purchase new appliances and these costs along with proximity and availability of traditional energy sources are more important in deciding energy choices for poor, and particularly rural households.

The following sections provide a discussion on how synergies might be achieved in access and efficiency policies in the case of each of the basic energy services necessary for households. The focus is on energy in homes, since this is an area where access policies tend to focus first as it relates to basic survival needs of humans. The same arguments are equally applicable to and important for other sectors and uses such as transport, industry and commercial enterprises, but this paper does not address the important synergies between efficiency and access policies for these end uses. A common theme running through each of the following sections is that to improve access to modern energy carriers and equipment requires a reorientation of subsidy policies to shift some of these from fuels to end use equipment.

Lighting

The first application of electricity in most households is for lighting and for many low income households this remains the main end use of electricity. Thus, for many poor households energy efficient lighting can markedly reduce electricity bills. Compact fluorescent lamps (CFLs) use significantly less power than conventional lamps (See Table 1). The relative efficiency of CFLs compared to incandescent lamps is about 1:4, and they can last as much as ten times longer (10,000 hours life versus 1000 hours) (Welz, Hischier et al., 2011).

Improved lighting services for households have traditionally been pursued via centralized grid electrification (Monroy and Hernandez, 2008; Barnes 2007). However, due to low potential electricity demand and economic

Table 1. Comparison of different bulbs

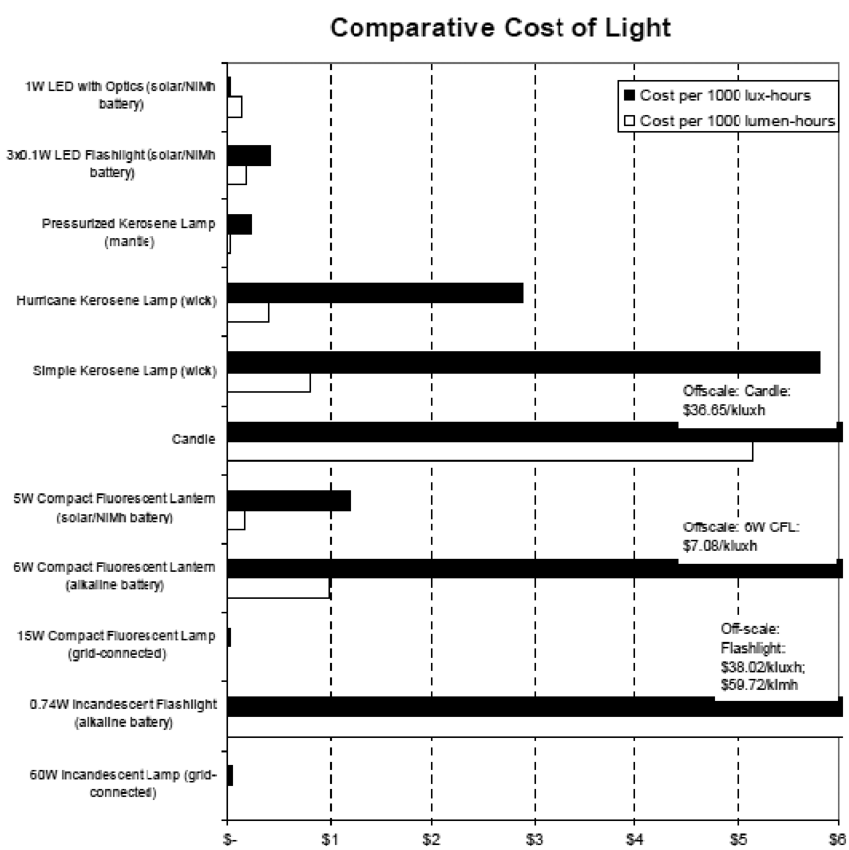
Lamps (types)	Power (W)	Efficiency (per cent)	Efficacy (Lm/W)	Output (Lumens)
Incandescent	100	1.9–2.6	17 (12–20)	1700
Tube	18	9–15	94 (70–100)	1692
CFL	23	8–11	74 (50–80)	1702
LED	15	20–22	113 (80–150)	1700
EEFL	21	9–14	81 (80–82)	1701
Ideal source	7	35–37	242	1700
Theoretical limit	2.5	100	683	1700

Source: Modified from (Khan and Abas 2007).

development, grid extension is often not a cost competitive option in developing regions with low population density and purchasing power. In such regions, access to improved lighting for households can be achieved through scaling up the dissemination of solar lanterns or other off grid decentralized technologies. Many such households depend on kerosene based lanterns (hurricane lamp and open wick lamps) or candles, which have extremely low efficiency and provide low luminosity. Figure 1 demonstrates the significant costs savings for non grid connections that can result by switching from kerosene based lamps to LED (Jones Du et al., 2010). In addition, kerosene lamps also result in compromised indoor air quality (Muller, Diab et al., 2003). Therefore, transitioning to power based lighting can substantially enhance the efficiency of energy used for lighting, with many other benefits such as better health and substantially improved lighting services, and can result in productivity gains as well.

