Manuscript received Oct. 11, 2007; revised March 20, 2008

Energy Efficiency in Croatian Residential and Service Sector – Analysis of Potentials, Barriers and Policy Instruments

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Abstract: - Energy efficiency is recognized worldwide as a single most powerful and cost-effective way for achieving goals of sustainable development. Energy efficiency being typically demand side option is hard to implement and requires carefully defined approach, i.e. policy interventions are needed to fulfill existing potentials for cost-effective efficiency improvements. In the light of recent trends in energy sector, especially liberalization and competitive market orientation, policy measures to enhance energy efficiency improvements should shift from strictly end-users oriented approach towards whole market approach. Optimal policy instruments mix should be designed to fulfill the existing energy efficiency improvement potentials and shift markets towards more energy efficient products and services. This paper addresses the energy end-use efficiency potentials in Croatia with special emphasis on residential and service sectors. It analyses the process of designing, implementing and evaluating policy instruments based on the results of the on-going UNDP/GEF project "Removing barriers to improving energy efficiency of the residential and service sector". The analysis of energy efficiency market development and transformation in the Republic of Croatia is given and future actions needed emphasized.

Key-Words: - energy efficiency, policy, market transformation, Croatia

1 Introduction

Energy sector hence the society in general is facing serious challenges, above all disturbed security of supply caused by volatile oil prices and insecure natural gas supply paths, but also by the fact that existing power systems are aged. Reducing growing adverse environmental impacts due to still prevailingly fossil fuel oriented energy consumption has become a number one priority. Thus, new strategies that will tackle these challenges in the most efficient manner, i.e. at the least costs to the society, should be found. Surely the most direct and cost-efficient way for meeting these challenges is energy end-use efficiency.

Energy end-use efficiency refers to all changes that result in decreasing the amount of energy used to produce one unit of economic activity or to meet the energy requirements for a given level of comfort. Energy efficiency is associated to economic efficiency and includes both technological and behavioral changes. It is exactly this social component of energy efficiency that makes the creation and implementation of energy efficiency policy with the best policy instruments mix a very complex task. In the residential and service sectors these aspects are creating the most significant barriers for fulfillment of energy efficiency improvement potentials, which are preventing market transformation towards more energy efficient solutions and behavior. This "market failure" must be then properly addressed by clever choice of policy instruments, the mix of which must be tailor-made for particular market, i.e. policy must respond to the real market conditions. The energy efficiency policy has to address not only energy end-users but also all other energy efficiency market players.

This paper addresses, firstly, the potentials for energy efficiency improvements in residential and service sector in Croatia. Secondly, the state-of-the-art of energy efficiency market is emphasized and analyzed, as the starting point of policy making process. Additionally, the results of the comprehensive UNDP/GEF and Croatian Ministry of Economy energy efficiency program "Removing barriers to improving energy efficiency of the residential and service sector" are presented.

2 Energy Efficiency Potentials in Croatia

Total primary energy production in Croatia in 2006 was equal to 208,76 PJ, while total primary energy consumption was 410,56 PJ [1]. Clearly, this indicates Croatian dependence on imported energy sources, primarily petroleum products, but also electricity import is increasing significantly.

Total primary energy consumption intensity in Croatia was equal to 179 kg oil equivalent per 1,000 US$2000 of GDP in 2006 [1]. This is 11.8% higher than

the EU-27 average, which is the first indicator of the potentials for energy efficiency improvements.

Energy end-use efficiency is evaluated by using energy intensity index for sectors and for total final energy consumption (Fig.1). The energy intensity gives the ratio of totally consumed energy and gross value added within a specific sector, for the observed year. The energy intensity indexes, however, take one year as a referent for final energy consumption (1995 in Fig.1), and express the ratio of energy intensity of individual sub-sector in the observed and in the referent year. In this way, the energy efficiency development trends and progress within each sub-sector can be monitored.

