POLICY PAPER

Role of Tariff Policy in Improving Energy Efficiency in the Residential Sector

The research is conducted in the framework of the project "Policy Research for Sustainable Economic Development", implemented by PMC Research Center by the financial support of Konrad-Adenauer Foundation

The content does not necessarily reflect the view of PMC Research Center or Konrad Adenauer Foundation

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Acronyms

EE – Energy Efficiency

GDP – Gross Domestic Product

GEL – Georgian Lari

GNERC – Georgian National Energy and Water Regulatory Commission

HH – Households

HPEP – Hydro Power Plant

NEEAP – National Energy Efficiency Action Plan

O&M – Operation and Maintenance

RBT – Rising block tariff

R&D – Research and Development

RE – Renewable energy

STATA – Software used in Econometrics for processing of large datasets

TNA – Climate Change Mitigation Technologies Needs Assessment

INTRODUCTION

Tariff policy plays an important role in providing "right" price signals for consumers, which is a necessary condition to improve the demand side energy efficiency (EE) in terms of the environmental, social and economic benefits. Improving EE is the most effective way to address challenges of energy security, import dependency and climate change. In spite of these benefits EE still remains underutilized in Georgia. Regulators can partly address this issue by creating "right" consumer incentives through adequate electricity tariffs. In other words, the price should reflect the costs considering all its components, and guarantee that the cost of the companies involved in electricity chain are covered. Electricity tariffs can stimulate energy efficiency, however, if other barriers remain unaddressed, raising utility tariffs alone will not lead to the desired effect. Another important factor affecting consumers' incentives is the transparency of the tariff. Consumers should be able to understand the electricity price and consumption so the tariff can motivate decisions toward both behavior changes and investments in energy efficient technologies.

Since Residential sector is one of the main consumers of electricity and represents the sector of the highest potential for energy savings, the research will be oriented on the residential tariffs and related issues. About 40% [1]of electricity is consumed by the Residential sector; in contrast to Industry and Commercial sectors level of energy efficiency is much lower. Private companies in contrast to residential sector customers are more oriented on costs minimization and are more "price responsive" and motivated to reduce costs through more effective energy consumption management and investments in more energy efficient technologies.

[1] For comparison, share of electricity consumed by Industry is 25%, commercial 13%. Source: National energy balance

There are three electricity distribution companies in Georgia: "Telasi"[2] – the distribution company of the capital Tbilisi, "Kakheti Energy Distribution"[3] – Kakheti's regional distribution company and Energo-Pro [4] –the biggest distributor covering the rest of Georgia. Tariffs in residential sector are **Block Tariffs** that can be partly considered as energy saving regulation. The residential tariff level was set by regulator in 2006 and was not changed until 2013, when the tariffs for the first and second blocks were reduced (table 1).The tariffs for Tbilisi electricity Distribution Company are fixed by the Memorandum with the government. According to the Memorandum, the tariffs have been reduced from their initial level for a fixed period of time, but will come back to the previous level after 31 December 2016. In addition to this reduction there are certain subsidies in the sector such as "social"[5] gas for thermal power plants, energy vouchers[6] distributed by Tbilisi city Hall. All this factors, together with inflation rate (53% during 2006-2014)[7] made real cost of electricity very cheap compared to initial 2006 year's value. The energy voucher program aiming to support electricity customers in Tbilisi, however, didn't address the issue well. Vouchers were equally distributed among all residential customers in Tbilisi in spite of income or consumption level of households. Moreover, while aiming to reduce burden of increased bills in winter the fact that in Tbilisi only 22%[8] of households use electricity for heating out of which only 9% use electricity as the main source of heating was not considered. From this year on Tbilisi City Hall

[2]Telasi serves about 450 000 residential consumers

[3]Kakheti serves about 150 000 residential consumers

[4]Energo-Pro serves about 850 000 residential consumers

[5]Georgian State owned companies (Georgian Oil and Gas Corporation and its affiliate Gas Transportation Company) are entitled to cheap gas and in-kind fee for gas transportation over Georgian territory. So called "Social" gas is provided to part of household customers and Thermal Power Plants at cheaper price. In 2013, gas supply (wholesale) tariff (excluding VAT) was determined by 250 GEL/1000 m3 (110 USD/1000 m3). Gas Regional market price ranges within 350-435 USD/1000 m3.

[6] In 2013 and 2014 Tbilisi City Hall has distributed energy vouchers of 100 GEL to all customers in Tbilisi in 5 cold months. The voucher was used to pay electricity, water and waste disposal service bills.

[7] GEOSTAT

[8]Winrock International Municipal survey

decided to distribute energy vouchers only among vulnerable (socially unprotected) customers.

Recently it became obvious that the electricity tariffs are not cost reflective anymore due to recent sharp increase in exchange rate and increased consumption that resulted in increased imports. Telasi has already submitted application to the Regulator requesting the tariff increase and it seems that the tariff for its customers will be increased. Sometime before, Energo-pro did the same and residential tariffs for its customers were recalculated and increased by 3.95 tetri for all three blocks.

TABLE 1. *ELECTRICITY TARIFF CHANGE BY SUPPLIERS FROM 2013 (TETRI/KWH, INCL. VAT – 18 %)*

	Telasi		Energo-pro		Kakheti	
Block	2006-2013	from 2013	2006-2013	from 2013	2006-2013	from 2013
Until 101 kWh	13.48	9.48	12.98	9.00	12.98	12.98
101-301 kWh	16.00	12.46	16.52	12.98	16.52	16.52
From 301 kWh	17.70	17.70	17.50	17.50	17.50	17.50

Apart from the elasticity of demand with respect to tariff rate, there are other elasticity effects that affect residential consumers' decision. One of such effects is non-energy elasticity. For examples, with increased income a consumer may buy additional electric appliances or move into a larger house which will lead to increased electricity consumption. Also cross elasticity may affect consumers' decision when with increased electricity price a consumer may reduce consumption of other goods rather than reduce electricity

consumption. Another important issue that distinguishes residential consumer from non-residential one is low awareness of energy efficiency. According to the recent Residential survey conducted by HPEP project less than 30% of residential consumers knew what term “energy efficiency” implies, however, this does not mean that even those who knew about the term possess sufficient information on modern energy efficient technologies and their benefits. This indicates that there is information gap that may be considered as one of the main barriers to energy efficiency. This information gap makes electricity price signals less effective in motivating residential consumers toward energy efficiency since increased electricity bill may induce consumer to reduce energy consumption at the expense of reduced comfort rather than invest in energy efficiency and receive the same service with less energy.

The goal of this research is to develop key policy recommendations to consider the role of residential energy pricing in a comprehensive complex of policies and programs to enhance EE in Residential sector and to tackle persistent barriers for EE. The paper does not address issues concerning price making process such as tariff methodology and tariff components as well as it will not propose any changes in existing electricity prices since it doesn’t serves the goal of the research.

- *Roadmap*
- The issues covered in the paper include:
- Analysis of electricity consumption dynamics and structure to assess seasonality and price responsiveness
- Main EE barriers in Residential sector
- EU electricity and EE requirements
- Current EE state, programs and practices
- *Limitations of the study*

Due to the absence of reliable historical data, elasticity of electricity consumption was not estimated for Residential sector in Georgia. Several studies examining relationship between tariff rate and electricity consumption behavior and role of tariffs in motivating EE were used to support the paper's goal.

Municipal Survey conducted by Winrock International covers only 10 biggest municipalities (not randomly selected) representing more than 50% of population and covering all regions. Limitation of this survey is that energy consumption behavior is geographically asymmetric and residents of some municipalities that may have radically different consumption habits may not be captured by the survey. Some outputs of the survey were used in analysis of consumption structure, however, data was compared to relevant results from another Residential survey. Mainly Residential Survey, conducted by HPEP project was used that is representative for households in Georgia excluding those residing in the occupied territories of Abkhazia and South Ossetia. The sample is representative of the country as a whole, as well as separate urban and rural areas of Georgia. Since no official data is available on consumption structure surveys conducted by donor projects were used.

Some of the proposed recommendations may be in line with activities under current donor projects promoting EE in collaboration with Ministry of Energy, Ministry of Economy and Sustainable Development, Tbilisi City hall, etc.

Recommendations proposed by the paper lists policy measures and approaches and does not include exact activities to be implemented within proposed measures.

I. METHODOLOGY

In order to achieve the goal of the research the following activities were performed.

- **Desk study** of available research papers and policy papers on customers' incentives for energy efficiency through electricity rate design, analysis of best practice. Review of developed countries' practice on considering tariff design options to motivate consumers toward energy efficiency will help to better understand price response behavior of households. Additionally, review of domestic energy efficiency policies and programs will be conducted to analyze other incentives affecting consumers' decision on improving energy efficiency and consider their effects in the research.
- **Analysis of electricity consumption structure**. The analysis will be conducted on for what purposes electricity is used in residential sectors and what appliances are currently used by average households in urban and rural areas. Analysis will be based on data from Residential Survey conducted by Deloitte/HPEP in 2014, Municipal Survey conducted by Winrock International as well as on data form Caucasus Barometer[9]. The dataset will be processed using STATA software. The analysis of electrical appliances used will help to see the tendency and possible income elasticity effect on electricity consumption change. For example, those households that currently do not possess some basic appliances (refrigerator, cloth washing machine, etc.) are more likely to purchase them once their income increases (as GDP/capita grows) and there will be tendency to increase electricity consumption. Dataset will give possibility to estimate number of such households and to see large scale effect. Another issue

[9] Annual Residential Survey conducted by CRRC

that can be analyzed using available survey is whether households' electricity consumption corresponds to their "comfort" level or whether they have to limit their electricity consumption due to financial constraint. This will point out to two things: 1. Once the households' income increases they are more likely to increase electricity consumption as well as reach the "comfort" level; 2. Portion of households that has to limit their electricity consumption indicates vulnerability of some households toward electricity tariff size, however, they still tend to conserve electricity rather than invest in energy efficient appliances which happens, probably, due to other barriers that will be reviewed in this research as well. Analysis of seasonal electricity consumption will be made to assess seasonal consumption patterns.