In the case where large populations segments are concerned, the kerosene savings that result might be large enough to affect national oil imports, thus resulting in an additional potential benefit for countries lacking indigenous oil resources. For instance, it is estimated that in India providing efficient lighting services to the approximately 70 million households that still rely on kerosene for lighting, could displace approximately 3600 litres of kerosene annually (Deshmukh et al., 2010). In total, the primary energy needs to provide illumina-

Figure 1. Comparison of performance and costs of lighting systems in developing countries.



Source: Jones and Du, et al., 2010.

tion at a regional scale are likely to decrease following a switch to more efficient lighting, until the level and duration of lighting significantly increases (which is often the purpose of such a program). Solar lanterns rely on a free fuel, and thus eliminate recurring costs for covering lighting needs (such as oil imports), making more family income available for other purposes, and therefore increasing social welfare. However, since these lanterns have capital costs, these potential welfare gains are only realized if the lanterns are subsidised, or if the energy saving benefits exceed the investment costs for such households. In addition, experience suggests that these programs are more likely to succeed if there are standards in place that ensure a minimum quality and if regular access to maintenance and repair services is locally available (Martinot et al, 2002).

Cooking

Cooking is the main energy demand for most low income households in developing countries, but progress on the widespread adoption of more efficient and modern cooking devices and fuels has been slow. Traditional fuels, normally available locally at low or no monetary cost, are relied upon by over 40 per cent of humanity for their cooking and heating needs even today (UNDP and WHO, 2009). Such fuels, including unprocessed biomass and coal as well as charcoal, are characterized by low combustion efficiency, especially when burnt in simple traditional cooking devices, many times cited at around 10–15 per cent (Kammen, 1995; WEC, 1999). The poor combustion and poor heat transfer of traditional cooking technologies also leads to unnecessary waste of the primary fuel supplies, largely wood and crop residues. As much of the biomass is often collected locally, this may lead to degradation and even deforestation when the biomass used is not sustainably harvested.

The poor combustion efficiency also results in emissions of greenhouse gases and aerosols such as black carbon, and suspended particles such as PM10 and PM2.5 (Kandpal, Maheshwari et al., 1995; Ramanathan and Carmichael, 2008). Emission levels of these particulates in most rural poor households are as high as 20 times more than recommended limits of the World Health Organization (WHO) and the United States Environment Protection Agency (USEPA) and associated with increased risk of acute respiratory infections (ARI) and other diseases such as cancer and tuberculosis (Bruce, Perez-Padilla et al., 2000; WHO, 2006). The drawbacks of using traditional fuels in combination with inefficient stoves can be mitigated by the use of energy efficient stoves (Amrose, Kisch et al., 2008) or switching to the use of cleaner combusting fuels. These options offer benefits such as higher biomass conversion efficiency, reduced biomass consumption and reduced smoke. Higher conversion efficiency, in turn, can lead to lower demand of local biomass or other resources.

The first technology often considered for improving the cooking experience for the poorest households are more efficient cooking stoves, often referred to as improved cooking stoves (ICS), which continue to burn wood, but have much higher efficiencies, reaching up to 40 per cent (Practical Action, 2006). Today, a number of low priced modern wood fuelled ICS have been developed, with improvements based on enclosure to retain heat, maximization of heat transfer to the pot and improvement in combustion. However, dissemination and use of such stoves remains rather low because of high capital costs associated with these (see Figure 2). In general, the greater the efficiency of an energy device or equipment, the higher its initial cost tends to be. Also, these costs are typically mostly front loaded, with the benefits accruing over time, as in the case of other energy efficiency investments. For capital constrained low income households that often have access to limited and expensive capital, the preference remains to invest in the cheapest (first cost) options available to meet energy needs. Consumers' internal discount rates also tend to be very high amongst the poorest households. In such circumstances, innovative financing involving the conversion of first costs into a payment stream that is spread over a longer period of time is a crucial method of helping to overcome the barrier faced by the poor and/or first cost sensitive. Consumers can be further incentivized to purchase and use more energy efficiency stoves if standards and certification schemes for such stoves are set and implemented and the financing and rebates on equipment (e.g. the interest rate) are tied to the energy efficiency of the equipment.

