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COSTS AND BENEFITS OF ENHANCING THE ENERGY EFFICIENCY OF EXISTING HOUSING STOCK IN LOW-INCOME COUNTRIES IN EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA AND SOUTH-EASTERN EUROPE

Note by the secretariat

Summary

This paper is an extension and elaboration of a short note (ECE/HBP/2008/3) that was prepared by the secretariat to stimulate discussion on the issue of energy efficiency in the housing sector at the Committee on Housing and Land Management's sixty-ninth session as requested by the Bureau meeting (ECE/HBP/2008/10).

I. INTRODUCTION – THE URGENCY OF FILLING THE ENERGY EFFICIENCY GAP

1. Energy conservation in the housing sector has been a major field of research in recent years in more developed countries, both for existing housing and for new housing construction. The future challenge, however, will be to increase energy conservation in middle- and low-income countries.

2. Why is enhancing energy efficiency particularly important in middle- and low-income countries in Eastern Europe, Caucasus, and Central Asia (EECCA) and South-East Europe (SEE)? The answer lies in a combination of unique characteristics of the regions and global environmental and economic dynamics.

3. The region-specific characteristics include the particularly 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 the EECCA and SEE region are significantly lower than in most other regions and often drop during the coldest days of the winter below -20^{o} Celsius (World Bank 2002[1]). Cold winters necessitate higher and lengthier expenditure on heat, which is required for five to seven months in most cases. This fact is exacerbated further 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.

4. More recent environmental and economic factors that make the need to deal with the issue of energy efficiency even more urgent are climate change and the alarming deterioration of the environment[2], combined with, what is believed to be, a long-term irreversible trend of rising energy prices of fossil fuels, and subsequently rise in costs of energy subsidies and the increasing opportunity costs associated with such subsidies (see figure 1). Combined with the stagnant real incomes, the above-mentioned rises in energy prices have adverse effects on communities' welfare, often going below survival levels.

5. A wide range of effective, mature and affordable technological solutions to enhance energy efficiency exist. This range includes, among others, insulation materials and techniques, high-reflectivity building materials and multiple glazing, high-efficiency lighting and appliances, highly efficient ventilation and cooling systems, solar water heaters and passive solar designs.

6. Thus the following paradox 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 extend affordable, energy efficiency enhancements are only realised at a very limited scale, below what is judged cost-effective. This is clear evidence that real world markets deviate from (Pareto) efficient resource allocation.

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[1] The World Bank, 2002, [by Julian A. Lampietti and Anke S. Meyer] *Coping with the Cold: Heating Strategies for Eastern Europe and Central Asia's Urban Poor*, World Bank Technical Paper No. 529, Europe and Central Asia Environmentally and Socially Sustainable Development Series, Washington D.C.: The World Bank.

[2] For more details see concept note (ECE/HBP/2008/2).

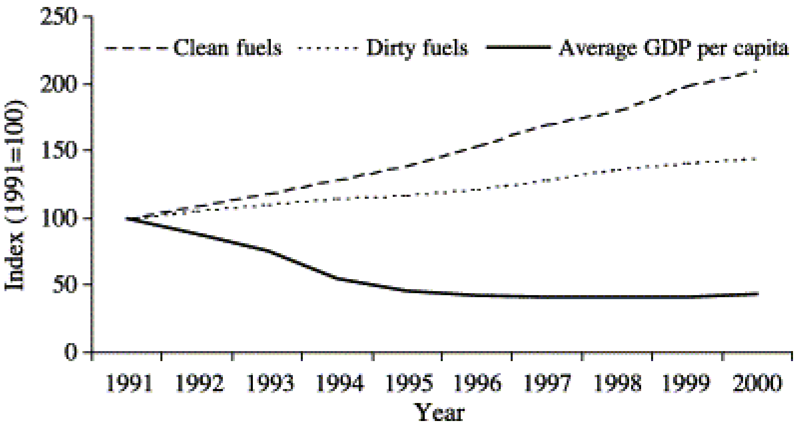

Fig. 1. *Relative changes in energy prices and incomes in Eastern Europe and Central Asia, 1991–2000. Reproduced from World Bank 2003, p. 6.*
[N.B. Dirty fuels include wood and coal; clean fuels include electricity and central gas.]

