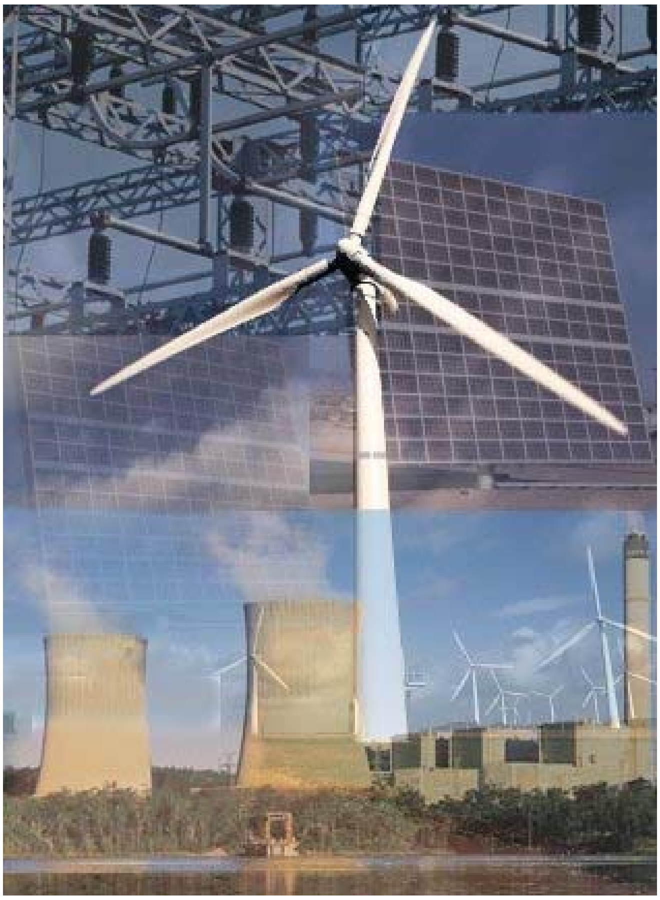
The impact of structural changes in the energy sector of CEE countries on the creation of a sustainable energy path

Special focus on investment in environmentally friendly energy and the impact of such a sustainable energy path on employment and access conditions for low income consumers
(Project No IV/2002/07/03)



FINAL REPORT

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EXECUTIVE SUMMARY

THE IMPACT OF STRUCTURAL CHANGES IN THE ENERGY SECTOR OF CEE COUNTRIES ON THE CREATION OF A SUSTAINABLE ENERGY PATH

(PROJECT NO IV/2002/07/03)

Background, aims and scope of the report

The energy sector of the 8 post-communist EU accession countries[1] is one of the most problematic areas of these economies. Strong legacies from the centrally planned era left this region with an obsolete, inefficient, centralised infrastructure, world-record energy intensities (i.e. very low levels of energy efficiency), and soaring levels of environmental emissions resulting in a heavy health toll, combined with a low level of environmental and energy-related awareness. Whereas the policy agenda to overcome these legacies and align the energy sectors of these countries with the rest of Europe is straightforward, the implementation of this agenda poses significant financial, political and social challenges.

While the pace and schedule of economic restructuring have been very diverse among these countries, the process of EU accession has provided a vital impetus to reforms, and a restructuring agenda with a set of uniform milestones. Therefore, by today, accession countries have largely aligned their energy sectors, or, at least, their legislative frameworks, with those of EU member states (MSs) according to the *acquis communautaire*. This process, however, has been very difficult from the social and political point of view. In addition, it was entirely a one-way process: the *acquis* has been designed to cater for the conditions and needs of the present EU-15, and thus it does not always offer ideal solutions to the problems of this economically, historically, geographically, socially and culturally different region.

Therefore, it is important to ask the following questions: What are the implications of the structural changes brought about by economic reforms and the accession process? What are the further potentials for a sustainable energy path in these countries? How can the entire enlarged Union benefit from the sustainable energy transformation opportunities provided by the accession? What are the major challenges ahead and what further EU-level instruments could contribute to promoting socially and environmentally sustainable energy solutions in the region?

The aim of this report is to provide a background document to briefly answer these questions, and to identify a few options for policy actions to be considered to address the issues raised. It is important to note that since the problematic of sustainable energy developments encompasses such a broad range of issues, this report, due to its limited length, does not claim to be comprehensive, but rather attempts to bring the attention of the reader to a selection of key issues in the field. The majority of the results in this report are drawn from research conducted on the "Visegrád Four (V4)" countries, i.e. Hungary, Slovakia, the Czech Republic and Poland. Where possible though, the attempt was made to present an analysis valid for all eight post-communist accession countries.

Overarching observations

Whereas its chapter in history was closed as many as 14 years ago in the Central and East European (CEE) region, the fingerprints of the socialist era still determine major characteristics of these countries' energy sectors.

[1] Estonia, the Czech Republic, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia.

One of the most important legacies from the Soviet past is the heavy dependence of this region on Eastern, mainly Russian, energy imports. As a consequence it must be observed that a post-enlargement EU will be heavily dependent on Russia in its energy supply, especially for natural gas, a dependence which is likely to increase in the near future. A positive aspect of this legacy is that many of the countries examined utilise natural gas, the cleanest of the fossil fuels, to a high extent and have very developed infrastructures for this energy source. The countries in the region are very diverse in terms of their fuel mix, with Poland relying on coal for close to 70% of its primary energy needs, and Lithuania, Bulgaria, Slovakia and Hungary all ranking among the top ten in the world in terms of reliance on nuclear energy for their electricity supplies. Another important characteristic of the energy supply sector in this region is the vast oversupply of electricity from cheap coal and nuclear power in several of the countries (such as Poland, Czech Republic and Slovakia). This overcapacity poses a barrier to many sustainable energy developments, such as the increase of renewable energy production.

Another key socialist legacy is the extremely low level of energy efficiency in the region[2]. This originates from several aspects of the centrally planned economy, including a general disincentive for economic efficiency; the decoupling of production and compensation; heavily subsidised and cross-subsidised energy tariffs; lack of metering and flat rates, resource valuation not taking into account market signals; dominance of large scale production units in the economy; the high share of heavy industry in the economy, and the lack of information data and understanding about the levels of efficiency and opportunities to improve it.

However, it must also be recognised that the planned economy left some positive legacies as well, such as the heavy use of public transport and rail freight shipping, and the high share of district heating and cogeneration. These areas require especially innovative policy-making at an EU-level, involving a recognition that simple transposition of EU-15 based regulations may not benefit, or may even hurt, the accession countries. For instance the planned directive on cogeneration requires a careful evaluation from this perspective.

When drawing up a policy agenda to overcome the socialist legacies, it is apparent that the transition to a truly market-based economy, including the liberalisation of energy prices, consumption-based billing, and privatisation and opening up of the energy markets should address the majority of the negative legacies. The adoption of the entire *acquis*, including the recently adopted directives on gas and electricity markets, should hence eliminate the reasons for the high energy intensities. Nevertheless, the report has demonstrated that market reforms alone will not close the energy intensity gap with present member states, and thus targeted and additional efforts are needed to further improve the efficiency of energy production and use.

As emphasised above, the process of EU accession has provided an important impetus towards economic, energy and environmental reforms and has had a major impact on the region. On the other hand it must be recognised that adopting the EU legislation has not proven sufficient in itself. While most of these countries have satisfied EU requirements for the transposition of the *acquis*, often the necessary secondary legislation and appropriate action plans are missing, enforcement is limited, and insufficient financial and institutional resources are devoted to implementation. As a result, compliance is compromised and the impact of the *acquis* in the field of sustainable energy is far from what it should be.

It is also important to recognise that the social, political and financial toll of the EU accession process has been considerable. It has been estimated that complying with the environmental

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[2] Although the actual level of energy intensity, an indicator often used to measure energy efficiency, varies broadly from country to country, see Chapter 3.4.

acquis alone will cost about EUR 48-78 billion[3]. One of the socially and politically most sensitive tasks of accession was the lifting of energy subsidies and liberalising tariffs. Since increases in wages and pensions have not kept pace with drastic energy price hikes, fuel poverty has increased, and covering utility bills has become a considerable burden for a large part of the population. Therefore several governments have still not dared to fully liberalise prices, and sophisticated structures for cross-subsidies remain, mainly for residential tariffs, such as for natural gas in Hungary. The employment implications of energy-sector reforms need to be mentioned as well. As nuclear power plants, coal mines and polluting fossil power plants close because of EU environmental and safety standards and energy companies are privatised, the sector is witnessing sizeable layoffs leading to higher unemployment.

Sustainable energy initiatives can arguably counter the social and financial burden of energy restructuring mandated by EU accession, in addition to many other benefits. For instance, it is demonstrated in the report that there are significant cost-effective potentials for improving energy efficiency (EE) in the region. Further improvements in EE, among many other generally applicable benefits, can ease the burden of paying the increased energy bills, can improve economic competitiveness and release capital for other investments; will reduce the environmental implications of energy production; and will decrease dependence on foreign imports and thus increase energy security. Along similar lines, promoting renewable energy generation, among other benefits, can help countries with nuclear reactors and obsolete fossil plants needing to be shut down in replacing generation capacity; improve energy sovereignty; boost local and regional development in less developed areas. It can also relieve some of the social burden of EU-imposed agricultural land set-asides through offering an alternative use of land (biomass); and can alleviate unemployment problems through offering local employment opportunities

Perhaps one of the most important barriers to more ambitious efforts towards sustainable energy paths in these countries is rooted in the low level of environmental awareness and the relatively low priority of environmental goals on personal and political agendas. Due to the economic recession and the lost social and financial security of the population compared to that enjoyed under the socialist regime, people attach little importance to the sustainability of development and environmental progress, as compared to economic, financial and social improvements. If their own constituency does not place a large emphasis on these issues, it is unreasonable to expect governments to be aggressive about environmental and sustainability objectives beyond levels required by international commitments and the EU. Therefore, **in the short-term it will remain essential to have EU-level policy-making to promote sustainable energy pathways in accession countries, as opposed to national initiatives in this direction (such as in present MSs)**.

Selected key recommendations

The report analyses in detail the developments, status, potentials and policies in the following areas related to sustainable energy paths in the V4 countries: (i) measures to cut energy intensity through the improvement of end-use efficiency; (ii) improving the efficiency of energy production, with special emphasis on cogeneration, district heating, combined cycle gas and clean(er) coal technologies; (iii) renewable energy generation; (iv) nuclear power; (v) implications of sustainable energy pathways, including social and employment issues; (vi) cross-cutting policy themes, including the opportunities offered by the Kyoto flexibility mechanisms and financing sustainable energy reforms. For a summary of the main issues in these specific areas, please see the "summary and recommendations" section in the appropriate chapter.

[3] For more details, see Chapter 5.3.2.

