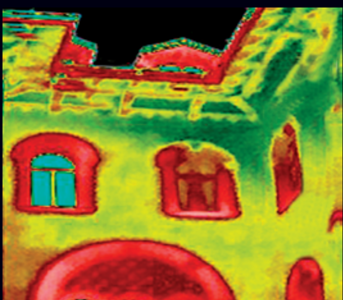
United Nations Economic Commission for Europe

GREEN HOMES



Towards energy-efficient housing in the United Nations Economic Commission for Europe region

UNITED NATIONS

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Green Homes

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UNITED NATIONS
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UNECE Information Service
Palais des Nations
CH-1211 Geneva 10
Switzerland

Phone: +41 (0) 22 917 44 44
Fax: +41 (0) 22 917 05 05
E-mail: info.ece@unece.org
Website: http://www.unece.org

Foreword

The housing sector is one of the priority areas with regard to energy efficiency in the United Nations Economic Commission for Europe (ECE) region – not only because it consumes a large amount of energy (up to 50 percent of total final consumption in individual member States in some of the recent years), but also because it remains remarkably wasteful. While the state of existing technology provides a high potential for drastically reduced energy use in housing, the sector currently maintains outdated inefficient practices, and is one of the drivers of high levels of consumption.

The implications are not trivial. Much more energy is used than necessary; the contribution of housing to carbon dioxide emissions is high and growing; many residents do not have affordable or "clean" energy sufficient to support their subsistence; the penetration of efficiency technology in housing is low and much of the related business potential is untapped. Rationalizing energy use in housing can address these challenges and thereby contribute to resolving today's global problems of climate change, energy security, economic uncertainty, and poverty.

It is this important policy field that the present report reviews. *Green Homes* outlines the economic, social and environmental impacts of the problem, considers current policies, solutions and barriers to effective policies. It discusses policy responses that Governments should develop. The study makes clear that success in setting large-scale energy efficiency measures in motion depends on the establishment of a proper institutional infrastructure; the efforts of Governments of member States are absolutely crucial in this respect. *Green Homes* also pays due respect to the social sensitivity of the subject and calls for responsible actions, so that energy efficiency policies and social policies are interlinked and help fulfil the Millennium Development Goals.

Written in an accessible language, the study intends to reach the broadest audience of national policymakers, decision-makers and experts. This report will serve as a foundation for the further development of the ECE Committee on Housing and Land Management programme of work in assisting Governments to achieve a sustainable transition to energy-efficient housing.

Ján Kubiš

Executive Secretary
United Nations Economic Commission for Europe

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Author: Oleg Golubchikov, School of Geography and the Environment, University of Oxford.

Project Manager: Paola Deda, Secretary to the Committee on Housing and Land Management, United Nations Economic Commission for Europe (ECE).

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The photo on the cover is a thermographic picture of a building after retrofitting (courtesy of Enrico Campagnoli).

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Contents

LIST OF FIGURES, BOXES AND PICTURES

LIST OF ABBREVIATIONS AND ACRONYMS

5-IN	Innovation, information, incentive, initiative and investment.
ADB	Asian Development Bank
AFD	Agence Française de Développement
CHP	Combined heat and power
CO2	Carbon dioxide
DOE	United States Department of Energy
EE	Energy Efficiency
EEA	European Environment Agency
EECCA	Eastern Europe, Caucasus and Central Asia
EPBD	Energy Performance of Buildings Directive
EU	European Union
GHG	Greenhouse gas emissions
IEA	International Energy Agency
IPCC	International Panel on Climate Change
Kgoe	Kilograms of Oil Equivalent
Kwh/m^2	Kilowatt-hours per square meter
LEED	Leadership in Energy and Environmental Design
LESA	Landlord's Energy Saving Allowance
Mtoe	Million Tons of Oil Equivalent
MRDPW	Ministry of Regional Development and Public Works
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
RD&D	Research, development and demonstration
REECL	Residential Energy Efficiency Credit Line
SEE	South Eastern Europe
SEH	Europe's Smart Energy Home
u-Value	Heat transfer coefficient
UNDP	United Nations Development Programme
ECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

In the United Nations Economic Commission for Europe (ECE) region, buildings are responsible for over one third of the total final energy consumption. Much of this energy is used by the residential sector (20–30 percent of total final consumption on average). Demographic, economic and cultural changes are further increasing the pressure of housing on energy use and are accompanied by even higher levels of related greenhouse gas emissions. However, it is the building sector – and particularly the residential sector – that could generate some of the greatest energy savings in comparison with other energy uses. To explore these opportunities, the present study outlines key benefits, challenges and prospects that ECE member States should consider for developing their policies with regard to improved energy efficiency in housing.

It is widely acknowledged that investing in energy efficient homes provides quicker and cheaper results than alternatively increasing capacities for energy supply. Moreover, improving energy efficiency in housing is a great opportunity to promote economic development, environmental stewardship, human rights, quality of life and social equality. This report outlines some of these **benefits and opportunities**, including:

- *Environmental benefits*. Better energy efficiency reduces the pressure of energy use on climate change. Furthermore, improving the energy efficiency of housing constitutes a climate change adaptation measure by better shielding homes from adverse weather conditions. There are also opportunities related to carbon trade possibilities due to reduced carbon dioxide (CO_2) emissions.
- *Energy availability and energy security*. Improving energy efficiency in housing permits more energy for alternative uses or for growing "structural" energy demands in the housing sector itself. It also alleviates the risks of political instability which may arise due to energy shortages or energy price inflation for households.
- *Economic benefits.* Better efficiency offers savings with respect to operational costs for tenants, and service providers benefit from the more efficient transportation of energy services. The development of the sector also has positive influences for research and innovation, business development, employment and investment. It therefore offers an effective tool to stimulate economic growth and to boost national economic competitiveness.
- *Regeneration of the built environment*. Retrofitting homes and using proper technologies for housing construction considerably improve indoor thermal, moisture and noise isolation, and imply higher levels of comfort of living and longer cycles of property repair. Comprehensive programmes can also improve the aesthetics of buildings.

- *Social and health effects*. Energy efficiency interventions in housing improve living conditions and the state of public health, address the problems of energy affordability and "energy poverty" and, as a consequence, mitigate social exclusion and inequality.

It is clear that the benefits from energy efficiency in housing represent a "multi-win" situation. They simultaneously embrace local, regional, national, and global dimensions. However, government policies must drive complex technological and institutional change towards improved efficiency of energy use in order to avoid contradictory microeconomic interests at the national and international levels. Although some progress has been seen in the field recently, the situation existing in virtually all ECE member States leaves much room for improvement. Even those countries that are considered to be advanced in terms of building standards are very far from realizing the sector's full potential. But it is the transition countries that especially lag behind. A specific challenge for these countries relates to overcoming what can be called the **energy inefficiency trap**, or a situation in which countries having lower energy efficiency are unable to change their respective status due to the lack of funds, experience, technology, motivation and initiative.

In the meantime, the state of existing technology demonstrates a very high potential for drastically reduced energy consumption in the housing sector. The technology includes passive houses, zero-energy homes or even plus-energy buildings which produce renewable energy and deliver excesses to the common energy grid. Many technological solutions are also cost-effective: it is estimated that 25-40 percent of only direct energy savings, depending on the particular country, may be achieved nationally in housing by applying cost-effective technologies. However, investment in energy efficiency is done on a limited scale, far below what might be considered as rational. This paradox is known as the **energy efficiency gap**. It appears that the most serious challenges to energy-efficient housing are not simply technological: they are connected with the need to establish proper and functioning institutional structures that can set large-scale efficiency measures in motion.

Better energy efficiency is considered to be the result of the application of technology and/or knowledge, which, in turn, is driven by the conditions that are conceptualized as five "in" keywords: **investment, information, innovations, incentives** and **initiative**. Government, landlords and building industries represent the triangle of the major stakeholders, whose mutual interrelations determine the status of **the "5-INs"** in delivering better energy efficiency.

Using this approach, a number of **barriers and challenges** to energy-efficient homes can be identified. The most common barriers to investing in energy efficiency in housing are a lack of incentive and the low priority of energy issues versus alternative opportunities available to households and economic agents. Energy prices are incomplete and energy-efficient products are more expensive than alternatives. If there are low priorities for efficiency and no mechanisms that allow the energy performance of buildings to influence property values, the whole technological chain involved in the design, production, and management of houses is malfunctioning. There is also the problem of high "transaction costs" in investing in energy efficiency: households are particularly sensitive to the time and effort necessary for improving energy efficiency. Other barriers include a lack of (a) information and awareness, (b) initiative and organizational barriers, (c) innovation, investment and finance (including limited affordability and access to capital, and the uncertainties and risks associated with energy efficiency projects). It is clear that the market alone cannot solve these issues if it is not supported by purposeful government policies based on a dialogue and partnership with all key stakeholders.

Following these considerations, this report discusses policy implications and provides a set of recommendations for Governments. These recommendations are divided into two parts, including six basic principles and six policy priority areas. These two parts should be considered as integral parts of a single **institutional infrastructure** to deliver better energy efficiency and improve the state of the housing sector.

BASIC PRINCIPLES FOR SUCCESSFUL POLICIES

- *Context*. There are significant differences across the ECE region with respect to level of economic development, legislative and organizational structures, the history and practice of the residential sector and climatic conditions. Policies should be sensitive to this diversity, and necessarily be embedded in specific local socio-economic, institutional and geographical contexts.
- *Multidimensional and integrative character*. There is no single quick and hassle-free solution to resolve energy efficiency in housing. Policies must be comprehensive, thoroughly developed and should integrate a number of instruments. Cross-sectoral multidimensional and multidisciplinary approaches are necessary.
- *Social responsibility and the safety net*. It is vital to create interlinkages between energy efficiency policies and social policies. Policies should ensure affordable access to energy, reduction of social inequality and improvement of social well-being. Energy-efficient housing is not simply a narrow technocratic issue but also a social and political challenge.
- *Organizational leadership and energy planning*. A devoted and continuous process of policymaking, planning, implementation and control is required. It is advisable to charge a special organizational structure with the responsibility to coordinate the efforts of different ministries, stakeholders and administrative levels.
- *Statistical data*. Policymaking and management activities need to rely on sufficient, reliable data that allows for assessing both the current situation and policy impacts. It is therefore important that statistical capacities are raised. In addition, the required information systems need to be set up at the regional and local levels to support decision-making.

- *Adoption of new knowledge and best practices.* Policies should both encourage and internalize best practices and innovations emerging from research and development, informational exchange, and demonstration or pilot projects. Necessary structures should be in place at the national level to ensure appropriate dissemination of the available information to as many stakeholders as possible.

- *Raising awareness and public dialogue.* Legally binding informational instruments such as mandatory energy performance labelling of household appliances, energy performance certification of buildings and other declarative and informing systems of energy consumption are already widely used. They should be promoted to make energy efficiency highly visible in the residential market. Other "soft" instruments should be encouraged, and should include capacity-building and educational measures, State-sponsored energy information centres, good practice and informational exchanges, voluntary energy labelling, demonstration projects, and the promotion of technology and sustainable lifestyles. The policies themselves should be transparent and widely publicized. It is particularly in those societies that have raised energy efficiency and environmental concerns to the level of everyday discourse that policy has received general public support and loyalty.

- *Energy performance standards for buildings.* Up-to-date and mandatory energy efficiency performance standards in buildings are among the most effective instruments for increasing energy efficiency and should therefore be actively used. Appropriate national targets and measures should ensure market penetration of passive, zero-energy, and zero-carbon building solutions. It is also important to develop legal mechanisms for improving the energy performance of existing buildings. All such instruments should be balanced against the level of prosperity of a given sub region, and may include differentiated requirements depending on the size of the affected project or status of the developer. One crucial step is to enforce the implementation of mandatory building codes. These should also be supported by other instruments, including subsidies to lower-income groups.