In the analyzed time period increasing trend in energy intensity is noticed in the service sector, transport and construction, while in other sectors, especially industry and agriculture, energy intensity has been decreasing. This can be well explained by the change in economic structure with fast growing service sector and shift towards less energy intensive industrial production. The development of service sector was especially strong since late '90ies, caused by the rapid increase of newly built shopping centers and other service facilities. At the same time, there were no strong building codes imposed, that would ensure highest energy efficiency performance. In households sector the initial increase in energy intensity was the result of new behavioral patterns and desire for higher standard of living, while recent lowering trend hide many different issues from climate conditions, more efficient appliances, higher costs of living etc.

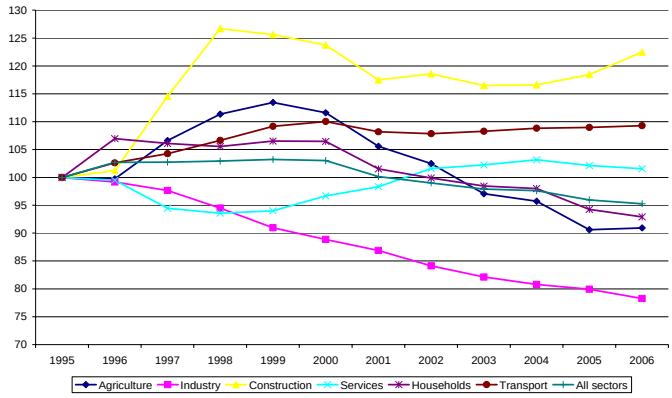

Fig.1 Energy intensity indexes in Croatia (1995-2006)

Residential and service sector together account for about 40% of total final energy consumption in Croatia, and offer the highest potentials for energy efficiency improvements.

2.1 Potentials in residential sector

Households are the single largest consumer of energy in Croatia with 29% of total final energy consumption according to data from 2006 [1].

As shown in Fig. 2, energy consumption in households from 1990s has been increasing. Consumption of electricity is now the highest among the sectors. Heat consumption in last few years is even higher then in industry sector.

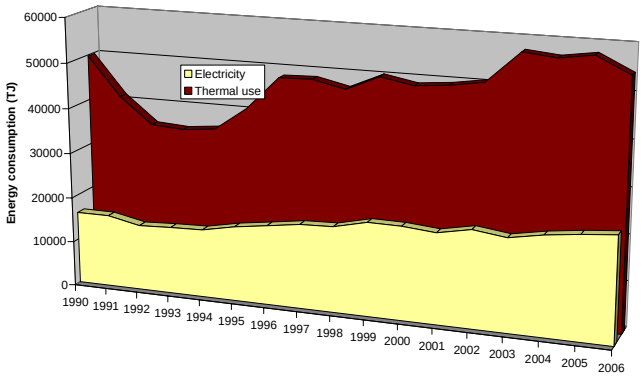

Fig.2 Development trend of energy consumption in residential sector (1990-2006)

For efficient thermal energy consumption, actions should be directed towards creation of mechanisms that will ensure permanent reduction of energy requirements in new and refurbished buildings. Important legislation and technical standards for thermal insulation of the buildings are already legally enforced. Improvements of thermal insulation of the existing buildings can bring savings 10-30%. Since heating and preparation of hot water in Croatian households account for more then 80% of total energy consumption the highest potentials are to be found exactly here. For electricity, the most important is labeling scheme for appliances, which is expected to encourage consumers to purchase more energy efficient equipment. The number of air-conditioning systems is rapidly increasing so promotion of energy efficient devices is one of the priority measures. Also, significant potential for improvements are found in the lowering the share and eventually eliminating electricity use for residential heating purposes.

2.2 Potentials in service sector

Service sector is considered to be very important in energy efficiency improvements. Services accounted for 10.5% of total final energy consumption in Croatia in 2006 [1]. Services are becoming the largest economy sector in Croatia, with increasing number of new facilities built.

As shown in Fig.3 energy consumption in service sector from 1990s has been increasing. Especially fast and constant growth is noticed in electricity consumption. Energy intensity in this sector notes constant and slight increase as shown in Fig.1.

