TACKLING CLIMATE CHANGE "AT HOME":

trends and challenges in enhancing energy efficiency in buildings in the UNECE region

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A long-term strategy for energy efficiency in housing is one of the key current priorities on the sustainable development agenda of UNECE countries. A growing urban population requires not only affordable homes, services and infrastructure, but efficient management of existing housing stock. At the same time, many countries suffer from a lack of energy resources, and energy prices are increasing. The housing sector and related infrastructure is a major consumer of energy overall: it is estimated that the housing sector accounts for 40-45 per cent of all energy consumption in society if low-income countries are included. Furthermore, buildings and infrastructure have a significant effect on carbon emissions. This situation is further complicated by a lack of incentives to invest in technologies to save energy, due to the long return on such investments.

This essay explores how energy efficiency in housing constitutes an important technical, political, economic and social challenge in the UNECE region. It also elaborates the costs and benefits of enhancing energy efficiency in the sector, devoting particular attention to the countries of EECCA and SEE.

THE TWIN THREATS OF ENERGY AND CLIMATE CHANGE AND THE URGENCY OF BRIDGING THE ENERGY-EFFICIENCY GAP

The availability and affordability of energy and the environmental impact of energy overconsumption are two inextricably linked global challenges of our times. Growth demands large quantities of energy, whose consumption increases the planet's temperatures and has a negative impact on the environment with often catastrophic effects on people and their lives. As energy is an indispensable element of growth, the challenge lies in identifying the proper technologies to produce clean energy, as well as policies and solutions to reduce energy consumption, in order to reduce the negative impacts.

If one looks at the contribution of different sectors to global emissions, it is very clear how they are all connected to two further interlinked major phenomena: population growth and growing urbanization.

Why is enhancing energy efficiency in buildings important in the region, and in particular in the middle- and low-income EECCA and SEE countries? The answer lies in both global environmental and economic dynamics and the unique characteristics of the two subregions. Estimates indicate that buildings could hold the key to most significant savings in global energy consumption, e.g. the EU has posited that "The largest cost-effective savings potential lies in the residential (households) and commercial buildings sector (tertiary sector), where the full potential is now estimated to be around 27 per cent and 30 per cent of energy use, respectively. […] For the manufacturing industry, the overall potential is estimated to be 25 per cent […]. For transport, a similar full potential of 26 per cent is estimated".[33] This view is shared by IPCC: "There is a global potential to reduce approximately 29 per cent of the projected baseline emissions by 2020 cost-effectively in the residential and commercial sectors, the highest among all sectors".[34] Indeed, it appears that their energy-saving potential is among the highest when compared to other sectors.

The UNECE region encompasses many different geographic and climatic realities, ranging from freezing tundra in Siberia to arid land in the Mediterranean. These different climates require a significant use of energy, either for cooling in summer or heating buildings in cold winters. Although this essay covers the whole UNECE region, particular attention is paid to the region-specific characteristics of cold climates, the adverse effects of the legacy of central planning, the drop in household incomes and the lack of cost-effective renewable alternative sources of energy. Average temperatures in EECCA are significantly lower than elsewhere and often drop during the coldest days of the winter to below -20°C. Cold winters necessitate more and lengthier expenditures on heat, required for five to seven months in most cases. This fact is further exacerbated by the alarming scale and intensity of the deterioration of the existing housing stock and (mostly district) heating systems, due to lack of maintenance and the legacy of central planning.

[32] *This article is based on papers prepared for the sixty-ninth session of the Committee on Housing and Land Management and discussions at the session.*

[33] *European Commission 2006, Action Plan for Energy Efficiency: Realising the Potential, Brussels, COM (2006)545, p.5.*

[34] *IPCC 2007, "Residential and commercial buildings", in Climate Change 2007: Mitigation, Contribution of Working Group III to the Fourth Assessment Report of IPCC [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007. p. 389.*

The following paradox thus emerges: although the variety of existing technological options means that large-scale energy efficiency programmes in the housing sector are technically feasible and to a large extent affordable, energy-efficiency enhancements are realized only on a very limited scale, below what is judged as cost-effective. This is clear evidence that real-world markets deviate from a (Pareto) efficient resource allocation. The resulting energy efficiency gap is an anomaly that policy needs to address urgently by reducing the difference between the level of energy efficiency actually achieved and the level estimated to be cost-effective. Various explanations exist for this energy efficiency gap. Addressing this gap would have a two-fold result: on the one hand reducing unsustainable production and energy consumption – and therefore their negative impacts on the environment – and on the other reducing energy costs for households and countries, allowing savings at the national to individual levels, and limiting the share of energy and electricity costs relative to incomes.

BUILDINGS' CONTRIBUTIONS TO CLIMATE CHANGE AND POTENTIAL FOR ENERGY SAVINGS

According to some estimates, 57 per cent of emissions are from burning fossil fuels in power, transport, building and industry. While direct energy emissions from the building sector are relatively low compared with other sectors, projected trends and the emission of indirect impacts are quite worrisome. In general, the contribution of buildings to climate change is greater than those that sectoral figures and calculations suggest, given that building dwellers are consuming energy produced by the energy sector.