- *Housing management and maintenance.* The system of housing management should operate within a framework of capacities and incentives intended to deliver better energy efficiency. Improving and professionalizing housing management is a key institutional requirement and presents a particular challenge to the multifamily housing stock of transition countries. There must be ways to enforce legal provisions for establishing collective coordinating bodies, such as residents' associations, on which obligations for maintenance and economic incentives can be imposed. The social/public housing sector should be prioritized in government energy-efficiency and retrofitting programmes.

- *The development of financial mechanisms.* It is necessary to develop and maintain a sound financial infrastructure for owners, tenants, the construction industry, technology providers and other stakeholders to be able to raise capital for retrofitting and efficiency technology, as well as for new technology to be able to establish its market niche. This involves a transparent system of subsidies, grants, loans, and investment programmes and self-sustainable funding mechanisms such as revolving funds. Improving cooperation between homeowners and financial institutions, including through provisions for collateral, guarantees and insurance is also important. Furthermore, it is necessary to change the conventional "giving" direction of fiscal incentives for landlords and tenants, by strengthening "taking" approaches, which may include a tax on energy inefficiency based on the building's energy performance.

- *Energy pricing and utility services.* One of the essential elements in the energy efficiency incentive system is energy pricing. It is important to establish an adequate pricing system and to eliminate fixed-cost payment systems. A number of measures should, however, parallel or precede energy price reform. Criteria could be developed related to the percentage of the household income spent on energy. For those facing "energy poverty", targeted subsidies should be provided (which would ideally help improve the energy performance of homes rather than provide cash assistance). Other measures might include block and differentiated tariffs, which make utilities affordable for lower-income families and yet encourage conservation, and the use of smart metering, which offers households more control over the pricing of the energy they use. Specific requirements and incentives must also be imposed on energy suppliers providing services to households; these should comprise both regulatory and financial instruments.
- *International cooperation and knowledge exchange.* Policies benefit greatly from international experiences. In particular, the countries in transition in the ECE region should receive assistance with the transfer and exchange of knowledge and experience regarding both good practices and lessons learned. The United-Nations, as a quality forum for all countries, has the capacity to achieve a broader outreach with respect to housing energy efficiency strategies.

1. Introduction

Initiatives to address the problems of energy efficiency are not new. They have been developed for decades if not centuries, especially intensifying as the oil crisis of the 1970s hit the capitalist economies hard. What has changed more recently is the growing sense of urgency and the globalization of the problem and its perception. Issues such as climate change, energy security, economic uncertainty, and poverty have all achieved global status, demanding immediate, adequate and comprehensive responses. Because of the scope of energy consumption in the housing sector and since dwellings belong to the longest lived parts of the human technological infrastructure, housing offers a major avenue for action. There have, indeed, been considerable improvements in the field over the past few decades, but as most houses today still are not as energy efficient as they could be, much of the potential of the residential sector remains untapped, while contemporary challenges require even faster action and improvement.

The principal aims of this study are therefore: (a) to provide a brief overview of the economic, social and environmental impacts of the problem; (b) to consider current policies, solutions and barriers to effective policies; and (c) to discuss priorities that need to be addressed by international and national organizations.

Improved energy efficiency in housing is defined as successful efforts to reduce the energy intensity of residential services, without compromising the levels of well-being of the residents or the environmental conditions.

While informed by the developments in the ECE region as a whole and considering cases from Western Europe and North America, this study makes a certain emphasis on countries that lag behind and where the greatest untapped potential for energy efficient housing exist – transition countries, including Eastern Europe, Caucasus and Central Asia (EECCA) and South-Eastern Europe (SEE). The specific challenge for policymakers of these countries relates to overcoming what can be called **the energy inefficiency trap**, or a situation in which countries having lower energy efficiency are unable to change their respective status due to lack of funds, experience, technology, motivation and initiative.

Although a number of studies exist to date which discuss various aspects of the complex problems raised here, the specific contributions of *Green Homes* are as follows:

- A sectoral focus: this study focuses on the housing sector and offers discussions on energy efficiency in housing;
- A holistic approach: the study lays out a multidimensional set of measures that is not restricted to any single sector of activity, but encompasses many areas in its complexity;

- A socially-responsible perspective: *Green Homes* maintains that maximising energy efficiency is a great opportunity to promote environmental stewardship, human rights, quality of life and social equality. Energy efficiency should improve all of the three pillars of sustainable development and contribute to the Millennium Development Goals.
- An applied utility and policy focus: Green Homes provides policy implications and recommendations to be considered by the Governments of ECE member States.

Picture 1. ECE on a mission in Kyrgyzstan discussing informal housing improvement with inhabitants

Source: Courtesy of Paola Deda.

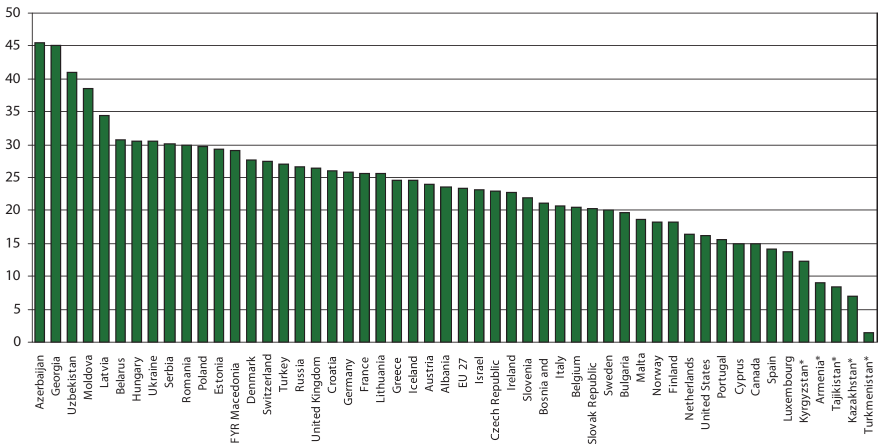
2. The multiple benefits of energy efficient homes

2. 1. THE IMPORTANCE OF HOUSING FOR ENERGY USE AND ENERGY EFFICIENCY

Approximately one third of the total energy in the ECE region is consumed in buildings, for the most part in the residential sector, which is responsible for 15–40 percent of total energy use depending on the particular country or about 20–30 percent on average across the region (figure 1). Less affluent countries consume less energy in housing per capita – with the exception of some energy-exporting countries. Southern countries tend to consume less energy per capita in the residential sector than northern countries (figure 2).

The existing statistical data may mask, however, the actual (higher) role of buildings and housing in energy consumption. For Armenia, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan, for example, only data for electricity consumption are reported by the International Energy Agency (IEA). At the same time, these countries number among those with the highest share for the residential sector in terms of energy use. For example, the

Figure 1. Residential energy consumption as in ECE member States, 2006 (percentage of total final consumption)

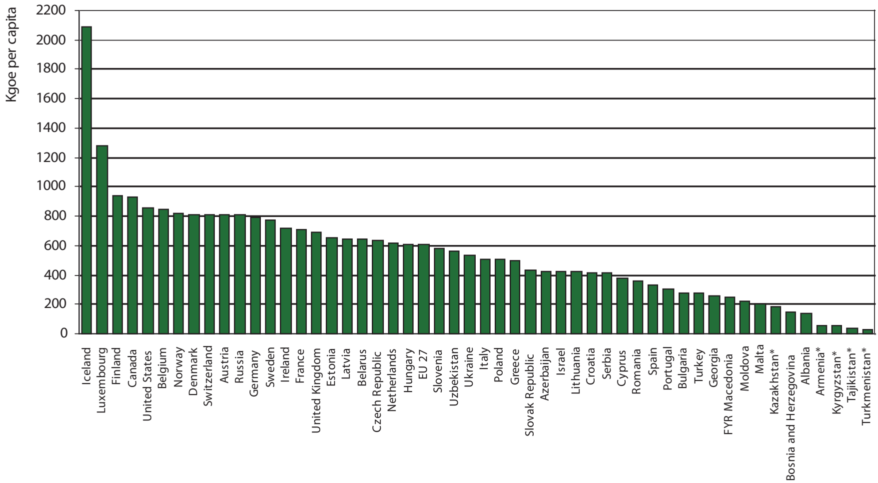


***Note:** For Armenia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, residential data only include electrici ty consumption.

Source: Based on IEA 2008a, 2008b.

Asian Development Bank (ADB 2005, 23) suggests that the share of housing in Kyrgyzstan's "total final consumption" was above 40 percent in 2004, while that of buildings was 46 percent. But the statistical data for many other ECE countries are not particularly reliable either and this may explain significant differences between individual countries, as well as statistical fluctuations from year to year. Lower figures of per capita consumption may mean that most energy is produced autonomously by combustion of coal, kerosene or wood; such energy-producing/energy-consuming activities are not counted statistically unless statistical bodies have access to adequate methodology. Even in the "older" Member States of the European Union (EU), energy statistics are widely distorted (Werner 2006).

Figure 2. Residential energy consumption per capita in ECE member States and the European Union, 2006 (in kgoe per capita)



***Note: For Kyrgyzstan, Tajikistan, Kazakhstan, Turkmenistan and Armenia, residential data only include electricity consumption.**

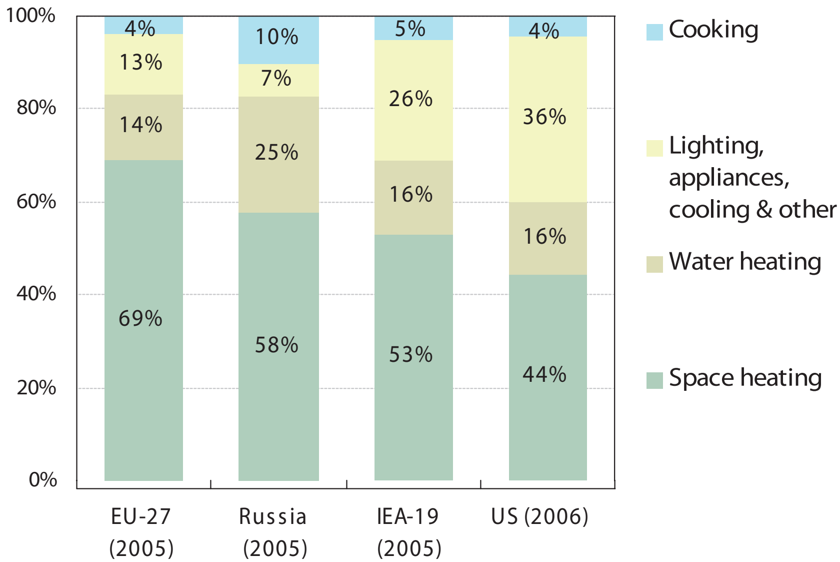
Source: Based on IEA 2008a, 2008b.

From 80 percent to 90 percent of total energy used during the life of a building is used during its operation, while the rest in the construction and demolishing phase (EEA 2007). Most energy in existing residential buildings in the region is consumed for space and water heating. As the ECE region stretches geographically north to the Arctic, there is also a climatic variation in the structure of energy consumption. This brings different requirements, opportunities and mechanisms for improved energy efficiency. Southern territories have a smaller share of space heating and a larger share of cooling in their energy balances than do their northern counterparts. Nevertheless, space heating and water heating are generally considered to be the areas where the opportunities for energy efficiency improvement and savings are the greatest, although the relatively more rapid increase in demand for energy in the other categories needs to be addressed seriously as well (see figure 3).

Numerous social, economic and cultural changes increase the pressure of the residential sector with regard to energy consumption. Importantly, demographic changes in many ECE countries mean that households become smaller, live longer and require more floor space per household. The increased levels of consumerism and technological change stimulate the use of energy-hungry electrical appliances. In the case of poorer countries, as incomes rise, so does energy consumption.