- **Awareness and other barriers analysis**. Using the same surveys, analysis will be made of what portion of residents heard about "Energy efficiency" in rural and urban regions separately, what types of EE measures they are going to implement in the nearest future and what are the main barriers they are facing. Additional root cause analysis of the main barriers will be made to better understand the barrier's nature and its consequences. Logic Problem Analysis method will help to develop recommendations to tackle the main barriers.
- **Residential electricity consumption dynamics** in the recent years will be analyzed as well as changes in electricity consumption growth due to recent tariff reduction. This will help to see whether there is any effect on electricity consumption due to decrease in the electricity rate and will indicate possible level of vulnerability of electricity consumption toward the tariff change. The level of vulnerability will be

also estimated using analysis of what portion of households' income is spent on electricity bills[10].

- **Review of EU Electricity and EE requirements** under Association Agreement. Last year Georgia signed Association Agreement and expressed desire to become a member of Energy Community. Under this environment Georgia will have to fulfill certain obligations, some of which concern electricity sector and energy efficiency. Although fulfillment of some directives is subject to negotiations they provide guideline to eliminate barriers and improve energy efficiency (like NEEAP[11]). Moreover, EU often provides technical and financial support by means of grants to improve energy efficiency, however, without government's clear vision and strategy their effort is uncoordinated and often overlapping important issues. Therefore, harmonization with EU in the field of energy efficiency can be considered as a viable route to development where best EU practice and experience can be used. Main findings will be included in the final recommendations.
- Results of the research are incorporated into a complex of recommendations for policy maker to consider using tariffs design to encourage energy efficiency together with other policies aiming at the elimination of persistent barriers to energy efficiency in the Residential sector.

[10] WEG has all necessary data for such analysis

[11] National Energy Efficiency Action Plan (NEEAP). EU provides a template and guideline how the plan should be developed and EU provides technical and financial support to new member states to develop NEEAP. EBRD financed development of NEEAP in Georgia.

II. RESEARCH RESULTS

2.1 DESK STUDY AND REVIEW OF EXISTING EE PRACTICES

There are number of research papers studying relationships between energy prices and energy efficiency or how energy tariff can affect consumer's behavior. Some papers study demand side management policies while some focus on electricity market design that can induce consumers to make "right" choices. The aim of the desk study is to review the most relevant studies as well as successful experiences of developed countries in influencing energy efficiency through energy rates.

Residential buildings are one of the main electricity consumers globally and in Georgia as well. Its energy consumption accounts for 40% of total energy consumption globally ((UNEP 2009)). Therefore, number of countries pay special attention to the building sector when developing energy efficiency measures and policies. Numerous studies report evidence of the strong impact from regulatory and control measures. Today, building codes[12] vary widely across countries. Regulatory and control measures can reduce transaction costs to end-users, and provide high energy savings at low costs, sometimes at negative costs to society ((Haney 2010)). In this respect Ministry of Economy and Sustainable Development of Georgia together with sector specialists developed draft of Spatial Panning and Construction Code which was then sent to the Parliament of Georgia for further adoption. The aim of the document is to minimize existing problems in the sector as well as to increase energy efficiency of newly constructed buildings. Even though the code is not adopted yet there is a new practice of insulating new buildings and using efficient construction blocks by

[12] A series of ordinances enacted by a state or local governmental entity, establishing minimum requirements that must be metin the construction and maintenance of buildings.

construction companies. Of course, since the code is has not been adopted yet there are no strong regulation mechanisms to control the energy efficiency level of newly constructed buildings, however, such practice shows that such regulatory mechanisms can bring substantial changes to at least newly constructed buildings. Another positive experience in this direction is newly launched EBRD project with aims to increase energy efficiency in the building sector though the analysis of different energy efficiency measures and development of construction norms that will include the most economically efficient and feasible measures. The project is being conducted by Finnish company VTT supported by think tank "World Experience for Georgia" together with Ministry of Economy and Sustainable Development. These norms will help to regulate and monitor current construction practices; in addition, it can also include some measures concerning improvement of energy efficiency performance of existing buildings, which are mostly inefficient resulting in large heat losses and inefficient energy consumption.

However, while norms and codes are effective mechanisms for improving energy efficiency in newly constructed buildings, they are difficult to implement for existing buildings. That's where awareness raising campaign should come in to stimulate residents of existing buildings to perform retrofit and energy efficiency measures (like insulation) in their houses. The impact of awareness raising campaigns is difficult to disentangle from joint measures, and possible short and long term effects. Campaigns are particularly successful when the message is clear, carefully adapted to the targeted population, relevant to its needs, and when it creates a social context which strengthens the impact ((Janet A. Weiss 1994)).Tbilisi City Hall assists condominiums to perform retrofit of existing multi-apartment buildings in the capital. In majority of cases Tbilisi City Hall provides 70% of necessary investment, however, condominium members should decide which

measure to implement. Therefore, it is important that they understand the benefits of building insulation and have all available information on the possible materials that can be used, and associated costs. Regulatory and economic instruments have a high potential, but their outcome is ambiguous if there are not accompanied by capacity building and educational measures ((Haney 2010)).

In general a successful strategy is the combination of “sticks” (regulations) with “carrots (incentives) and “tambourines” (awareness raising campaign) ((Sonja Koeppel 2007)). Effective energy efficiency policy requires systemic approach where package of measures are aimed at existing barriers overcoming accounting for complexity of the energy system and possible responses. In other words, there is need for integrated policy approach or energy strategy, where energy efficiency should be an integral part with clear vision and action plan so that all energy efficiency barriers are accounted for and complex of proposed energy efficiency measures is consistent with other sectors’ development proprieties and measures. Georgia is in the process of development of energy strategy. There is no energy efficiency legislation or norms, so that the sector is left without proper support from the government and number of donor projects promoting energy efficiency are lacking coordination due to absence of common vision. One of the positive changes in this direction is new EBRD project that has been launched recently with aim to assist the Ministry of Energy of Georgia in development of the first National Energy Efficiency Action Plan (NEEAP). The process will help to unite local and international sector experts’ knowledge to create common vision and develop economically efficient complex of measures to improve energy efficiency in the country. Particular attention will be paid to residential sector which is one of the main consumers of energy and has the largest energy efficiency potential.

However, all the measures can be ineffective if there is no right pricing. If the energy price, for example, is too cheap it is very difficult to convince consumer to invest in expensive advanced technologies, since payback period of such investment will be long. Prices and tariffs are not an effective mechanism to address many of the barriers alone, but they play a supporting role to other measures. In Georgia there are increasing block tariffs for electricity in the residential sector. Such tariffs could reduce the incentives for suppliers to help households with energy efficiency due to the marginal profitability increasing rapidly with the volume. The impact on suppliers' incentives is not always sufficiently recognized ((Anna Kulhavy 2009)). On the other hand, such tariffs create incentives among consumers to minimize the electricity consumption; however, without other supporting measure consumers' response may not lead to energy efficiency but reduce consumption by lowering comfort level or leading to substitution with other products where applicable (other energy sources). Using pricing structures to affect consumers' choices may result in a welfare effects on those consumers that cannot afford buying advanced technologies or insulate their houses. In such situation pricing structure will hinder the eradication of fuel poverty. Therefore, it is very important to protect vulnerable consumers and ensure that they do not suffer from any unintended consequences. Another important factor that should be taken into consideration is that low income households are relatively more price sensitive than middle and high income ones. As a rule, energy consumption of low income households is lower, since they usually do not have many electrical appliances limiting themselves to only the most basic ones.

Demand responses to price change also differ by the time period. (James A Espey 2004)Review of 36 existing studies on residential demand found the median estimates for residential electricity price elasticity was -0.28 in the short run, and – 0.81 in the long run. These estimates suggest that domestic

energy demand is not very responsive to price changes in the short run. It does, however, increase over time. This is likely to be a result of consumers making some adjustments in usage such as the acquisition of new appliances (Anna Kulhavy 2009)