In addition to direct emissions, another 8 per cent should be added to reflect emissions due to direct combustion of fossil fuels and biomass in commercial and residential buildings, generally for heating and cooling. Also, land use changes account for a very high proportion, almost 7 per cent of global emissions. These are often due to deforestation and loss of biodiversity linked to urban expansion. Moreover, as changes in land use leave space for low-density settlements, this increases the likelihood of people using private transport, thus also considerably increasing the individual level of emission-related activities and behaviours. This fact should also be taken into account when looking at the impact and contribution of buildings to the climate change equation.

In terms of energy consumption, it is estimated that, worldwide, 30-40 per cent of all primary energy is used in buildings. According to current trends, the building sector is not likely to reduce its impact, as direct emissions are, for instance, expected to grow by approximately 70 per cent between 2000 and 2050.

In OECD countries, buildings are responsible for 25-40 per cent of the total energy use. In Europe, buildings account for 40-45 per cent of energy consumption, contributing to significant amounts of CO_2 emissions. In the EU, the residential sector represented 77 per cent of all CO_2 emissions from buildings in 2002. In low-income countries, the share can rise to over 90 per cent.

As noted above, of the total energy used in a building, approximately, 80-90 per cent of total energy used during the lifespan of a building is consumed during the use phase (i.e. not in the construction phase), which is dominated by control of the inner environment (heating and cooling), followed by use of hot water, appliances and lighting.

REASONS FOR IMPROVING HOUSING ENERGY PERFORMANCE IN THE UNECE REGION

There are several good reasons to invest in technology and to implement policies that support energy efficiency in buildings.

In general, across the region, infrastructure damage costs will increase substantially due to climate change-related phenomena. Retrofitting buildings in an energy-efficient way will contribute to climate change adaptation and mitigation in two ways:

(a) By reducing the energy intake and consumption of the building;

(b) By making buildings more resistant to more severe weather events, which are likely to increase in the near future.

As convincingly stated in the Stern Review, unless measures are taken in this direction, the highest costs of the effects of natural disasters will be borne mostly by developed countries, given the "high value and large amount of infrastructure at risk".

In the UNECE region, several high-latitude regions are already experiencing the effects of warming on previously frozen land. The weakening of soil due to higher temperatures will lead to severe damage to buildings and roads in settlements located on permafrost in Canada and the Russian Federation.

With respect to energy consumption, while, due to rises in energy efficiency, in the period 1990–2005 the number of households in the EU increased by 18 per cent and related emissions only grew slightly, in Eastern Europe and Central Asia the situation did not improve.

Unless efficiency is raised in many EECCA and SEE countries, increased housing construction and homeownership will be accompanied by increasing electricity consumption, thus resulting in higher emissions. In general, existing buildings, in particular those constructed between the 1960s and the 1980s, are characterized by low thermal efficiencies and wasteful heat distribution systems. New buildings are also being built with low thermal efficiency. Many of the countries in the region still use construction norms and regulations dating back to the Soviet period. For instance, energy efficiency in Ukraine's housing stock is 3 to 5 times lower than that of western countries. Heat loss in buildings in Kazakhstan is 50 to 60 per cent higher than in developed countries under comparable conditions.

Energy loss is also very high in the heating and water supply networks. It was estimated that in the Russian Federation, heat loss during distribution reaches 20 per cent in some areas. Average losses of 30-50 per cent are normal in EECCA and SEE countries.

Low thermal efficiency in these countries has other impacts as well, including social ones, which are becoming significant for lower-income groups with little or no district heating in EECCA and SEE. This was for instance the case in Armenia, Azerbaijan and the Republic of Moldova during the late 1990s, when many tenants heated their houses at survival levels only. These groups have also been using "dirty" fuels (e.g. kerosene) in cheap stoves, with detrimental effects on indoor air quality and health. Thus, improving energy performance in residential buildings can help to avoid social exclusion, as an increasing number of low-income households can no longer afford the costs of heating – often the largest part of total expenditures on housing.

In general, the case for increased efficiency is strictly related to the compelling issue of sustainable refurbishment and restructuring of the housing stock in the region, which, although more acute in EECCA and SEE countries, is shared by all UNECE member States.

THE ECONOMIC SIDE OF ENERGY EFFICIENCY IN BUILDINGS

Is investing in large-scale energy efficiency retrofitting programmes an economically rational decision for Governments, communities and individuals? What are the costs and benefits involved? It should be clear so far that increasing energy efficiency in the existing housing stock makes sense from an environmental point of view. Prior to the implementation of large-scale energy-efficiency programmes, however, it is important to know whether they make economic sense. To answer this question, issues at two levels of analysis need to be considered.