Given the importance of the residential sector for energy consumption, this chapter follows with some considerations of the benefits that energy efficiency in housing may bring and is bringing, as well as some of the pitfalls of inadequate practices. It will be shown that many benefits from energy efficiency arise from the quantitative saving of energy; but benefits are not restricted to this. Qualitative and quantitative impacts stretch beyond direct energy conservation.

Figure 3. Household energy consumption by end-use (percentage)



Sources: Odyssee Project 2008; Bashmakov 2009; IEA 2008d and DOE, 2008.

Picture 2: Inside a passive house in Germany. The building is well insulated and optimized for natural light. The only radiator in this spacious hall is never used unless the outdoor temperature falls very low.

Source: Courtesy of Wolfgang Förster.

2. 2. ENVIRONMENTAL IMPACTS AND OPPORTUNITIES

At the global scale, environmental impacts of energy efficiency in housing stem from energy use as the major contributor to climate change. As most energy produced for the moment comes from fossil-fuel power plants, it is energy production that is responsible for most CO_2 emissions into the atmosphere. Increasing CO_2 emissions are believed to result in irreversible changes in the global climate and the global environment, the consequences of which are hard to predict, but which are believed to impose tremendous economic cost of mitigation and adaptation, if not catastrophic effects on the human future (e.g. Stern 2007).

Due to their energy consumption, buildings are responsible for a considerable portion of CO_2 emissions. In the ECE countries, the main sources of energy in the buildings sector are electricity, district heat (especially in EECCA) and natural gas. This entails both direct CO_2 emissions from the building sector via "on-site" combustion of fossil fuel and indirect (upstream) emissions via demand for electricity and district heat; upstream emissions are dominant in the ECE countries. The degree of electrification and the type of energy source used to generate heat and electricity influence the volume of emissions from the buildings sector. For example, the upstream CO_2 emissions from buildings in France are low because nuclear power is the main source of electricity in the country and because of the high degree of electrification.[1] This also applies to countries relying on hydropower as main sources of energy for houses, and to Iceland, which uses geothermal energy to heat housing.

There are no reliable data with regard to the relative share of buildings in total CO_2 emissions and statistical data do not usually report indirect (upstream) emissions. However, some estimates suggest that both direct and indirect contributions of buildings in total CO_2 emissions globally in 2005 were around 33 percent as a sum of "households" (21 percent) and "services" (12 percent) (IEA 2008d, 17). There is much variation at the country level, however. In the United States of America, for example, buildings emissions constituted 38 percent of the country total in 2006; the share of the residential sector was 20 percent (DOE 2008).

Moreover, land use changes account for a high proportion of global carbon emissions; this is mostly due to deforestation linked to urban expansion and the use of wood as a fuel. It should also be considered in the impact and contribution of buildings to climate change.

If these trends continue, direct and upstream CO_2 emissions from buildings globally are expected to rise 70 percent and 140 percent to 2030 and 2050, respectively (Stern, 2007). Similarly, the International Panel on Climate Change (IPCC) assumes the baseline growth of CO_2 emissions from the building sector from 8.6 Gt a year in 2004 to 11.1Gt in 2020 and 14.3 Gt in 2030 (including electricity emissions). However, the IPCC survey indicates that there is a global potential to reduce by 29 percent by 2020 and 30 percent by 2030 the projected baseline emissions for the residential and commercial sectors by using existing cost-effective energy efficiency technology (Levine et al. 2007). This is the highest potential gain in comparison with other sectors. In general, most scenarios envisage that curbing the growth of energy consumption in the building sector will not prevent the overall growth from today, but the rate of this growth will be considerably slower, while a decarbonization of the energy used in the building sector may reduce CO_2 emissions below present levels (e.g. IEA 2008c).

Also related to decreased CO_2 emissions are opportunities to sell carbon credits, especially for those countries that due to their industrial decline in the 1990s and improved environmental standards have seen a gap between CO_2 emissions allowed and the actual emissions. Increased energy effectiveness may widen this positive gap. Alternatively, countries that are required to buy carbon credit due to exceeding their quotas will be able to economize by increasing energy efficiency.

[1] The nature of the nuclear fuel cycle inevitably involves a debate on health and safety associated with the risk of release of radioactive materials (as most tragically demonstrated by Chernobyl), as well as with the risk of proliferation. It remains a sensitive issue; in the United States, for instance, not a single nuclear power plant has been ordered in over three decades (UNDP 2007, 134).

In addition to contributing to climate mitigation, better energy efficiency for homes in the ECE region also makes the sector more resistant to the extreme weather events that are predicted to increase in frequency and magnitude. Energy efficiency in homes may therefore also be considered to be a contribution to climate change adaptation measures in the housing sector (Deda and Georgiadis 2009).

Picture 3. In Gardsten, Sweden, 1400 m^2 solar panels provide energy for some 500 flats.

Source: Courtesy of C. Nordström.

2.3. ENERGY AVAILABILITY, ENERGY SECURITY AND POLITICAL STABILITY

For energy importing countries, the dependence of national economies on energy imports is considered to be a major political challenge. More efficient homes not only allow for an improved availability of energy nationally, but also protect the housing itself against possible energy disruptions. The collapse of the energy and heating systems in several Central, Eastern and South-Eastern European countries due to the disruption of gas delivery left several million people without adequate heating at homes – even if energy for the heating of homes was diverted from manufacturing and other consumers. The magnitude of the collapse would have been smaller if the housing sector were more efficient.

On the other hand, investing in energy efficiency for countries that are exporters of energy can be a cheap alternative to increased capacities of energy supply. In both exporting and importing countries, inefficient energy performance in housing means more opportunity to resort to electrical heating during a drop in temperatures. Such loads may trigger breakdowns in major electricity networks.

As a further benefit of improved efficiency, the risk of internal political instability is mitigated. Since housing affects virtually everyone, citizens are very sensitive to the circumstances in this sector. Rising energy bills for residents – not least in those countries where energy prices are still substantially subsidized and striving to liberalize – may also provoke social unrest, protest and political turmoil. As discussed below, energy efficiency decreases the risk of energy poverty for the population, and thus mitigates such political risks.

2.4. ECONOMIC IMPACTS

In addition to energy security, benefits from improved energy efficiency in housing include positive impacts on research and innovation, business development and employment, as well as strengthened national competitiveness.

Investing in retrofitting can have a strong positive impact on the job market. For instance, it is estimated that in France the work required to implement criteria set by the national Grenelle de l'Environment could create 220,000 jobs just in one year (CECODHAS, 2009). Retrofitting and construction projects often rely on labour-intensive, locally-implemented projects and can lower unemployment rates. On the other hand, new technologies require a high level of expertise for their development, implementation and user training, while achieving a necessary level of the market capacity for the energy efficiency can also boost the associated retail and consulting industries. This implies that direct and indirect impacts may stretch far beyond the construction industry, having a genuine multiplication effect. This effect is little investigated, however, so it remains open to judgment and interpretation.

The basis for the calculation of the cost-effectiveness of energy efficiency projects is usually savings on capital from energy conservation; these are therefore the key to any extensive deployment of such projects. Indeed, energy savings in the housing sector may range from 25 to 40 percent across the ECE region. A crucial variable for cost effectiveness assessments is energy prices. Subsidized energy prices imply longer payback periods, so that such projects are often considered unprofitable, especially in transition countries, given the higher expected rates of return elsewhere in the economy. However, when reduced costs for municipalities are included, such projects have much shorter payback periods (EEA 2007). Unfortunately, there always remains an asymmetry between different levels of economic consideration in this respect, as well as split incentives between different stakeholders and market uncertainties (as further discussed in chapter 3) so that even if prices correspond to the market ones, they alone do not necessarily present a strong case for individual economic actors to invest in energy efficiency. Nevertheless, a number of further benefits from improved energy efficiency in housing are available at the microeconomic level. These are discussed below, and with sufficient awareness may be included in investors' cost-benefit analyses.

2.5. REGENERATION OF THE BUILT ENVIRONMENT.

Better indoor thermal and moisture conditions imply higher levels of comfort as well as lower rates of wear and tear and longer cycles of refurbishment and repair. Reduced exposure to the fluctuation of outdoor conditions due to thermal insulation prevents dampness, rusting and mould formation. In winter, internal walls remain warm and the cold-radiation effect is eliminated; in summer, thermal insulation prevents walls from becoming heated and thus has a cooling effect. Distributive electricity networks also experience less load intensity due to improved energy efficiency in housing and their life is extended. Positive side-effects from energy retrofitting projects can also improve the aesthetic qualities of buildings, give better noise isolation and – if combined with more comprehensive measures – add other technical improvements to buildings.

Such factors, taken together, can also have beneficial impacts on property values. Leading real estate associations such as the Appraisal Institute or the Royal Institute of Chartered Surveyors have started considering energy efficiency standards in their methodologies at least since the early 1980s (Levy 1987). With the introduction of mandatory energy certifications and raised awareness, the influence of energy efficiency and green standards on the appraisal process has increased, even though it is still far from being strong vis-à-vis other factors (see, for example, Guidry 2004).

Picture 4. Workers installing solar panels in Eastern Europe.

Source: Courtesy of Lisa F. Young.

2.6. ENERGY POVERTY, HEALTH, AND FURTHER SOCIETAL EFFECTS

It is well known that low thermal efficiency in housing, especially if combined with deficient social welfare, has detrimental health and living effects. Such negative social effects are becoming more significant for lower-income EECCA and SEE countries, but are by no means limited to them. The increased cost of fuel, the liberalization of energy markets and decreased levels of welfare provision in Europe since the 1970s mean that an increasing number of low-income households cannot afford the costs of heating. In the United Kingdom, this problem has become known as the "choice between heating and eating". Alternatively, it is known as "fuel poverty" or "energy poverty".

Those who cannot afford adequate levels of energy consumption (usually for heat and hot water) either go into energy indebtedness and face the threat of disconnection by the utility provider or the prospect of reducing their consumption. Either choice entails hardship, exposure to health risks and feelings of social alienation – which only deepen the vicious circle of social exclusion.

More energy poverty thus leads to more energy conservation, but energy conservation of this kind is disgraceful. It is important to draw a clear line in this respect between energy efficiency and energy conservation. If residents are forced to sacrifice their energy consumption to a level that threatens their health and welfare, the situation is unsustainable. Energy efficiency, on the contrary, improves structural energy requirements and thus decreases the energy consumption needed for the same useful amount of energy services, and is thus having a positive impact on the household's wealth and welfare.[2]

Unfortunately, energy conservation via energy poverty has been a common trend for many post-socialist countries, which are experiencing a sharp decline in real income and at the same time considerable inflation in energy prices. Yet some of these same countries are among the coldest in the ECE region, with the heating season lasting up to seven months. The scale of the problem is being further exacerbated, as in many EECCA and SEE countries, residents have increased the levels of the use of "dirty" fuels and retreated to cheap stoves, which may have high levels of CO_2 emissions and pollution, and the attendant detrimental effects on indoor air quality and health.

As residents are trapped in energy poverty, society ultimately bears the shameful cost of inequality and underdevelopment.

Since it is the most vulnerable, poorer strata of the population that experience the dilemma of "heating or eating", it is they who face the associated health risks first. Cold and damp houses expose occupants' health to the risk of respiratory, cardiovascular, allergy-related and infectious diseases, psychological stress and cold-related death. But the detrimental effects also affect all other social groups; for instance, decreased comfort, mould and the

[2] See also the section concerning "the rebound effect" in chapter 3. In the residential sector, the effect particularly concerns poorer households and therefore implies positive social effects.

faster deterioration of housing, with the necessity of repair and refurbishment measures coming more frequently than in efficient homes.