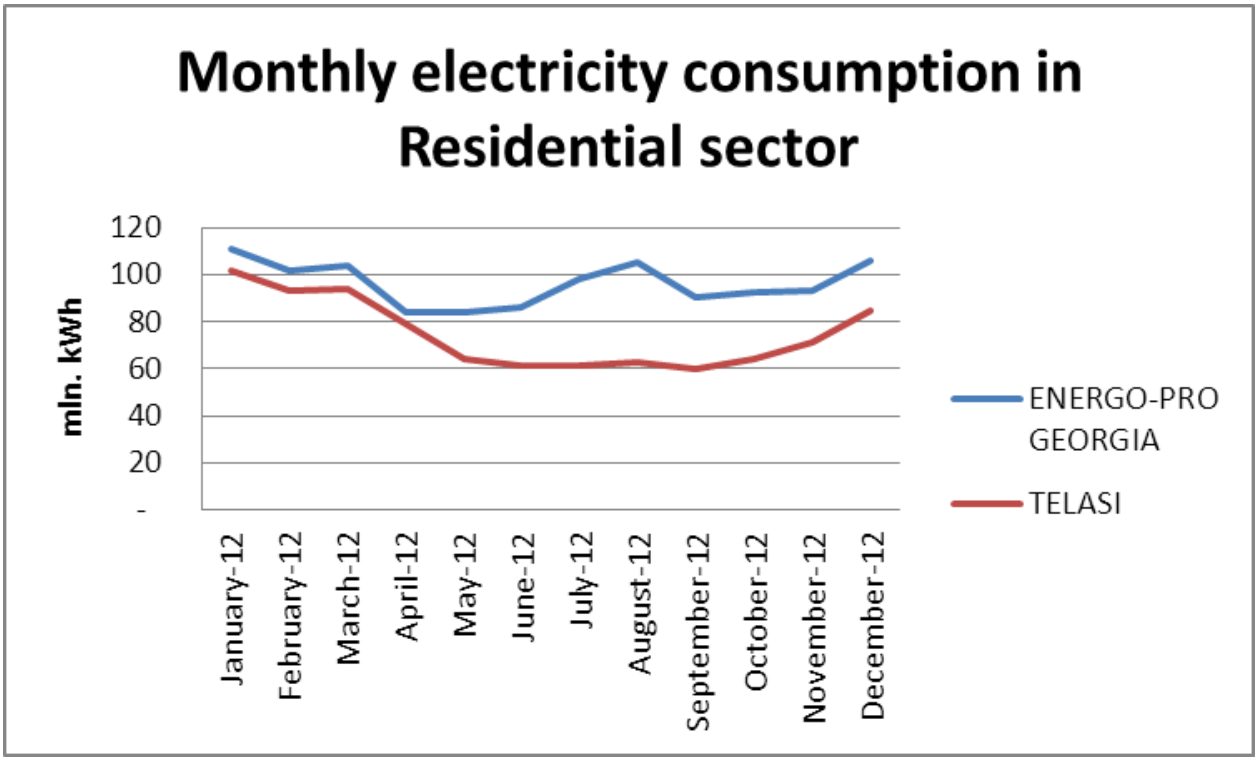
Rising Block Tariff (RBT) is not very popular in the countries with liberalized electricity markets where consumers have freedom to choose the supplier. However, some countries such as Albania, Bulgaria, Moldova and Romania use it to provide incentive for more efficient use of energy (especially make consumer's shift from heating with electricity) as well as to make electricity more affordable for low income consumers.

2.2 ANALYSIS OF ELECTRICITY CONSUMPTION STRUCTURE

Electricity consumption is quite seasonal in Georgia. Figure 1 shows monthly consumption by Residential sector of two main electricity distribution companies. Interesting fact is that consumption of Telasi customers (Tbilisi and suburbs) is more seasonal than consumption of Energo-Pro customers (rest of Georgia except Kakheti region). Difference between typical winter and summer months' electricity consumption is 67% and 13% for Telasi and Energo-Pro customers correspondingly. In hottest months (July and August) consumption of Energo-Pro customers almost reaches winter's level which is explained by cooling especially in warm regions like Adjara. In Tbilisi summer consumption is smoother, which can be partly explained by the fact that usually households leave the capital during the hottest period. Seasonal consumption is due to seasonal service demand such as cooling and heating. Lighting can also be partly considered as seasonal due to shorter days in winter and increased demand for lighting. Smoothing of seasonality or reduction of winter's consumption is very important for Georgia, since there is deficit of water in winter and even with addition of thermal power plants

(operation of which is more expensive than HPP) there is need for import of electricity. Reduction of electricity consumption and especially winter's increased consumption through improved energy efficiency can save expenditures on energy and improve energy security through reduced imports.

FIGURE 1. *ELECTRICITY CONSUMPTION BY RESIDENTIAL SECTOR*



Source: Ministry of Energy (2012)

Analysis of electricity consumption structure will help to understand what service demand is satisfied with electricity and what types of appliances are used in Residential sector to assess EE potential. For this purpose two recent surveys datasets were used: Residential survey conducted within HPEP project in 2014 and Municipal Survey conducted by Winrock International in 2014.

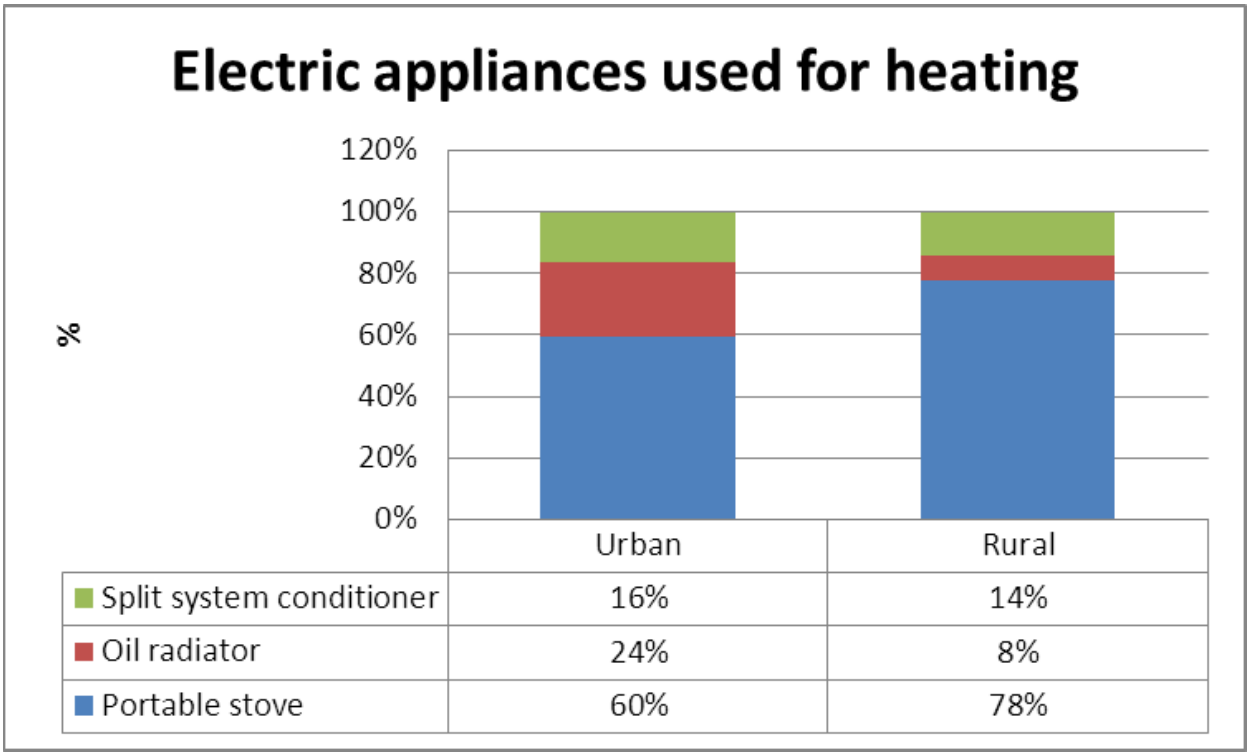
As was mentioned above types and number of appliances as well as energy sources used differ in rural and urban area, therefore, those two will be analyzed separately.

The main energy sources used for heating are natural gas (mainly in urban areas) and wood (mainly in rural areas). Electricity is not the main source used for heating. According to Municipal Survey only 20% of urban and 5% of rural residents use electricity as additional source for heating (in addition to main heating system), while only 11% of urban and less than 1% of rural residents use it as the main source for heating. Figure 1 shows shares what types of appliances used by households that use electricity for heating. Neither of mentioned devices provides enough heat for all rooms, therefore, once income of households will increase there will be tendency of switching to individual central heating system[13] which is fueled by natural gas. On the other hand, those who use split system conditioner[14] will use it in winter as well, as an additional source of heating. Therefore, as income of households (GDP/capita) will grow the share of households that use split system conditioner will increase.

[13] Individual central heating system provides heat for all rooms of one particular flat.

[14] Efficiency of this device when used for heating is higher than any gas stove or wood stove once used when outside temperature is above 0 degree.

FIGURE 2. *APPLIANCES USED FOR HEATING*

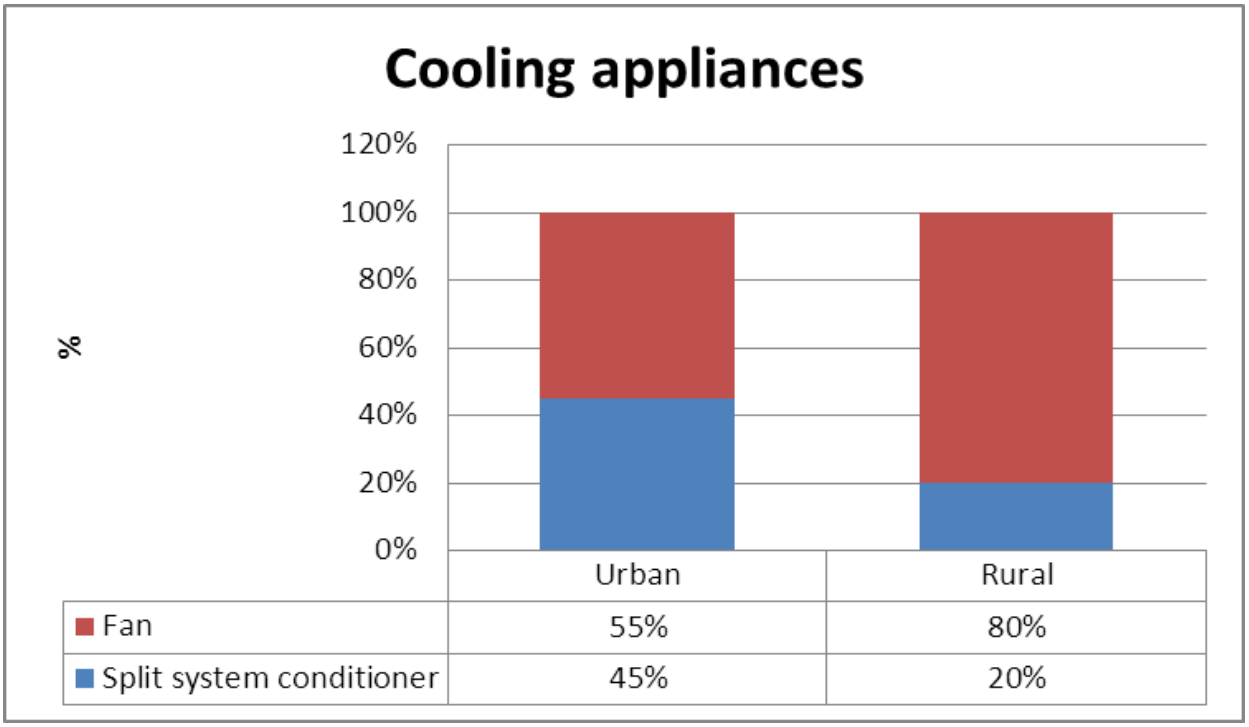


Source: Residential survey (2014)

Another seasonal service demand is cooling. The main appliances used for cooling in Georgia are air split system conditioner and fan[15]. However, still majority of households have neither of these appliances. Only 4% of rural residents and 19% of urban residents use cooling devices. Figure 3 shows what type of appliances use.