The first level is macro/global. At this level, the question of economic rationale has been answered in unequivocal terms by the benchmark study on this topic, the Stern Review, which concludes that delaying action in curbing CO_2 emissions will most likely result in unsustainably increasing costs for mitigation and adaptation or, even worse, irreversible damage with unpredictable economic consequences. Investing in energy efficiency is therefore an economically rational decision.

This essay, however, focuses mostly on the second level, which is national and looks at the question of costs and benefits for society at large from the more specific angle of cost-benefit analysis and the key parameter of payback times for investment. At its core, such analysis considers, on the one hand, the costs of the programmes and, on the other, the energy savings and other benefits they are expected to generate. But what should be counted as costs and benefits? Answers vary widely, but the two most obvious choices are to maintain a narrow focus exclusively on energy cost savings, or a broader one, integrating wider but relevant social-economic consequences and benefits.

Many methodological and substantive challenges exist. Methodological issues aside, one of the most important challenges is the lack of reliable studies on assessing the economic costs and benefits for society of large-scale retrofitting programmes in EECCA and SEE countries. This section identifies and adapts key themes of cost-benefit analysis that are of relevance to EECCA and SEE countries, from their original application in developed countries.

Narrow (energy cost-savings) cost benefit analysis – costs

Enhancing energy efficiency through retrofitting existing building stock entails two types of direct costs: technology (including materials) and labour. Technology and materials costs may include: roof and/or wall insulation, double glazing, draught sealing, central heating and lagging jackets. To the extent that these materials are produced domestically, regulation and economic instruments such as taxation, subsidies or other incentives/disincentives may assign differential costs and thus affect both demand and supply for these products. To the extent that these technologies and solutions are manufactured in high-income countries, which is more often the case, they can be expected to have an impact on the country's balance of payments and trade deficit.

Labour costs are more complicated to calculate. They depend on availability of labour (unemployment rate) and the level of skills required. Certain types of technologies, such as draught stripping, fitting of lagging jackets and roof insulation, require low levels of expertise and can therefore be undertaken by unskilled staff with little training. Other types however, such as wall insulation, central heating and double glazing, should be undertaken by skilled workers and commercial companies.

The value of labour costs depends, among other things and to a large extent, on the level of unemployment in the country/region. Under conditions of full employment, any increase in employment in one sector will reduce the availability of labour in another sector, especially if economic migration does not respond flexibly to such conditions. On the other hand, under conditions of high unemployment it could be foreseen that increases in employment in the retrofitting sector would not necessarily lead to shortages elsewhere (employment additionality). However, the lack of skilled workforce and of training facilities means that the application of certain technologies cannot proceed in the short run relying on domestic resources alone (i.e. without external assistance).

To properly account for these two different scenarios, proper valuation of labour costs requires use of shadow prices (i.e. additional costs for society at large), which depend on the level of unemployment. Specifically, under conditions of full employment, the shadow price of labour equals the market wage. On the other hand, under conditions of unemployment and to the extent that the increase in employment is not expected to be larger than the level of unemployment in the country, the shadow price equals zero. Because of the relatively high unemployment in EECCA and SEE countries, in most cases between 8 and 10 per cent (see table), it can be expected that the shadow price of large-scale retrofitting programmes will be relatively low.

Unemployment rate (percentage) - both sexes						
	1996	2002	2003	2004	2005	2006
World	6.2	6.6	6.5	6.4	6.4	6.3
Developed economies and European Union	7.8	7.3	7.4	7.2	6.9	6.4
EECCA and SEE countries	9.8	9.8	9.4	9.3	9.0	8.8

Source: International Labour Office (ILO), 2008, Key indicators of the labour market

Large-scale country-wide programmes of retrofitting may themselves have an effect on the level of prices in commodities and labour used in the broader housing sector. The effect may be an upward pressure on prices if, for example, capacity constraints in terms of materials or of supply of skilled workforce exist. It is very likely, however, that the effect on the level of prices will be a downward pressure, since increased competition, gains in competitiveness and efficiency, technological and technical improvements and the spread of know-how tend to push prices down. It is of course entirely possible – and most common – that the two dynamics described here operate at the same time.

Any cost-benefit analysis inevitably has to be made on the basis of a certain level of prices. To test the sensitivity of the analysis to changes of level of prices, scenarios need to be drawn reflecting the two different dynamics described above and therefore predicting plausible upward or downward swings of the related level of prices. These scenarios need to complement the baseline scenario of no change in the level of prices. In this way, it will be possible to gain a better understanding of the potential divergence from the baseline predictions, if the cost-benefit analysis assumptions on price levels do not hold empirically.