Here we summarise some of the key recommendations offered in the report (cross-cutting and sectoral):

- As discussed above, the low level of environmental awareness is one of the key barriers to an adequate political will and government-level commitment to foster sustainable development. Therefore, **raising environmental awareness, environmental education targeting all groups of the population, and transforming the value systems of the inhabitants** are steps which would be instrumental towards the introduction of sustainable energy pathways as well. There should be a more concerted effort on the part of the EU to improve awareness and to transfer the environmental values (more) established among the societies in present MSs to the accession countries.
- Since these governments are typically cash-strapped and constantly fight with high budget deficits, and since taxes are typically already extremely high, and energy prices have already risen substantially, it is difficult to expect a drastic increase in public spending on sustainable energy transformations. Therefore, **market-based instruments** and **private sector actors** to promote such pathways **should receive special emphasis** as vehicles towards sustainable transformations in this region, and should be supported by all possible means, such as the legal framework, incentives, and designated programs. Such instruments and actors include performance contracting and ESCOs, market transformation and information/labelling programs, public-private partnerships, as well as voluntary agreements and corporate social responsibility programmes. However, it is important to recognise that market-based instruments do not have strong traditions in these countries and face significant cultural and institutional barriers, thus their facilitation requires innovative policy-making. Case studies described in this report demonstrate that this is possible.
- While CEE governments are spending considerable, although far from sufficient, amounts on supporting sustainable energy projects, there is very little, public information currently available on the status, potentials and cost-effectiveness in these sectors. Since good data collection and research form the basic foundations for sound, effective policies, it is very important that these countries devote **substantially more effort to energy data collection** (especially in the areas of end-use, renewables, and CHP); and to **research** related to the current status of **sustainable energy activities** (such as reliable figures on CHP shares; indicators of end-use energy efficiency, etc.), and to **potentials, costs and priorities** (such as detailed renewables, CHP, and energy and carbon conservation potentials and the respective cost curves). While this is mainly a national responsibility, the EU could and should encourage/support/facilitate a harmonised approach to such activities across the CEE region. For instance, it is worth considering making such research areas a priority in EU R&D funding, even though they are not as important for present MSs.
- Since many efforts contributing to the sustainability of the energy sector are rooted at the community level, regional-, municipal- and community-based initiatives should be encouraged more. **Municipalities and regional governments should be granted greater financial and legislative independence to be able to engage in local- and community-level renewable energy and energy efficiency measures**. The EU should support capacity building in municipalities in order to facilitate them in playing this role.
- EU-level instruments and policies should **facilitate and promote the integration of sustainable energy objectives into other sectoral policies**, such as social, economic and fiscal policies, agricultural, industrial, transport, regional development, and urban planning policy regimes. Therefore, EU support programs should incorporate

requirements related to improving energy efficiency and the environment in the various economic areas and facilitate monitoring of such improvements.

- As discussed above, the adoption of EU legislation alone is not sufficient to ensure the desired impact of the directives. **Beyond the legal transposition**, the EU should both **require and support adequate implementation and enforcement** as well, with secondary legislation and ambitious action plans, and **encourage the establishment and development of the proper institutional background (ministries, statistical offices and energy and environmental agencies)** and the **allocation of adequate financial and human resources**.
- During the accession process and after full membership the candidate countries have access to a wide array of EU Funds. However, this fact alone is not sufficient guarantee that these funds will be used in the most optimal way to foster sustainable energy development. First, **the EU should evaluate and make sure that adequate amounts of funding are mobilised at the national and local levels to match EU resources.** Second, since many areas covered by these funds have a profound impact on the sustainability of the region's energy sectors as well, it is crucial to evaluate the utilisation of these funds from this perspective. **The authors of this report strongly recommend that the EP initiates a study which evaluates the current plans under these funds, as well as how (more of) these funds could be used (more effectively) to promote the goals highlighted in this report.**
- While it is difficult, if not impossible, to prioritise among the different areas of sustainable energy policy analysed in this report, perhaps one general conclusion can be made. The (further) **improvement of energy efficiency** can typically be regarded as the **highest priority goal for sustainable energy pathways** in this region. This is due to the still high prevailing energy intensities, the economic and other side-benefits of improved energy efficiency for the region outlined above, the gap to EU levels of specific energy consumption figures in production, the profitability of many energy efficiency related investments, and the relatively lower costs of such measures compared to some other areas, such as renewable energy.
- As discussed above, the structural changes of economic transition and EU accession in the energy sector, and especially the climbing energy prices, give rise to pressing social problems. The most highly recommended solution to this problem is to **use the funds for social compensation for the improvement of energy efficiency**, thereby investing in long-term solutions to reduce energy bills rather than continue (cross-) subsidisation or direct payments to affected households.
- **District heating** (DH), as a potentially appealing heating option from a sustainability perspective, has a much higher share in the accession countries than in present MSs. Since there are many problems with DH systems in the region, this area should receive much greater attention at EU levels. For instance, the present draft of the CHP directive is being formulated primarily for existing MSs, while it will probably have a greater impact on the accession countries. Furthermore, the lack of EU-level legislation or policy on district heating per se means that no accession funds are available for district heating as there are for water sanitation, for example.

In summary, not only are there significant opportunities for further improvements in the sustainability of the energy sector in the CEE region, but this process also offers important economic, social and political gains on the entire EU-level, such as increased energy security, higher economic efficiency, reduced social and employment problems, and rural development.

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PART ONE: INTRODUCTION, AIMS AND BACKGROUND

1. INTRODUCTION, AIMS AND METHODS

1.1. INTRODUCTION AND BACKGROUND

The fall of communism has left one of the most environmentally polluted regions in Europe behind. The single largest contributor to this pollution problem was, clearly, the energy sector with its environmentally negligent mining practices, its inefficient and obsolete energy production, its transmission and distribution sectors with some record high losses, and finally also its highly inefficient, obsolete and polluting energy end-use such as heavy industry. The result was not only a destroyed landscape with acid-rain damaged forests and dissolved architectural beauties, but also a heavy health toll. For instance, in the 90's, life expectancy in the so-called "Black Triangle", the areas of heavy industry and coal mining of Poland, former Czechoslovakia and East Germany, was 3 to 6 years below the average for Europe (Moldan and Schnoor 1992), while levels of particulates and sulphur dioxide were more than two to three times WHO air quality guidelines (Hofmarcher 1998). Per capita sulphur emissions in 1989 were 2 to 6 times higher than in OECD countries (WRI 1992). Carbon emissions per unit of economic output also ranked among the highest in the world.

Beyond the general socialist disregard for the environment and emission control, there were other important factors contributing to the energy sector's huge contribution to poor environmental conditions. While industrial output and living standards were far behind those in OECD countries, the level of energy consumption, and therefore energy-related environmental emissions, were comparable to those in "the West". Thus energy and carbon intensities – the primary energy necessary for and carbon emitted per unit of economic output – were several times higher than those in OECD countries. In fact, the energy and carbon intensities of most Central European countries and Former Soviet Republics were, and for some still are, among the highest in the world[4]. This represented massive economic inefficiency, which also translated into unsustainable environmental consequences.

The authors of this report argue that since this inefficiency, represented by the world-record energy intensities, is at the core of the majority of energy-related environmental problems in the region, the most important policy goal for improving the sustainability of energy in the region is to reduce energy intensities.

The economic transition to a market economy and social transitions to a democratic society have resulted in a major restructuring of the economies of this region, including their energy sectors, which have brought improvements in many aspects of the energy sectors of these countries. The process of EU accession has provided a major further impetus for restructuring and environmental improvements in the energy sectors.

However, the process of EU integration has been an entirely one-way process. The candidate countries had to adopt the "*acquis communautaire*" in their legislation, with the only possibility for taking local conditions or preferences into account was to request a delay in the implementation of certain legislative elements. On the other hand, due to their different historic development pathways, frame conditions in accession countries are often very different from those in present EU member states. These different conditions may require different, new, or modified instruments from those that work best in the present MSs.

[4] For more detailed figures, see later.

Therefore, the European Parliament's intention to understand the impacts of structural changes in the energy sectors of these countries and the **possibilities for sustainable energy transitions represents an important step towards gaining an insight into how present and future EU policies could and should provide a better recognition of this region's needs, and how the entire enlarged EU can benefit most from the sustainable energy transformation opportunities provided by the accession countries. The purpose of this report is to provide a brief background for this attempt.**

1.1. AIMS OF THE STUDY

This study has been prepared for the European Parliament on their restrictive tender issued in October 2002, in the subject of EU enlargement and sustainable energy paths.

The *general objective* of the study is to analyse the process of structural change in the energy sector of accession countries and the impact of these changes on a sustainable energy path.

The *aims* of the study are to:

- Review the status of structural changes in the accession countries
- Identify the potential for a sustainable energy path integrated with the present restructuring processes in CEE countries;
    - within this, provide an understanding of developments and sustainable energy paths in the following areas: end-use efficiency, efficiency in the production of energy including CHP and district heating, renewable energy, nuclear power, and energy policy.
- Foresee the possible implications of these sustainable developments for relevant fields such as security of supply and for social aspects such as fuel poverty.

For the description of methods used to achieve these objectives, see the methodology section in the Appendix.

1.2. THE SCOPE OF THE STUDY

While the countries of Central and Eastern Europe share a common past and therefore a common set of economic and energy sector legacies from the centrally planned system, their economies have followed very different development pathways since the fall of communism. Some countries embarked upon an ambitious agenda to restructure their economies, including their energy sectors: for instance in Hungary, where the majority of the economy is in private hands, the opening of the electricity sector to competition started in 2003, and the country is preparing to accede to the European Union in 2004. At the other extreme, Romania still applies heavy subsidies in its energy tariffs, and industrial structures have remained largely intact.

Therefore, the energy sectors in the region of Central and Eastern Europe are also on different development trajectories and drawing a common picture could be misleading. The present study thus has the following country coverage. The study will pursue an overarching analysis of general trends in the energy sectors from a sustainability perspective in the eight former communist CEE accession countries: **Hungary, Poland, Czech Republic, Slovakia, Slovenia, Estonia, Latvia and Lithuania.** However, for the in-depth analysis aimed at achieving the key goals of the study the research will focus on a group of countries following a similar development pattern. The authors believe that for such a purpose it is best to examine countries that have undertaken the most advanced reforms, since most probably similar steps will be embarked on in the remaining accession countries as well in due course.

Hence the analysis of sustainable energy pathways and their evolution concentrates on the three countries furthest advanced in their restructuring schedules: **Hungary**, the **Czech Republic**, and **Poland**. Since **Slovakia** is not only geographically, but also politically closely integrated in its economic and social context with these countries, many sections of this study cover all four "**Visegrád Countries**".

When describing the scope of the proposed study, it is also important to review the elements of a sustainable energy pathway to be studied, since this concept can be integrated in different ways by different experts. The report concentrates on the following components of a sustainable energy economy:

- efficiency of energy end-use (buildings, industry, electricity)
- efficiency of energy production (with a main focus on the electricity generation and district heating sector and problematic areas: coal, combined heat and power)
- renewable energy generation
- the impacts of the Kyoto flexibility mechanisms which affect the energy sector
- the future of the nuclear power industry.

While transportation is a cornerstone of sustainable energy pathways, it was not the mandate of this report to analyse this sector.

2. REVIEW OF THE ECONOMIC AND ENERGY SECTOR AT THE START OF THE TRANSITION

2.1. INTRODUCTION

In order to understand today's energy landscape in CEE and the possibilities for sustainable energy pathways, it is first important to understand the legacies of the communist past in this region. The centrally planned economy left a significant fingerprint on these societies, which still affects the foundations of energy and economic structures, society and culture. Therefore, we first review the legacies from the past which affect the sustainability of energy, and then review what policy agenda follows from these legacies. Next, we assess the first period of transitions, and review how much of this policy agenda has been implemented, and what the energy landscape looks like today.

2.1. LEGACIES FROM THE SOCIALIST ERA

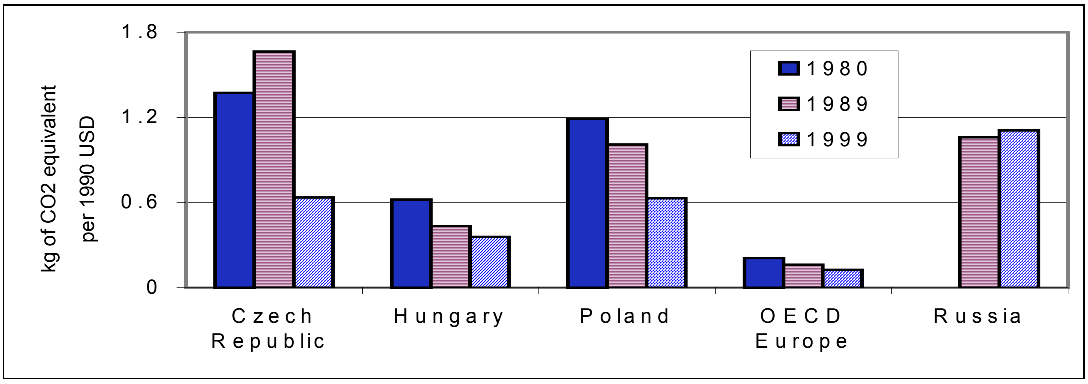
Energy in Central and Eastern Europe was supplied by some of the most monolithic fuel mixes in Europe during the socialist era and this is still largely the case today. For instance, Poland relied on coal for close to 70% of its primary energy and 97% of its electricity supply in 2000 (see Figure 14 in Appendix IV), while oil shale supplied close to 60% of Estonia's primary energy in 2000 (IEA 2000). Lithuania, Bulgaria, Slovakia and Hungary rank among the top ten in the world to rely most on nuclear energy for their electricity supply: in 2002 Lithuania produced 80.1%, Bulgaria 47.3%, Slovakia 54.7%, Slovenia 40.7% and Hungary 36.1% of their electricity from nuclear energy (IAEA 2003). Another key characteristic of the energy supply of Central European countries and Former Soviet Republics was that they relied heavily on energy imports from Russia: energy was one of the ties through which Russia kept its republics and the satellite countries of CEE dependent. Large imports of natural gas, electricity, oil, nuclear fuel and other primary energy carriers from Russia comprised the basis of CEE's energy supply.