7. 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.

8. Various explanations exist for this *energy efficiency gap* (Howarth and Sanstad 1994; Soest and Bulte 2001[3]). Particularly significant among them, both at the individual and collective levels, are insufficient information of the profitability of, and lack of understating of returns to, such investments. Trade barriers and high transaction costs further add to this challenge. Structural deficiencies and market failures further complicate matters.

9. Building-level retrofitting solutions explored in this paper offer an independent contribution to enhancing energy efficiency in the housing sector, although this approach could be applied as part of a broader package including heating systems (either building level or district level), raising awareness of energy consumption through metering and non-technological solutions such as education.

10. Non-technological options, such as occupant behaviour or the impact of culture on consumer choice, are major determinants of energy use in buildings and may play a significant role in reducing carbon dioxide (CO_2) emissions (IPCC 2007[4]). Although the potential reduction through non-technological options and the potential leverage of policies and education over these options are still not well researched and understood, existing evidence suggests that significant savings can be generated from these non-technological sources.

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[3] Howarth R and Sanstad A., 1994, 'Discount Rates and Energy Efficiency', *Contemporary Economic Policy,* Vol 13 (3), pp. 101-109. Van Soest, D and Bulte, E, 2001, 'Does the Energy-Efficiency Paradox Exist? Technological Progress and Uncertainty', *Environmental and Resource Economics* (18): 101–112.

[4] "Residential and commercial buildings", in *Climate Change 2007: Mitigation,* Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [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.

II. BENEFITS, CO-BENEFITS AND COSTS

11. 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 from the Concept note (ECE/HBP/2008/2) 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 in two levels of analysis need to be considered.

12. 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 2006 Stern Report[5], 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.

13. This paper, however, focuses mostly on the second level, which is national and looks at the question of costs and benefits for the 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.

14. There exist many methodological and substantive challenges. 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.

A. Narrow (energy cost-savings) cost benefit analysis

Costs

15. Enhancing energy efficiency through retrofitting existing building stock entails two types of direct costs: materials and labour.

16. Material costs depend on the choice of energy saving technologies and 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 materials are

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[5] Stern Nicholas, 2006, *The Economics of Climate Change – The Stern Review*, Cambridge: Cambridge University Press.

manufactured in high-income countries, which is more often the case, they can be expected to have an impact on the countries' balance of payments and trade deficit.

17. 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 skill 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.

18. 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).

19. 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, where unemployment ranges in most cases between 8 and 10 percent (see table 1), it can be expected that the shadow price of large-scale retrofitting programmes will be relatively low.

Table 1. Unemployment rate (%) - both sexes

	1996	2002	2003	2004	2005	2006
World	6.2	6.6	6.5	6.5	6.4	6.3
Developed Economies & 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 Organization, 2008, Key indicators of the labour market*

20. 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 is downward pressures, since increased competition, gains in competitiveness and efficiency, technological and technical improvements and the spread of know-how may push prices down. It is of course entirely possible, and most common, that both dynamics described here operate at the same time.

21. 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.

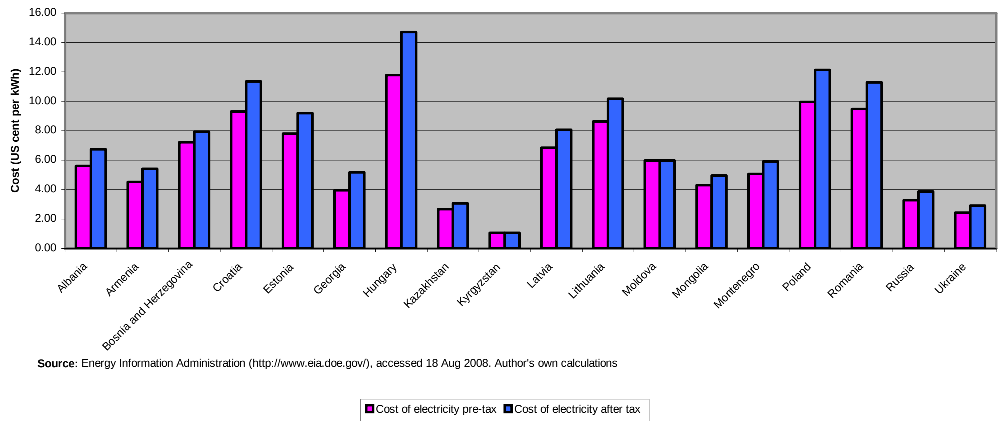
Benefits

22. Benefits in the narrow cost-benefit analysis are primarily derived from savings in energy use and therefore in energy costs.