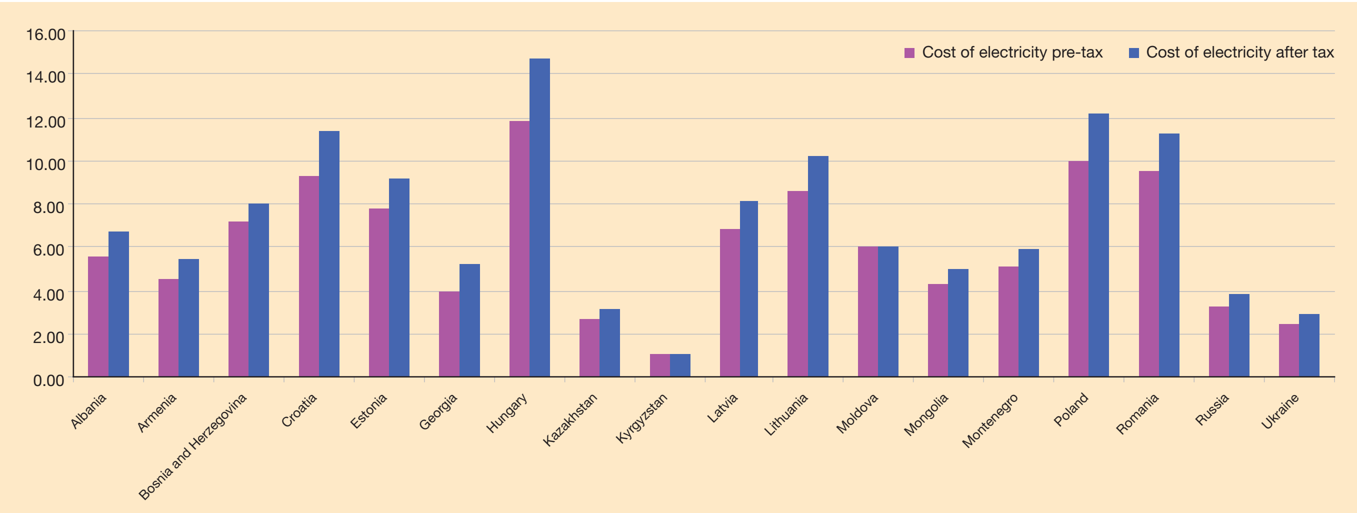
Benefits

Benefits in the narrow cost-benefit analysis are primarily derived from savings in energy use and therefore in energy costs. Energy savings may range from 25 per cent to over 40 per cent, depending on the country in question. Savings are primarily expected in heating/cooling followed by savings in hot-water generation, cooking, washing and other household chores that require electric machinery.

The economic value of those energy savings crucially depends on the cost of energy. In this regard, UNEP has observed that "low, subsidized energy prices in many developing countries imply very long payback periods of up to 25 years for energy efficiency investments, which renders such projects unprofitable".[35] Similarly, the European Environmental Agency (EEA) has concluded that "In the final analysis, the economic incentive for retrofitting will exist only if energy tariffs are set high enough. […] When the full cost savings are included, with reduced costs for municipalities, retrofit projects have a much shorter payback period".[36] For example, the German Ministry of Environment (2007) estimates that payback time for roof improvements, among the most expensive retrofitting applications, is 10 years (14 years without subsidies). Higher oil prices may shorten the payback period significantly.

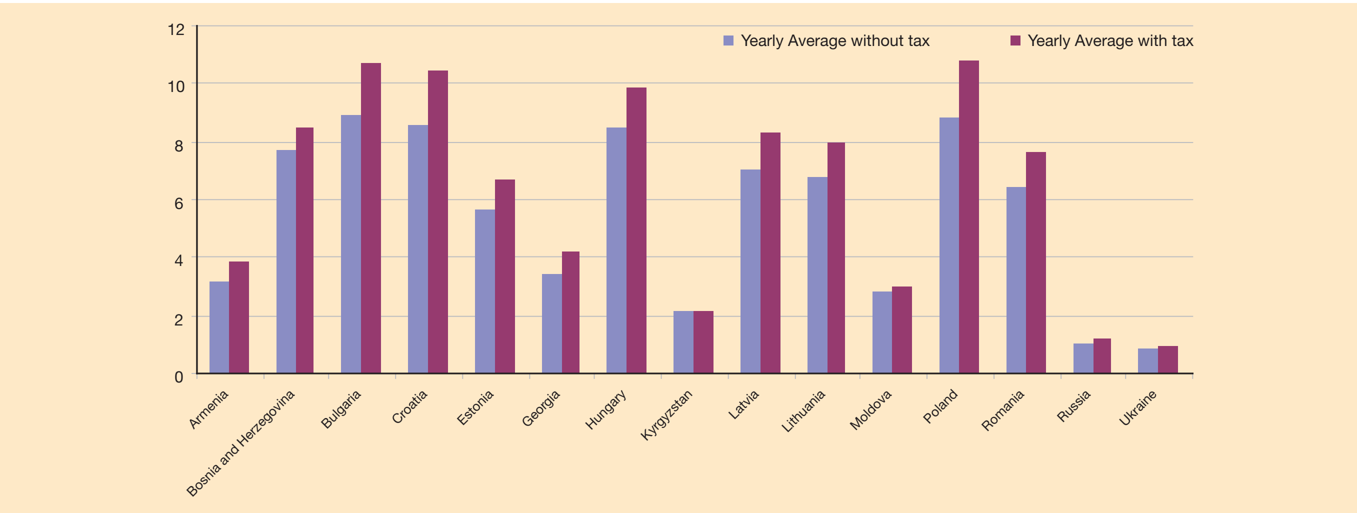
In this sense, and despite their otherwise significant negative economic impact, high energy prices create a favourable climate for improved energy efficiency in low- and high-income countries. Indicative prices of electricity and natural gas in 2005 in selected EECCA and SEE countries (figures 1 and 2) show very clearly that prices in EECCA countries are significantly lower than in their SEE counterparts.