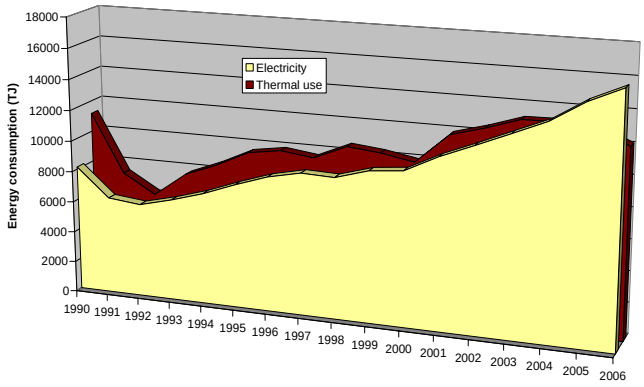

Fig.3 Development trend of energy consumption in service sector (1990-2006)

Especially for commercial services, energy efficiency is expected to be a clear financial interest but also a promotional mechanism. Potentials are primarily found in the rational use of electricity. Energy efficiency can be improved by installing efficient lighting systems with automatic control, optimization of HVAC systems, using of solar thermal collectors instead of electricity for heating and preparation of hot domestic water (especially in coastal area), revitalization of boiler-rooms and using efficient water fixtures. It is estimated that savings can be around 25% of current electricity consumption and 10-15% of thermal energy.

Situation is somewhat different in public services sector, where barriers for energy efficiency are especially strong. They include inherited attitude and opinion that energy costs are fixed expenditures, low motivation and awareness about energy efficiency among employees, restricted possibilities for allocation of budget means to energy efficiency projects, non existence of energy management system and structure, etc. Results of number of performed energy audits in public sector facilities show that potential for savings is at least 20% of total annual energy consumption costs. Possibilities for improvements are in compensation of reactive power, introduction of load control, revitalization of HVAC and replacement of old appliances and office equipment. It is estimated that technical measures could bring savings of approximately 15% of current electricity and 30% of thermal energy consumption.

3 Energy Efficiency Market in Croatia

3.1 The concept of energy efficiency market

For the fulfillment of identified energy efficiency improvement potentials it is necessary to identify barriers and develop solutions that will tackle both supply and demand side of energy services, energy efficient products and practices. In that sense, we are talking about energy efficiency market.

Clearly, as every other market, energy efficiency market also has supply and demand side. Fig. 4 shows energy efficiency market in Croatia and micro and macro environment key-factors that influence its operation and development.

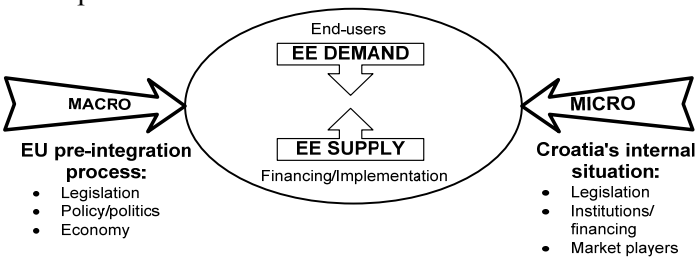

Fig.4 Energy efficiency market in Croatia and influencing factors

The development of any market depends on its macro and micro environment, the frequency of products and services exchange and, of course, successfully linked supply and demand.

Supply side of energy efficiency market consists of organizations involved in financing and implementation of bankable projects (banks, investment funds, energy service companies, service providers, equipment manufacturers, design engineers, constructors, etc.).

The demand side represents project sponsors with ideas for energy efficiency improvements (end-users, i.e. building owners and renters, building managers, public sector institutions and local authorities).

Therefore, energy efficiency market has a variety of players with different backgrounds and as such is highly influenced by behavioral, socio-economic and psychological factors that govern market players' decisions.