One of the few *positive* legacies of the Soviet era for the CEE region is the consequence of this politics: the high share of natural gas in the fuel mix, and the relatively developed infrastructure for natural gas. Since Russia is endowed with the lion's share of the world's natural gas reserves, it has developed an extensive pipeline network to provide Central European economies with natural gas. This has resulted in a relatively high dependence on natural gas in these countries. The share of natural gas use in Hungary presently exceeds 40%, whilst more than 60% of all Hungarian households are supplied with natural gas (MOL n.d.). Other countries in the region also rely largely on natural gas in their total primary energy supply, such as Romania (37.7%) and Czechoslovakia (19.9%) (data is for the year 1999, source: IEA 2001a). Since natural gas is the least polluting of the fossil fuels, and emits approximately half as much carbon to the atmosphere per unit energy as coal, this has had a small positive impact on the overall environmental performance of the energy sectors of these economies.

While this high reliance on natural gas was desirable from an environmental perspective in the short-term (when it replaces poor quality coal or nuclear fuel), after the fall of the Soviet era, it raised concerns of national sovereignty and energy security in several CEE countries and former Soviet republics. Since diversifying the import sources of natural gas is burdensome due to costly and time-consuming pipeline construction, fuel diversification emerged instead at the top of the energy policy (politics) agenda of several CEE countries as a tool to promote energy security. Natural gas, however, remains an important fuel in the CEE region, and imports from Russia dominate.

The energy sector, as mentioned above, was the single largest polluter of the CEE region at the end of the socialist era. In the black triangle referred to above, acid rain has turned square miles of forests into a moonscape. Carbon emissions per unit of economic output are among the highest in the world; several times higher than those in OECD countries (see Figure 1).

Figure 1. CO_2 emissions per unit of economic output in selected countries and OECD in 1980, 1989 and 1999.



Source of data: EIA 1999

One of the reasons for high environmental emissions was the relatively poor quality of the fossil fuels, especially concerning sulphur contents. For example, pollution from the combustion of coal is consistently worse in Poland than in OECD nations. Sulphur dioxide emissions in 1989 were estimated at 32 kg per toe of coal in Poland, well ahead of most OECD countries, where typical values range between 2 to 4 kg per toe (Financial Times 1993). In addition to poor fuels, energy production had no or limited environmental pollution control, and energy facilities were old by the turn of the 90s and equipped with obsolete, inefficient technologies.

However, at the root of all environmental damage related to the energy sector was one single reason: the wasteful production and use of energy in the CEE region. While life quality was much behind that in OECD countries, levels of per capita energy consumption were comparable to those in the most developed economies (see data for 1989 in Figure 3, page 11). The inefficiency of the energy chain is often characterised by the indicator of energy intensity (TPES/GDP). While this is an indicator which is subject to discussion in the literature, the scale of the differences it points to in CEE definitely reveals real and serious problems.

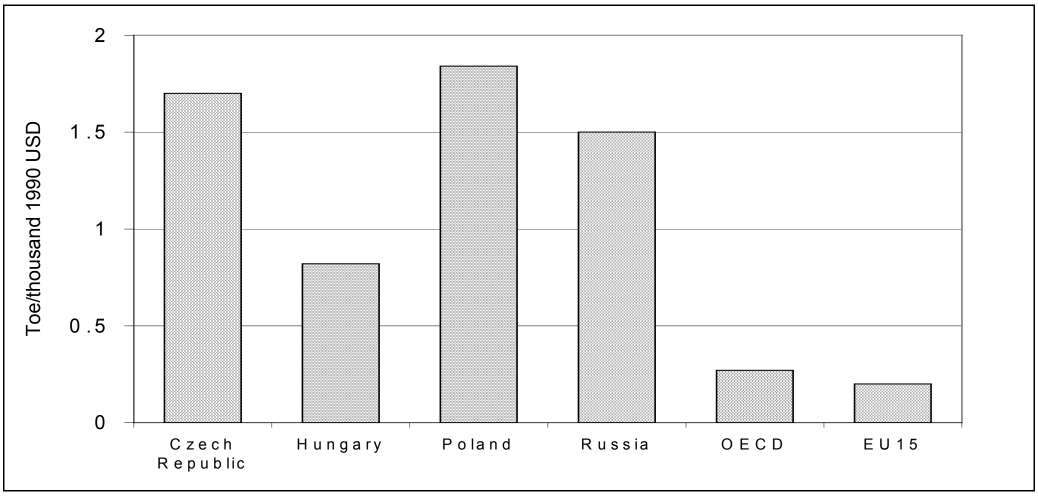


Figure 2. Energy intensities in selected countries and country groups in 1989
Source of data: IEA 2001a

Figure 2 above and Figure 3 (page 11) lead us to the key sustainable energy policy goal of the economic transition: the reduction of the high energy intensities. Improving the efficiency of energy consumption and production would not only deliver an improvement in environmental conditions, but would enhance national wealth by increasing economic efficiency and productivity and by cutting waste. A significant increase of energy efficiency would also bring other key benefits including the reduction of the need for energy imports (thereby increasing national sovereignty), an improvement in economic efficiency, the reduction of foreign debt to which energy imports have contributed significantly, the freeing up of badly needed capital to other sectors of the economy, and the easing of the social burden of increasing energy bills as a result of tariff hikes.

But to understand how to most effectively reduce energy waste, we need to understand the reasons for these world-record energy intensities. The reasons for the high energy intensities are embedded in the nature of the socialist economy. Several features of the centrally planned economy contributed to wasteful practices and energy intensive structures, leaving legacies behind for the economies in transition. The following section explores these legacies, both negative and positive.

2.1.1. Negative legacies

First of all, the planned economy did not reward efficiency. In fact, sometimes it encouraged inefficiency: an enterprise obtained energy resource allocations for the next planning period based on its consumption in the previous 5-year plan. Not only this practice encouraged waste, but sometimes companies reported higher than actual use to achieve higher allocations. Production processes themselves were inefficient too: for example Polish cement required twice as much energy per ton as French cement; in the 80s Soviet steel mills used 1.5 tons of coal to produce a ton of steel, while Japanese mills used half as much (Chandler 2000).

On an individual level, the communist paradigm of "each to work according to his capabilities, and to be rewarded according to his needs" entirely decouples consumption from production, therefore again encouraging waste. This paradigm has manifested itself in several features of the economy: highly subsidised energy prices, flat rates charged independently of actual consumption, and the lack of metering. Furthermore, prices for residential consumers were typically much lower than those charged for industrial consumers, resulting in cross-subsidisation.

With regard to the consumption of natural resources, Marxist economics also detached consumption from resource availability and other features of nature by providing no price signals. In Marx's labour theory of value, natural resources (or rather "raw materials" as he preferred to refer to them) had no intrinsic value; the value of a commodity was determined only by the amount of labour which went into producing it (Papp 1977). Thus, the market had no mechanism for signalling resource scarcity, market shortages or environmental damage associated with the use of the resource.

In addition to resource pricing and the economy not penalising inefficiency, the oversized scale of economies also discouraged efficiency. Instead of local demands driving production, a socialist system-wide "division of labour" resulted in giant industrial establishments producing typically not only for one country, but for several of them. This division of labour resulted in inefficient, large production structures, and an unnecessary need for shipping resources and goods.

However, beyond the wasting of energy, high comparative energy intensities resulted also from the structure of the economy. Heavy industry, being a highly energy intensive sector, comprised the lion's share of socialist economies. In addition, the strong militarisation during the cold war also required an extensive heavy industry basis.

Even when there was an intention to increase energy efficiency such as in the late 80s and early 90s, it was hard to make it happen: there was a lack of information and detailed data about real energy consumption; and there was also a lack of awareness of energy wasting practices and how to improve efficiency. Corruption, widespread in the former socialist bloc, is also a factor contributing to economic and energy inefficiency. Firstly, corruption contributes to general economic inefficiency, further increasing energy intensities. Secondly, corruption related to energy payments eliminates the incentives for conserving energy and efficient energy management (Popiashvili 2000). Corruption in the energy sector in CEE has been shown to be present at all levels, from the level of the household to that of large companies (Lovei and McKechnie 2000). A milder version of corruption prevalent in even the four examined, most developed, CEE countries, is energy theft. Utility officials estimate that as much as 20% of revenues are lost in Hungary in some electric utility areas due to non-payment and electricity theft. Interestingly, an important portion of the theft occurs not in order to meet elementary human needs, but to heat indoor swimming pools or to heat driveways in the winter.

2.1.2. Positive legacies

However, in addition to the negative legacies of the centrally planned economy, usually well known and often blamed for today's poor economic performance, there were a number of "positive" legacies left to the economies in transition as well. These positive "by-products" of socialist planning are also important to acknowledge, since they could result in leap-frogging in certain aspects of the economy compared to the present EU member states.

One of the few features in which former socialist countries were leading the world at the time of the fall of communism was the high share of organised modes of transport, i.e. urban public transport, and rail passenger and freight transport. For instance, in Warsaw, 80% of all trips were made by public transport in 1985, and the figure was similarly high in Budapest as well (Vorsatz 1996). In 1988, only approximately one-third of the average 6000 km travelled per person was by car in all the countries examined by the IEA (1997), including Poland, Estonia and the USSR, while this share was around 80% in European OECD countries[5]. As a result of the high load factors and the high share of trips made by public transport and rail shipping, specific energy consumption by transport (expressed as energy per passenger-kilometre) was much lower than in OECD countries, even that of Japan (Vorsatz 1994). For instance, while a Polish citizen travelled only about 40% less in 1988 than West Europeans, he consumed less than a quarter of the energy for travel than they did (IEA 1997). This was just the opposite of the general energy intensity comparisons described above. However, transportation does not fall under the scope of this report, so we do not cover this issue or its consequences here in more detail.

One of the reasons CEE settlements were easily serviceable by public transport was the concentrated socialist land use planning. High-rise buildings and concentrated settlements also provided ideal structures for district heating networks, and the high share of district heating among heating modes also results in a "positive" legacy from an energy perspective. Most district heating though is in multi-storey apartment buildings in urban areas: for instance 80% of the apartments in urban areas in Poland were served by district heating in 1995 (IEA 1997, p. 119). Large-scale heating systems, especially if provided from a "waste" heat source of industrial units or from other cogeneration sources, are more energy-efficient than individual heating systems. As a result of integrated settlement planning, it was often possible to utilise the waste heat of power plants or industrial plants for district heating or other heat needs. Thus, cogeneration is not a new invention in the former socialist world, but a rather common practice in several CEE countries.

[5] Based on data from Italy, France, United Kingdom and Germany.

However, district heating (DH) is a double-edged sword: while the general concept is desirable, as often in socialism, the implementation was poor: today systems are leaky, inefficient, obsolete and have high losses, and are thus often uneconomic and expensive. Therefore parts of this report (see section 5.2.2, page 30; 5.4.3, page 38; and 5.4.4, page 40) are devoted to a discussion of the present picture in DH, and priorities for its development.