Figure 1 Cost of residential electricity in selected EECCA and SEE countries, 2005



Source: Energy Regulators Regional Association (http://www.erranet.org), accessed 18 August 2008. Author's own calculations.

Figure 2 Cost of residential natural gas in selected EECCA and SEE countries, 2005



Source: Energy Regulators Regional Association (http://www.erranet.org), accessed 18 August 2008. Author's own calculations.

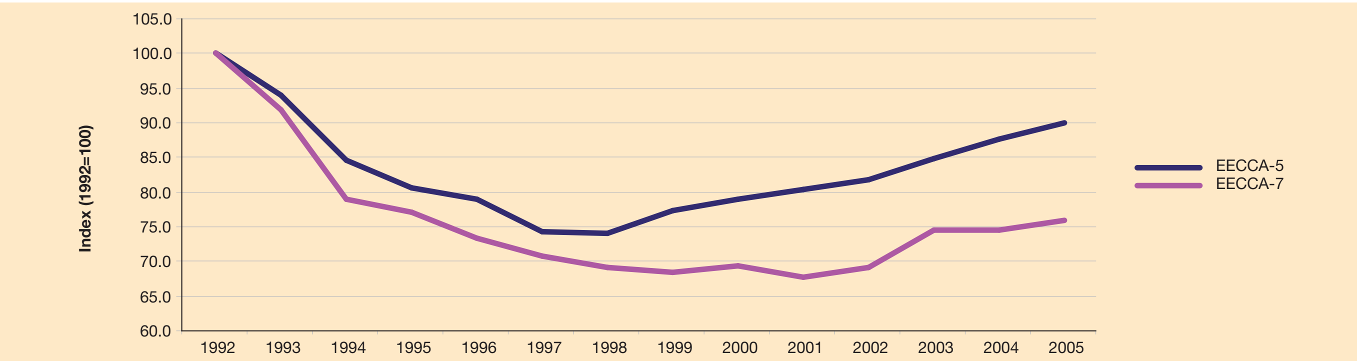
[35] *UNEP, 2007. Assessment of Policy Instruments for Reducing Greenhouse Gas Emissions from Buildings, Report for the UNEP-Sustainable Buildings and Construction Initiative [Sonja Koeppel, Diana Ürge-Vorsatz, Budapest: Central European University].*

[36] *EEA 2007, European Environmental Agency Report, Sustainable consumption and production in South East Europe and Eastern Europe, Caucasus and Central Asia, Copenhagen, No 3/2007, p. 120.*

A special case – fossil fuel-rich countries

Fossil fuel-rich countries form a rather particular subset of countries, where a separate type of cost-benefit analysis might be required EECCA countries producing oil, coal and gas, e.g. Azerbaijan, Kazakhstan, Russian Federation, Turkmenistan and Uzbekistan (EECCA-5), are often among the least concerned with energy efficiency and subsidized prices are frequently observed. This is also reflected in the per capita energy consumption observed in the EECCA-5 countries, when compared to the non-producing EECCA-7 countries (Armenia, Belarus, Georgia, Kyrgyzstan, Republic of Moldova, Tajikistan and Ukraine; see figure 3). From these countries' perspective, an alternative way of assessing costs and benefits is to examine the question of payback times from the angle of opportunity costs. How much more would an oil-producing country earn if, due to increases in energy efficiency, savings in oil quantities used in subsidized domestic markets were sold instead at world prices in international markets? Increased earnings, in turn, could be used to fully finance or subsidize necessary investment that would lead to further gains in energy efficiency, thus creating a virtuous policy cycle. As figure 4 shows, EECCA-5 countries already take advantage of high energy prices in international oil markets (the trend is similar in coal exports). There is, however, room for improvement, through energy efficiency measures that optimize the financial impact of natural resources while contributing to social welfare.