[15] Fan as a technology is not cooling the air instead just moving it around, however, due to financial constraint some households use this technology for cooling in hot summer days.

FIGURE 3. *APPLIANCES USED FOR COOLING*



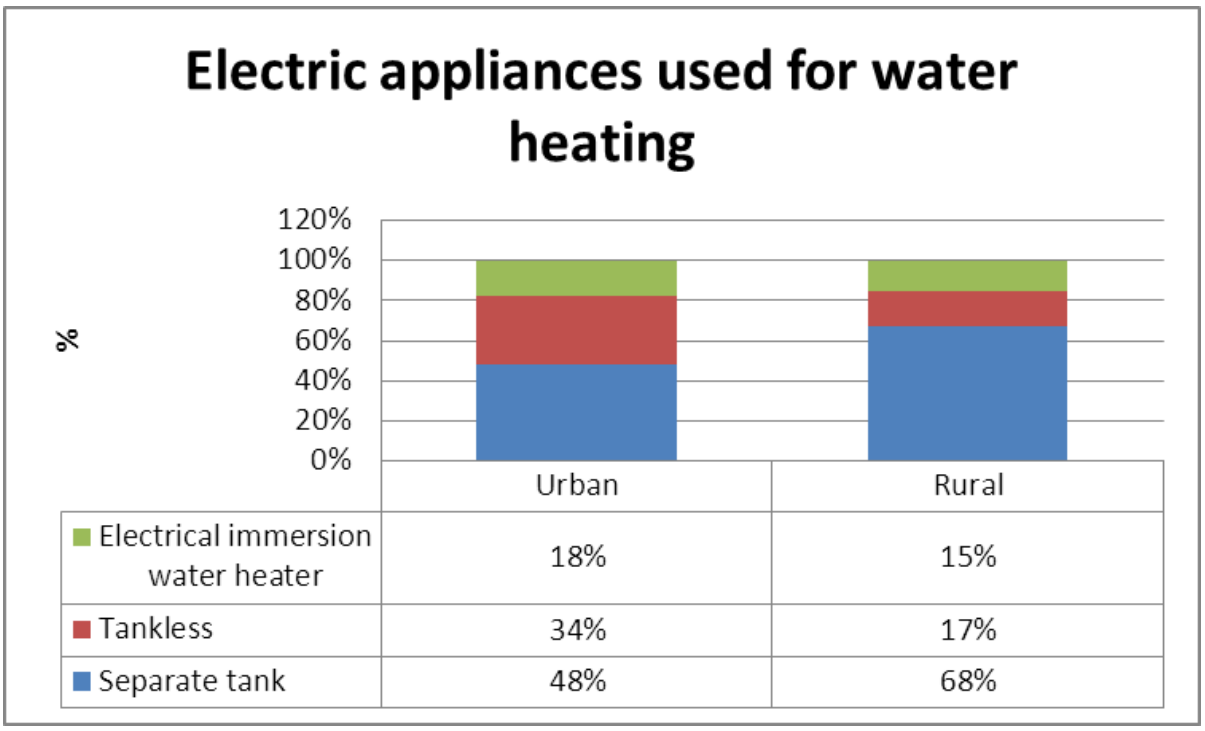
Source: Residential Survey (2014)

Those households that have cooling devices. According to the same survey approximately 10 % of those households, who do not use cooling currently, are going to buy cooling appliances in the near future (next three years).This implies that electricity consumption for cooling in summer will increase as well as electricity consumption in winter (split system conditioners).

According to Residential survey 26% of urban residents and 10% of rural use electricity for water heating. The main technologies used are collector type (separate tank), tankless ("atmor") and electrical immersion water heater. Figure 3 shows types of devices used by those households that use electricity for water heating. As can be seen from the figure there are number of households that use tankless ("atmor") water heater and immersion water heaters that are neither comfortable nor safe. Efficiency of

immersion water heater is approximately 75%[16], while efficiency of tankless water heater is 93%. However, the main factors that affect decision to use these appliances are availability of energy sources and price of energy. Since there are block tariffs for electricity in Georgia, increased consumption volume leads to increases in tariff and significant increase in total bill, majority of households prefer using natural gas as energy source for water heating.

Figure 4. *Appliances used for water heating*

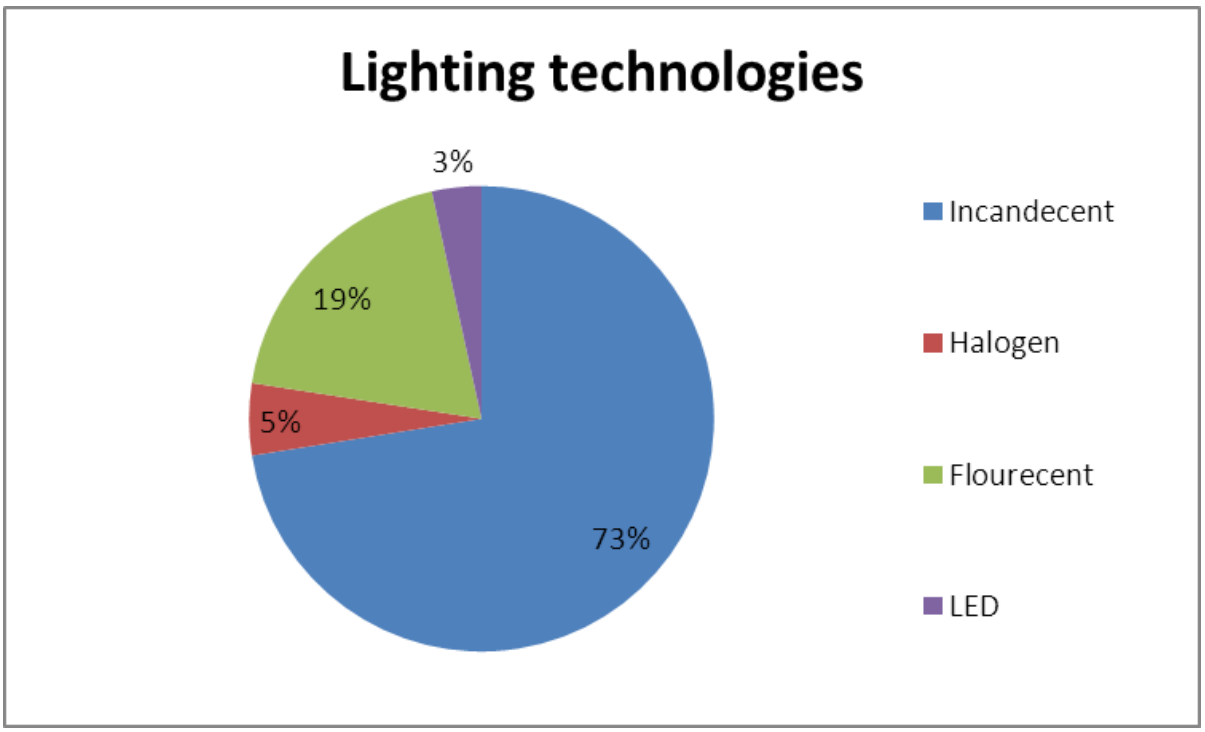


Source: Residential Survey (2014)

Another significant service demand is lighting. Almost all population in Georgia (except for several remote villages) have access to electricity and have lighting. Figure 5 shows types of lighting technologies used.

[16] http://www.1teplo.ru/pages/otopit04.html
http://www.torgtech.com/NsHotWater.htm

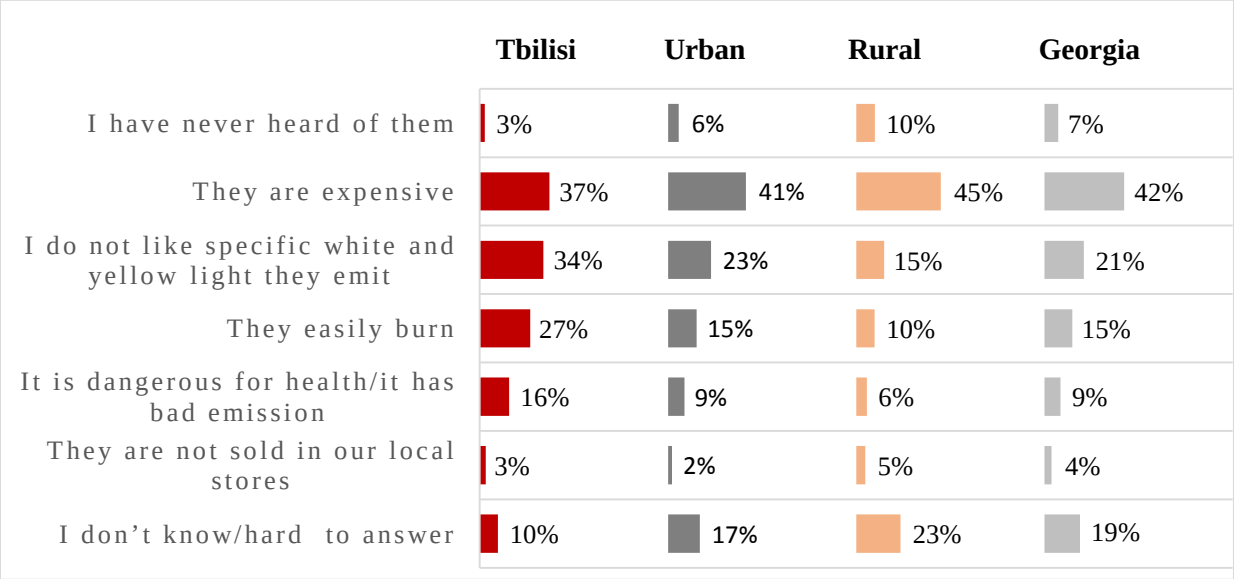
Figure 5. *Lighting technologies*



Source: Residential Survey (2014)

As can be seen from the figure, majority of households still use inefficient incandescent light bulbs. According to Municipal Survey the main reason for not using energy saving bulbs is the price – people consider energy efficient bulbs expensive. One of the reasons for rejection is that people don't like the specific white or yellow light emitted by energy efficient bulbs. It is interesting that a number of respondents consider this type of light bulb dangerous for health due to emission. Figure 6 shows list of reasons for not using EE light bulbs.