Thus, even without all the other benefits, social and health problems alone would provide a strong case for energy efficiency policy in housing (Bell et al. 1996). More developed countries have funds for welfare support to the vulnerable groups, including for energy. But the problem of energy poverty has both the income and expenditure side, so that a policy to improve efficiency may bridge the two and represent a better value for money in the long term than energy support (Boardman 1991). Of course, this is only so if energy efficiency measures achieve at least the same targets as energy welfare subsidies (i.e. "affordable warmth" in Boardman's words) and if social inequality, poverty and social exclusion are promptly addressed by broader social welfare policies.

The issue of affordability of energy efficiency measures themselves also needs to be addressed. Social housing may provide one of the most fruitful avenues here, since social housing is able to integrate both social welfare policies and energy efficiency measures.

Picture 5. Insulation problems in informal settlements in Kyrgyzstan

Source: Courtesy of Paola Deda.

2.7. THE CASE OF THE FORMER SOCIALIST COUNTRIES

Although many problems and potential benefits are common for the ECE countries, there remain a lot of sub regional specificities. The EECCA and SEE countries themselves differ greatly from one another. In terms of the present discussion, important differences include, inter alia, their energy production status, climate and levels of economic development. However, there are many features that are common for these sub regions and which relate to their history as socialist countries and their experience of transition to the market economy.

As a rule, these countries are characterized by relatively lower standards of energy efficiency, especially for the panel-built housing of the period between the 1960s and 1980s, and when compared with countries located in similar geographical conditions. Although during the socialist era heat and hot water in larger cities were administrated centrally via a district heating system, distribution systems were typified by large energy losses, with residents having little control over spatial temperature other than by inefficient means such as opening windows (EEA 2007). Furthermore, socio-economic problems linked to post-socialist transition have brought many novel and specific challenges, such as the downgrading of infrastructural quality, increased energy prices and lower standards of living, leading to energy conservation in the form of self-deprivation (Buzar 2007). Many of the post-socialist countries have seen a growing degradation of their housing stock, as well as alarming trends of the emergence and growth of informal settlements, with self-made, low-quality, poor energy-efficient housing (Tsenkova et al. 2009). High prices for centrally-distributed energy have prompted many residents to switch to alternative and less efficient heating means such as kerosene, electricity, coal or wood, increasing deprivation and environmental pollution. If the problem becomes a large-scale one in any location, as the operation of infrastructure and energy supply (heating and hot water) to that location becomes unfeasible, even those residents who are able and willing to pay are also penalized (the situation is familiar in SEE, the Caucasus and Central Asia). This has certainly worsened the energy efficiency status of these countries.

Post socialist countries, with their legacy of central planning, have unique opportunities compared with other ECE countries. The large number of standard multi-apartment residential building blocks means that similar solutions for improved energy efficiency may be used, thus ensuring an economy of scale. The strong tradition of centralized district heating in larger cities represents an excellent institutional and technical foundation for efficient heating and cooling in the future; in particular, the high use of combined heat and power (CHP) stations in Kazakhstan and Russia is a positive phenomenon. Furthermore, despite the extensive privatization of the housing stock, there remains a tradition of strong municipal and State involvement in the issues of housing management, which may simplify the task of large-scale, publicly funded retrofitting programmes (EEA 2007).

Box 1 Cost-effective energy efficiency potential in the residential sector in the Russian Federation

A study by the World Bank Group (2008) is illustrative of the degree of direct economic potential in the residential sector in a single country. The amount of potential energy savings was considered in the study at three levels of investment:

- Technically viable: energy savings are determined by the best technologies available;
- Economically viable: energy savings are greater than the cost of alternative increase of production, i.e. investment can save energy and money for the Russian Federation, but the savings cannot necessarily be captured by any single energy consumer; the method assumed a 6 percent opportunity cost of capital;
- Financially viable: energy savings are greater than buying energy, i.e. investment can save energy and money for individual consumers; the method assumed internal tariffs as in 2007, a 12 percent opportunity cost of capital for private firms, and a 50 percent opportunity cost of capital for household.

The study found that the residential sector offers the greatest potential for improving energy efficiency. Energy use in buildings (144.5 mtoe) was responsible for more than one-third of energy end-use in Russia, mostly consumed in the residential sector (108.3 mtoe). The technical potential to reduce energy consumption in the residential sector is estimated as 53.4 mtoe (or -49 percent), of which 84 percent was achievable through investments that are economically viable and 46 percent that are financially viable.

Most of the potential energy savings come from improvements in space heating and water heating. Space heating is estimated to be responsible for 58 percent of overall energy consumption in residential buildings in Russia (with district heating systems serving three quarters of dwellings), while water heating for 25 percent. Only a small percentage of the buildings erected after 2000 in compliance with new thermal insulation standards meet modern thermal performance requirements; the Russian average annual heating energy intensity for multi-family high-rise buildings is reported as 229 kWh/m^2 versus 77 kWh/m^2 for new multi-family high-rise buildings built in Moscow. The technical potential to reduce energy consumption in residential space heating ranges from 17 to 42 mtoe, equivalent to 35 percent to 49 percent of total 2005 final heat consumption. The technical potential for improving the efficiency of water heating is 13.4 mtoe, equivalent to 35 percent of use in 2005.

Installation of hot water meters alone can save 30–40 percent energy on hot water by encouraging changes in consumer behaviour. Most of the investments required to improve space and water heating efficiency are viable economically (78 percent) and financially (38 percent) with 2007 heat prices.

The study argues that the most significant barriers to energy efficiency in residential housing relate to building standards, public behavior and difficulties in organizing and financing energy efficiency improvements in common areas. Mandating energy standards in new and renovated buildings is the most cost-effective way to ensure energy savings in the residential sector.

Source: World Bank Group (2008)

Picture 6. A power station overlooking housing estates in Moscow, February 2009

Source: Courtesy of Oleg Golubchikov.

After more than a decade of stagnant housing production in the EECCA and SEE counties, recent years have seen a recovery in new housing programmes, with some larger cities – at least in the years preceding the most recent financial crisis – experiencing something of a construction boom. Many government representatives from EECCA and SEE acknowledge that they are aware of energy efficiency problems, but that they have little direct incentive to improve the state of affairs in the areas under their direct responsibility. It is therefore important to raise awareness about the whole bundle of possible benefits.

3. Current experiences and barriers to effective practices

3.1. THE 5-IN APPROACH: INNOVATIONS, INFORMATION, INCENTIVES, INITIATIVE, AND INVESTMENT

The previous chapter discussed the multiple benefits of enhanced energy efficiency in housing. The other side of the equation is the availability of technology and the cost of providing energy efficiency (material resources and labour). As one study after another has demonstrated, a wide range of effective and affordable technological solutions already exists and may easily unlock the benefits that energy savings bring. It is estimated that from 25 to 40 percent of direct energy savings may be attained in the housing sector, depending on the country. If wider benefits are also taken into account, it may be supposed that all rational actors would be rushing to capitalize on these benefits. In reality, however, the investment in energy efficiency is done on a very limited scale. It appears that most vigorous challenges are associated not with technology – which is well understood, readily available, fast developing and, if embraced under the economy of scale, becomes increasingly cost-effective – but rather with establishing the right institutional structure that would set large-scale energy efficiency measures in motion. This chapter provides an overview of the current state of technological development, policy and experience in the ECE countries, and discusses the barriers to bridging the energy efficiency gap in the residential sector.

These issues are considered from the perspective of our 5-IN analytical approach (figure 1). This approach recognizes several key concepts and stakeholders important for more energy-efficient housing. As shown in figure 4, improved energy efficiency in housing is the result of the application of technology and/or knowledge (including that of knowledgeable behaviour). The application of technology and knowledge in turn is driven by a number of conditions, which may be conceptualized by the 5-IN keywords (investment, information, innovation, incentives and, importantly, initiative).

Investment (usually of capital and time, but also effort) is a necessary precondition for improved energy efficiency; financial resources in particular represent an important limitation. Another important element is initiative, or the purposeful enterprise that initiates and steers investment into energy efficiency. Such initiative is based on available information (including awareness and know-how) and incentive(s) (financial, legal and other stimuli and supportive institutions). There are a number of stakeholders involved, with three groups notably representing "a triangle" of the major groups of actors (government, property owners and building industries). It is the interaction between the stakeholders that determines the relationship and status of the 5-INs: if their interactions make any of the 5-INs a weak link, the results are deficient.

As is also reflected in figure 4, interactions between stakeholders are also shaped by more general socio-economic and institutional contexts, which include not only existing policies and strategies, but also social and economic realities and inherited preconditions. It is important to take into account the different levels of economic development and budget constraints of countries/groups of countries belonging to the ECE community.

3.2. THE DEVELOPMENT OF ENERGY-SAVING TECHNOLOGY

Most of the housing stock for many years to come will represent the same stock as exists today, and it will take long time before buildings built after 1980 constitute the majority

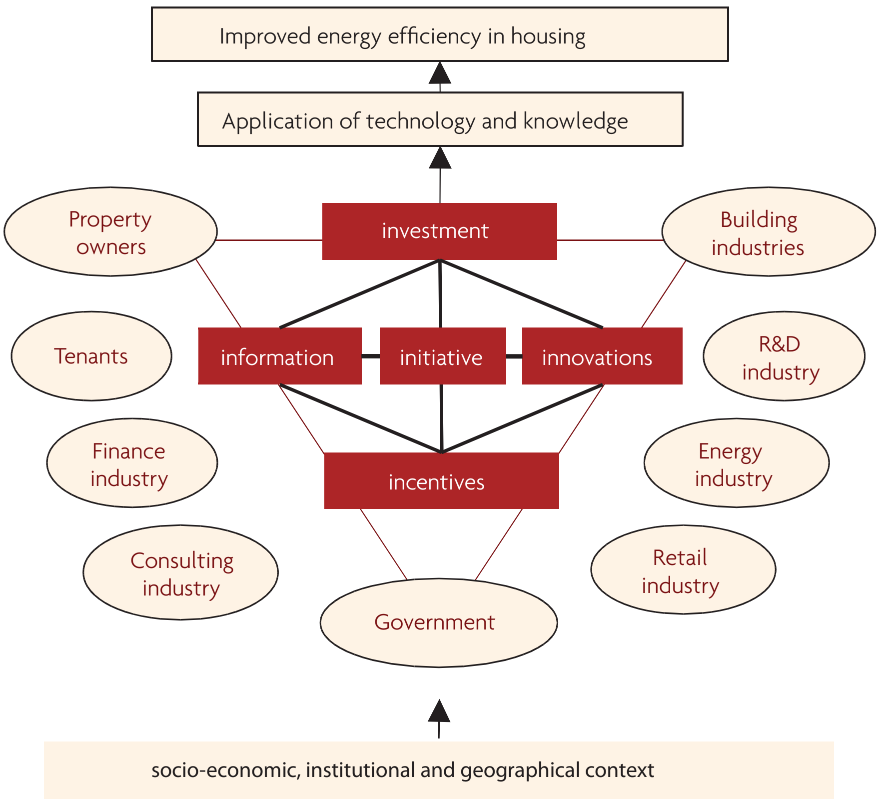


Figure 4. Key concepts and stakeholders in energy efficiency in housing

of homes.[3] Given these conditions, it is important to invest money and efforts the energy-efficient refurbishment and retrofitting of existing buildings. Such measures typically address the structural parts of buildings, including the thermal integrity of the building envelope, air conditioning system efficiency, mechanical ventilation, lighting systems, water heating, and elevators. In addition, the conditions of electrical appliances and electricity and heat losses during distribution are addressed. Retrofitting techniques usually concern roofs, wall and floor insulation, multiple window glazing, draught sealing, central heating, lagging jackets and ventilation improvement. A great variety of insulation and glazing materials and other energy-efficient technologies and techniques are available. Applying them more comprehensively to, for example, the housing stock dating from the 1960s to 1980s, demonstrates that an average reduction of energy consumption by 50 to 60 percent is quite possible (ECE 2008).