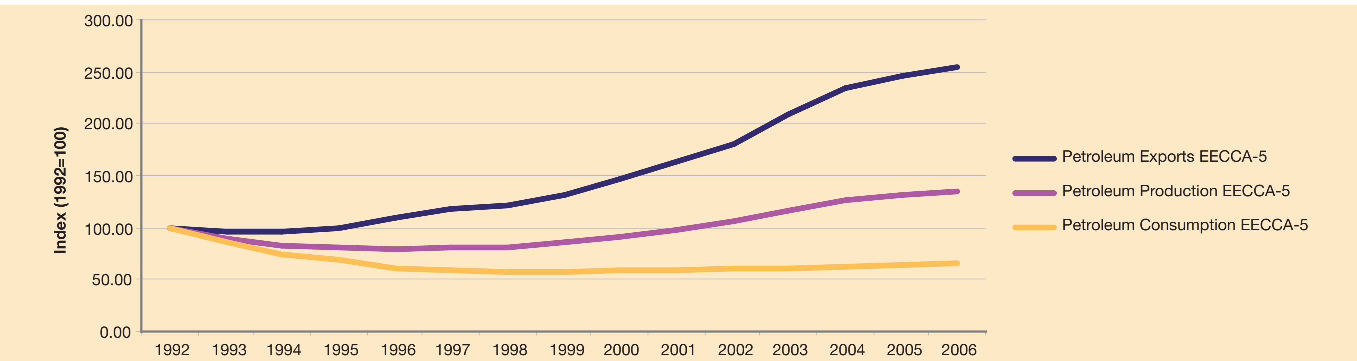
Figure 3 Per capita energy consumption in oil/gas producing and non-producing EECCA countries



Source: Energy Regulators Regional Association (http://www.erranet.org), accessed 18 August 2008. Author's own calculations.

As an example [37], in 2006 the Russian Federation produced 12.1 per cent of world crude oil output (or 477 Mt) and exported roughly half of that (or 253 Mt); by contrast, Saudi Arabia produced 12.9 per cent of world crude oil output and exported over 70 per cent of that in world markets.[38] Similarly, the Russian Federation produced 22 per cent of global natural gas in 2006 (or 656,290 Mm3) and exported less than one third of that output to world markets (ibid). The Russian Federation's export ratio in hard coal was slightly higher than one third of its production: of the 233 Mt of hard coal produced in 2006, only 37 per cent (or 92 Mt) was exported. Kazakhstan's export ratio in the same category is even lower: of the 92 Mt of hard coal produced in 2006, only slightly over a quarter (26 Mt) was exported.

Figure 4 Petroleum - EECCA-5



Source: Energy Regulators Regional Association (http://www.erranet.org), accessed 18 August 2008. Author's own calculations.

[37] *Without taking into consideration other parameters of importance such as distance from transit routes and consumption, which may be particularly important in the case of natural gas, for example.*

[38] *Data from International Energy Agency, 2007 Key world energy statistics.*

A broader analysis of costs and benefits

More recent studies have argued convincingly that a narrow analysis of costs and benefits only of direct energy cost savings may underestimate the true benefits of energy efficiency programmes. It is therefore important to also take into account so-called co-benefits (positive externalities) and their economic value for society.

These positive externalities include environmental benefits, increased energy security, the creation of jobs and business opportunities, heightened economic competitiveness and improved industrial productivity in the short and medium run, as well as poverty alleviation and improved social welfare, better indoor and outdoor air quality, greater comfort, reduced mortality and morbidity and enhanced health.

Health and comfort-health dividends for individuals and society

An energy-efficient home can enhance comfort and lead to health improvements for its residents. For instance, it is common to observe in countries with heavy winters that the number of deaths increases significantly during the winter season. This surplus mortality could be avoided to the extent that energy efficiency measures would raise the ability of people suffering from energy poverty to maintain at least a "survival" level of heating. To calculate the economic value of this benefit would require placing monetary values on mortality benefits, indeed a highly controversial area of economics, commonly through the "value of statistical life" (VSL), which can be used to value the impact of enhancements in energy efficiency standards on the risk of death.

Empirically, households rarely fully utilize energy conservation gains following the application of energy efficiency measures. To understand why, one needs to consider the two borderline options that increased energy efficiency creates: households can either achieve the same level of heating with less energy (energy-saving option) or achieve higher levels of heating with the same energy they used before (comfort increasing option). The reality lies somewhere in between: based on experience, households will forgo part of the potential savings in exchange for increased comfort. Valuing comfort can be very difficult, because it involves individual preferences that are not possible to estimate objectively. Because of the inherent subjectivity of the task, increases in comfort levels can be valued as the difference between maximum potential energy savings and actual energy savings. This of course is not a direct measure of the value that people place on increased levels of comfort, but may be a reasonable proxy of this variable.

How will individuals react following the installation of energy efficiency measures in their houses? To answer this question, it is necessary to predict the balance that communities will choose between comfort and savings on energy bills. Although hard to predict, certain conclusions can be drawn. Socio-economic status, both domestic and international, is a good predictor of the tendency: poorer communities and countries will most likely move further towards the comfort-enhancing end than richer communities and countries, which will most likely show a higher preference for the energy-saving end. As an example, in Ireland it has been estimated that 30 per cent of savings are channelled back to households to increase comfort.

It can be expected that in low-income countries such losses from unrealized energy savings in the form of increases in comfort will be higher. Such unrealized gains in energy savings can be thought of as an overall loss. However, to the extent that increases in comfort also have health impacts, they also have positive economic consequences. In other words, despite losses in unrealized energy savings, there are also gains in terms of increased productivity and health that only a broad analysis of costs and benefits can capture.