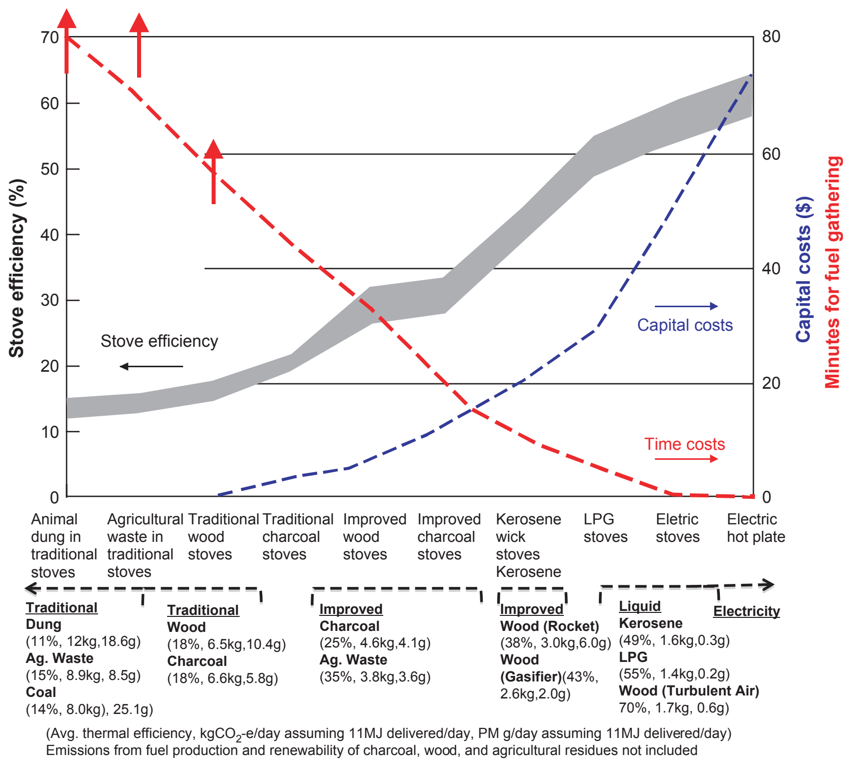
The other option for improving the cooking energy experience of poor households is through a transition to more efficient, convenient and cleaner combusting fuels like liquid petroleum gas (LPG). In India, for instance, LPG was subsidized in the past to encourage a faster transition to the use of this fuel for cooking purposes. Research has shown, however, that the subsidies have largely been appropriated by more affluent urban consumers and have not served the equity objectives they were put in place for (Gangopadhyay et al., 2005). This suggests that financing schemes and loans for the purchase of new LPG stoves need to be coupled with more targeted fuel subsidy policies to accelerate a transition to LPG use in the future.

Space Conditioning

Thermal comfort in the case of moderate temperature differences can be achieved through a wide variety of approaches. The 'simplest' of these is just the flip of a

COLOUR

Figure 2. Stylized comparison of efficiency and costs of cooking stoves in developing countries.



Source: GEA forthcoming.

switch – i.e. turning on cooling or heating equipment. More sophisticated solutions include state-of-the-art building design and shading, energy efficient construction and machinery; cutting edge cooling/heating technologies combined with active energy management practices and potentially adaptive behavioural comfort measures (Levine, Ürge-Vorsatz et al., 2007; Heiskanen, Johnson et al., 2009; Enerdata, 2011). The wide spectrum of energy use levels observed, normalized for climate differences, demonstrates the importance of such efficiency measures on disposable household budgets (for e.g. it takes 2–4 times as much energy to 'heat' the same floor area in Russia than in Japan where innovative energy management practices and localized heating devices minimize household energy used for this purpose).