It is also quite important to develop and introduce energy-efficient technologies for new housing construction, as eventually it is new housing that will determine the status of energy-efficient housing in the future. In many ECE countries, **low-energy buildings** are becoming increasingly widespread, with heating energy consumption per m^2/year of less than 50 kWh, as compared with 150 to 200 kWh in **normal housing** (ECE 2008). Many countries have officially designated "low-energy buildings" as a class of certain energy performance.

Some of the latest developments include **passive housing**. The passive house standard was defined in 1988, and the first passive house was built in Darmstadt in Germany in 1990. Comfortable room temperature is achieved by means of passive components, such as high levels of insulation of walls, roofs and windows, heat recovery from recycled air, and the use of internal sources of heat (including existing household appliances and human heat). Passive homes are designed to fit a specific location and to use passive lighting, active shading, and energy-efficient appliances and lighting. Additional energy for electricity, the cooling system or hot water can come from conventional sources or from autonomous renewable energy such as solar energy. Passive housing is mostly defined for colder European climatic conditions. It reduces heating energy consumption to at least 15 kWh, or by up to 90 percent as compared to normal housing and by 60 percent compared to innovative low-energy buildings. The experience of Austria, Germany, Switzerland and the Scandinavian countries show that such buildings are popular with residents, as they may be even entirely independent of off-site energy supplies and have lower operating costs than more conventional buildings.

Related types of buildings include **zero-energy buildings**, which do not use fossil fuels but get their required energy from renewable energy sources. While there are no established definitions for zero-energy buildings or homes, Laustsen (2008) distinguishes a few subtypes of such buildings:

[3] The new building stock amounts to only 1–3 percent of the existing building stock in any given year, while representing about half of the value of the construction industry, including construction and renovation.

Picture 7. Passive house in Germany

Source: Courtesy of Wolfgang Förster.

- **Zero net energy buildings** deliver as much energy to the supply grids over a year as they use from the grids.
- **Zero carbon buildings** do not use energy that entails CO_2 emissions, or balance, over a year, off-site fossil fuel use by producing enough CO_2-free energy on site.
- **Zero stand-alone buildings** do not require connection to the grid other than as a back-up. Stand-alone buildings have the capacity to store energy for night-time or wintertime use.
- **Plus energy buildings** deliver more energy to the supply systems than they use. Over a year, these buildings produce more energy than they consume.

It is not only the technological attributes of buildings and their interiors that contribute to the reduction of energy use, but also the very spatial and density attributes of communities and cities at large. Town planning and land use zoning can therefore make a big difference, particularly as far as new building sites are concerned. Certain levels of residential density, mixed-use developments, good public transit provision and integrated district heat-electricity systems are believed to be important considerations for energy efficiency and reduced greenhouse gas (GHG) emissions, since such measures typically reduce vehicle use, bring more efficiency to energy consumption, and reduce municipal infrastructure requirements (see, for example, Droege 2008, Brown and Southworth 2008, Ewing et al. 2007).

However, there are higher costs of the production for innovative buildings and creating sustainable communities. These costs, coupled with the lack of established mechanisms to promote sustainable buildings (e.g. the lack of information), inertia in the construction industry (e.g. the lack of initiative), market barriers (e.g. the lack of incentives) and only limited financial resources available (e.g. the lack of investment) present serious challenges to their widespread use (see section 3.4).

3.3. EXISTING REGULATORY AND OTHER MEASURES IN THE ECE REGION

Reduction of energy consumption in the buildings sector constitutes an important part of measures to reduce GHG emissions and thus comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) and other legally binding international commitments (annex A of the Protocol addresses energy efficiency). As the commitment period of the Kyoto Protocol expires in 2012, a treaty succeeding the Protocol is expected to be adopted at the Conference of the Parties to UNFCCC in Copenhagen in December 2009.

Important regulatory developments can be seen at the EU level. The EU Directive (2002/91/EC) on Energy Performance of Buildings (EPBD) is the main tool providing for a holistic approach to efficient energy use in the building sector, including regulatory and information-based instruments (see box 2). Apart from the EPBD, there are a number

Box 2. The European Union Energy Performance of Buildings Directive

The EPBD came into force in January 2003. It is intended to lead to substantial increases in investments in energy efficiency measures within residential and non-residential buildings. It requires Member States to set up:

- A methodology to calculate integrated energy performance of buildings, based on a general framework established by the EPBD, to be set up either at the national or regional levels.
- Minimum energy performance requirements for new buildings (and mandatory consideration of alternative heating systems for planned buildings over 1,000 m^2).
- Minimum energy performance requirements for building with a total useful floor area of over 1,000 m^2 undergoing major renovation.
- Energy performance certificates (EPC) of buildings required when a building is constructed, sold, or put up for rent. The certificates are for information only and may include recommendations for the cost-effective measures to improve the building's energy performance.
- Either a regular inspection of boilers of a certain specification or adequate provision of advice to users on the heating system, as well as a regular inspection of air-conditioning systems.

The certification of buildings, the drafting of the recommendations and the inspection of boilers and air conditioning systems should be carried out by independent, qualified and/or accredited experts, private or public. Member States can go beyond the minimum requirements set by the Directive and be more ambitious.

In November 2008 the European Commission proposed a new version of the EPBD that seeks to strengthen the main pillars of the Directive (including deleting the 1000 m^2 threshold). Member States will also be required to actively promote the higher market uptake of buildings of which both CO_2 emissions and primary energy consumption are low or equal to zero by producing national plans with clear targets. Some of the expected benefits of the (upgraded) EPBD include:

- 60–80 Mtoe/year energy savings by 2020, i.e. a reduction of 5–6 percent of the EU final energy in 2020;
- 160 to 210 Mt/year CO_2 savings by 2020, i.e. 4–5 percent of EU total CO_2 emissions in 2020;
- 280,000 to 450,000 potential new jobs by 2020, mainly in the construction sector, energy certifiers and auditors and inspectors of heating and air-

conditioning systems. New jobs would also be stimulated by the need for the products, components and materials used or installed in better performing buildings.

of other EU Directives dealing with the energy aspects in buildings, for instance the Eco-Design of Energy-Using Products Directive (2005/32/EC), the Directive on the Promotion of Cogeneration (2004/8/EC), the Energy End-Use Efficiency and Energy Services Directive (2006/32/EC), and the new Directive on the Promotion of the Use of Energy from Renewable Sources.

In December 2008, the European Parliament endorsed an integrated package of energy and climate policy proposed by European Commission in 2009, including the following legally binding targets to be reached by 2020 (known as "20-20-20"):

- To cut GHG emissions by at least 20 percent in 2020 compared to the 1990 levels (30 percent if other developed countries commit to comparable cuts);
- To raise the share of renewable energy to 20 percent of total energy consumption by 2020;
- To reduce energy consumption by 20 percent of projected 2020 levels by improving energy efficiency.

The 20 percent energy efficiency target was also incorporated in the Commission Communication of 19 October 2006, the Action Plan for Energy Efficiency: Realizing the Potential (COM(2006)545), which was endorsed by the European Parliament in its non-legislative resolution of 31 January 2008 and identified the significant potential for cost-effective energy savings in the buildings sector. The Action Plan is set to run for the period of January 2007–December 2012. In its resolution, the European Parliament proposed considering measures such as: (a) to require all new buildings needing to be heated or cooled to be constructed to passive house standards from 2011; (b) to gradually introduce district heating and cooling grids for all buildings; (c) to create a transparent database of national, regional and local measures promoting energy efficiency in buildings, in the interest of exchanging best practices and raising public awareness; (d) to ensure that tax systems reflect the aim of improving energy efficiency in buildings; and (e) to increase research into human behaviour regarding energy use.

The EU Structural Funds can be used to realize energy-saving measures. Housing expenses of the European Regional Development Fund are eligible only in new Member States, but the funds are to be opened in 2009 to all Member States and regions for the purpose of energy efficiency refurbishment in existing housing. This, it is believed, will contribute to the implementation of the 2008 European Economic Recovery Plan.

Box 3. Regional policy for energy efficient housing: the case of Vienna

The case of Vienna demonstrates a comprehensive approach to energy efficiency that effectively integrates elements of housing maintenance and energy strategies. Vienna is one of the nine autonomous provinces of the Federal Republic of Austria. It has its own housing policy, including subsidies, renewal programmes and housing allowances. The City Administration is also the largest landlord in Vienna (with 220,000 housing units), followed by a number of limited-profit housing associations, so that the major part of housing in the city is under public control. This facilitates energy efficiency measures with respect to both new housing construction and housing refurbishment.

All new housing projects that receive public subsides (currently 7,000 apartments annually) have to pass a selection competition, one of the criteria of which is energy performance. As a result, most new housing estates in Vienna have much better thermal performance than the requirements of the Building Code; while the law requires the maximum of 38 KWh/m2/year for heating, most new housing estates achieve 20–25 KWh, and there is an increasing number of passive buildings that use less than 15 KWh.

The main challenge, however, is believed to be with the existing building stock, including some 170,000 apartments still in need of thermal improvements. A special regional programme provides subsidies to the refurbishment of 10,000 public dwellings per year, reducing the heating energy consumption from the average of 120–200 KWh to around 50 KWh. The subsidy covers one third of the refurbishment costs, while the rest is covered by a rent increase. This increase is, however, normally not higher than the saving on energy cost achieved by the refurbishment. So far, the programme has involved 80,000 apartments and led to a reduction of 97,000 tons of CO_2 emissions per year, which is roughly equivalent to the emission of 61,000 cars. But the energy efficiency policy in Vienna goes beyond the mere thermal insulation of the exterior walls to also provide, for example, naturally lit staircases, switch-off wall sockets, environmentally friendly construction methods, the greening of the roofs, and providing good connections to infrastructure and public transport.

The City Administration believes that such a policy achieves several goals at once: (a) climate protection; (b) reduced energy costs to households and better social cohesion; (c) reduced energy imports and strengthening of the national economy; and (d) the creation of new local jobs. The latter reason is also why the Austrian Government, as part of its efforts to cope with the economic crisis, recently approved further thermal improvement programmes nationally in the building sector.

Source: Förster, 2009

Relevant EU funding programmes also include the Intelligent Energy Europe Programme, established by the Decision of the European Parliament and of the Council of 24 October 2006 as part of the EU Competitiveness and Innovation Framework Programme (2007–2013). It distributes funds in energy efficiency areas such as capacity-building, exchanges of experience, development of an efficiency market, awareness-raising and information provision.

In March 2009, the European Commission approved a plan to phase out sales of the conventional light bulb between 2009 and 2012, beginning in September 2009 with the 100-watt bulb. The plan is to replace them with energy-efficient bulbs that use up to 75 percent less electricity.

At the national level, most Governments in the ECE region have their own strategies and laws to improve energy efficiency in their economies. These documents are translated into regional and local policies. In addition to the regulatory instruments, a number of financial, educational, and voluntary instruments can be found across the region (see the annex at the end of this report for examples). The workability of the national and regional initiatives, however, varies considerably. In many countries, especially in EECCA, energy efficiency legislation and strategies often remain declarative and include only limited mechanisms of implementation (EEA 2007). The most successful and comprehensive programmes of housing energy efficiency improvement are usually found in those places which have been able to achieve: (a) strict minimal energy performance requirements; (b) a good level of absorption of innovative know-how; (c) general public awareness; (d) a sufficient level of financial resources in support of housing renovation; (e) good integration of energy and housing policies and, more specifically, the incorporation of energy performance standards into the housing management and maintenance system (see box 3 for the case of Vienna).