23. Energy savings may range from 25 to over 40 percent (for more details see Concept Note *op. cit.*), depending on the country in question. Savings are primarily expected in heating followed by savings in cooking washing and other household chores that require electric machinery.

24. The economic value of those energy savings depends crucially on the cost of energy. In this regard, the United Nations Environment Programme (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" (UNEP 2006[6]). 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" (EEA 2007[7]). 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 select EECCA and SEE (figures 2 and 3) show very clearly that prices in EECCA countries are significantly lower than in their SEE counterparts.

Figure 2: Cost of residential electricity in select EECCA and SEE countries - 2005



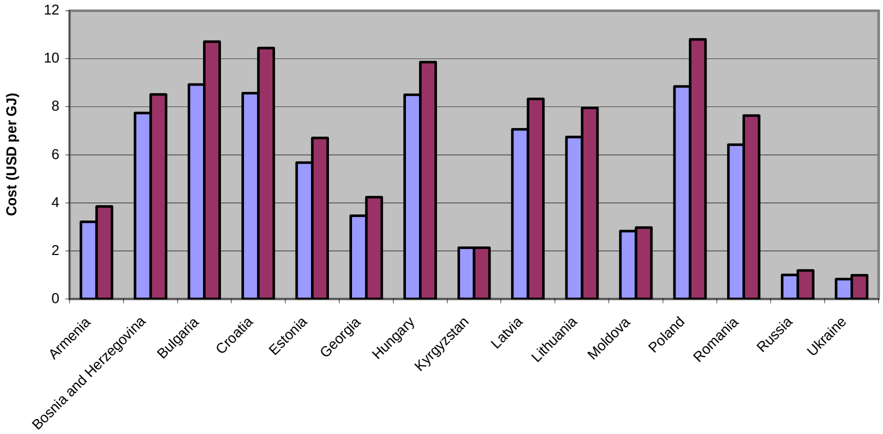
Source: Energy Information Administration (http://www.eia.doe.gov/), accessed 18 Aug 2008. Author's own calculations

6 UNEP, *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], 2007, p.60.

7 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.

25. For example, the German Ministry of Environment (2007) estimates that payback time for roof improvements, among the most expensive retrofitting applications, is ten years (fourteen years without subsidies). Higher oil prices may shorten the payback period significantly.

Figure 3: Cost of residential natural gas in select EECCA and SEE countries - 2005



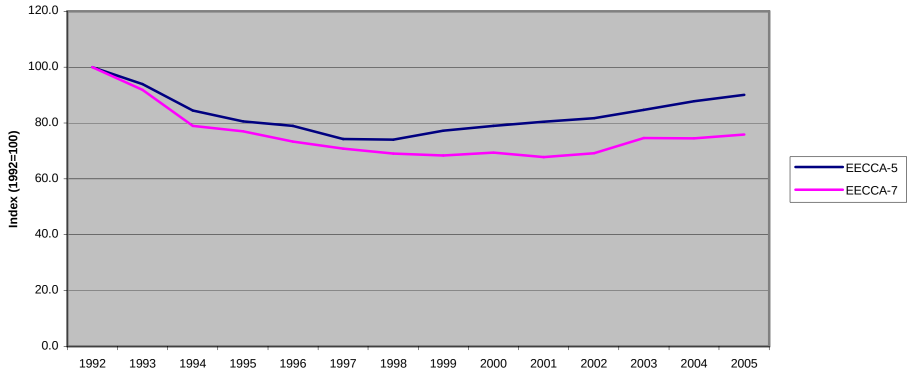
Source: Energy Regulators Regional Association (www.erranet.org), accessed 18 August 2008. Author's own calculations

Yearly Average without tax Yearly Average with tax

A special case – fossil fuel-rich countries

26. Fossil fuel-rich countries form a rather particular subset of countries, where a separate type of cost-benefit analysis might be required. Oil/coal/gas producing EECCA countries include Azerbaijan, Kazakhstan, Russia, Turkmenistan and Uzbekistan (EECCA-5) and are often among the least concerned with energy efficiency and subsidized prices are often observed. This is also reflected in per capita energy consumption observed in the EECCA-5 countries, when compared to non-producing (EECCA-7) countries in the region (see figure 4). From their 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 subsidised 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 5 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 optimise the financial impact of natural resources while contributing to social welfare.