2.2. POLICY AGENDA FOR SUSTAINABLE ENERGY MARKET TRANSITIONS IN CEE

In the section above we concluded that the single most important goal of a sustainable energy policy for the economic transition in CEE is the reduction of energy intensities. After identifying the key legacies from the socialist economy, a policy agenda can be drawn up which can serve as the basis for sustainable energy transitions in the region.

First of all, the key energy policy priority of most CEE countries and former Soviet Republics is the diversification of energy imports and fuels, to increase national sovereignty and energy security. This has been achieved over the first decade of transition to some extent, for instance by joining CEE's electricity grid to the UCTE, thus strengthening the electricity and gas supply infrastructure with other countries. However, more energy transmitting capacity needs to be constructed: e.g. Hungary has limited export/import capacity.

When reviewing the list of factors which resulted in the high energy intensities, it can be concluded that a transition from the planned economy to a market economy is expected to address many of these causes. A market economy, ideally, introduces incentives to cut waste, rewards efficiency and penalises inefficiency, allows economic activity on a smaller scale more tailored to local conditions and demand, and provides price signals for excessive use of resources.

However, there are some painful aspects of a market-based energy sector which need to be introduced as part of the transition process. One of the socially most problematic aspects of the transition to a market economy in the energy sector is the lifting of energy subsidies and thus increasing energy prices. The report discusses this problem in detail in section 9.

In addition to the raising of prices, it is important that consumers pay for their real consumption instead of flat rates. Thus, metering of energy consumption needs to be introduced to end-users where this was not the practice during socialism. However, consumption based billing alone is not enough for cutting waste: tenants need to be able to control their energy consumption. This often needs systemic changes, for instance in the case of district heating, where sometimes thermostats, control valves and bypass pipelines need to be installed for users to allow individual consumption control.

The dominance of heavy industry was also identified as a key factor contributing to the high energy intensities. With the transition to a market economy, it is expected that economically inefficient, obsolete industrial operations will go out of business, and heavy industries will stay in operation only where the availability of the resources justifies this, or where demand supports it. In general, the economies will likely shift towards more service oriented structures, thus reducing energy intensities.

Table 1 summarises the key legacies from the centrally planned economy contributing to the high energy intensities identified in the previous section, and the policy responses to address them.

Table 1. Policy agenda to reduce high energy intensities and unsustainable energy practices in CEE

Feature of centrally planned economy contributing to high energy intensity and unsustainable energy practices	Policy response to address feature
No competition, no penalty for inefficiency	Transition to a market economy Privatisation
Unrealistic resource valuation	Introduction of market prices
Subsidised energy prices	Lifting subsidies Liberalisation of energy prices
Flat rates	Consumption based billing Introduction of metering
Dominance of heavy industry	Transition to a market economy Restructuring
Large-scale economies: oversized enterprises	Transition to a market economy, Privatisation
Lack of expertise and awareness	Education, technology transfer
Insufficient data and understanding related to energy use	Data collection on end-use practices Establishment of energy related state institutional background Open access to information Public awareness raising campaigns on efficient energy use practices
Lack of pollution control	Harmonising environmental legislation with EU; improvement of enforcement; privatisation

With regard to the "positive" legacies identified in the previous section, it is an important question whether any of them should or could be preserved. It is clear that a large part of these positive features cannot be sustained in a market economy, such as the artificially low rate of individual transport and the very concentrated settlement patterns integrated with industrial areas. However, preserving as many of the more sustainable positive legacies in the market economy as possible could certainly result in leapfrogging in certain aspects of the economy.

Hence, preservation of as many of these positive trends as is realistic in market conditions is a key to sustainable energy consumption. These countries should pay careful attention to how to sustain the high ridership of public transport, the high utilisation of rail for freight shipping, how to improve district heating so that it is an economically attractive heating option and maintain district heating consumers. Obviously these goals need "policy leapfrogging": in this respect there are no examples (or very few) from developed market economies to follow in the process of transition. However, this requires dedicated and creative policy-making and policy-makers who are ready to choose non-traditional development pathways. Unfortunately, the first period of transition has shown that few of these opportunities have been utilised, and only little windows of these opportunities remained in CEE.

3. ECONOMIC AND ENERGY RESTRUCTURING, 1989 – 2003

3.1. BACKGROUND: ECONOMIC AND ENERGY TRANSITIONS

In 1989 CEE countries ended the era of state socialistic administration of the economy and society. The whole region experienced a severe recession, exacerbated by serious indebtedness. The economic restructuring in the discussed countries has encompassed (i) the transformation of the once state administered and bureaucratic business units into market based corporate entities, (ii) the privatisation of the state owned companies, and (iii) liberalisation of the economy, moving it from a centrally planned, monopolistic and regulated system towards a more market-oriented, entrepreneurial one.

By the beginning of the new millennium the most successful countries were able to stabilise their economies, and meet the Maastricht criteria for joining the EU.

Taking into account the first decade of transition, the following common features and trends can be identified[6]:

- **Great recession during the period**

Growth was restored in this group of countries by 2000/2001 following a sharp initial output fall and a subsequent recovery period. Both the length and depth of the output decline varied among the CEE countries, as demonstrated in Table 2. Among the countries discussed, Poland experienced the lowest decline and largest absolute growth, while the economies of Latvia and Lithuania shrank to the largest extent.

Table 2. The extent of recession during the transition era

	Consecutive years of output decline	Cumulative output decline (%)	Real GDP (% 2000/1990)
Czech Republic	3	12	99
Hungary	4	15	109
Poland	2	6	144
Slovakia	4	23	105
Slovenia	3	14	120
Estonia	5	35	85
Latvia	5	51	61
Lithuania	5	44	67

Source of data: World Bank 2002

- **Output shifted from industry to services**

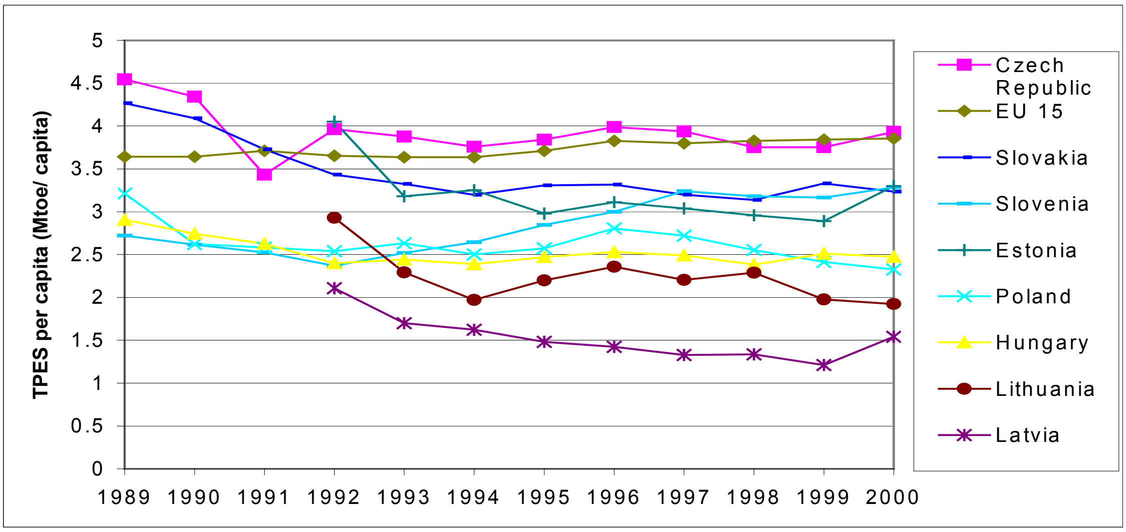
During the communist era, the industrial sector played a key role in the economy. As a result of the transition the industrial sector shrank, while the share of services grew. For instance, the share of industry in GDP dropped from 45% to 33% between 1990 and 1998 in CEE countries (World Bank 2002), and basically this entire shift has benefited services, which grew from 41% to 53%.

- **Energy consumption fell**

Along with economic recession and sectoral shifts in the economy, energy demand fell in these countries (Figure 3). As demonstrated in the figure, TPES has not significantly rebounded despite the end of the recession, and thus a decoupling of economic growth and energy demand has been taking place in most CEE countries, resulting in an improvement of energy intensities. A detailed analysis of this trend is provided later in the report.

[6] Here we only discuss trends and features which have fundamental importance for the sustainability of energy restructuring

Figure 3. Development of the Total Primary Energy Supply per capita for the CEE countries and the EU



Sources of data: IEA 1999a, 1999b, 2001a, 2001b, 2001c, 2002c 2002d, 2002g

- **Privatisation**

The share of the private sector in these countries grew from 10-20% to more than 70% during the period.

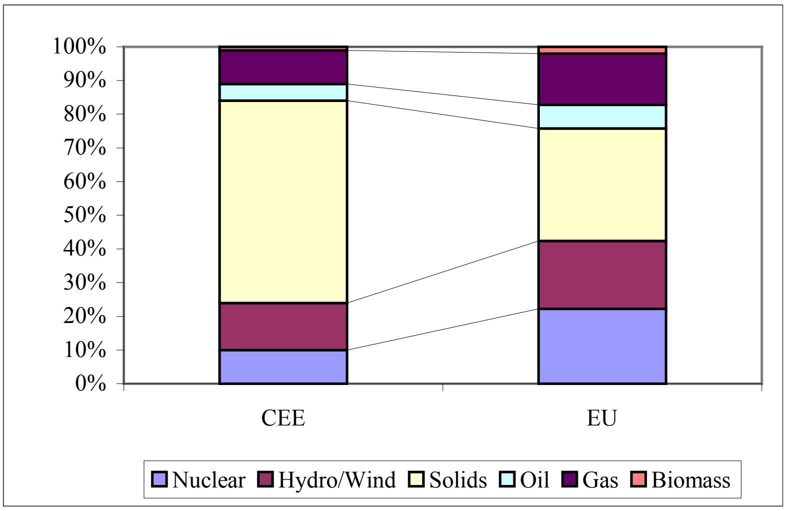
- **Poverty Increased**

Poverty and inequality in the region increased significantly partly due to the fall in output. For further discussion of this issue, see 9.1.

3.2. THE POWER SECTOR TODAY: FUEL MIX AND GENERATION CAPACITIES

The development of the primary energy fuel mix in the Visegrad-4 countries is indicated in Figure 14 in Appendix IV, while the present situation with regard to the fuel sources used in the power generation sector is shown in Table 19 in Appendix IV. These figures demonstrate the relatively high heterogeneity of the CEE region with regard to fuel mix. Nuclear power is not present in Latvia, Estonia and Poland, while it provided the highest share of electricity produced in Lithuania, Slovakia and Slovenia in 2001. Similarly, fossil fuels supplied the vast majority of power generated in Estonia, Poland and the Czech Republic, while they do not play a leading role in the other countries. A regional comparison between the fuel sources of electricity generation in CEE countries and the EU is shown in Figure 4.

Figure 4. Fuel sources utilised by the power sector in 1999 in the CEE countries and the EU



Source: Froggatt 2001

The surplus of power generating and transmission capacities is not only a prerequisite to market competition, but both are important factors in terms of security of supply. From this perspective, CEE countries have sufficient reliability margins and reserves, even sometimes more than those of the EU UCTE countries (see Table 3). On the other hand, a large amount of surplus capacity may strongly inhibit incentives to add new, more sustainable capacity, such as renewable fuel-based ones.