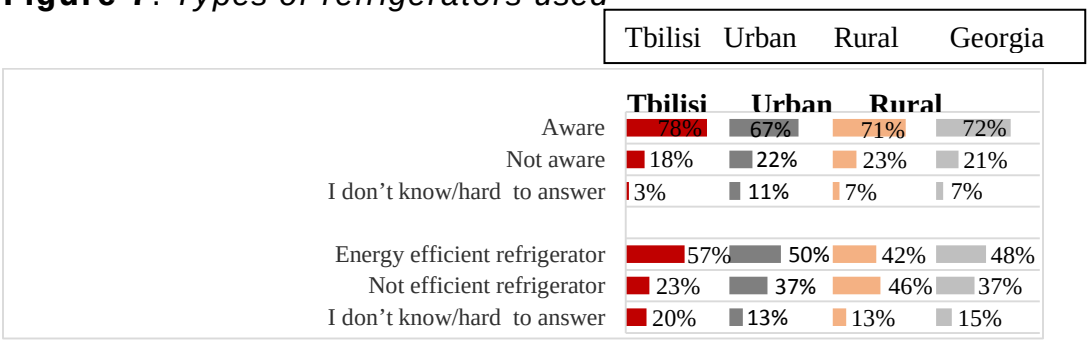
Figure 6. *Reasons for not using EE light bulbs*



SOURCE: MUNICIPAL SURVEY (2014)

According to the same survey 83% of urban households and 78% of rural have refrigerator. Out of those households who have refrigerator 29% and 46% of urban and rural households correspondingly switch off refrigerator in winter to save on electricity bills.50.5% of those households that do not have refrigerator are going to buy it in the next 3 years. Since refrigerator can be considered as one of essential appliances as income of households increase those households that do not have refrigerator will buy it and households not switch off refrigerator. As can be seen from the figure 7 half of households have energy efficient refrigerators.

Figure 7. *Types of refrigerators used*



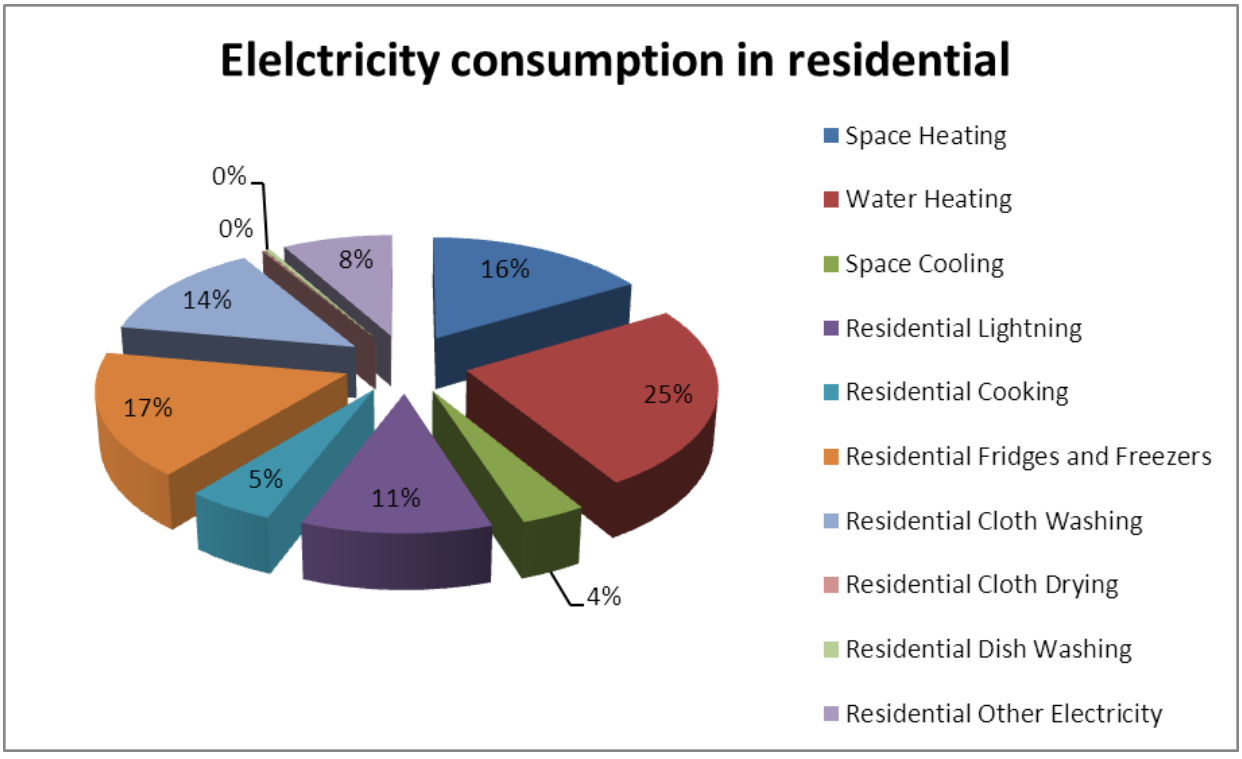
Source: Municipal survey (2014). Sample size 1002

Similar to refrigerators, not all households have cloth washing machine: only 55% of rural and 74% of urban households. According to Residential survey cloth washing machine is used on average 3.5 times per week. Among those who have washing machine 41% are washing cloths by hand. 48% of those who do not have this appliance are going to buy it in the next three years. This implies that with increased income households will purchase cloth washing machine and will not tend to wash clothes by hand.

Vast majority of households have cloth washing machines issued after 2001, so they can be considered as energy efficient.

Using data on appliances, their capacities, time of use and number of households owing it electricity consumption structure was estimated.

Figure 8. *Electricity consumption structure in Residential sector*



As can be seen from the figure 8 water heating consumes most electricity followed by refrigerators, cloth washing and heating. Lighting also holds important share in total consumption, accounting for 11%.

Cooling has insufficient share of 4% since not many households have cooling device, however, this number will increase as income of households increases. High EE potential is in lighting, since majority of households use inefficient light bulbs. Through improved efficiency in lighting technologies sufficient savings can be reached. Relatively small EE potential is with refrigerators and cloths washing machines, since majority of households already have EE washing machines and almost half of households have EE refrigerators. Those who have inefficient ones mostly use old refrigerators issued before 2000 year. Once they change their old refrigerator with the new one, they will buy efficient one. Therefore, no special program is needed.

As for space heating, since electricity is used as additional source for heating EE potential can be utilized by improving buildings' insulation to reduce heat losses. This in turn will reduce the need for additional heating. Vast majority of buildings are poorly insulated resulting in big heat losses. Programs supporting insulation practices will help households to save energy, improve their living conditions and will contribute to energy security through reduced imports of fuel.

As for hot water, according to Municipal survey almost none of the households implement hot water usage and cost reduction behavior and the situation is less likely to be changed in future: most of the respondents either don't know whether they will change behavior or think it is not likely. Programs on awareness raising and some supporting schemes to stimulate efficient hot water use will help to improve the situation. Moreover, since some portion of households use tankless water heater and immersion water