3.4. FACTORS LEADING TO ENERGY EFFICIENCY GAP IN HOUSING

It is thus apparent that energy reduction in housing has been and is an important field for policy, research and development. There remains an energy efficiency gap connected to “contextual” problems, such as economic downturns. But even in those ECE countries that have had more stable economies and been traditionally considered to be advanced in terms of building energy standards, signs of sluggishness or even regress are not unusual. For example, Ryghaug and Sorensen (2009) note that office buildings built in Norway after 1997 are less energy-efficient than those built before the 1930s. As another example, the housing stock in the United Kingdom – a country that has pioneered many energy efficiency initiatives – is still among the least energy-efficient in the EU, and technical capacities remain limited. It is therefore important to identify barriers that explain the gap and to further develop policies and strategies to address the problem. Some major barriers are considered below in light of our 5-IN approach.

3.4.1. Lack of incentives

The most common barrier to investing in energy efficiency in housing is the limited incentive to do so – that is, the low priority of energy issues versus other problems and the alternative opportunities facing those individuals, households, firms, developers and other economic actors who could invest their capital and effort in energy efficiency. Even if the individual actors share concerns about energy, they may be incapable of responding appropriately. Energy-efficient products are usually more expensive or require additional efforts and/or knowledge, and the provision of such products is not necessarily rewarding in terms of property value. This lack of incentives can be seen at three different levels – households, landlords and the construction industry.

Households see high "transaction costs" for investing in energy efficiency. Households are sensitive to the effort and time spent improving the energy efficiency of their home. They generally face a broad range of "things to do", among which energy efficiency is a low priority.

The position of landlords is most important, but not uncontroversial. As Bell et al (1996: 5) noted: "Unless we understand the motivation of owners (owner-occupiers and landlords) to invest in energy efficiency and are able to devise the means by which they can be encouraged to do so, it is unlikely that the problems which give rise to energy concerns (the environment, fuel poverty, health) will be solved". However, landlords will have little incentive to invest in energy efficiency, if the expected benefits are enjoyed by tenants, while the tenants may not see the complete return of their capital investment in energy efficiency during the life of their tenure (this is also known as "split incentives"). Subsidized energy prices may entail very long payback periods, so that energy efficiency projects are often considered unprofitable with respect to current assessment techniques. When reduced costs for municipalities and other benefits are included, such projects have a much shorter payback period. Even so, there always remains an asymmetry between different levels of economic consideration.

If the priority of energy efficiency is low and there are few mechanisms to make energy efficiency an integral part of market value, the technological chain involved in the design, production, management and operation of homes will not work. Engineers and architects will be discouraged from increasing the costs of energy efficiency projects. If developers are building housing solely for sale or speculation, they may not consider it profitable to increase energy efficiency beyond minimally required standards.

Incentive asymmetries also exist between the producers of energy and utility companies and the demand side. Energy producers are naturally interested in increasing their production at low cost; these ambitions usually run counter to energy conservation. There must therefore be more incentives that align utilities' and consumers' interests.

3.4.2. Information asymmetries and lack of awareness

Energy efficiency in housing is surrounded by information barriers, failures and asymmetries. Actors on the demand side in the building chain have little knowledge, skills and training in energy efficiency, while the supply side has limited understanding of how to promote energy-efficient technologies. Even if customers are interested in buying or investing in energy efficiency, information about energy technologies is often incomplete, hard to obtain or hard to understand. There are obstacles to finding competent and affordable advice locally, especially for financial institutions, whose energy expertise is almost nonexistent (IEA and AFD 2008). As a result, the rate of market penetration of energy efficiency technology, technique and other know-how, even when they exist in practice, may remain low.

Besides these problems of information, there is also great fluctuation in the energy markets, leading to uncertainty and consequently higher risk premiums for energy efficiency investment analysis. Under conditions of relatively low or distorted energy prices, high transaction costs for obtaining sufficient information and greater costs of technological solutions due to their limited market penetration, energy efficiency projects may turn out to have negative profits in traditional investment analysis and as such low appeal to self-interested actors. There is a strong argument in favour of changing traditional financial approaches and evaluation techniques for energy efficiency – including increasing time horizons to fully accommodate the life cycle of buildings (T'Serclaes 2007).

Public awareness is another important issue, as psychological aspects and perception affect human behaviours and lifestyles, and these are difficult to change. In particular, household lifestyles influence energy use via the choice of indoor temperature, airing habits and consumption of hot water and electricity. As just one example, a survey of almost identical homes in one village in southern Sweden showed that energy consumption varied by a factor of 2.5. Such a large variation could not be explained by factors other than lifestyle (Nylander et al. 2006). Although there may be inflexible conditions apart from lifestyles (such as the health or age of inhabitants), the potential for reducing energy demand in housing by change lifestyles is generally very high.

3.4.3. Lack of initiative, innovations, and investment capacities

The provision of technology and services for improved energy efficiency depends on champions in industry. However, the construction industry is traditionally one of the most conservative. The voluntary intake of even simple cost-effective solutions is low in this sector in many countries. As the market for energy-efficient technology is not developed, the technological solutions and innovations remain relatively expensive, thus further raising the issues of affordability and cost-effectiveness. Limited access to capital for low-income borrowers or small businesses further aggravates these vicious cycles.

As was noted in a 2008 ECE Concept Note[4], which preceded the present report (ECE 2008), in the EECCA and SEE counties, such barriers are even more pronounced. They include a weak public sector with insufficient budgets for housing, outdated building codes, low innovation capacity in the local construction industry, weak public and private research and development activities, and immature demand-driven housing markets, which weaken the role of consumers seeking more efficient homes. Besides, there is the lack of proper organizational structures and decision-making structures in municipalities and in multi-family buildings. In the latter case, responsibilities for management and operation (M&O) are often unclear, with the result that there are few organized initiatives to renovate common spaces. Improvements have often been technically incorrect, bringing poorer performance instead of better efficiency. In other cases, subsidies and grants have led to the construction of random pilot projects, which are not replicable and do not contribute to the overall solution of energy efficiency.

A specific challenge for these countries relates to overcoming the energy inefficiency trap, or a situation in which countries having lower energy efficiency are unable to change their respective status due to the lack of funds, experience, technology, motivation and initiative. Low-income ECE countries would therefore benefit from know-how transfer from other parts of the ECE region, including technical knowledge, capacity-building and institutional development. Where the high initial cost of energy-efficient technologies delay their application in lower-income countries, especially when the technologies need to be imported, domestic capacities should also be enhanced.

3.4.4. The rebound effect: a barrier or a benefit?

When assessing the impacts of energy efficiency on energy savings and emission reductions it is important to remember that there may also be a certain "rebound effect" (or take-back effect) of energy efficiency (see Sorrell 2007, Greening et al. 2000). This effect means that an economic agency or households who have gained an efficient technology for a given energy service, may actually offset some of its conservation effect by a greater use of that service, because it becomes more affordable and more productive. More insulation, for example, has historically been followed by higher indoor temperatures – hence, some of the energy conservation is "lost back".

In the residential sector, this effect may offset 10–40 percent of energy saving gains depending on energy service. The economy-wide implication of the rebound effect is that energy efficiency may improve productivity and accelerate economic growth rather than decrease energy consumption and carbon emission to the extent envisaged by engineers and policymakers. The concept of the rebound effect is not without controversy, but it is nonetheless sensible to discount technological energy/emission savings in estimating future gains. As it is energy conservation and emission reduction that are usually the primary target

4 Energy Efficiency in Housing: Concept Note (ECE/HBP/2008/2).

of national energy efficiency policies (rather than the corresponding benefits), even greater use of energy efficiency is required for achieving the desired levels of energy/carbon saving. Certain policies may discourage the rebound effect, e.g. differentiated progressive energy tariffs that offer certain minimum amount of energy at a very affordable prices, but are increased for higher levels of energy consumption.

Picture 8. One of the many buildings in the UNECE region waiting for retrofitting measures

Source: Courtesy of UNDP Bulgaria.

4. Policy implications and recommendations

This chapter considers policy implications and provides some recommendations in the field of energy-efficient housing to be considered by Governments. Its first section highlights a number of principles that can form a solid foundation for effective policy in the sector, followed by a section focusing on priority areas for energy policies in housing.

4.1. BASIC PRINCIPLES FOR SUCCESSFUL POLICIES

4.1.1. Contextual underpinning

Exchange of experiences and knowledge and continuous learning from mutual experiences are the key to policy advancement. There are significant differences across the region with respect to the levels of economic development, legislative and organizational structures, the history of the housing sector, as well as to the outdoor climatic conditions. Organizational, legislative, financial or technical approaches that are effective in one context will not necessary be so in another. Policy and practice should be sensitive to this diversity and, if necessary, be sufficiently embedded in local socio-economic, institutional and geographical contexts.

4.1.2. Multidimensional and integrative character

Many studies and assessments suggest that there is no "silver bullet" able to resolve the problem of energy efficiency in housing in a quick and hassle-free manner (e.g. IEA and AFD 2008). It would not be right for policymakers to concentrate on one specific challenge or obstacle or to rely on a limited number of instruments. The problem is multidimensional, so policies should be comprehensive and thoroughly developed, and should integrate a number of measures and instruments, both regulatory and non-regulatory (e.g. technological, informational, educational, organizational and fiscal). Despite the seeming difficulty of operating comprehensive cross-sectoral solutions, they have a "snowball" character and will much sooner lead to self-sustaining energy efficiency results than a series of disintegrated policy actions.

4.1.3. Social responsibilities and safety net

Energy in housing is an integral part of the housing policy. It is therefore vital to interlink housing and social policies seeking to improve energy efficiency in housing. To consider energy-efficient housing in narrow, technocratic terms (e.g. merely through a lens of energy conservation or the extra income generated to utility services by higher energy prices) is wrong from both a social and political point of view. Technological targets are important, but they are only appropriate as part of a larger, socially responsible policy package. Sufficient measures should be sought (a) to ensure affordable access to energy, (b) to decrease fuel poverty, (c) to mitigate social inequality and social exclusion, and (d) to improve social well-being in general. At the same time, the social safety net for low-income citizens and other vulnerable groups must include energy considerations.

4.1.4. Organizational leadership and energy planning

The nature of the problem requires a continuous and assiduous process of decision-making, planning, implementation and monitoring, rather than one-off endeavours or declarative programmes. Energy efficiency policies are rarely successful unless they are underpinned by strategic thinking and strong leadership – and especially so when critical changes are to be set in motion. It is advisable that a special organizational unit is charged with the responsibility of coordinating such policies and that it have certain responsibilities over other departments and local governments as far as these policies are concerned. It is particularly important to establish coordination between the housing and energy authorities. A specific tool to facilitate such coordination can be regional and local energy planning, of which housing must be an integral part.

4.1.5. Statistical backing

Policymaking and management activities directed toward improved energy efficiency need to rely on data that allows for assessing the current situation and monitoring the results. In many countries, however, relevant statistical data are limited and dispersed between sectoral agencies, while central statistical bodies have neither the methodology nor the authority to process and analyse the data. It is necessary that statistical capacities and universal standards are raised in all ECE countries. In addition, energy information systems need to be set up at the regional and local levels.

4.1.6. The adoption of new knowledge and best practices

Policies must both encourage and internalize best practices and innovations emerging from research and development, information exchange, and demonstration or pilot projects. There should be necessary structures in place nationally and internationally to ensure appropriate dissemination of the available information to as many stakeholders as possible. The development of affordable technology for low-energy and passive buildings should be prioritized. National activities in research, development and demonstration (RD&D) should stimulate technological advances in this respect. It is not, however, necessary that energy-efficient solutions and innovations are based on “high technology” or are expensive; on the contrary, affordable solutions should be preferred whenever possible (see box 4).

4.2. ACCOMMODATING ENERGY EFFICIENCY: PRIORITY AREAS

4.2.1. Raising awareness and public dialogue

Very much can be achieved through increased public awareness. Informational instruments positively affect energy efficiency by promoting informed choices and contributing to behavioural change.