Table 3. Surplus installed capacity in 2002 (MW)

	Capacity			Import options	
	Installed capacity	**Peak demand**	**Gross overcapacity (% to peak)**	**Technical option**	**Need for licence**
Czech Republic	15, 324	10, 128	**5, 196 (51%)**	CENTREL, UCTE 1	no
Estonia	3, 213	1, 370	**1, 843 (135%)**	BALTIC, IPS/UPS	yes
Hungary	8, 282	5, 742	**2, 540 (44%)**	CENTREL, UCTE 1	yes
Latvia	2, 151	1, 200	**951 (79%)**	BALTIC, IPS/UPS	
Lithuania	6, 156	1, 700	**4, 456 (262%)**	BALTIC, IPS/UPS	yes
Poland	34, 552	24, 208	**10, 344 (43%)**	CENTREL, UCTE 1	limited only
Slovakia	8, 277	4, 275	**4, 002 (94%)**	CENTREL, UCTE 1	yes
Slovenia	2, 870			CENTREL, UCTE 1	yes

Sources of data: Szorenyi 2003; UCTE 2003

3.3. ENERGY RESTRUCTURING AND ELECTRICITY MARKET LIBERALISATION

The energy sector played a crucial role in these countries, given the priority accorded to the development of energy intensive sectors during the period of forced industrialisation (metallurgy, machine building, chemical industry). The USSR-dominated bilateral trade co-operation network of the COMECON region was based on the fuel supply coming from Russia to the CEE countries in exchange for agricultural and industrial goods provided by the latter parties. On the other hand, the energy supply for households was treated as an elementary social benefit provided on a non-market basis.

During the last 10-14 years Western investors have played a significant part in the energy industry of the these countries. However, the region, typically poor in domestic energy sources, remains a major client of CIS fuel and energy exports.

As far as the energy sector restructuring is concerned, this transition proved to be a rather controversial and slow process. Progress and transition was very country-specific. Poland and Hungary represent two different approaches to the schedule of liberalization and privatization, with the former opening up its energy market relatively early without significant privatization, while the latter almost fully privatized the energy industry in the mid 90s, and postponed liberalization.

The liberalisation of electricity markets has been a great challenge since the late 1990s for the countries in question. The transposition of the relevant EU directives (mainly Directives 96/92/EC and 2003/54/EC) into national legislation required tremendous efforts from the CEE countries. The chosen competitive market structure patterns and the scheduling of the market liberalisation vary in the countries of the region (see Table 4).

Table 4. Summary of electricity market structures in the CEE region

	EE	LV	LT	PL	CZ	SK	HU	SI
Year of market opening	1998	2000	2002	1998	2002	2002	2003	2001
Vertical integration	yes		no	no	no	no	no	no
Public Wholesaler	no	no	no	no	no	no	yes	no
PSO remains	yes	yes	yes	no	yes	no	yes	yes
Unbundling of TSO	M	L	L	L	L	L	A	L

TSO- transmission systems operators; PSO –Public service obligations; M – management, L –legal and A-accounting unbundling

Sources of data: Szorenyi 2003; Energy Agency of the Republic of Slovenia 2002; EC 2003

Effective competition within the power market strongly depends on the number of players both on the generation and the retail supply side. Table 20 in the Appendix summarises the key indicators of the level of competitiveness in the power sector of these countries. The relatively low number of generating companies in some countries strengthens the importance of cross-border trade transactions.

The full opening of the electricity market, which is envisaged in the newly adopted Directive 2003/54/EC, is expected to create competitive conditions, to increase the transparency of tariff formation, and to ease the access of third parties, while preventing cross-subsidization between actors and reducing the energy subsidies in general and in particular for nuclear and fossil fuels. In the long-run liberalization can offer to consumers an effective choice of energy suppliers including green electricity (such is the case of the Netherlands where one third of households have switched to green electricity) and can promote new DSM incentives to reduce the peak load (such as in Italy) (Bergasse pers. comm.). Along with the restructuring of the sector, creation of an independent regulator, and **unbundling** of the different actors (generation, transmission, distribution and retail) are among the most important steps in the liberalization of the electricity market. According to this Directive legal unbundling is required of the transmission and distribution system operators. While there has not been a comprehensive evaluation on the impact of the Directive on accession countries, some facts can be observed (see Table 4). Most of the accession countries already have established the legal unbundling of their transmission systems operators[7] (EC 2003a).

[7] Consistent information on the unbundling was found only for the TSO

Despite the progress made by most CEE countries in TSO unbundling there are concerns that the relatively small number of dominant companies on both the supply and generation side (E-On, EdF, RWE, Vattenfal, Electrabel, etc.) may inhibit the access of third parties to the market and constrain incentives for demand-side efficiency. Nevertheless, due to the restructuring and privatization in the 90s, most of the CEE accession countries are in fact further ahead in unbundling than most member states. This implies that the impact of the unbundling requirement in the new Directive might be less problematic to be fulfilled in the accession than the current member states.

3.4. THE DEVELOPMENT OF ENERGY INTENSITIES

As discussed above, high energy intensities in CEE economies were at the core of energy related environmental problems in accession countries at the fall of communism. We identified the key legacies contributing to these high intensities, and the policy agenda to overcome these legacies. It was concluded that a transition to a market economy jointly with the restructuring of the energy sectors would take care of most of the legacies, and therefore should reduce energy intensities to levels close to those in the EU, since the systemic reasons for them will disappear. Let us then review the development of energy intensities during the economic transition.

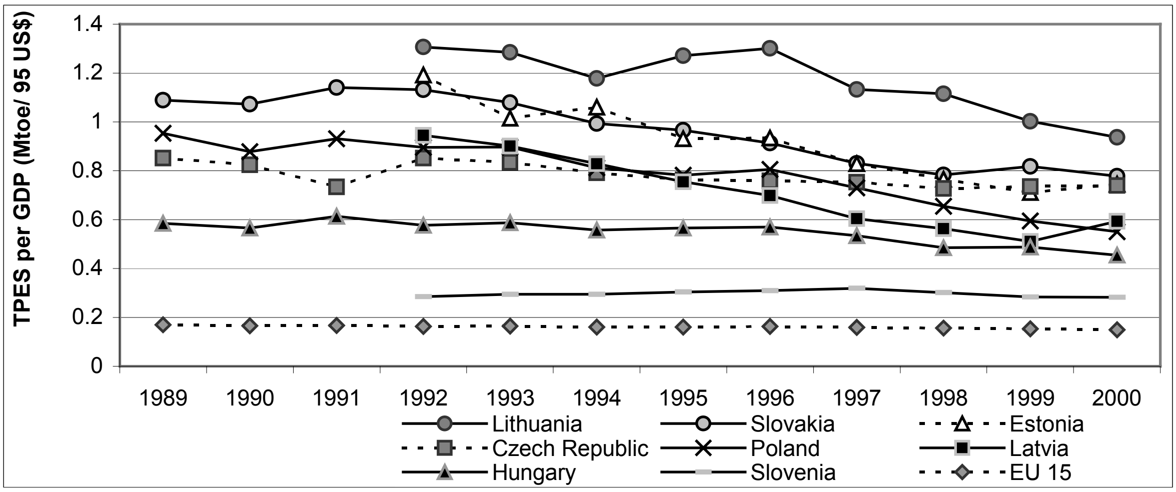


Figure 5. The development of energy intensities (measured at real exchange rates) in CEE.

Sources of data: IEA 1999a, 1999b, 2001b, 2001c; 2002c, 2002d

Figure 5 above and Figure 15 in the Appendix show the development of energy intensities in the 8 CEE accession countries in comparison to the EU-15, measured both at real exchange rates and in PPP[8].

What is clear from the figures is that there is still a wide distribution in energy intensities within these countries. Calculating at real exchange rates, half of the countries in the group are approximately four times as energy intensive as the EU average, while the best performing, Slovenia, is 50% worse than the EU average. Measured at PPP rates, the spectrum is even wider. Slovenia performed only 16% worse than the EU average in 2000, proving to be less energy intensive than 3 present member states. In contrast, Estonia's energy intensity is over twice as much as the EU average even at PPP rates. The other four CEE countries are between 51% and 80% more energy intensive than the EU average. The

[8] According to possible overestimates of PPP rates, GDP measured at PPP rates possibly overvalues the real wealth and living standards of these societies, thus the reality is most likely in between the two figures for a single country. The choice of one or the other energy intensity indicator varies with author. For instance, in the EBRD report, Cornillie and Frankhauser (2002) selects to conduct analyses of energy intensities for the transition economies at real exchange rates.

present "ranking" in energy intensities is Slovenia < Hungary < Latvia < Poland < Lithuania < Czech Republic < Slovakia < Estonia. The ranking is very different if measured at real exchange rates, with Latvia doing worst. None of the rankings can be easily explained based on climate, level of development, fuel structures, or the status of reforms implemented.

Not only is there a broad diversity in the values of energy intensities among these countries, but there is also a large variety in the development of their energy intensities. While Estonia's and Latvia's energy intensity has been reduced by one-third since 1992, Slovenia has not achieved any improvement at all during this period. Again it is not possible to give an easy explanation for the reasons why some countries achieved major improvements and others have achieved little.

The European Bank for Reconstruction and Development (EBRD) has conducted an analysis (Cornillie and Frankhauser 2002) aimed at the identification of the main factors that have driven the changes in energy intensity in CEE and FSU. Energy intensity changes were broken down into four components: changes in industry, transport, the rest of the economy (agriculture, services and domestic), and structural changes. One of their important findings which is probably contrary to some expectations is that *structural changes have not contributed in a significant way to the reduction of energy intensity* anywhere in the region. The energy intensity of transport has virtually stayed constant during the examined period (1992 – 1998). In three countries, **Hungary**, **Latvia** and **Slovenia**, **industrial energy intensity came down sharply**, while that of the rest of the economy remained constant or decreased less[9]. The reverse was true for **Poland**, the **Slovak Republic, Estonia and Romania**, where the **energy intensity of industry remained constant**, but that of the rest of the economy improved. In **Latvia**, **both industrial and other energy intensities declined**. These countries' heavy industries typically contribute a large share to their GDPs. However, even after this breakdown it is difficult to draw a clear picture about why some countries have improved significantly in certain areas while others have not.

Nevertheless, a few general conclusions can be drawn. First, the level of energy intensities among these eight countries is converging. Second, while it is converging, there is still a major gap between EU levels and CEE levels: the average for CEE is still 50% higher than for the EU. This striking difference suggests that 'substantial inefficiencies remain, whatever the differences in socio-economic conditions there may be' (Cornillie and Frankhauser 2002). Third, it is clear that **economic and energy sector reforms** alone are not the key drivers towards energy intensity improvements (i.e. countries which embarked upon more ambitious reforms have not necessarily performed better in improving their energy intensities). As the EBRD states, 'while there is a clear correlation between enterprise restructuring and energy use, there is little evidence that privatisation, on its own, will reduce energy intensity'. Fourth, after 14 years of economic and energy sector reforms, it is today clear that the transition to a market economy and energy sector restructuring **alone will NOT close the energy intensity gap** between CEE and EU.

In conclusion, *the closing of the energy intensity gap undoubtedly require targeted efforts towards the improvement of energy efficiency*.

3.5. THE PRESENT ENERGY LANDSCAPE IN CEE

With regard to the present energy landscape, the following additional issues need to be observed for the coming discussion of sustainable energy pathways.

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[9] In fact other research sharply contradicts these findings. For instance, the Energy Charter Secretariat found (Energy Charter Secretariat 2001) that 75% of the decrease in final energy intensity in Hungary between 1994 and 1998 can be accounted for by structural changes, and specific energy consumption in the major industrial branches have not decreased significantly or at all between 1990 and 1998.

3.5.1. Obsolete and/or improper infrastructure

Much of the infrastructure in the region was designed to accommodate the political-economic requirements of the communist ideology and vision. Countries in the region are now faced with having to adapt this infrastructure to meet their own changing needs. Much of this infrastructure is also in serious need of reconstruction and repair because of its age, poor efficiency of power stations, and the low maintenance levels of the transmission lines.

3.5.2. Supply security

As discussed above, energy sovereignty and security of supply are among the main concerns of the newly independent countries of CEE. Table 5 reviews the main energy dependency indicators of the countries under discussion.