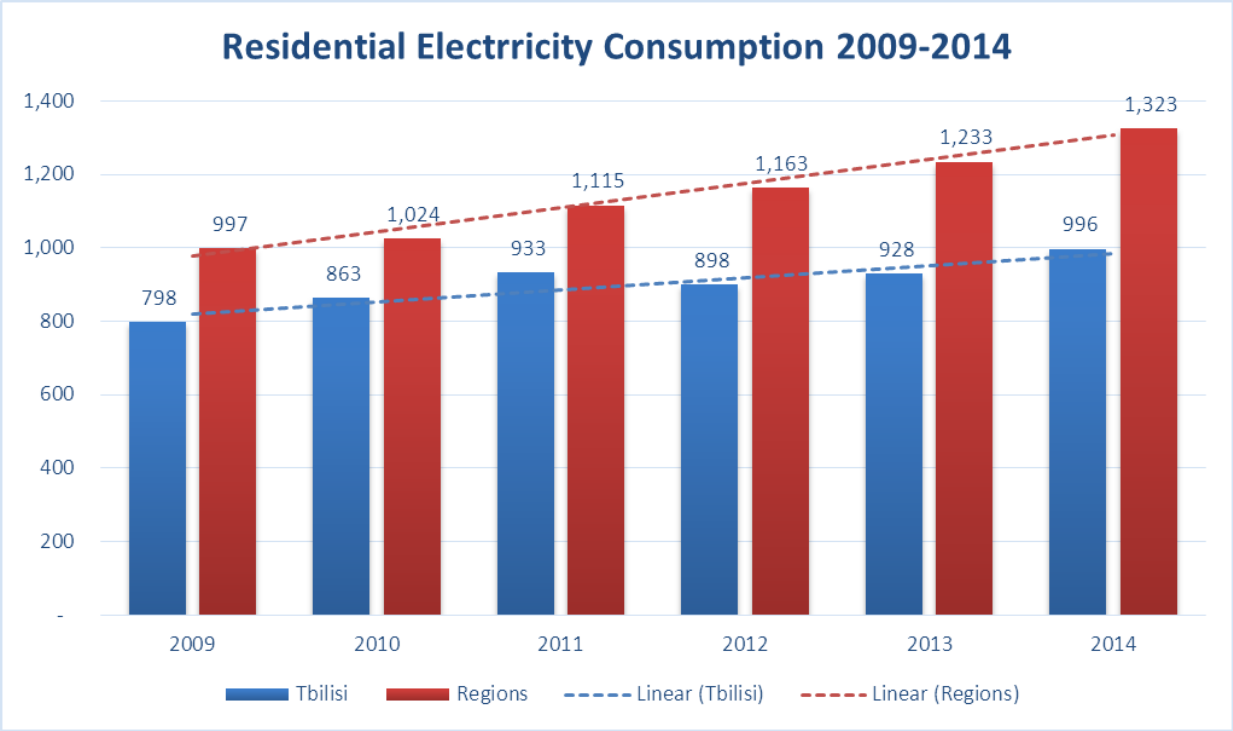
heater which are not comfortable and safe, switching from them will improve living conditions of households and save energy.

2.3 RESIDENTIAL ELECTRICITY CONSUMPTION DYNAMICS

According to Decision #23 of GNERC dated 27 December 2012 and based on signed memoranda between the government and Inter RAO-UES (the owner of Telasi electricity Distribution Company) and Energo-PRO, residential tariffs for electricity were reduced by 3 tetri (on average 20% reduction) for 1st and 2ndblocks ofTelasi and Energo-Pro customers. In 2013 the tariff for residential customers of the 1st block was further reduced by 0.39 tetri for Telasi customers and by 0.37 tetri for Energo-Pro customers. In addition to this reduction in 2013 Tbilisi City Hall introduced special energy subsidy“Energy Voucher” which was distributed among all households. Vulnerable households received 250 GEL voucher, while all other households received 100 GEL voucher that was equally distributed between 5 cold months. Out of 20 GEL monthly subsidy 8.45 GEL was devoted to cover electricity bills. The same practice was applied in 2014 year with the only difference that amount of subsidy depended on the number of inhabitants in the households. The subsidy together with tariff reduction substantially reduced electricity expenditure in residential sector in Tbilisi, however, as can be seen from the Figure9 this does not really affect electricity growth rate. Before the tariff reduction electricity consumption in Tbilisi was increasing by 8%, and then was reduction in 2012 of 4% and afterwards in 2013 and 2014 3% and 7% increase respectively. According to basic economic rules once price for commodity decreases its consumption should increase, however, in the given case we can consider that electricity consumption of 1 and 2 block is not elastic to price reduction, or in other words majority of households consumed electricity at optimal level. It should be also pointed out that share of households consuming electricity up to

100kwh monthly is about 10% in Tbilisi. Majority of households are either in the second or in the third block. In winter share of households in the third block increases. Tariff for the third block has not been changed.

Figure 9. *Residential Electricity Consumption Dynamics*

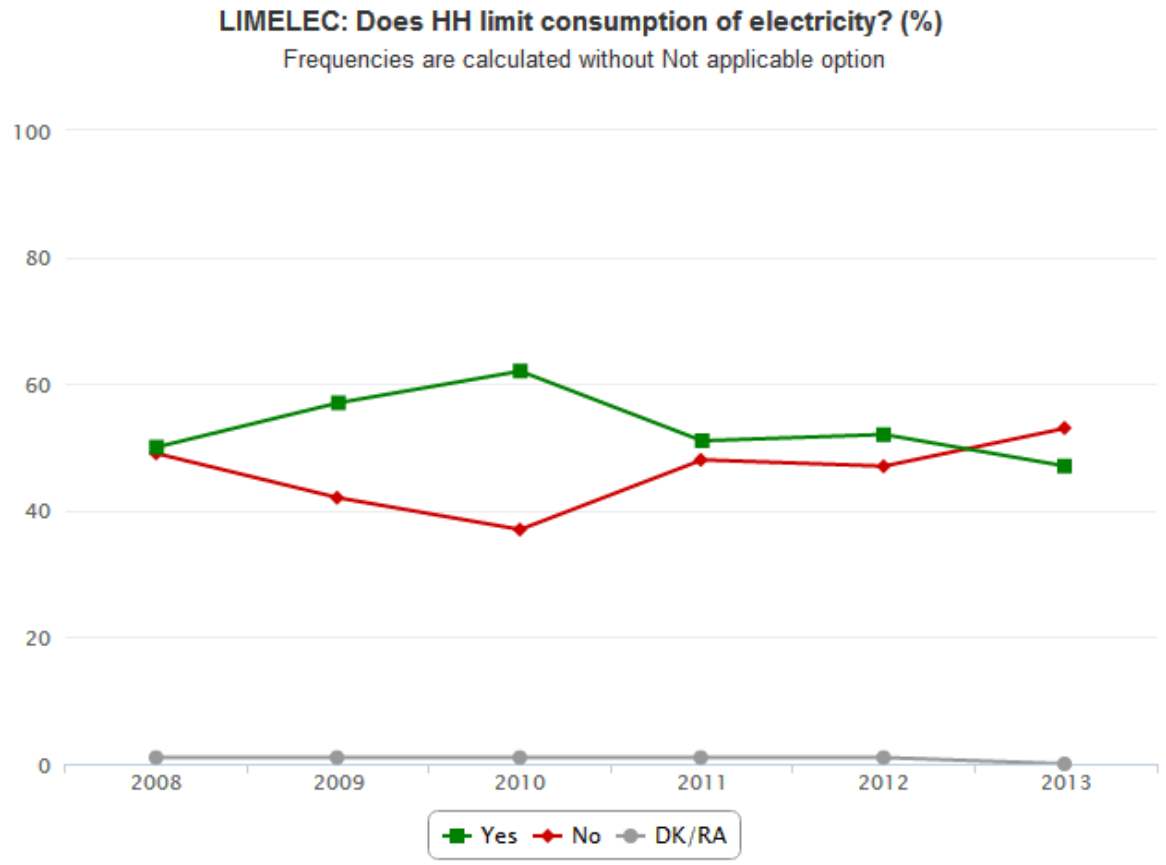


Sources: GNERC report (2011-2014), Telasi and Energo-Pro (2009-2010)

The situation is a bit different with customers of Energo-Pro. Its customers, majority of which live in rural regions, seem to be more price responsive. After tariff reduction electricity consumption growth rate increased by 2% on average even though there were no additional subsidies in the regions. This can be explained by the fact that in the rural regions income of households is much lower than in the capital or other major cities, therefore, the number of appliances that are fueled by electricity is smaller and consumption in majority of cases is not optimal. However, only two years have passed since tariff reduction and the data is not enough to make robust conclusion, although certain observations can be taken into consideration.

As can be seen from the Figure 10, the share of households that have to limit electricity consumption due to financial difficulties[17]decreased in 2013 becoming lower than the share of those who doesn't limit their consumption. However, the trend of reduction starts in 2011 which may be partly explained by improved economic conditions as well.

Figure 10. *Do households limit consumption of electricity?*



Source: Caucasus Barometer CRRC

Income per housholds is lower in rural regions and, in general, economic conditions are poorer there. Table 2 shows that one third of rural households does not have enough money to buy food. The data is for 2013.

[17] The question text in CRRC survey was "Households may experience financial difficulties. Please tell me, over the course of a typical month, does your household have to limit consumption or use of the following due to budget difficulties?"

Table 2. *Economic condition by settlement type*

Cross tabulation (%)	Not enough money for food	Enough money for food only but not for clothes	Enough money for food and clothes but not for expensive dura	Enough money for some durables fridge etc.	Enough money for everything needed
Capital	18	28	39	11	4
Urban	28	33	33	5	1
Rural	34	35	25	5	1

Source: Caucasus Barometer CRRC

Table 3 shows share of income spent of electricity bill. As can be seen from the table the share is not sufficient and electricity bill on average (if not count vulnerable customers) is not a big burden for households. Another interesting fact that can be seen from the table is that the share is lower in rural regions. This can be supported by data from table 4. This can be explained by the fact that in rural regions income of households is lower and they cannot afford number of appliances (see section “Analysis of electricity consumption structure), therefore, their consumption is lower. Additionally, from Table 3 we can conclude that since in cold and warm months bills are the same in rural regions, vast majority of households there do not use electricity for heating.

Table 3. *Share of HH income spent on electricity bills*

	2009	2010	2011	2012
Share of HH income spent on electricity in URBAN	4.0%	3.6%	3.7%	3.2%
Share HH income spent on electricity in RURAL	2.8%	2.9%	2.6%	2.3%

Table 4. *Expenses on electricity*

Energy Sources		Tbilisi	Urban	Rural	Georgia
Electricity bills in GEL	Monthly bills during summer – warm season	28.06	21.39	16.22	20.68
	Monthly bills during winter – cold season	44.08	30.85	16.17	27.38
	Annual bills	**475.03**	**256.67**	**200.28**	**285.93**

Source: Winrock International Municipal Survey (2014). Sample size 1200

2.4 REVIEW OF EU ELECTRICITY AND EE REQUIREMENTS

In 2014 Georgia signed the Association Agreement with EU, thus committing to harmonize its legislation with EU acquis in the energy sector. Negotiation between the Ministry of Energy of Georgia and the European Commission on the conditions of implementation of EU energy acquis is still continuing and presumably will be finalized until September of 2016 with the membership of Georgia to the Energy Community. EU energy regulations and directives provide energy efficiency measures and recommendations for the development of effective tariff policy.