Two groups of information instruments should be used: "hard" and "soft". The former represents legally binding informational instruments, e.g. mandatory energy performance labelling of household appliances, energy performance certification of buildings or other declarations of energy consumption. These instruments, already widely in use in the EU and other countries, are low-cost and should be promoted by national regulatory regimes in all ECE countries to make energy efficiency highly visible in the residential market. If potential buyers or residents receive reliable, verifiable and controllable information about their future operation costs, they will make more informed choices and the market will adjust.

The "soft" instruments of raising energy efficiency awareness can include, inter alia, informational campaigns; capacity-building, educational and training measures; policy guidelines, good practice and informational handbooks; energy information centres (i.e. State-sponsored offices giving free advice to citizens on energy investment); voluntary energy labelling of products; demonstration projects; advertising and promotion of energy-efficiency buildings and technologies; and promotion of sustainable lifestyles. Accordingly, policy measures should be undertaken for the relevant sectors, including programmes for (a) primary, secondary and tertiary education, (b) continuing education programmes and advanced training, (c) support to environmental NGOs, assistance to RD&D, and (d) tax incentives and financial opportunities for businesses that provide energy efficiency solutions.

Polices should be encouraged and broadcasted widely and transparently, with much use of the national and local mass media. Experience suggests that it is particularly in those societies that have raised energy efficiency and environmental concerns to the level of everyday public discourse that relevant policies receive public support and loyalty.

4.2.2. Energy performance standards for buildings

Evidence internationally suggests that updated and mandatory energy efficiency standards in buildings (being independent or part of building codes) are among the most effective instruments for increasing energy efficiency. While in those countries that have voluntary building codes (e.g. Japan) such codes do not play a significant role in improved energy efficiency, the countries that have institutionalized mandatory buildings codes have been able to achieve much progress (Geller et al. 2006). In countries where sub-national States

Box 4 Improving energy efficiency in Kyrgyzstan using affordable local materials

The collapse of the Soviet Union left Kyrgyzstan with poor energy resources. This has had negative implications not only for the nation's economy, but also for households' access to affordable energy. Kyrgyz households spend 30–50 percent of their income on energy; while the Asian Development Bank (ADB 2005, 23) estimates that the country's housing sector is responsible for about 40 percent of the total use of energy resources (as of 2004).

There have recently been several projects supported by foreign aid that offer simple but effective technological solutions to reduce households' dependency on expensive energy resources. The idea is to develop safe, healthy and energy-efficient building practices using local resources and developing the associated skills of local people.

The Swiss-supported Central Asian Mountain Partnership's project, "Thermal Insulation of Buildings in Rural Areas of Kyrgyzstan" (2002–2004) focused on the use of dried reeds on the external surfaces of walls and ceilings. The project demonstrated that this method could reduce energy consumption by 65 percent. Similarly, a project called the "Construction of a Passive-Solar Straw Bale House" demonstrated a possibility of reducing energy consumption by up to 95 percent using straw bales with a high capacity for heat insulation. Straw-bale homes are affordable for all incomes. However, it is also important to avoid stigmatization of such construction methods. All income groups should be encouraged to use them. Other efforts in Kyrgyzstan include the promotion of compact building design and the use of passive solar power in new construction. Experience suggests that a compact building design could result in a 15–30 percent reduction in energy consumption in Kyrgyzstan, whereas solar power allowed for a 20–60 percent reduction.

Source: Based on the materials of Boronbaev (2009) and ADB (2005).

are responsible for building codes, there should still be a clear national policy for this well-grounded in model national building codes.

Mandatory building codes must consider buildings as complete systems and be regularly reviewed so that minimal requirements are raised to the new levels, are cost-effective and use feasible, energy-saving technology. Many countries choose to set future energy demands years before implementation, in order to give industry time to adjust and prepare for new regulations. This mechanism of “dynamic building codes” reduces the costs due to the change and, effectively, reduces the opposition from the building industry or from manufacturing (Laustsen 2008). Appropriate national targets and measures should also ensure an increasing penetration of passive, zero-energy, and zero-carbon buildings and other innovative solutions, with preparations to eventually require all new homes to be based on these technologies.[5] It is also important to consider introducing legal mechanisms to improve energy performance of existing buildings.

In any case, buildings codes should also be adjusted to the general levels of economic prosperity of a particular country. Stringent and universal buildings codes may be unfeasible for smaller developers and individual self-builders in less prosperous countries, thus pushing them into informal or illegal practices. It may be advisable to have differentiated requirements depending on the size of the given project and the developer’s status. Larger developments and the public sector may be required to meet higher and more challenging standards than private individuals who build their own homes. There must also be a degree of flexibility for local municipalities to set their own standards (e.g. more stringent regulations than minimal national requirements).

Developed mechanisms to enforce and control the implementations of the mandatory codes will be a crucial element in this system; there is no point to having advanced building codes that are not followed. Building codes should also be supported by other instruments, including subsidies to lower-income groups to acquire energy efficiency technologies. On the other hand, energy efficiency must be a precondition for subsidies for construction or capital renovation. Conversely, energy efficiency considerations should be sufficiently accommodated in spatial and land use planning (see section 3.2).

4.2.3. Housing management and maintenance

Another important area for policymakers is the integration of energy performance standards and housing maintenance so that it is not only new buildings that conform to high standards, but also existing homes. An institutional environment should therefore be in place that can enable the system of housing management and maintenance to operate in a strong framework of capacities and incentives to deliver better energy efficiency.

[5] In the United Kingdom, for example, a complete transition to zero-carbon homes is currently envisaged for either 2016 or 2019.

Box 5. Bulgaria's pilot project for the renovation of multifamily buildings

Almost 97 percent of the Bulgarian housing stock is private, while most urban homes are apartments in multifamily buildings (65 percent). The majority of the multifamily buildings are characterized by low thermal efficiency and wasteful heat distribution systems. The main barriers to energy efficiency improvement of these buildings include the lack of a tradition of joint management of common property in Bulgaria and the population's financial inability to afford renovations (only 30 percent of households can afford a standard retrofitting package of € 3,000–5,000 in 2008–2009).

In 2007, the Ministry of Regional Development and Public Works (MRDPW) and the United Nations Development Programme (UNDP) launched the nationwide Demonstration Project for the Renovation of Multifamily Buildings. The Project aims to develop a replicable scheme that consists of three major components: (a) conditional subsidies to condominiums for renovation; (b) facilitated access to loans for renovation; and (c) technical assistance to voluntarily homeowners' associations. The project is organized as a public-private partnership. MRDPW establishes overall conditions and provides subsidies. UNDP is responsible for a model renovation scheme. A National Energy Efficiency Fund is being developed as a mechanism for providing guaranteed loans. Municipalities carry out informational campaigns and make a commitment to renovate surrounding public areas. Residents wishing to take part in the Project must organize voluntary associations (condominiums) representing all households in the building in question.

The Project only supports the full renovation of buildings, not partial interventions. The participating condominium owners also receive comprehensive informational support and advice. The achieved energy savings in the participating buildings in several Bulgarian locations are typically 40–60 percent (with an equal amount of reduced energy bills for the owners). The Project is helping to develop organizational models for renovation activities for a full-scale implementation of the National Housing Renovation Programme, which is expected to provide retrofitting of more than half of multifamily buildings in Bulgaria. The Government also considers these measures to be an important mechanism for ensuring a sustainable demand for construction services during the global economic crisis.

BEFORE

AFTER

Source: Based on MRDPW, UNDP 2009 and Naniova 2009.

Improving and professionalizing housing management is a necessary institutional prerequisite. This is important in all ECE member States, but represents a particular challenge for the former socialist countries, which are characterized by a conflict between a large proportion of multi-apartment buildings on the one hand, which now have complex forms of ownership, and on the other, limited self-management skills and capacities of the residents. One specific aspect is advancing rent and homeownership legislation. There must be mandatory provisions for setting up collective coordinating bodies such as homeowners' associations, for which legal obligations for maintenance should be established (see Guidelines: ECE 2003). These collective bodies should also be required to keep their maintenance funds, which can finance energy efficiency projects as part of maintenance activities and serve as collateral for loans. Homeowners' associations should also have certain enforcement recourse against owners who are not willing to take part in maintenance schemes or are otherwise unable to fulfil their obligations. At the same time, support schemes should be provided for low-income households (e.g. income-related subsidies for refurbishments) to improve energy efficiency, including for residents in condominiums that are undergoing refurbishments according to the homeowners association's decision (see box 5 and section 4.2.4 below).

Separate efficiency polices should target the public/social housing sector, which presents particular opportunities from the institutional point of view. Public housing in some countries such as the United Kingdom already deliver better standards of energy efficiency than average private homes; among other advantages, this helps tackle fuel poverty. There should be special programmes for investing in retrofitting of the existing public stock and stricter requirements for better energy efficiency performance for new homes. As the organization of public housing varies considerably across the ECE region, different combinations of financial and legal measures should be provided, depending on the context. In some transition countries, private housing now reaches as much as 80–90 percent of the total housing stock, while remaining public/non-privatized homes may be scattered among privatized flats in multifamily buildings. While such a structure promotes socio-spatial mix, it also requires government to find proper organizational solutions.

4.2.4. The development of financial mechanisms

Subject to specific possibilities existing nationally, it is necessary to develop and maintain a sound financial infrastructure for all stakeholders to be able to raise capital for retrofitting and investing in efficiency technology, and for new technology to establish its market niche. This would include a transparent system of subsidies, grants, loans, public investment programmes and leasing, as well as self-sustainable funding sources (e.g. revolving funds). Such instruments should be targeted at appropriate stakeholders, including owners, tenants, builders, technology producers and retailers. It is also advisable that information about such financial instruments is systematized and accessible from one single user-friendly portal.

Various fiscal incentives and subsidies are already in use in different countries (see, for example the examples in the annex). Local or national states must play a direct part in the process of housing upgrade when they are major landlords (see box 3). Alternatively, innovative forms of economic and legal incentives should be designed to stimulate homeowners to deliver better energy efficiency and to solve the problem of split incentives between owners and occupiers. In this light, the conventional "giving" direction of fiscal incentives for landlords and tenants might need to be supplemented by "taking" approaches, such as the energy inefficiency tax suggested in box 6. This tax would still be supported by "giving" incentives, but would increase the value of energy-efficient housing as "tax-free".

It is also important to improve cooperation between homeowners and financial institutions. While financial institutions should learn how to incorporate energy efficiency projects in their practices and raise technical expertise for appraisal and risk assessment, provisions should be made for collateral, guarantees and insurance that the banks can use for financing such projects.

4.2.5. Energy pricing and utility services

One of the essential elements in the energy efficiency incentive system is the organization of energy pricing and billing. If residents view their use of energy with budgetary burden , they attach a greater value to energy-efficient housing and are more willing to reduce energy consumption. Importantly, the threshold of cost-effective energy efficiency investment also rises as energy prices rise. It is therefore vital to establish an adequate pricing system and also to eliminate fixed-cost payment systems for energy (electricity, heat, gas, and hot water). However, there are at least two preconditions to be met. Firstly, energy payments must be directly linked with households' actual energy use, and they must be informed of this through energy bills and energy metering. Metering system installation should therefore precede energy price reform. Secondly, pricing according to use is only sensible if users are able to fully control their use of energy, otherwise they will not respond to price stimulation (e.g. heat will be taken as supplied by district heating provider) and there will be a zero energy efficiency effect (Wollschlaeger 2007).