Table 5. Energy Dependency Indicators, 2000

	CZ	HU	PL	SK	SL	ES	LV	LT
Total net energy import (PJ)	394	582	403	484	145	71	97	176
Import Dependency (% of TPES)	**23%**	**56%**	**11%**	**66%**	**53%**	**37%**	**63%**	**59%**

Source of data: IEA 2002c, 2002d

Energy import dependency in the CEE countries is certainly significant. Since **the majority of these imports originate from the FSU, EU enlargement will increase the Union's overall import dependence on this region**. Some factors, e.g. the growing trends of natural gas consumption can further hamper this situation. Furthermore, some of the measures taken by these countries seeking diversification of the supply sources/corridors have not resulted in real supply choice (the physical origin of alternative gas supplies still remained overwhelmingly Russian) (Balmaceda 2002).

The progress of the complex restructuring of the energy sector and the **fostering of sustainable energy pathways,** could result in effective markets and a **higher share of the utilisation of indigenous renewable fuels, and also might reduce energy demand through higher efficiency and CHP. This in turn could lead to increased supply security in a broader sense**. *Therefore, sustainable energy pathways have a major role to play from an energy security perspective for the entire enlarged EU.*

3.5.3. Energy prices

As mentioned above, energy prices were heavily subsidised during the communist era, and therefore one of the largest challenges of energy sector reforms was the lifting of subsidies. This was difficult mainly due to social factors, which will be discussed later in this report. While most direct subsidies on energy prices had to be removed during the accession process, there are still a number of problems with energy prices. Table 21 in Appendix IV details the development of residential and industrial electricity and natural gas prices during the transition in the Visegrad-4 countries. While cross-subsidies between residential and industrial tariffs have also mainly been removed (see Table 6), other forms of cross-subsidisation still remain. For instance, natural gas prices in Hungary have been kept low for political reasons through various cross-subsidisation mechanisms (from the oil sector). Recently residential natural gas prices has been low as a result of increased domestic production charged at non-market rates. The power prices of the CEE countries also show a certain level of under-pricing, though to a different extent in the individual countries (Table 6).

Table 6. Electricity prices (USD/MWh) in 2000

Country	Residential price	Industrial price	Industrial/Residential price ratio	Residential price/LRMC[1] ratio
Czech Republic	45	43	1.0	0.6
Hungary	59	45	0.8	0.7
Poland	84	31	0.4	1.1
Slovakia	59	46	0.8	0.7
Slovenia	76	70	0.9	1.0
Estonia	67	57	0.9	0.8
Latvia	64	53	0.8	0.8
Lithuania	61	47	0.8	0.8

Note: [1] The US Long Run Marginal Cost, cca. USD 80/MWh for household consumers is taken by EBRD as the benchmark for the transition economies.

Source of data: EBRD 2001

3.6. CONCLUSION

The present chapter has outlined the economic and energy sector reforms in CEE since 1989. While recession has been the key determinant for these economies during this period, all of them have resumed economic growth for a number of years. Energy consumption declined in the first part of this period, and then more or less stayed constant, translating into a decoupling in most of these countries between growth and energy use. While most countries have embarked and are embarking upon ambitious corporate and energy sector restructuring to align their legislation with the EU *acquis*, the pace of reforms and achievements has been diverse. Similarly, the present level and past developments in energy intensities have been diverse.

However, the most important conclusions from the economic and energy sector review are the following. First, due to the high level of energy dependence in these countries, mainly on FSU imports, **the promotion of sustainable energy pathways is a key strategy to enhance energy security in the enlarged EU**. Second, **corporate and energy sector reforms alone will not close the energy intensity gap with the EU-15**; rather, a concerted effort is needed towards further improving energy efficiency level through targeted energy efficiency policies.

PART TWO: ELEMENTS OF SUSTAINABLE ENERGY PATHWAYS: ANALYSIS OF THE VISEGRAD COUNTRIES

4. MEASURES TO CUT ENERGY INTENSITY THROUGH THE IMPROVEMENT OF END-USE EFFICIENCY

It was concluded in the first chapters of this report that even after almost a decade and a half of economic and energy sector transitions, still the key vehicle towards increased energy sustainability in CEE is the improvement of energy intensities. The previous chapters have analysed in detail to what extent energy intensities have improved over the period of transition until today.

The present section will go into detail regarding further possibilities to improve end-use energy efficiency.

4.1. POTENTIALS FOR THE IMPROVEMENT OF ENERGY EFFICIENCY

The high energy intensity levels in the countries of the CEE region discussed above implies that there should be a high potential for the improvement of energy efficiency. Unfortunately, detailed, publicly available studies on end-use energy efficiency potentials, especially those which are still relevant and not outdated, are rare in the region. Perhaps the key reason for this is the **lack of consistently collected end-use energy data**, which makes such research difficult and imprecise. From among the countries in focus, the most comprehensive in scope are the studies the authors were able to identify on the total energy efficiency potential for the Czech republic, prepared in cooperation with the Energy Research Centre of the Netherlands (Maly 1999) and for the Slovak Republic, prepared by Energy Centre Bratislava (ECB 2002a). Other studies cover different sectors only, most commonly housing and industry. Some of them include calculations about the market and achievable potential, but usually only the technical and economical potential is estimated. Unfortunately, the available information about Hungary and Poland is very scarce and out of date, despite the research team's best efforts to obtain data[10].

4.1.1. Total Energy Efficiency Potential

The summary of total energy efficiency potential in the three Visegrád countries about which relevant studies are available is presented in Table 7. In most of the countries energy savings can be achieved by no-cost/low-cost measures such as correct energy management practices. However, there is undoubtedly considerable scope for further savings to be achieved through investment in energy-efficient technologies.

[10] According to a Hungarian Ministry official (Szerdahelyi pers. comm.), the latest study (from 1999) should not be used because it is outdated: and since then the design of energy efficiency action plans and financial support allocations, have been based on back-of-the-envelope style calculations, leaving no documentation behind.

Table 7. Potential for improvement of total energy efficiency as a share of selected indicators

	Czech Republic	**Poland**	**Slovak Republic**
Indicator	End-use energy demand in 2010	Final energy consumption in 1997	Expected end-use energy consumption in 2012
Indicator value	1 129 PJ	N/A	537 PJ
Technical potential	**47.5%**	**26%**	**43.9%**
Economic potential	**21.7%** (d.r. 5%) **18.8%** (d.r. 10)	**18%**	**19.8%** (d.r. 5%)
Market potential	**13.0%** (PBP 3 years) **18.0%** (PBP 6 years)	**12%***	**10.7%** (PBP 4, 5, 7 years**)
Source of data	Maly 1999	OECD 1997	ECB 2002a

d.r. – discount rate, PBP – pay-back period, N/A – no information available.
** achievable potential; ** the pay-back time is as follows: 4 years for households, 5 years for the industrial and private tertiary sectors, 7 years for district heating companies and the public tertiary sector*

The definitions of the potentials used in most of the studies are summarised in Table 23.

There are measures that can be realised at relatively low cost and can lead to a large reduction of energy consumption. In the text below some of the measures that are calculated to be the most economic and energy-saving on the basis of the available studies are discussed. Some of them are summarised in the box on **Individual Measures for Improvement of Energy Efficiency** in Appendix IV.

While comparing the data in Table 7 it should also be taken into account that the figures for Poland claim to be 'conservative', or low, because they are based on old studies (OECD 1997). There exist no publicly available valid data about Hungary.

The **technical potential** for the Czech Republic and Slovakia represents a considerable fraction (over 40%). For the Czech Republic it was calculated that the total investment needed to implement fully the indicated technical potential would be 118 billion Euro, which represents over 200% of the annual Czech GDP in 2001 and 650 % of the state budget (18 billion Euro in 2001). The average relative cost of implementation of energy saving measures is 105 Euro / GJ; it is highest in the transport sector (395 Euro / GJ) and lowest in the industrial sector (77 Euro / GJ) (Maly 1999).

The **economic potential** is about 20% for all three countries. Again, more precise economic estimates are found for the Czech Republic. According to these the total investment needs are only 4 - 6 % of the investment needs calculated for the technical potential, and are equal to roughly 10 % of annual Czech GDP and 33 % of the state budget. If a 10 year realisation period is considered for the economic potential of energy savings, this would require an annual investment of about 1 % of Czech GDP, i.e. 3.3 % of the Czech state budget.

The **market potential** varies for the three countries from 12% to 18%. It is roughly 80% of the economic potential, for the Czech Republic and 50% for Slovakia. For Poland the so-called 'achievable potential' is calculated, which is 12% of the final energy demand. It is based mainly on expert estimates and represents two-thirds of the economic potential. As the majority of Polish heat and electricity is produced from coal (96%) it is estimated in the study that this will lead to about a 12% decrease in CO_2 emissions (OECD 1997). Other calculations about Poland have shown that a potential saving of 15 - 20%, perhaps even 25% on average in all sectors of the economy is a very realistic possibility (Skoczkowski 2001).

Since there is a large potential even for **no-cost measures**, the Czech study also estimated this figure. According to Van Wees et al (2002), **6% of end-use demand can be saved without investment.**

Achieving their energy efficiency potential could significantly lower the energy intensity of these countries. Calculations carried out in the study for Slovakia (ECB 2002a) showed that the realisation of technical potential could lead to a 62% decrease in energy intensity by

2012, and for the economic potential this figure is 50%. Even when the market potential is considered the intensity could be reduced by 44%, which is still very high (ECB 2002a).

4.1.2. Energy Efficiency Potentials by Economic Sector

Opportunities for the reduction of energy consumption vary significantly according to economic sector. There are detailed data about the share of the main economic sectors only for the Czech Republic and Slovakia, which are presented in Table 8. There are also separate studies for the industrial and residential sectors for Poland and Hungary, which are discussed further in the text. The industrial and residential sectors account for a large share of energy efficiency opportunities, and thus these receive special attention in the present study.

Table 8. Potential for energy efficiency improvements as a share of energy consumption (end-use or primary) for the Czech Republic and Slovakia

Potential as % of the indicator[11]	Technical potential		Economic (5% d.r.) potential		Market potential
Sector \ country	Czech Rep.	Slovakia	Czech Rep.	Slovakia	Slovakia
industry	17.4%	18.8%	9.8%	8.1%	4.7%
households	14.5%	11.1%	5.4%	3.9%	1.8%
services	5.7%	5.6%	3.0%	3.4%	1.7%
transport	4.3%	4.5%	2.5%	3.1%	1.4%
municipal energy systems/district heating	4.7%	3.9%	0.6%	1.2%	1.0%
agriculture	0.9%	N/A	0.5%	N/A	N/A
total	**47.5%**	**43.9%**	**21.7%**	**19.8%**	**10.7%**

d.r. – discount rate; N/A- no data available

Sources of data: Maly 1999; ECB 2002b

For all the four countries the ***industrial sector*** is a very energy intensive one. For example Polish industry in 1997 had an energy intensity 3 times higher than the European Union average (Bates 1997). In Poland the structure of the industrial sector is now not significantly different from that of most EU countries, and the prices of industrial products are close to market levels. The high energy intensity must therefore be attributed to technical inefficiencies in the use of energy (Bates 1997).

This explains why the possibilities for improvements are highest in this sector. From Table 8 it can be seen that a reduction of close to 20% of total domestic energy consumption can be achieved if the technical potential is realised in the Czech and Slovak industrial sectors alone. The figure is about 10% if the economic potential is achieved. Industrial sector savings comprise 35% of the total technical potential and 40-45% of the economic potential for the Czech Republic (Maly 1999). For Slovakia the potential in industry is about 40% of technological, economic and market potentials (ECB 2002a).

A study on the energy saving potential in Poland (Wnuk 2002) has shown that the technical potential in industry is also very high: 40–50% of total industrial primary energy consumption. However, only about half of it can be fulfilled economically.

The ***residential sector*** is the second most important when looking at the possibilities for energy efficiency improvements. A decrease of 11 to 15% in total energy consumption can be achieved if the residential technical potential is realised for the Czech Republic and Slovakia (Table 8). In the Czech Republic the technical potential in the residential sector accounts for 30% of the total national technical potential and 25 to 28% of the economic potential (Maly 1999). If the technical potential is reached in this country there will be a decrease of 65% of

[11] *For the Czech Republic the indicator is primary energy use in the period 1995-2010 and for Slovakia end-use energy consumption in 2012.*

the expected primary energy use in households. The economic potential will lead to a decline which represents half of the reduction under the technical potential. The study for Slovakia estimates an almost equal (25 and 20%) technical and economic potential, respectively, for improvements in the residential sector (ECB 2002a). Achieving this potential would lead to a smaller decease of the expected consumption of the sector in 2012 – or 45% upon the realisation of the technological potential and 17% for the economic potential (ECB 2002a).