CHALLENGES IN IMPROVING ENERGY EFFICIENCY IN BUILDINGS

Promoting energy efficiency in the existing housing stock makes environmental and economic sense in a context of scarce and increasingly high-priced, non-renewable energy resources. Energy reduction in housing has been a major field of research in recent years in more developed countries, both for existing housing and for new housing construction. This has led to vast improvement programmes for existing housing stock, with an emphasis on buildings dating from the 1960s to the 1980s. Experience shows that such programmes lead to an average reduction of energy consumption by 50 to 60 per cent.

Why, then, is investment lagging and, more importantly, what policies are available to help change the situation?

It should be clear from the start that barriers are often different depending on countries and regions analysed. While some countries have carried out impressive programmes, others are still lagging behind, often because of insufficient technical or organizational know-how. Ironically, this leads to a situation where dwellers in "rich" regions pay significantly less for energy than those in poorer regions (under the assumption that energy costs will reach similar levels in all countries within the coming years).

Particularly in EECCA and SEE countries, a number of challenges need to be overcome to allow the use of the full range of options currently available. Some of these constraints are specific to EECCA and SEE – namely, a weak public sector with no or insufficient housing budgets, outdated building codes, little knowledge within the local construction sector about new technical improvements, low levels of research activity both in the public and private sectors, and a market dominated by high demand rather than by sufficient supply, weakening the role of critical consumers. Other barriers are more global in nature.

Global barriers include the lack of reliable information on energy efficiency measures, market failures that lead to lack of proper incentives at the individual level (e.g. landlords who would pay for energy efficiency equipment and tenants who would gain from such investments), limitations in access to financing and subsidies on energy prices.

Successful projects depend on the identification of the appropriate building techniques, as well as effective distribution of roles and responsibilities and on the availability of financing instruments. In general, it has been noted that increased investments in the design and construction techniques in the construction phase, which can lead to improvement in the energy efficiency of the building in the use phase, will lead to economic and social benefits throughout a building's lifetime. On the other hand, lack of such investments will lead to higher energy consumption. Despite this logical realization, several buildings are still being renovated or constructed without use of the appropriate techniques.

The main constraints to energy-efficient buildings are often associated costs. Purchasing more efficient equipment implies higher first costs. This represents an important impediment for low-income consumers with limited capital to invest, and is often a psychological barrier for consumers in general. In addition, construction companies tend to save on material and building costs, so that real estate markets may also focus on the cutting construction costs. In EECCA and SEE countries, insufficient financing by owners after the privatization of formerly public rental housing stock has prevented investments in this sector. This is often coupled with a weak public sector with no or insufficient housing budgets. In Western Europe on the other hand, in most cases budgets have stimulated such innovations.

Lack of proper knowledge and information is also an important challenge to be addressed. Despite the existence of technologies, lack of information hampers the use of appropriate tools to increase energy efficiency in housing. As the result of – and in some cases despite – the support of public subsidies, improvements have been technically incorrect, often bringing poorer performance instead of increased efficiency. In other cases, subsidies have led to the construction of sporadic pilot projects that were very expensive and not replicable. This holds true in particular for EECCA and SEE countries, which would benefit greatly from the know-how developed in other parts of the UNECE region.

This lack is also often associated with weak or non-existing public and/or private research and development activities as well as insufficient knowledge of new technical options with respect to thermal improvement of existing residential buildings. Within this category, it is also possible to include lack of knowledge of proper organizational structures for companies, or the decision-making structures within municipalities and even multi-family storey buildings. In the latter case, responsibilities are often unclear, as no organized initiatives are promoted to renovate common spaces.

Moreover, lack of energy information for potential buyers, as well as lack of knowledge and resistance to change within the construction industry further delay the transition towards more sustainable building technologies. In EECCA and SEE should also be added the limited knowledge within the local construction sector about new technical improvements as well as the low levels of research activity both in the public and private sectors.

If to the above we also add obsolete building codes that might promote the construction of energy-efficient buildings, and weak local construction industries with limited capacity for innovation, it is easy to understand why, in particular in EECCA and SEE countries, the energy performance of most new housing projects is far behind the standards achieved in other, more developed parts of the UNECE region.

It should be noted, however, that in most developed countries in the region the reduction of energy consumption of new residential buildings has come about in several stages. Initial improvements – mainly made by adapting building codes – were already being implemented after the 1970s "oil shock" (e.g. double and triple glazing). It is only rather recently however, that significant changes have taken place, encouraged by new technical developments. Today, in many of these developed countries, "low-energy" buildings (i.e. with an energy consumption per m^2 and year of less than 50 kW, as compared with 150 to 200 m^2 in "normal" housing) have become widespread.

Given the higher level of awareness and technical knowledge, as well as investments in these technologies, the comparatively wealthy regions profit from such innovations, while those which already struggle with increasing energy costs lag behind.