Traditional policies for making space conditioning more accessible to the poor has been through subsidies. However, if heating/cooling fuels are subsidized, investments needed to minimize heating/cooling loads or to purchase more expensive heating/cooling equipment are not likely to be forthcoming (Boza-Kiss, Novikova et al., 2009). It is therefore paramount to evaluate if, beyond the fuel, equipment, or even more importantly, the building shell can be subsidized. Building codes, combined with innovative financing tools, can be fundamental for achieving these goals. When subsidies for heating fuels are considered, it is important to carefully analyze if it is feasible, and likely superior, to reallocate some or all of the available subsidies to support investments into high efficiency equipment (e.g. through rebates), or, even better, to cutting edge building design and construction. This could provide a longer term solution to the energy poverty/access problem.

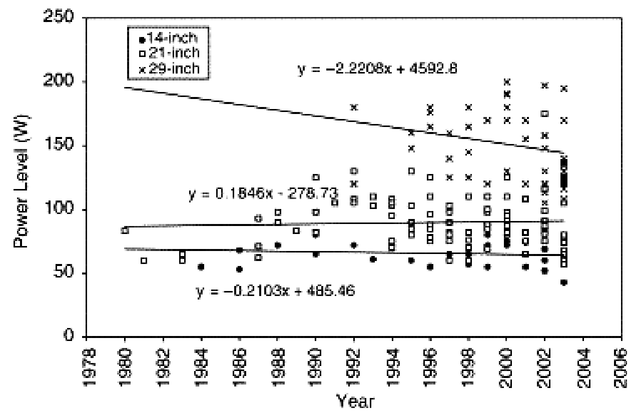
While much of the developing world does not have a high heating demand, in some countries where access is a crucial policy goal there are cold regions where the efficiency of the building stock and heating/cooling equipment matters for the energy cost burden. Policies are needed to address efficiency both in the existing building stock and new buildings. Building infrastructure lasts for decades, sometimes centuries, and thus inefficient, uninsulated buildings may lock their residents into energy poverty for long periods (Ürge-Vorsatz et al, 2006). Subsequent insulation is possible, but is often rather costly, and can also have environmental and social impacts if not properly done. Consumers in energy poverty typically do not have the capital to invest in improving their building stock (Petrichenko and Urge-Vorsatz, 2011).

The situation is different in the case of new buildings. In dynamically urbanizing countries access to commercial heating energy can often be provided through relocating, sometimes to new urban housing developments. As GEA (forthcoming) has demonstrated, for new buildings, cost premiums on buildings that use very little heating energy, such as passive houses, can be marginal, or in some cases even negative (a very well designed and insulated and artificially ventilated building with heat recovery may not need a heating system at all). Thus setting as a goal that new housing developments should be designed and executed to be very low energy is desirable and can be an important policy goal for enhancing energy access.

As far as cooling is concerned, a concerted effort at urban design, zoning, urban foliage, state-of-the-art building design and shading, as well as conscious behaviour can also eliminate, or substantially reduce active cooling needs. Therefore it is important that when access to commercial energy is provided, this is coupled with assistance for ensuring high(er) quality infrastructure, insulation, efficient heating/cooling equipment, and access to information on energy conserving habits/behaviour. Since this is typically associated with investment costs, this will not happen by itself, as most consumers gaining access to commercial energy are unlikely to have the capital needed for this. Therefore, innovative financing, such as pay-on-the-bill or ESCO type funding, are paramount. Nevertheless, since energy efficiency retrofits of buildings can be very capital intensive and can have long payback times, they do not get on the radar screens of private investors, especially low income ones who typically have very high discount rates and thus short required payback times. Subsidies on capital equipment are, therefore, often unavoidable if efficiency is to be advanced in cooling/heating energy use (Sharmina, Tuerk et al., 2009; Ürge-Vorsatz, Arena et al., 2010). If such funding options are not available, education, or access to information, on low and no cost measures to keep heating energy use down can be important.

Building energy codes, appliance standards, appropriate financing schemes as well as subsidies are key policy tools to achieve these stated goals as related to buildings (Levine, Ürge-Vorsatz et al., 2007; Boza-Kiss et al, 2009a; Ürge-Vorsatz, 2009). Efforts to ensure efficient heating/cooling energy consumption facilitates more access to such energy services. In very low income population segments it is likely that these energy services will initially be utilized only at constrained levels due to affordability reasons (i.e. not heated to the ideal 21 degrees), and thus efficiency can enable higher levels of comfort.

Figure 3. Variability of power consumption levels for televisions in stand by mode.



Source: (Varman, Mahlia et al., 2006).

Electric Appliance Based Home Energy Services

Typically, the first energy services following lighting people will take advantage of after gaining access to electricity are related to communication and entertainment: televisions (TVs), phones and mobiles. Later, at higher levels of affluence, refrigeration may be added, an appliance which then constitutes a substantial part of a household's electricity consumption. In what follows we examine how the efficiency of such appliances influences access and vice versa.