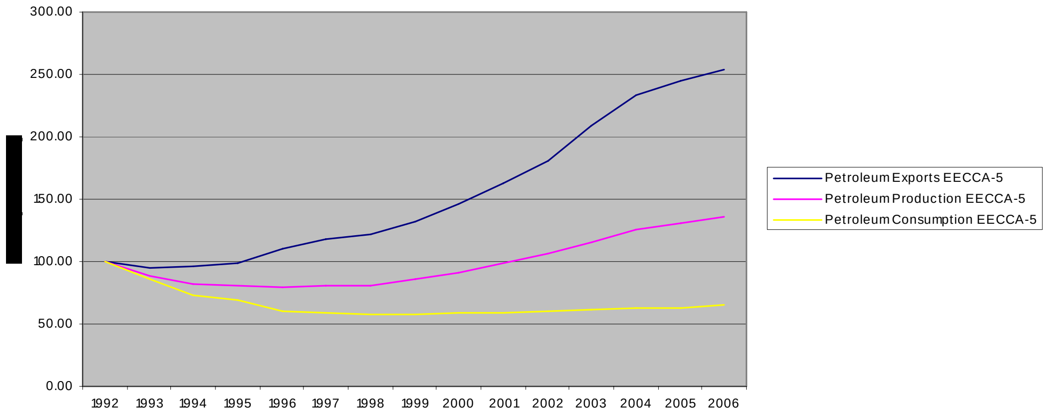
Figure 4: Per capita energy consumption in oil/gas producing and non-producing EECCA countries



Source: Energy Information Administration (http://www.eia.doe.gov/), accessed 18 August 2008. Author's own calculations

27. As an example[8], in 2006 Russia produced 12.1 percent of world crude oil output (or 477 Mt) and exported roughly a half of that (or 253 Mt); by contrast, Saudi Arabia produced 12.9 of world crude oil output and exported over 70 percent of that in world markets (International Energy Agency 2007[9]). Similarly, Russia produced 22 percent of global natural gas in 2006 (or 656,290 Mm^3) and exported less than a third of that output to world markets (ibid). Russia’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 percent (or 92 Mt) were 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 5: Petroleum - EECCA-5



Source: Energy Information Administration (http://www.eia.doe.gov/), accessed 18 August 2008. Author's own calculations.

[8] 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.

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

B. A broader analysis of costs and benefits

28. More recent studies have argued convincingly that a narrow analysis of costs and benefits only of direct energy cost savings is rather limited and therefore 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.

29. 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 (IPCC *ibid*, p.389; UNEP *ibid*).

30. As a general note, although it is hard to quantify all co-benefits, they are real and may have considerable impact. A more detailed discussion of health and comfort benefits follows.

Health dividends for individuals and society

31. An energy efficient home, *ceteris paribus*, leads to health improvement for its residents. As a result, less time, energy and resources are spent on sick-leave, thus leading to losses of productivity. Thus improvements in the energy efficiency of a house will very likely lead to decreases in lost productivity[10].

32. In order to estimate the value of health benefits and to include them in a cost-benefit analysis it is necessary to calculate the number of illnesses (and deaths) that result from inadequately heated houses and to weigh in reduced risk of illness and death.

33. Then, the objective is to assess the avoided individual and collective cost from the individual's avoided illness due to improved energy efficiency. The avoided collective cost includes costs of hospitalisation and drugs that would have been paid by the state, and losses in productivity.

34. It is common to observe in countries with heavy winters that the number of deaths during the winter season is far greater than during any other season. This surplus mortality can be avoided to the extent that energy efficiency measure will 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, an indeed 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.