A study financed by the World Bank for Poland (OBRIGE *et al.* 2001) calculates that if the technical potential is realised, primary energy consumption for residential heating in 2010 could be 30% less.

The residential sector in Hungary also offers opportunities for energy efficiency improvements. In the study of GKI-EGI (Economic Research Institute Rt. and EGI) from 1998 two scenarios were considered. One of them includes retrofit type measures, while the other one focuses on replacement strategies. Maximum savings of 45% of the total energy demand of the sector or 13.4% of national energy demand could be achieved if replacements with a payback time of more than 10 years are realised. Within both of these scenarios there is scope for highly cost-effective measures which are rather similar for the two scenarios. Implementation of these measures would result in 10% savings of total energy demand in the sector at the cost of 2% of the total considered investment for the retrofit scenario and 11% savings of the total energy demand of the sector at the cost of 2% of the total considered investment for the replacement scenario.

In summary, the greatest potentials lie in the residential and the industrial sectors. However, progress in the reduction of energy intensities in these sectors has followed very different pathways in the four studied countries. While Hungary has made remarkable progress in the reduction of its industrial energy intensity, Poland and Slovakia have developed little in this sector (Cornillie and Frankhauser 2002) (for more information see Section 3.4.). By contrast, Hungary has made very little progress in the rest of the economy to decrease energy intensities as discussed above, while Poland has achieved a reduction of over 20% in this field for at least four consecutive years (1995-1998). Thus, Poland should start tackling the efficiency opportunities in its industrial sector, while Hungary may need to focus on the other sectors of its economy now to capture further efficiency potentials.

A Box with a selection of recommended individual energy efficiency measures and their economic implications is included in Appendix IV.

4.2. ENERGY EFFICIENCY POLICY IN CEE

It is clear from the discussion of cost-effective energy efficiency potentials above that energy efficiency should be a key priority for CEE governments. In addition to the untapped profitable investment opportunities, EE can deliver several other crucial benefits for these economies. Increasing EE improves general economic efficiency and therefore competitiveness. Reducing energy bills through the improvement of EE can compensate for some of the burden of drastic energy tariff hikes causing severe social problems in some countries. EE can and has caused the decoupling of growth and energy demand, therefore eliminating the need for increased energy imports, and capital-intensive capacity expansions, releasing badly needed capital for other important investments. Since energy imports constitute a heavy burden on export/import balances, reduced needs for energy imports will improve foreign account deficits as well as improving the political sovereignty of some highly energy-import dependent countries. Finally, improving EE (both on the supply and the demand sides) is the most effective method of energy-related environmental pollution control.

The improvement of energy efficiency has already been recognised among the key priorities in the energy policies of CEE countries since the fall of communism (Hungary: Government resolution 21/1993; (IEA/OECD 1995, 1997; IEA 1994, 1995). However, for a long time this goal remained largely at the rhetorical level rather than moving to the level of action. The accession process has provided an important impetus towards the translation of strategic goals in energy efficiency into real government actions, i.e. concrete policy tools, action programs, and earmarked funds.

Some countries have adopted ambitious targets to close the energy intensity gap with the EU. For instance, Slovenia adopted a program in 1996 aiming at improving energy efficiency by 2% annually (IEA 2003a). Hungary has indicated a target of a 7-8% reduction in energy consumption per year until 2010 (IEA 2003b) in its Energy Saving Action Programme of 1999, requiring a 3.5% annual reduction in energy intensity (Energy Charter Secretariat 2003).

Table 22 reviews the presently (Spring 2003) applied main policy instruments affecting energy efficiency in the Visegrád countries. As demonstrated by the table, the countries mainly have the instruments in place that are required by the *acquis* and further measures are exceptional: recently most countries are focusing their efforts on measures required by the *acquis* (Energy Charter Secretariat 2003). Despite this effort, the *European Commission has evaluated the progress of* **the Czech Republic, Poland, Romania and Slovakia** *as* ***unsatisfactory*** *in the field of improving energy efficiency* (Energy Charter Secretariat 2003).

However, there are a few examples of good practice in individual energy efficiency initiatives taken by governments. For instance, the *Czech Republic* has **an energy audit obligation** for establishments above a certain size and an *obligation to implement low-cost recommended measures*; it also presently allows tax reductions for energy efficient goods and services (unfortunately this will have to cease after EU accession). *Poland* has an **excise tax on electricity**; and the Energy Law allows energy companies to include the costs of end-use energy efficiency measures in tariffs (Energy Charter Secretariat 2003). The *Slovak Republic* has **energy efficiency provisions in its public procurement laws**. The problematic areas are the universal lack of utility demand-side management programs (DSM) – these used to exist until liberalisation but were discontinued recently in all countries; the absence of energy efficiency provisions in public procurement; the lack of or obsolete energy efficiency standards (IEA 2003b, 2002a); and the lack of funding for energy efficiency related research and development (while there are large sums cited in Table 22, these amounts are typically directed at supporting the realisation of actual projects rather than any research or real development). For instance, Hungary adopted very strict mandatory building codes in 1992, comparable to the strictest standards in the EU, but enforcement and quality control are lacking. As standards were not respected, the government made these standards voluntary in 1994 (IEA 2003b).

While the table suggests a picture which is quite supportive of energy efficiency improvements, the reality is often different due to poor implementation (such as appliance labelling in Poland, as found by Soehl (2002); lack of enforcement (IEA 2003b; Energy Charter Secretariat 2001); outdated specifications (such as the Hungarian building codes); and the lack of funds assigned for the implementation of the programs and policies (such as the Czech auditing obligation) (IEA 2003a).

General problems with energy efficiency (EE) policy-making in the CEE region. (as with renewable energy policy, described below) are:

- a general lack of real political commitment towards EE: EE is still lower on the priority lists of governmental agendas than supply-oriented policies (often conflicting with EE interests)
- the fragmentation of EE policy-making among several institutions
- lack of coordination between different institutional actors

- lack of sufficient resources and capacity for the energy efficiency agencies (for example Polish Kape has a staff of 20 to cover 39 million inhabitants compared to 500 at the Dutch Novem for 16 million inhabitants) (Bergasse pers. comm.)
- lack of integration of EE priorities into sectoral policies
- lack of research and development in EE. Most CEE countries have closed or sold their energy-related research institutions (such as EGI in Hungary), and currently there is extremely limited capacity for research supporting the design of energy policy-making in the field. In addition, support for EE research has been minimal.
- End-use data collection and statistical reporting is limited
- Access to existing data and information is constrained.

Specific problems with energy efficiency policy include the following concerns:

- Energy efficiency standards are non-existent or obsolete, and are often not enforced (IEA 2003b, 2002a)
- The tax regimes of some countries do not create a level playing field for economic competition between energy efficiency investments and supply (i.e. taxes favour supply purchases as opposed to efficiency investments). The worst case for this is Hungary with a 13% disparity in VAT rates between supply (electricity and gas) and efficiency equipment and services.
- Voluntary agreements are uncommon in CEE countries (Energy Charter Secretariat 2003), even though they could relieve some of the burden from cash-strapped governments in the implementation of energy efficiency. This may be the result of a general lack of a tradition in markets and therefore market-based instruments. Since cultural changes have a large momentum and may require generational changes in the corporate elite, such tools may take longer to be become integral parts of energy efficiency instruments.

Case Study: The success of ESCOs in Hungary

While regulation-based energy efficiency policies limp behind those in EU countries, and there is a general lack of traditions in market-based instruments in former communist countries, in one market-based EE “instrument” CEE countries have excelled, outperforming most EU countries: energy service companies (ESCOs). The most successful case is Hungary, where the flourishing of the ESCO industry has been celebrated internationally (at the First International Conference on ESCOs, Milan, 2003). Presently there are approximately two dozen companies specializing in the provision of energy services in Hungary, with another 200 companies engaging in some activities in this field (Ürge-Vorsatz and Langlois 2003). Most ESCO activities are concentrated in the public sector, with some recent projects starting in the industrial sector as well (thus the residential sector’s energy efficiency potentials cannot be expected to be captured through this “instrument”.) Typical projects target public lighting, combined heat and power, and district heating. Ürge-Vorsatz and Langois (2003), and EGI (Ürge-Vorsatz and Langlois 2003) have analysed the key reasons for this success. While EGI identifies a variety of reasons which are country- and context-specific, such as the large and sudden increases in fuel oil prices combined with the gas-sector privatisation which made fuel switching in old DH boilers very attractive, there are also important contributing factors that can be duplicated over the region. Such factors include the early and extensive bank sector and energy sector reforms, including price reforms, the important spin-off effect of a few large-scale multilaterally supported ESCO development projects; the significant budgetary and legal autonomies of cities allowing ESCOs to enter into performance contracts directly with public institutions; the favourable feed-in tariffs for CHP; state support schemes for ESCOs and third-party financing; and the partial liberalization of price heat (using a price cap formula), which provided a strong incentive to operators to reduce their costs.

4.3. OPPORTUNITIES AND RECOMMENDATIONS IN ENERGY EFFICIENCY POLICY

It has been demonstrated that there remains significant cost-effective energy efficiency potentials in the region even after over 13 years of restructuring in this field. The greatest potential lies in the industrial and residential sectors. To achieve the technical potential significant investment is needed. The realisation of the market or achievable potential could lead to a substantial decrease in the energy consumption and energy intensity of the countries in focus. However, the design of well-targeted policies requires reliable assessments of end-use efficiency potentials and costs, which, in turn, relies on detailed end-use data collection. Therefore, in order to make sure that these countries distribute their taxpayers' money in the most cost-effective manner to promote energy efficiency, efforts should be made to ensure more detailed end-use data collection and reporting, and investment is required in detailed and up-to-date studies on potentials and costs. It has to be acknowledged that the Visegrád countries have all made significant progress towards improvement of energy intensities in terms of pricing reforms, energy sector restructuring, establishing institutional structures for energy efficiency, and introducing various energy efficiency policies and programs. However, the capturing of the remaining potentials are still inhibited by major barriers, some of which are region-specific.

Beyond the barriers, however, there are also several **opportunities** for improving energy efficiency in the region. First, **EU accession** provides stricter criteria for energy efficiency standards, labelling, and building codes; and new incoming and planned directives (the emissions trading directive, the buildings directive, the energy services directive, etc.) will further promote energy efficiency. Another potential engine of further energy efficiency improvements may be **Joint Implementation** under the Kyoto Protocol (see later in this report for the expected impacts of JI). While the liberalisation of energy markets typically does not favour energy efficiency activities of market actors, there may be some exceptions to this in CEE countries. For example, in Hungary utilities reacted to the coming market opening by establishing ESCO-type daughter companies concentrating on offering energy services to increase their market share and to capture further customers. It is also anticipated that Hungary will see more value-added services offered by deregulated Hungarian suppliers than by their counterparts in the EU, since there is not so much room for price-based competition. This may favour energy efficiency services.

Since it is going to be extremely difficult to introduce any further taxes or levies placed on energy to finance energy efficiency (or renewables) in the short term due to the recent drastic increases in energy prices, and since these countries all face strong budgetary constraints, **market-based instruments** which can deliver savings in energy consumption should receive much attention in the CEE region as a way to foster sustainable energy pathways. However, introducing market-based policy mechanisms is not going to be easy in the region. First, there is little tradition in market-based mechanisms, and most of the corporate elite in energy-intensive industry and the energy sector has been working for decades under command-and-control approaches, and thus is sceptical about market-based environmental policy tools. Second, such instruments also need adequate and elaborate regulatory frameworks providing multiple pillars, such as the one in Hungary favouring ESCO businesses. It should also be mentioned that there are some general concerns about the viability of market-based instruments in the CEE region.