The energy consumption of televisions as well as other audiovisual equipment, especially stereos and VCRs, is determined primarily by four factors: on mode wattage, standby mode wattage, off wattage, as well as the share of time the equipment spends in each of these modes. The total energy consumption can be extremely variable, but almost unpredictable. The reason is that there is a very broad range of wattages in each of the three modes even for very similar equipment (see Figure 3). Age, brand, price, or other factors are not good indicators of the energy consumption in any of these modes: new models could consume as much as old ones; expensive brands may have as high a standby consumption as a cheap one, etc. The 'hidden' consumption maybe very high: stereos may draw as much as 20 W even in 'off' mode, potentially 'eating up' dozen(s) of dollars worth of power per year. Similarly, some TVs can consume as much power in standby mode as in 'on' mode, even over 10 or 20 W, again resulting in potentially dozen(s) of wasted dollars (and much energy) annually (Koeppel, Novikava et al., 2008).

Policies or initiatives that encourage energy efficient appliances/equipment can make a difference to the welfare of low income households. If it is assumed that the saved energy costs will be used to afford running more equipment, the levels of energy services that can be afforded from limited budgets will be higher. Appliance standards are among the most cost effective energy efficiency instruments available for this purpose (Koeppel, Ürge-Vorsatz et al., 2007), typically saving energy at substantial 'negative' costs, i.e. at net benefits to the consumer. This means that the potential cost premium of a more efficient model is very quickly recovered from the energy cost payment savings. The benefits of long term, sustained, and progressively improving appliance standards do reach low income households as well but, often with some time lag. This is because the vast majority of consumers just gaining access to electricity do not purchase new equipment, and thus do not directly benefit from appliance standards programs. This could potentially raise questions about the benefit of such policies especially for the poor. However, even equipment sold on the used market was new at one point. Thus, if appliance standards are continuously improved, the benefits will ultimately trickle down to even the poorest.

Nevertheless, for some equipment, such as refrigerators, this lag or 'delay' in the replacement of the stock has a significant 'efficiency penalty' and thus results in wasted energy. This is because some appliances, notably refrigerators, have undergone dynamic and progressive efficiency improvements over the past two decades or so, more than halving their specific energy consumption during this period. Therefore using second hand (or older) equipment may make the household (and the utility) spend up to twice the maintenance costs as that on a new model. Therefore encouraging the purchase of new equipment could save family resources as well as save energy at the aggregate level. However, low income households will only be able to afford new more efficient equipment if they receive rebates or other forms of subsidies or appropriate financing schemes can be devised for them. If energy using equipment is considered an integral part of the access infrastructure needed for providing the most access to the largest populations from limited resources, this fits into the overall framework of access provision. Such initiatives could benefit utilities as well since it could enable them to provide more access with less capacity, or may even put off the need for them to construct new power plants.

Policy implications

As demonstrated above, access policies should go hand in hand with encouraging energy efficiency. This is because this can enable (1) households to afford more energy services from the same limited budgets or save money on energy costs; (2) more energy access to be provided from limited production capacities, reducing the need for capacity expansions and thus pressure on utilities; (3) reduced energy consumption that can also save governments subsidy expenditures if tariffs do not reflect the full costs of energy; (4) many additional cobenefits, such as reduced indoor air pollution and associated health gains, potentially reduced oil imports, improved local and global environmental conditions, climate change mitigation, etc.; (5) the prevention of technology lock in and potentially high intensity energy use and thus potential energy poverty for many years/decades to come.