It is often incorrectly assumed, however, that deregulated energy prices are sufficient to stimulate energy efficiency and that therefore particularly the countries that remove energy subsidies will be the ones with better prospects. Firstly, such measures are not sufficient and need to be understood as only one element of the integrated package of efficiency policy. Secondly, energy pricing needs to take into account the socio-economic context of a particular country. Even in the most affluent countries there is no smooth energy efficiency response to price stimuli, due to the failure of energy prices to fully incorporate externalities, uncertainty in future price dynamics, and other market asymmetries discussed above. Moreover, privatized utility companies or energy producers are interested in selling more energy at market prices and not in improved energy efficiency and reduced consumption. There should therefore be many supplementary policy solutions. Furthermore, there is a real danger particularly for less affluent countries in that – given their poorer population's limited investment capabilities and the inefficient housing stock – increased energy prices

Box 6 Raising incentives and awareness through an energy inefficiency tax scheme?

One possibility to stimulate property owners to invest in energy efficiency is a scheme under which owners are required to pay an energy inefficiency tax on their property unless they are able to document that it complies with certain minimal energy requirements (in which case the tax is not levied). There is already such a successful practice in Bulgaria. This provides building tax exemption for up to 10 years to owners of buildings who have obtained energy performance certificates of one of the higher classes. It is a possible alternative to the energy inefficiency tax suggested here, but it is a "giving" initiative, rather than "taking", and is therefore less "visible" for the owners and the market.

The inefficiency tax scheme would encourage landlords to improve energy efficiency and/or to acquire necessary energy documentation for their property (e.g. energy performance certificates). In either case, the tax scheme would raise their awareness. In parallel, public subsidies and grants should be made available for improving energy efficiency. The energy inefficiency tax may partly or completely offset the expenditures from such funds.

There are a number of further benefits from the scheme. It would (a) boost the submarket for energy audit and advisory services, (b) provide extra incentives for property owners to prioritize energy efficiency and for the real estate market to include energy efficiency in property valuation, (c) create statistical data on energy efficiency at little cost to the public budget, and (d) bring more tax revenues for targeted public assistance in the field of energy efficiency.

The energy inefficiency tax might be small in the beginning, but could increase as capacities and awareness grow. The tax might be levied based on the value of real estate or be proportionate to the size of property. Sufficient actions would need to explain the purpose of the tax and potential exemptions.

will only aggravate social problems, the cumulative cost of which will outweigh energy efficiency gains. In many transition countries, monetary "incentives" alone have proven to lead to non-payment and disconnection, public infrastructure degradation, increased levels of dirty energy and – while possibly lessening loads on electricity or gas distribution grids – have worsened both living conditions and the environment.

A number of measures should be taken alongside energy price reforms (or in order to correct the energy market mechanism where market prices are already in force). Criteria may be developed in terms of what percentage of household income is spent on energy before it is considered to be in fuel/energy poverty. For those in energy poverty, targeted subsidies or assistance should be provided, which would ideally help improve the energy status of housing, so that less energy is consumed to achieve the same levels of comfort. More universal (non-targeted) measures may include differentiated tariff systems such as block tariffs, which make energy affordable for lower-income families, yet encourage conservation (EEA 2007). Under such systems, households are charged progressively for the unit of energy used depending on energy use bands or thresholds. To be effective, the tariff difference between energy use bands should be large.

The use of smart metering and differentiated tariffs based on the time of day and the season may additionally help to improve energy efficiency by making households aware of the cost of the energy they use and giving them incentives to spread their energy use more evenly throughout the day. Using new technologies, buildings that generate their own power could sell the excess to the grid.

Specific requirements and incentives should also be imposed on energy suppliers providing services to households; these should include both regulatory and financial instruments. One example is the White Certificates increasingly used in the EU (see annex). Other measures may include, for example, obliging energy providers to spend the extra income received from the higher energy use bands exclusively for energy efficiency.

4.2.6. International cooperation and knowledge exchange

Policymaking will benefit greatly if informed by wider international developments (e.g. experiences and best practices) and if it considers their transferability or adaptability to the local context in a sustainable manner. International organizations should accumulate and exchange knowledge and experience in the housing field.

Furthermore, capacities should be established to assist the less developed countries of the ECE region with the transfer of technological and institutional know-how. While information about energy efficiency practices and experiences in the EU and North America is widely accessible due to a rather high level of mutual exchange of this information, many countries in EECCA and SEE remain relatively more isolated in this regard. Their experiences are poorly monitored, and they have only limited access to best practices and advice internationally.

One suggestion for international organizations such as the Committee on Housing and Land Management of the ECE could be to include specific analysis and recommendations on energy efficiency in housing in the Country Profiles for those countries that lag behind, in order to evaluate their contextual requirements and to offer targeted policy advice. Another possible direction is developing more detailed and concrete “action plans” to inform international and national policy and to ensure a broader outreach for housing energy efficiency strategies. The ECE is particularly well placed to provide such assistance, as it is a unique pan-European forum for multilateral dialogue and delivers policy advice to countries with a diversity of social, cultural, economic and political backgrounds.

Picture 9. London hosts the tallest timber residential building in the world

Source: Courtesy of Andrew Waugh.

Annex

EXAMPLES OF MEASURES IN ENERGY EFFICIENCY IN HOUSING FROM ECE MEMBER STATES

Policies	Examples	Challenges and constraints
Regulatory measures		
Mandatory building energy codes/energy performance standards	- Most countries have building codes, including requirements for energy performance. Laustsen (2008) calculated "total u-value" for the building envelopes from the national prescriptions of some OECD members. The strictest code for overall u-value was found in Sweden with an overall value close to 0.7, followed by Denmark (0.77) for renovation or extensions (while u-values are not set for totally new constructions), Norway (0.84), then followed by Finland (0.94) and Ontario, Canada, for its coldest parts (0.93).	Opposition from the building industries, problems with enforcement and monitoring, limited means for poorer self-builders to meet the requirements.
White certificates/ energy saving certificates	- In Italy, France and the United Kingdom, energy (distribution) companies are obliged to achieve energy savings for end-users consistent with their annual energy deliverance. If they do not meet the targets, they are required to pay a penalty. The tradable White Certificates are issued for proven energy saving and can be used to demonstrate target compliance or can be bought and sold.	Opposition from energy companies, transaction costs, organizational barriers.
Financial and fiscal incentives		
Grants and subsidies to homeowners for EE equipments, the development of credit facilities	- In Austria, there are subsidies which are combined with energy efficiency (EE) requirements that are stricter than the building codes and which can include additional insulation, improved windows or installation of renewable energy sources or efficient appliances. In some Austrian provinces, this has led to nearly all buildings being constructed with EE exceeding code requirements (Laustsen, 2008; see also box 3) - The Residential Energy Efficiency Credit Line (REECL) project in Bulgaria helps develop credit mechanisms for supporting residential EE improvements. Individuals may benefit from incentive grants of up to 30 percent of the amount they borrow from participating banks for predetermined EE measures (to a max of € 2,000). It is anticipated that the total number of loans will be up to € 30,000 (www.reeecl.org).	The amount of grants may be insufficient to meet demand.

Grants to low-income households and affordable housing providers	- The US Department of Energy provides grants through the Weatherization Assistance Programme since 1976. It helped lower space heating energy consumption in participating low-income households by 30 percent between 1993 and 2002 (Geller et al. 2006). - The Canada-Ontario Affordable Housing Energy Efficient Programme, launched in 2007 is funded by both the provincial and national governments and offers affordable housing providers up to $850 per unit to help offset the incremental cost of purchasing ENERGY STAR-qualified products to encourage the use of energy-efficient products and practices. - England's Warm Front Scheme offers grants up to a maximum value of £3,500 (or £6,000 if oil central heating is involved), as well as technical assistance to low-income owners and tenants for insulation or heating measures.	Increased burden on the public budget, and sometimes lack of information and complicated procedures for vulnerable groups.
Tax credits, tax deductions on energy-efficient investment	- In the United Kingdom, all new zero-carbon homes up to £500,000 in value are exempted from stamp duty land tax (until 2012). The Landlord's Energy Saving Allowance (LESA) provides tax deductions to owners who make investments in certain energy saving measures; VAT deductions are also available. - In France, tax credits for EE installations apply to all those responsible for paying energy bills (at different rates, up to 50 percent since 2006). The tax credits are coordinated with other measures, such as direct subsidies; the limit is € 16,000 (from 2005) per dwelling per couple. (IEA and AFD, 2008). - In Sweden, households can benefit from a 30 percent tax credit when converting from direct electric heating and oil-based heating to systems based on bio mass or heat pumps (since 2006). - Bulgaria offers property tax exemption for owners of efficient to very energy-efficient housing having obtained the necessary certificates. The tax exemption is for up to 10 years.	A risk of costly efforts with little impact – unless financial incentives are coordinated with other instruments. It is advisable to provide incentives for newly commercialized technology with a high initial cost but good prospects, rather than for mature products in the market.

Voluntary measures, partnerships		
Voluntary and semi-voluntary energy performance standards in housing	- Switzerland's voluntary Swiss Minergie standards require that total energy consumption of the building must not exceed 75 percent of that of average buildings, with less than 50 percent of the energy from fossil fuels. The Minergie-P standard requires virtually zero energy consumption. - England's Code for Sustainable Homes (2007) assesses new homes against nine sustainability categories, rating the "whole home" as a complete package from 1 to 6 stars (6 stars for highly sustainable and zero net carbon homes). From 2008, all new social housing must be built to a minimum of 3 stars. The Code is voluntary for privately-built housing; however, all new homes are required to have a Code rating in the mandatory Home Information Pack (HIP); if they are not assessed against the Code, HIP must include a nil-rated certificate. This is done in anticipation of a gradual tightening of the building regulations towards a zero carbon home target from 2016.	Effective only if firms see more benefits of participating over costs. The goals may not be stringent enough. To be effective, voluntary agreements need to be complemented by financial incentives, technical assistance and the threat of taxes or regulation if companies fail to meet their commitments (Geller et al., 2006)
Green building partnerships	- Europe's Smart Energy Home (SEH) consortium consists of a number of multinational companies supporting sustainable and affordable buildings. SEH initiative sets up a network of DEMObuildings: attractive, multi-dwelling buildings adapted to local conditions with energy performance rankings among the top of the national building stock.	Limited impact as stand-alone initiatives, but a greater impact en masse.

Educational measures and capacity-building		
Energy labelling and certifications	- EU Energy Performance Certificates (mandatory) – see box 2. - In the US Environmental Protection Agency's Energy Star Programme (voluntary), a home may earn the Energy Star label if it is verified to be 30 percent more efficient it its heating, cooling, and water heating than the requirements of the 1993 Model Energy Code, and if it is 15 percent more efficient than the State energy code. Energy Star homes are eligible for financial incentives. - Leadership in Energy and Environmental Design (LEED) standard has been developed by the US Green Building Council for commercial, institutional and high-rise residential buildings.	Voluntary certifications have only limited impacts; mandatory certifications are likely to meet industry opposition.
Research and development programmes	- The development and commercialization of innovations such as new energy technologies.	Long pay-back periods. Need to be complemented by other incentives to overcome market barriers.
Comprehensive programmes	- European Commission's Intelligent Energy for Europe (in operation since 2002) has as one of its goals to increase EE by 1 percent a year across the EU. It supports strategy development, financial and marketing structure, promotion schemes, R&D activities, monitoring and evaluation and energy targeted initiatives.	Sufficient information and high skills are required to obtain funding.

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In the United Nations Economic Commission for Europe (ECE) region, buildings are responsible for over one third of the total final energy consumption. Much of this energy is used by the residential sector. Demographic, economic and cultural changes are further increasing the pressure of housing on energy use and are accompanied by even higher levels of related greenhouse gas emissions. However, it is the buildings sector – and particularly the residential sector – that could generate some of the greatest energy savings in comparison with other energy uses. To explore this opportunities, the present study outlines key benefits, challenges and prospects that ECE member States should consider for developing their policies with regard to improved energy efficiency in housing.

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