Comfort-health dividends

35. Empirically, households rarely fully utilise energy conservation gains following the application of energy efficiency measures. To understand why, one needs to consider the two borderline options 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

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[10] To the extent that the largest part of those experiencing ill health due to insufficient heating are elderly, the impact of energy efficiency measures on productivity should not be overstated.

the same energy they used before (comfort increasing option). Reality lies somewhere in between and 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 which 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 a reasonable proxy of this variable.

36. 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. Socioeconomic 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 percent of savings are channelled back to households to increase comfort (Clinch and Healy 2000).

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

The German case: building sector

- New buildings must now be constructed according to the more stringent Energy Saving Ordinance and the Renewable Energies Heat Act: they will have improved insulation and a renewables' share in heat generation (e.g. solar thermal installations). Overall, these measures are expected to be economically efficient as the investment should pay off well within the service life of the installations.
- The energy-efficient modernisation of buildings will be comprehensively supported by the building modernisation programme. House owners who wish to insulate their roof or replace windows receive a grant or low-interest loan. The German government is providing a total of 1.4 billion euro per year for the energy-efficient modernisation of buildings.
- Those who wish to equip their house with heat from renewable energies will receive extensive funding from the market incentive programme. Solar thermal installations, biomass boilers and heat pumps will be supported with grants or low-interest loans. The funds earmarked for this will rise from 130 million euro in 2005 to up to 350 million euro in 2008 and up to 500 million euro in 2009.
- The German government will also provide grants for the energy-efficient modernisation of schools and kindergartens (200 million euro).

(From *The Integrated Energy and Climate Programme of the German Government*, p. 10, December 2007, German Ministry of the Environment)

III. BARRIERS TO EFFICIENCY

38. The above analysis has shown that 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. Why, then, is investment lagging and, more importantly, what policies are available to help change the situation?

39. As underlined in the concept note (ECE/HB/ 2008/2), in EECCA and SEE countries there exist a number of barriers that do not allow the use of the full range of options currently available. Some of these barriers are specific to the region – 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.

40. 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 (IPCC *ibid*).

IV. AREAS TO BE ADDRESSED

41. The section below highlights some important policy issues which should be taken into consideration while promoting energy efficiency in housing. These issues can provide some additional ideas for discussion during the Committee session on energy efficiency in housing.

42. Three key policy-related issues have been identified by the paper and the Concept Note. First, over 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 (IPCC *ibid*). Second, there is a wide range of mature and cost-effective technologies and know-how that have not been widely adopted in the developing or developed countries (IPCC *ibid*, p.389). Third, there exist non-technological (usually behavioural and demand-side) solutions to attaining significant energy conservation in the housing sector which have not been fully integrated in policymaking.

43. 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.

44. The effectiveness of policy will be further increased if choices are based on a strategy that prioritizes feasibility and impact, starting with easier yet effective measures first. 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.

45. There are a number of existing technologies that are effective, mature and increasingly affordable. In order to ensure that these technologies are available at affordable prices, supply

(from developed countries) must meet demand (from low-income countries) through comprehensive investment and trade polices as well as technology transfer programmes aimed at exporting climate-friendly technologies, including green buildings.

46. 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.

47. From an institutional point of view, 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.

48. The 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.

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

50. The supply side needs to have the right incentive structure as well. To achieve this, profits should be decoupled 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.

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

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

53. 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.

V. CONCLUSIONS

54. 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 is favourable to the undertaking of energy efficiency programmes, regardless of whether benefits are defined in narrow or broader terms.

55. Currently, availability and affordability for lower-income countries in Eastern Europe, Caucasus and Central Asia (EECCA) and South-Eastern Europe (SEE) remains a major obstacle. Since technology originates primarily in developed countries, it is necessary to encourage and facilitate the application and availability of that technology in low-income countries through investment, trade, or technology transfer programmes which 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.

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

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

58. Significant added value will be derived by the systematic collection of data to enable in-depth cost-benefit analysis to be conducted at the national levels. A cost-effective strategy would be to add such data collection activities and cost-benefit analyses to existing programmes, such as the housing reviews conducted in the framework of the Committee of Housing and Land Management.