The performance of energy efficiency market is evaluated according to the actual energy savings delivered, i.e. according to number of successfully implemented energy efficiency projects. Basically, the energy efficiency market transformation depends on the success of the project development process. If all the stages in the project development from the initial idea through evaluation of project's feasibility and cost-effectiveness to actual financing and implementation of project are considered, this process can be represented as a pipeline shown in Fig. 5.

Croatian experience shows that only few identified opportunities for energy efficiency improvements actually reach the stage of bankable project, becoming actually implemented. Thus, for every stage in this process existing barriers must be identified and support instruments designed to ensure project pipeline throughput. Experience shows that not every support instrument is relevant for every stage of the project

development! And what instrument is relevant for particular stage of project development process is determined according to the barriers that are preventing the shift to the next stage. It is important to realize that the development of energy efficiency market will be achieved only when actual energy efficiency projects are "distilling" from the pipeline.

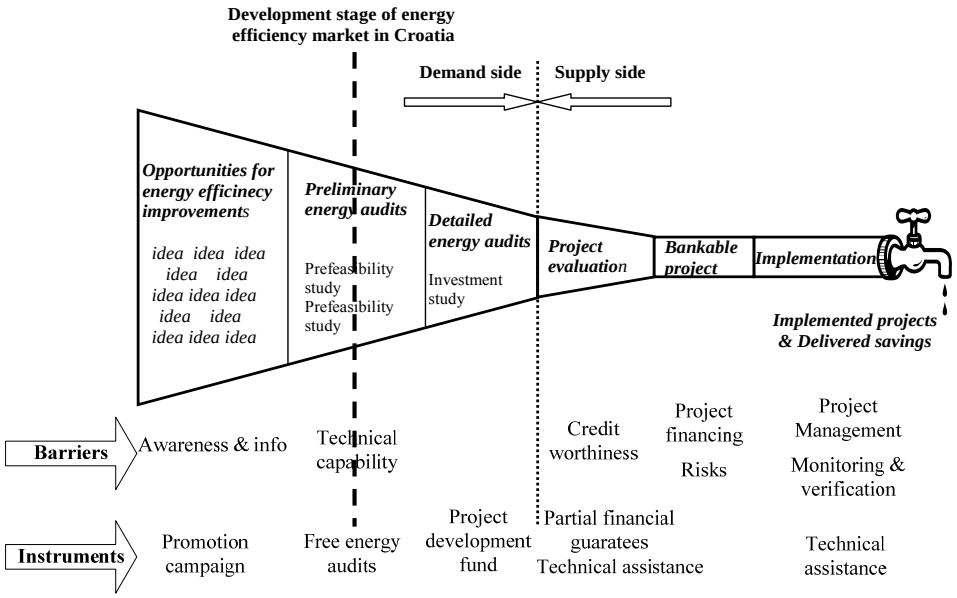

Fig. 5 Development stage of energy efficiency market in Croatia [6]

3.2 Identification of main market barriers

In the reality, and especially in countries with economies in transition like Croatia, the situation in the energy efficiency market is not balanced and can be characterised by weak demand and underdeveloped supply, resulting in very few, if any at all, actually implemented projects. This is also easily confirmed by energy statistics showing that energy efficiency market is not functioning properly and overlooks and prevents cost-effective energy efficiency measures and technologies to be implemented on much wider scale. This is referred to as "market failure" caused by number of "market barriers".

The diagram in Fig.5 provides main barriers to energy efficiency project implementation. In essence, there are many opportunities for project implementation, but these opportunities needed to be examined through preliminary energy audits before any action is taken. In larger projects detailed energy audits and investment studies must be carried out before project can seek funding and be evaluated for feasibility. Finally, if these projects are deemed feasible, they are classified as "bankable projects", which must be then implemented. Over the course of this "pipeline", opportunities for energy efficiency improvements are decreased due to various barriers within the market.

Based on Croatian experiences, these barriers are summarised as follows.