POLICY CONSIDERATIONS

Three key policy-related issues have been identified so far. First, of the total housing stock, the most significant portion of carbon and energy savings by 2030 will be made in retrofitting existing buildings and replacing energy-intensive equipment. Secondly, there is a wide range of mature and cost-effective technologies and know-how that has not been widely adopted in the developing or developed countries. Thirdly, the existence of macro- and micro-level barriers obstructs investment and the application of energy efficiency measures to the extent that they are considered cost-effective and economically justifiable.

What can be done to overcome these obstacles? A number of solutions at different levels of policymaking, ranging from strategic to technical and from national regulations to international trade, should be considered.

At the national level, the effectiveness of policy instruments will be enhanced if they are part of a strategic framework in which energy conservation becomes a high-priority national goal, e.g. improving the energy efficiency of existing buildings over a defined period. These policies could be linked with broader ones related to housing maintenance and retrofitting.

The effectiveness of policies will be further increased if choices are based on a strategy that prioritizes feasibility and impact, starting with easier yet effective measures. One example of a simple-to-implement yet effective measure would be the establishment of national lighting efficiency standards coupled with the phasing out of traditional inefficient (i.e. incandescent) light bulbs within a reasonable amount of time (say, 10 years) following the adoption of the policy.

Capacity-building and training are essential elements in any national plan to ensure an energy-efficient building stock. While the training of a country's own architects and other construction-related professions is a medium-term solution, technical assistance through international consultants and organizations can offer a temporary yet effective solution in the short term. However, the issue of training needs to be addressed immediately in order not to rely on external help and expensive solutions.

From the point of view of institutional capacity, the creation of a properly staffed energy agency can greatly contribute to better coordination of national efforts, as well as increased technical and policy capacity.

When cross-border trade is necessary to ensure that suitable technologies become available at affordable prices, trade barriers and impediments should be eased. Supply must meet demand domestically or internationally through comprehensive investment and trade policies as well as technology-transfer programmes aimed at exporting climate-friendly technologies, including green buildings.

The higher initial cost of energy-efficient technologies may still delay their application in EECCA and SEE countries, especially if these technologies need to be imported. Domestic capacity, both in production of such materials and in their application, should be enhanced.

Lack of information and awareness are among the major barriers to generating sufficient bottom-up demand for environmental housing in low-income countries. Awareness can be raised through extended information campaigns, or through pilot projects administered and financed by international organizations or bilateral donor agencies. Energy efficiency should also be promoted through the exchange of best practices and regional cooperation programmes.

The establishment of incentives for early adoption of energy-saving measures can go a long way towards accelerating their introduction. For example, one option would be the extension of "early-bird" grants for early adopters (e.g. municipalities, communities or other appropriate administrative units in each country), to reward those localities that take the first steps in implementing energy efficiency retrofits for existing buildings.

The supply side needs to have the right incentive structure as well. To achieve this, profits should be uncoupled from increased energy usage. Instead, incentives for energy conservation should be provided to ensure that utilities see increased profits for improving energy efficiency. Such an incentive structure would align utilities' and consumers' interests.

Poorer consumers would need financial support or affordable loans to encourage investment. It is possible that low-income countries could – at least partly – raise money through public benefit charges or taxes to implement such support programmes. Most likely, however, they would also have to rely on bilateral or multilateral international assistance for pilot projects, which should be easily replicable.

Governments should be the leaders in the effort to save energy, by assessing the energy efficiency of existing government buildings and introducing measures to drastically increase energy conservation.

CONCLUSIONS

In summary, the consensus in the economic and policy literature is that, subject to the high price and insecurity of fossil fuels, the cost-benefit analysis of energy efficiency programmes favours the undertaking of such programmes, regardless of whether benefits are defined in narrow or broader terms.

Currently, availability and affordability for lower-income EECCA and SEE countries remain major obstacles. Since technology originates primarily in developed countries, the application and availability of that technology in low-income countries must be encouraged and facilitated through investment, trade, or technology-transfer programmes that can be easily applied, are not too expensive and can be reproduced. This can often only be achieved through policy interventions at the national and international levels.

Investment strategies must carefully consider the available alternatives. This essay is a step towards better understanding the key issues associated with costs and benefits, especially with regard to improving existing housing stock with retrofitting technologies.

A perfect methodology for evaluating large-scale energy efficiency programmes is not yet available. Yet we have argued here, aiming for an estimate of an overall benefit to cost ratio – as opposed to a narrower energy cost savings cost to benefit ratio – is preferable, since it allows a more accurate capturing of the benefits derived from enhancing the energy efficiency of existing housing stock through large-scale retrofitting programmes.

Policies to bridge the gaps between policymakers and decision-makers and practitioners are being developed. Overcoming the barriers identified here and creating a suitable institutional and a fiscal environment to support the transition towards energy-efficient building are goals shared by UNECE member States. A first promising step was made by UNECE Governments at the Committee on Housing and Land Management meeting in September 2008, where it was decided to initiate work through the convening of two international workshops on energy-efficient buildings in 2009.