For promoting energy efficiency *the Directive 2009/72 on the Internal Market in Electricity* sets the following requirements for the member states:

- National regulatory authorities should ensure that transmission and distribution tariffs are non-discriminatory and cost-reflective.
- Consumers should have right to receive transparent information on applicable prices and tariffs.
- Member states should guarantee the public service requirements for electricity supply. Consumers should also have the right to be properly informed about their energy consumption. Information on energy consumed and its corresponding costs provided to consumer will create enough incentive for energy savings because it will give customers direct feedback on the on the effects of investment in energy efficiency and change of behavior.
- Member States shall take appropriate measures, such as formulating national energy action plans, providing for support for energy efficiency improvements, to address energy poverty where identified, including in the broader context of poverty.

- Member States shall implement measures to achieve the objectives of social and economic cohesion and environmental protection, which shall include energy efficiency/demand-side management[18] measures and means to combat climate change, and security of supply.
- In order to promote energy efficiency, the regulatory authority shall strongly recommend that electricity undertakings optimize the use of electricity, for example by providing energy management services, developing innovative pricing formulas, or introducing intelligent metering systems or smart grids, where appropriate.

In 2006 the European Union adopted *Directive 2006/32/EC on energy end-use efficiency and energy services*, which will make the end use of energy more economic and efficient by the following measures:

- Establishing indicative targets, incentives and the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent efficient end use of energy;
- Develop attractive market environment for energy serving companies, which would ensure energy saving in the different sectors of energy use with the help of relevant programs and mechanisms;
- Member States must adopt and achieve the predefined indicative energy saving target in the framework of a national energy efficiency action plan (NEEAP).
- They must also appoint one or more new or existing independent public sector authorities or agencies to ensure overall monitoring of the process set up to achieve these targets.

[18]According to the directive 2009/72 'energy efficiency/demand-side management' means a global or integrated approach aimed at influencing the amount and timing of electricity consumption in order to reduce primary energy consumption and peak loads by giving precedence to investments in energy efficiency measures, or other measures, such as interruptible supply contracts, over investments to increase generation capacity, if the former are the most effective and economical option, taking into account the positive environmental impact of reduced energy consumption and the security of supply and distribution cost aspects related to it;

- Member States must ensure that energy distributors, distribution system operators and energy retail businesses that sell electricity, natural gas, heating oil and district heating supply information on their final customers needed to develop and implement programs to improve energy efficiency;
- Member States using voluntary agreements or other market-based measures, offer and promote energy services to their final customers or offer and promote energy audits and/or measures to improve energy efficiency or contribute to the financial instruments for improving energy efficiency.

40% of the whole energy consumption of the European Union and 36% of CO_2 emissions fall on buildings. Therefore, the reduction of energy consumption and the use of renewable energy resources in the buildings is the main priority. In Georgia the situation is much worse. In old and new buildings the loss of energy is three times higher than in the European buildings with the same climatic conditions.

Directive 2010/31/EU on the Energy Efficiency of Buildings establishes the following principles and requirements:

- Member States shall put in place, in compliance with predefined methodology, minimum requirements for energy performance in order to achieve cost-optimal levels. The level of these requirements is reviewed every 5 years. When setting requirements, Member States may differentiate between new and existing buildings and between different categories of buildings.
- Technical systems in the buildings such as heating, water supply, cooling and aeration systems shall meet the preliminarily established minimal requirements. Also there shall be ensured the system of their regular checking.

- This Directive strongly encourages the introduction of intelligent energy consumption metering systems whenever a building is constructed or undergoes renovation.
- Member States shall implement a system for the energy performance certification of buildings. It shall include information on the energy performance of a building and recommendations for cost improvements.
- When a building or building unit is offered for sale or for rent, the energy performance indicator of the energy performance certificate shall be included in advertisements in commercial media. The certificate is to be shown to the new tenant or prospective buyer and handed over to the buyer or new tenant.

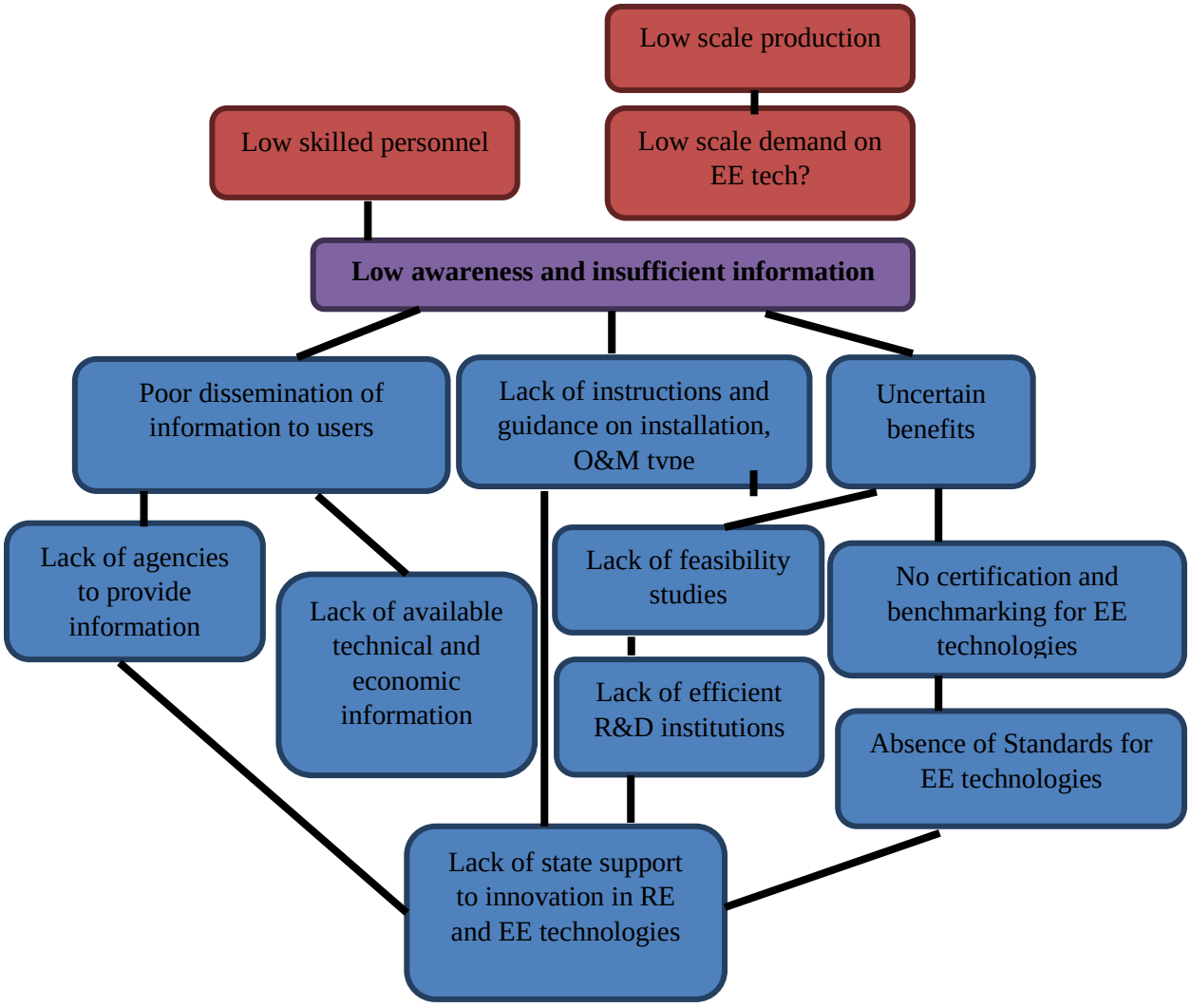
2.5 AWARENESS AND OTHER BARRIER ANALYSIS

Currently there is no energy efficiency policy or legislation in Georgia. There are number of projects funded by international donor organizations, however, due to the absence of strategy and state's common vision their effort is uncoordinated and often is not followed up. Energy efficiency is integral part of technological progress and even without governments' special support such market for energy efficient technologies is still developing; however, due to certain barriers its development is impeded. One of the most important barriers is low awareness at different levels of society. There are number of different surveys showing low awareness of energy efficiency as a concept and low awareness of energy efficient technologies among residential customers. According to Municipal survey conducted by Winrock International only 11% of urban residents are familiar with concept "energy efficiency" and only 8 % of rural population. Root cause analysis of low awareness barrier

illustrated in Figure 12 underlines the scale the barrier makes in development of market for energy efficient technologies.

The root cause of this barrier is as follows: since there is lack of state support of innovation in energy efficient technologies there are few agencies to provide information, no efficient and active R&D institutions, and no standards for energy efficient technologies and as a result there is poor dissemination of information to technology producers and users. Moreover, without efficient R&D institutions there is lack of feasibility studies and no certification and benchmarking for energy efficient technologies. As a result benefits of energy efficient technologies are not evaluated fully and are uncertain. Methodology of root cause analysis of energy efficient technologies is taken from the country official TNA report ((N.Shatirishvili, M. Tsereteli, M. Shvangiradze, M. Margvelashvili, G. Lominadze, V. Geladze, …B.Beritashvilil. 2012) Figure 11.

Figure 11. *Root cause analysis of information barrier*



R & D is needed to conduct feasibility studies, and develop instructions and guidance on installation, O&M etc. At present these activities are not conducted. There are certain R&D institutions, like EE and RE laboratory at Georgian Technical University. However, it does not have a clear program or agenda devoted to development of energy efficient technologies in Georgia. Ideally such an entity would be involved in testing and adapting different types of energy efficient technologies and proposing standards as well as certification of concrete product. Government needs to support R&D

institutions and/or donor programs for above tasks as well as to disseminate the developed information. This would allow both producers and consumers to have sufficient information on this technology for decision making.