- *Lack of or insufficient information/knowledge about energy efficient technologies and solutions*. This barrier is characteristic for the earliest stage of the project development (Fig.5). It manifests in insufficiently developed activities of the actors on the demand-side, characteristic typical for current energy efficiency market in Croatia. A vast majority of Croatian population does not use and is very poorly aware of possibilities for energy efficiency improvements and related benefits. Interesting are the following results [2]: 58.1% of the population does not use CFLs at home and the main reasons are high price (38.7%) and lack of information (35.3%). 82% of the users mentioned energy savings as the main reason for use of CFLs, while only 32% mentioned money saving as an argument, which shows that majority of Croatian population does not look at the energy savings as money savings!
- *Scarce technical capability.* There is general lack of expertise and know-how to develop feasible projects on the demand side (end-users do not have enough knowledge to even think about energy efficiency, building managers do not care since "it's not mine" way of thinking, etc.). At the same time there is the major lack of knowledge and know-how on how to evaluate and implement project at the supply side (there is only one energy service company in Croatia, design engineers are unwilling to change their usual practices, installers likewise, etc.). Banks are generally lacking specific know-how they could use to make a reliable evaluation of financial viability of investments.
- *Financial barriers.* Financial barriers are also the reason for both failures on the supply and demand side

of the market in both examined sectors. On the demand side the problem is in high investment costs. For example, according to market survey 48.6% of CFLs non-users said that the best motivation for them to start using CFLs would be their lower price [2]. Because of weak purchasing power of end-users investments are made according to the least initial cost and not life cycle cost approach. The market is "stuck" on the supply side also. Although the bank sector in Croatia is very dynamic, still there are no "energy efficiency loans" offered. However, this should not be a surprise! Namely, banks are able and willing to provide financing for commercially viable energy efficiency projects, however there is the lack of market demand for financing such projects [3].

Clearly, combination of policy instruments has to be used simultaneously when markets are "stuck". A mix of policy instruments is needed to change behavioural patterns of the society towards lower energy consumption while maintaining the same quality of life. In other words, producers/service providers have to be stimulated to produce/offer more efficient products/services, while consumers have to be stimulated to by such products/services. Policy instrument have to be designed to move this situation from deadlock and to fulfil the ultimate goal of market transformation - to achieve public benefits from increased energy efficiency as accepted mode of behaviour.

4 Definition and Evaluation of Policy Instruments

4.1 Definition of policy instruments

In creation of energy efficiency policy it is absolutely crucial firstly to determine the status of the market. Namely, different instruments have different effects and are therefore appropriate at different market maturity levels, i.e. some measures could stimulate market introduction, whereas other measures could accelerate commercialization, or increase the overall penetration of energy-efficient products and services [4]. Market analysis is required to identify market forces that have to be strengthened by incentives or diminished by penalties. Here the crucial inputs are empirical findings gathered through market research surveys.

Mix of policy instruments used within the energy efficiency program in Croatia was designed to deal with barriers for energy efficiency perceived at the time of project inception (late 1990s). The following instruments are defined:

- *Free energy audits.* The instrument was designed to stimulate demand for energy efficiency projects by providing end-users screening of their energy consumption and revealing possibilities for cost-effective improvements.
- *Project development fund.* This instrument is aimed to co-finance project investment documentation (up to 50% of total costs of the investment study). Potential users are both end-users (especially in service sector) and suppliers of equipment/services (ESCOs, consultants).
- *Partial financial guarantees fund.* This instrument is aimed to stimulate the supply side of the market. i.e. it is aimed to remove barrier for financial institutions to invest in energy efficiency projects thorough reduction of risks for local banks.
- *Technical assistance.* It is offered to all market players engaged in the process of development, evaluation and approval of energy efficiency projects.
- *Promotion campaign.* Strong mass-media campaign that uses concrete principals of, so called, "social marketing" was launched in February 2007. Marketing campaign is based on "benefits recognition principle" [5], meaning that each market player will find their own commercial interest in offering or consuming energy efficient products and services leading to sustainable and long-term energy efficiency market development.