While this can be considered as a common sense conclusion, it is far from being the standard practise in development assistance. While there are examples of successful programs taking advantage of these synergies, other programs either do not consider the two policy goals synergistically, or consider efficiency only on a rhetorical level. There are a number of policy implications of these synergies between access and efficiency policies. Improved access to energy services for households have traditionally been pursued via centralized grid electrification programs with a significant subsidy component for poor and rural households (Monroy and Hernández, 2008; Barnes, 2007). Many of the subsidy programs have often taken the form of below cost low tariffs, which while justified on welfare grounds, can result in wasteful and inefficient consumption in the long run. If consumers pay less than market prices for energy, the economic signals will 'encourage' inefficiency, resulting in wasteful equipment; often in place for many years or even decades. Large subsidy expenditures can also have an impact on the long run financial viability of electric utilities. More recently, there has been a call to provide either a subsidy or financing and credit mechanisms that allow the initial costs (meter deposit and other connection costs) for new utility customers to be spread over time to promote electrification by making it more affordable for poor households. This coupled with a 'lifeline' tariff for the first block of electricity consumption might be justified on equity grounds for low income households. However, in order to avoid the distorting long term impact of tariff subsidies, as well as ease the other impacts of subsidies, coupling such policies with similar subsidies or easy financing for more efficient equipment and appliances could avoid lock in, prevent related energy poverty and could be a real way to both improve the effective supply of electricity to households and might lead to an ultimate cost savings or higher energy service affordability for the consumers. In other words, support mechanisms that subsidize access should not stop at the end of the 'wire', but should extend also to at least considering the support of high efficiency energy using equipment, for instance, distributing high efficiency lamps, or coupons/rebates for the purchase of high efficiency appliances.

Among the most cost and environmentally effective policies to improve energy efficiency are appliance standards and building codes. Consumers are in general too first cost sensitive and thus often do not make the purchase decisions that would result in the economically most optimum solution for them. This is especially true for the poor segments of society who are even more first cost sensitive, or have extremely high internal discount rates and thus cannot value future savings, even if the benefits of such equipment far outweigh the extra investment costs. For such situations appliance standards coupled with financing schemes for efficient equipment purchases are a very easy and low cost solution that can prevent households from locking themselves into owning wasteful equipment. The fact that most of the equipment owned by the poor who are the beneficiaries of access policies are purchased second (or third or...) hand does not diminish the long term value of such policies for this purpose since the equipment purchased today by the more affluent will be passed down in a matter of few years to the poorer segments of society, and thus result in benefits to them through lower operating energy costs in the future. Appliance standards are becoming popular throughout the world, also in developing regions. It is beyond the scope of this paper to go into details about the design of appliance standards and building codes. However, the fact that at least 26 developing countries have some sort of appliance standard or label in place[1] suggests that this is increasingly being considered as a policy tool that could have impact. There are still challenges to the enforcement of such standards and codes that need to be addressed. Several international organisations are active in assisting countries to develop appliance standards and building codes, including the Collaborative Labelling and Appliance Standards Program; ClimateWorks; and the Global Environment Facility. Building codes, however, can be more challenging to implement especially in countries with a large informal construction sector.

Conclusions

The discussion presented above highlights potential synergies in energy access and efficiency policies. The assessment presented above clearly highlights the need for and advantages of keeping efficiency consideration in mind when designing policies that aim to provide improved energy access to low income households. In what follows, these key synergies are not summarized again. Instead, in this section, we conclude with a few recommendations on areas where these synergies may be leveraged in the future.

A clear area for action that emerges from this assessment is in the design and implementation of standards and labelling programs in developing countries. Having clearly specified standards and labelling is important both from an efficiency perspective and can be an important means to enhance energy access. While there are costs associated with such programs, developing countries have the potential to reap multiple benefits from the implementation of standards and labelling programs as already described in earlier sections of the paper. These can be an effective way to encourage adoption of technologies spanning the spectrum from solar lanterns for lighting and improved biomass stoves for cooking, to regular household appliances like televisions and refrigerators. In addition, building codes and regulations can be an effective means of attaining desired levels of thermal comfort (heating or cooling) without the use of large amounts of energy in heating and cooling equipment. Such standards, labelling programs and codes can help inform and sensitize even poor households about their energy use and provide them with a means of meeting their desired energy service needs through lower energy use.

The key constraint for the purchase of more efficient equipment and appliances in all households, whether poor or rich, tends to be the upfront costs associated with these. This is an area where energy access policies might be designed to leverage the synergies with efficiency policies more effectively. Most energy access policies include a fuel or electricity subsidy component to enable low income households to afford the energy. In some cases, subsidies are also provided for the upfront costs of connection. Recent research suggests that the higher costs of energy end-using equipment associated with a switch to the use of cleaner and more efficient energy carriers can be as large a deterrent for households to transition to these carriers as the recurrent costs associated with their use (Ekholm et al., 2010; GEA, forthcoming). In these circumstances, it seems prudent to consider policies that combine subsidies for access provision for fuels or electricity with rebates for the purchase of more energy efficient end use equipment. If this is not done, it is likely to continue to provide a perverse incentive to newly connected households to use energy inefficiently.

Note

1. See www.clasponline.org

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