State should support innovation in EE technologies. It should assist/establish and fund if necessary R&D institution working on energy efficient and renewable energy technologies. Such an entity would provide the information and technology support to producers and consumers.

Standards for energy efficiency are to be developed and approved. Such standards could be set by standardization agency and serve for benchmarking of energy efficient technologies performance. The standards shall not be mandatory but would provide the reference information and benchmarks for consumer choice. Agencies providing information (EE & RE state agency) should be established, or the existing agencies should be stimulated to widely disseminate the information about efficient use of fuel wood including the efficient stoves, weatherization, heat exchange basics etc. The mission of such agencies is to disseminate existing information provided by R&D institutions, to adapt it for ordinary users and make it easily available. Agency could distribute leaflets, books, brochures, conduct small seminars and trainings on O&M develop a website, etc.

Georgia does not produce electric appliances and those imported from EU already have labeling indicating the level of energy efficiency of the product. However, no special campaign was made to explain the meaning of this labeling or to promote energy efficient appliances. As a rule, this is mainly done by local shops and markets guided by desire not to promote energy efficiency but rather to sell relatively expensive energy efficient product. However, their effort is not enough to fill the information gap. One good example of this is the situation with energy efficient light bulbs. In Municipal survey those residents that do not use such bulbs were asked for the reason

of not using them. The prevailing answers were that they are expensive, have specific light and yellow color that they emit and they easily burn. The fact that such bulbs easily burn is caused by either low quality of the product (which is associated with relatively low price) or with inappropriate location in apartment. Florescent bulbs are easily burnt in places where lights are often switched on/off, therefore their producers do not recommend installing them in entrances or bathrooms or other rooms where lights are often switched on/off. Information on similar technical specifications should be available for customers in terms of small guidelines or brochures that could be distributed even in stores or some information centers.

According to Municipal survey residents mostly get information on energy efficiency from store/market (31%). The lowest rate of responses was for schools and universities; however, this is exactly the place where energy efficiency could be promoted through knowledge multipliers (teachers, students, etc.)

Energy efficiency is not only about end- use devices but also about energy efficient construction that can reduce energy consumption for heating and cooling. In construction sector as well one of the main barriers is low awareness as well as absence of state common vision and support. It entails absence of tax breaks, subsidies and grants, absence of voluntary or mandatory standards, certification, labeling and lack of information in the market. This all results in low skilled personnel and low qualification of design and construction companies and low awareness demand on efficient construction materials and buildings.

One of the main roots of this barrier is absence of EE & RE strategy. The strategy is necessary not only for efficient construction market development but also for development of other energy efficient technologies. Without state strategy in EE & RE there is no EE & RE legislation and action plans,

lack of support to research and development in EE and RE technologies. As a result there is low awareness and interest of policymakers for decision making and consequently public. These factors are applicable not only for efficient construction but for other EE technologies as well, therefore, tackling them is important and could benefit several markets simultaneously.

However, some efforts are made in this direction by Ministry of Economy and Sustainable Development that is in charge of construction sector development. Recently Ministry drafted the Law on Spatial planning where energy efficiency requirements were included. The draft should be adapted by the Parliament. Another important project is funded by EBRD and will help Ministry to develop construction norms for Residential buildings. Department of Sustainable Development at the Ministry took obligations to harmonize with EU energy efficiency aquis and to implement requirements of the following directives: 1. Directive 2010/31/EU “On Energy Performance for Buildings”, 2. Directive 2006/32/EC of 5 April 2006 “On energy end-use efficiency and energy services”, 3. Directive 2010/30/EU “On the indication by labeling and standard product information of the consumption of energy and other resources by energy-related products”. Similar activities rise awareness on energy efficiency among policy makers and help to create efficient regulatory environment for energy efficient construction development.

Another important barrier is financial barrier that impedes penetration of energy efficient technologies. The main financial obstacle for consumers follows from low income of households combined with the relatively high price of energy efficient technologies. General consumer loans and even dedicated financing mechanisms (including EBRD/BP funded Energy Credit facility) are not cheap and not developed enough to bridge this gap. In addition to low awareness and uncertain benefits of EE technologies for

users, latters prefer to buy traditional less expensive technologies. This barrier is tightly associated with energy prices. If electricity price is low then the payback period of EE technology is longer. Since consumers are "impatient[19]" they prefer buying less expensive technologies rather than wait for future potential savings of EE technologies that are uncertain.

Information, regulatory and financial barriers are the main factors that impede penetration of EE technologies, however, there are other barriers as well, like market adaptation, technical, lack of qualified personnel, etc. Overcoming the main barriers will push the development of EE technologies market and contribute to technological progress through strengthened innovation and penetration of EE technologies. All together will reduce consumption of electricity and will contribute to energy security and reduction of imports, both through reduction of electricity imports and through reduction of natural gas imports required for electricity generation.

[19] In Economics a consumer is said to be impatient if he prefers current consumption to postponing consumption into the future, in other words, a dollar forthcoming a year from now is not worth as much as dollar today.

III. RECOMMENDATIONS

Based on research results the following set of recommendations and key messages is made:

- Tariff setting is a complex process that serves several goals and energy efficiency is one of them. Policy-maker should consider the significant role of tariff policy in end use energy efficiency improvements, as well as negative impact of artificially risen or decreased tariffs on consumers' decisions. However, right tariff policy creates environment for effective energy efficiency policy, since rising tariff alone without addressing persistent energy efficiency barriers will not lead to improvements in energy efficiency. It is important that while setting tariff Regulator consult with consumers and other stakeholders and take care of awareness rising among wide public concerning tariff setting process and reasons for tariff change. Tariff that does not guarantee cost recovery for electricity companies will lead to degradation of EE both on demand and supply side.
- The tariffs should be transparent and consumers should understand it as well as reasons for changes in tariff, so that there are no doubts that tariff is fair and the process is not politicized. Understanding of tariff and its components is necessary for providing consumer incentives through electricity rate designs. For this purpose some TV or other mass media information advertisements may be used.
- Vulnerable customers should be protected. Such customers are unable to invest in more expensive energy efficient appliances and have to limit their consumption in favor of reduced living conditions. Their protection can be realized through supporting schemes or targeted subsidies.

- Some improvements can be made in distribution network, such as arrangement of smart meters. This will help consumers to better understand their energy usage and change their behavior accordingly. This will also help to smooth electricity consumption load curves, reducing picks and generation from relatively less efficient and expensive units.
- State support for R&D working on energy efficient technologies is needed. Such an entity would provide the information and technology support to producers and consumers. This will stimulate innovations in the sector as well as help tackle information barrier.
- Information barrier should be addressed through awareness rising campaigns. Information provided by R&D could be distributed among knowledge multipliers (schools, universities, information centers, etc.) Message should be clear and presented in user friendly manner. Website platform can be created to make useful information more available to wide public. Information centers in public places (ZOO, Justice House, etc) can be created to disseminate information on EE technologies and supporting programs. Awareness raising is needed not only for consumers but for suppliers of technologies as well.
- Significant EE potential in Residential is in lighting. In consumption structure lighting's share is estimated to be 11% while majority of HH still use inefficient light bulbs. Programs stimulating arrangements of EE light bulbs are needed together with information campaign. Some financial supporting schemes might be applicable as well. In many developed countries sale of incandescent light bulbs is prohibited which led to significant energy savings in Residential sector. In case of Georgia some quotas on import of incandescent light bulbs may be more applicable.

- There is need for state support to energy efficiency in buildings. While construction norms are being developed for newly constructed buildings not enough attention is paid to existing ones. Some supporting schemes to stimulate insulation are needed to eliminate financial barrier. Increased demand for insulation will stimulate market development and competition which will create variety of products and lower prices. Reduced heat losses will save energy consumed for heating. This measure will help to reduce not only electricity consumption but mostly consumption of natural gas (main energy source for heating) which will reduce expenditures on fuel and save cheap “social” gas so less expensive commercial gas is purchased. Information campaign is needed to raise awareness on benefits of insulation and products specifies. Some pilot projects for demonstration purposes may be financed by either state or donor organizations. Such pilot projects will also help to estimate energy saving volume associated with insulation.
- Programs to stimulate efficient hot water usage are needed. Some financial supporting schemes should be available to arrange EE water heater. HH that use tankless and immersion water heater should be motivated to switch to more safe, comfortable and efficient technology. Similar to other EE technologies efficient water heaters need information support.
- State strategy and vision in EE technologies should be developed. Essential parts of this strategy should be a new approach to EE legislation, taking into account all externalities and long term sustainability interests of the country. Support from the Donor Organizations for enactment of a Legal Framework will be needed. Donor programs should be well coordinated with local specialists and have a common vision based on close situation analysis. This shall

result in improved promotion and lobbying with government as well as industry

- Mandatory or voluntary standards, certification and labeling, building energy passports should be implemented. This will help to control quality of buildings as well as provide information on level of energy efficiency in the building which in turn will raise demand for energy efficient buildings.

IV. CONCLUSION

For EE policy to be effective “right” price signals should be in place. Tariff should reflect real price of energy guaranteeing all cost associated with production/ transmission/distribution are covered, otherwise it will add disturbances in the market. Tariff itself as well as tariff policy should be transparent and calculated by an independent authority so that consumers understand it well and have no doubt in fairness of the proposed rate. This will help to avoid any political speculations on the topic. Right tariff is necessary condition for effective EE policy, however, if other barriers are not addressed only tariff design is not sufficient instrument for promoting EE. The main barriers are information (low awareness), financial and regulatory barriers that should be addressed by complex of measures accounting for all externalities and considering sector development priorities.

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