Defined instruments correspond to the stages in energy efficiency project development (Fig.5) and they aim to remove barriers existing in these stages. However, due to constantly changed market conditions it became evident that not every instrument is relevant in every stage of the market and project development. Thus, evaluation of these instruments was needed.

4.2 Evaluation of policy instruments

The evaluation of previously defined instruments is performed based on their relevance to the actual status of the energy efficiency market in Croatia, past success and technical/financial feasibility to overcome the related barriers.

- ***"Social marketing" campaign.*** The level of awareness of end-users in Croatia is very low leading to the lack of demand for energy efficiency services/products/projects. Thus, the stage of energy efficiency market development in Croatia can be represented with dashed vertical line in Fig. 5. This situation called for strong marketing promotion campaign (note that this instrument was not defined initially, but after the start of the project!). While a market analysis of the increase in energy efficiency products sales would be necessary to have a full understanding of the success of this instrument, the first results actually show the increased interest of Croatian public for energy efficiency. Namely, in eight months of the campaign 964 phone calls were received at the

helpline asking for advice about energy. The project web site registered 51,000 visits with most visited contents being promotional materials and advices on how to save energy. It provoked also the supply side of energy efficiency market, confirmed by increased interest of producers and retailers of energy efficient technologies to promote their products.

- ***Free energy audits and consultation.*** Until now, the most demanded instrument in Croatia was free energy audits and consulting. Considering the stage of market development this should not come as a surprise. In 2006 the money invested in free energy audits generated approximately 30 times higher investments in energy efficiency improvement projects. This proves, at the first glance, the importance and effectiveness of this instrument. The net impact of this instrument in terms of delivered energy savings still remains to be evaluated in quantitative terms and it will depend on the overall throughput of the project pipeline, i.e. on the number of actually implemented projects.
- ***Project development fund.*** However, there are very few clients that have requested assistance in creating investments studies for implementation of energy efficiency measures identified through energy audit (only two) [3]. The reasons could be found in the fact that project owners are moving forward with investments themselves or are lacking capital. This have lead to the project development fund being the instrument which has been still weakly used in Croatia, proving that the market is still "stuck".
- ***Partial guarantees fund.*** In the initial policy design, the largest amount of money was allocated to the partial guarantees fund. At that time it was believed that lack of specialized credit lines for financing energy efficiency was one of the major barriers to the market development. However, in the mean time the banking sector is Croatia developed rapidly and now there is a large number of banks and strong competition among them to attract the customers. Banks welcome partial guarantees as an instrument that will lower their risk, but the lack of it is not either a "deal-maker" or "deal-breaker" [3]. In other words, the lack of interest in banks is a secondary barrier induced by primary barrier – the lack of prepared bankable projects! Furthermore, end-users from public sector did not make queries to commercial banks about possible loans, because they would try to use a maximum of their own funds or to apply for other forms of financial support [3]. Thus, the evaluation of this policy instrument shows that adoptions have to be made. It was, thus, decided to lower initial financing allocated for partial guarantees and to alternatively use of one part of it to finance other instruments, i.e. free energy audits and promotional campaign.

5 Conclusion

It is clear that there are significant potentials for energy efficiency improvements in Croatian residential and service sector. However, there are number of barriers preventing fulfillment of economic potentials for energy efficiency. Policy interventions are needed to remove these barriers. Policy should approach markets as complex systems of supply-demand interactions undergoing evolutionary change and direct that change toward efficiency, environmental benefits and social well-being.

Both policy design and evaluation have to be based on the adaptive approach. The requirement for different instruments varies with maturity of the market and timing of utilization. Current maturity of energy efficiency market in Croatia is such that it requires instruments like free energy audits and strong promotion campaign to stimulate the demand for energy efficiency projects. As we go further in time it is expected that more and more projects will "flow" through the pipeline, and other barriers will then become more important in this process causing increased interest for use of other instruments like project development fund and finally partial financial guarantees. As this "flow" approaches "faucet" the need for technical assistance will decrease while the need for financial guarantees will increase.

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