In general, **ESCOs** provide a unique opportunity for capturing energy efficiency potentials in these budget-constrained countries with high cost-effective energy efficiency potentials. However, as emphasised above, the flourishing of the ESCO industry needs a large number of conditions which countries must first establish.

These countries should also consider the introduction of **white certificates**, or tradable energy efficiency certificates with EE obligations.

While much of the regulatory, price and sectoral reforms in the examined countries have been completed (or are close to being completed), vertically integrated, large utilities still constrain the proliferation of EE. In order to prevent a conflict of interest related to the promotion of EE, **vertical unbundling** of utilities should not only be mandated by bookkeeping, but preferably by legal separation. The new electricity Directive will have an important impact in this direction.

However, before the introduction of new instruments, it is crucial that governments place a real priority on energy efficiency (even when this is contrary to supply development). Without real **political commitment** no policies, instruments or programs will achieve their intended impact. While many of the studied countries have ambitious objectives to reach EU energy intensity levels, and ambitious action programs, the **resources allocated** are often largely **insufficient** to reach these ambitious objectives (Energy Charter Secretariat 1999): "*energy efficiency in EITs suffers from an imbalance between a large energy saving potential and insufficient resources allocated to policies to reach the objectives"* (IEA 2003a). The PEEREA process recommends for several countries to develop an energy efficiency strategy and action plan with well-defined, general and specific objectives (Energy Charter Secretariat 2001, 2000, 1999).

A fragmented approach to energy efficiency policy has always proven to be less effective than an integrated, comprehensive policy framework in which energy efficiency policies are **integrated into sectoral policies** (IEA 2003a), as well as with other economic, social and environmental goals (Energy Charter Secretariat 2003). Well-defined **sectoral targets** are needed in line with national energy efficiency targets (Energy Charter Secretariat 2000).

Beyond national level strategies, it is important for countries to place an emphasis on **regional and municipal level energy efficiency strategies**. Good practices in municipal strategy development and practices have been demonstrated in Hungary, Poland, Bulgaria and Romania, although significant further progress is needed (Energy Charter Secretariat 2003).

Since policies cannot be efficiently designed without an understanding of the situation, more detailed data collection and **statistical reporting** on energy consumption should be implemented (Energy Charter Secretariat 2000), and **energy efficiency indicators** should regularly be developed and monitored (Energy Charter Secretariat 2003). Open, public access (such as via the internet) to these data and information should be ensured. Greater emphasis should be placed on EE-related **research** (and development, although this may not be as crucial) through support programs (Energy Charter Secretariat 2000) and re-establishing some of the related research capacities.

While, as opposed to the EU, much of the CEE population has a strong interest and motivation to conserve energy, most people do not know how to (they lived much of their lives in a highly subsidised energy era without incentives to conserve). EE is also not taught much to those who would be well-placed to implement it. For instance, while passive solar construction had strong traditions in much of the region even a few decades ago, by today most basic architecture curricula do not include a mention of passive solar features. Therefore, **public and specialist education** should both be strengthened in the EE field.

5. EFFICIENCY OF ENERGY PRODUCTION

The power generation sector is very important in terms of achieving a more rational use of natural resources, a reduction of emissions and pollution, and for improvement of the social services it provides. The change from planned to market economies in the CEE countries led to changes in energy usage by the different economic sectors. The stricter environmental standards and economic considerations about the profitability of enterprises resulted in a need to improve technologies in energy production. The efficient utilisation of fuel depends in large part on the technologies applied and the equipment used. The reduction of exhaust gases at large combustion plants can be obtained by retrofitting with flue gas desulphurisation (FGD) equipment and technical installations such as selected catalytic reduction (SCR) for reducing NOx emissions. However, by retrofitting with FGD and SCR systems and by modernising existing power plants, **the efficiency of the combustion process will be diminished**. In the following subchapter the efficiency of power generation from fossil fuels in the Visegrád four will be discussed.

5.1. TRENDS IN THE EFFICIENCY OF ELECTRICITY PRODUCTION

The efficiency from fossil fuelled power plants in Western Europe in 1999 was about 40%, while in Eastern Europe the figure was much lower – about 30 % (EEA 2003). This difference is significant, which is why the issue demands special attention.

The results obtained from calculations of efficiency based on IEA data (IEA 2002b) are displayed in Figure 6 [12]. The efficiency in the three countries considered is above the average calculated by EEA for the CEE region. In fact in the case of Slovakia it reached the Western European average at the end of the nineties. This is most probably due to modernisation of the Slovak power plant, the small percentage of fossil fuels used in power generation in Slovakia, and the fact that there are only a few large power plants that can easily be modernised. Efficiency improved from 33% to almost 39% in ten years (between 1990 and 2000). Improvements were made in Hungary as well but for the Czech Republic there has been a step backwards compared to the efficiency level in 1980 and only a slight increase since 1990.

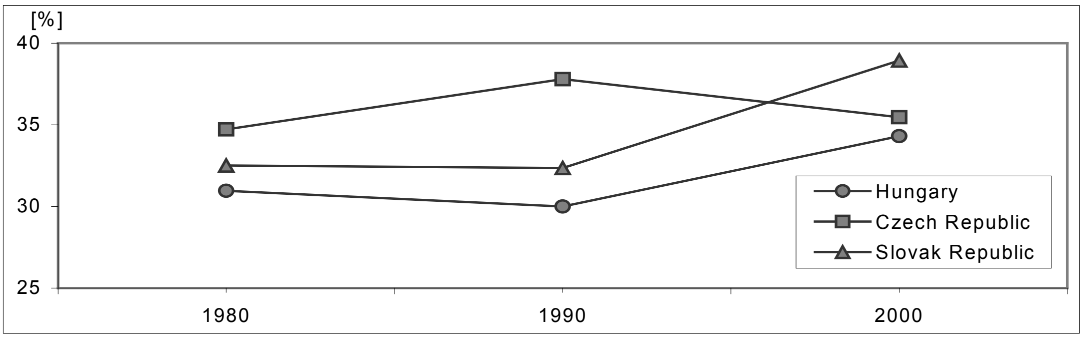

Figure 6. Efficiency of power plants in Hungary, the Czech Republic and Slovakia

Source of data: IEA 2002b

Concerning the total efficiency of CHP units the IEA data (IEA 2002b) shows considerable variations, between 50% and 80% in the Czech Republic, Hungary and Poland. These figures suggest that there is significant scope for improvement of the efficiency of CHP, although it is already much higher than that of the conventional power plants.

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[12] In the present section the efficiency of electricity produced from fossil fuels of three countries – Hungary, the Czech Republic and Slovakia, is studied. Poland is not included because there is no statistical data about its power plants in the IEA publication used (IEA 2002b).

5.2. DEVELOPMENTS AND FURTHER POTENTIALS IN CHP AND DH

5.2.1. Combined heat and power (CHP) generation

Using CHP units for production of energy can be very environmentally benign because of the high efficiency of CHP units compared to conventional ones and the lower emissions, especially when natural gas is used as a fuel. The environmental benefits of CHP technologies are appreciated by the European Commission, which has set a targets of 18% of the electricity in the EU to be produced using the CHP mode by 2010 (ESD *et al.* 2001). In 2000 CHP accounted for only 12% of the electricity generated within the EU borders (ESD *et al.* 2001), whereas in CEE countries CHP represented a substantial part of the electricity produced by industry and by district heating plants during the Communist period. In 2000 it accounted for 19% of electricity production in the ten CEE countries[13]. However it should to be mentioned that some of the units are obsolete, coal-fuelled, and not as efficient as in the Western countries (Euroheat&Power 2001; Gochenour 2001).

Share of CHP in Total Energy Production, Installed CHP Capacity and Fuel Mix

In Table 6 the share of CHP in total heat and electricity production for the four countries in focus is presented. It can be seen from it that in the Czech Republic and Hungary CHP technologies are widely used for heat production. For these two countries about 70% of the total heat was produced using CHP in 2000. For Poland this figure was about 60% in 2000 and for Slovakia only 27% (in 1996). While large-scale CHP plants still dominate in the four Visegrád countries, the small-scale cogeneration units are growing in number (van Wees 2000a, Mikula pers. comm., Sigmond 2003).

Share of CHP in the total:	Czech Republic	Hungary	Poland	Slovakia
CHP installed capacities [MWe]	3,900	960	7,900	1,130
Heat production	74.5%	67.6%	48.9%	27%
Electricity production	27.1%	13.6%	15.5%	15.7%

Table 9 Share of CHP in the total energy production and installed CHP capacity in the Visegrád countries in 2000[14]

Sources of data: IEA 2002c, 2002d; Mikula pers. comm.; ISPE *et al.* 2003; Europrog 2001

CHP plants also play an important role in electricity production in the countries studied (see Table 9 above). In 2000 the Czech Republic had the highest share (27%) of electricity produced in CHP mode of the four Visegrád countries, while Hungary had the lowest share.

The environmental benefits of CHP production can be undermined when the units are obsolete and consequently of low efficiency, or are pollutive because coal is predominantly used. Figure 7 demonstrates the high dependence on coal in CHP production especially in the Czech Republic and Poland where coal-fired CHP units in 2000 represented 79% and 97%, respectively, of total installed CHP capacity (Europrog 2001). The share of coal in CHP capacity is expected to decline by 27% in Poland by 2010 and by 6% in the Czech Republic (Europrog 2001). In Hungary natural gas is the major fuel in the CHP units (78% of installed capacity in 2000). The share of natural gas fired units is expected to increase in the three countries (Europrog 2001). In Poland it is expected to reach 30% of total installed CHP capacity, replacing some of the old coal-fired plants by 2010. This increase will be fostered

[13] The 10 CEE countries studied in ESD *et al.* (2001) report are: Bulgaria, the Czech Republic, Estonia, Hungary, Latvia Lithuania, Poland, Romania, Slovakia and Slovenia.
[14] For Slovakia the data is for 1996

by completing the construction of two pipelines – one from Russia via Poland to Western Europe and another from Norway to Poland (Baniak 2003).

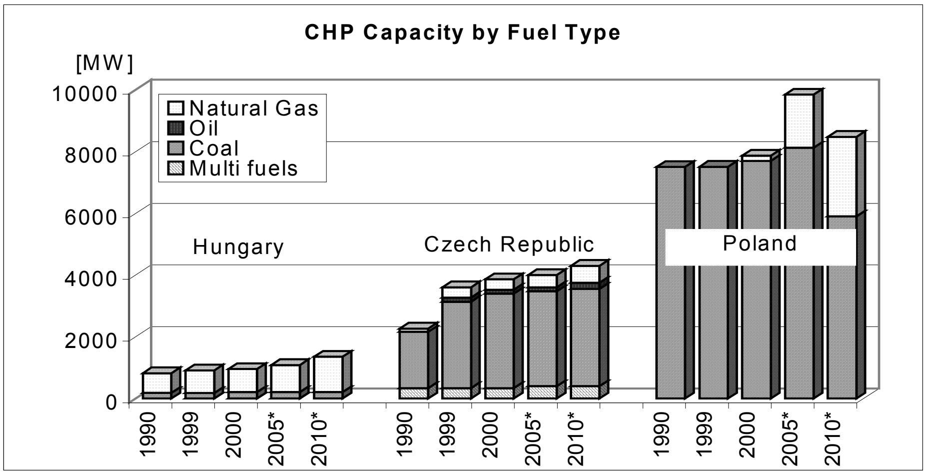

Figure 7. CHP capacity by fuel type
* potential capacity
Source of data: Europrog 2001

Potential for Growth in the CHP Sector

A comprehensive evaluation of the future prospects of CHP technologies was made in two projects - 'future cogen' and 'Prochp' (ESD *et al.* 2001, ISPE *et al.* 2003), under the SAVE Program of the EU[15]. The two studies demonstrate that there is significant potential for the introduction of CHP technologies in the four Visegrád countries. Realisation of this potential depends a lot on national policies and the present situation in the energy markets. For example in the Czech Republic the introduction of new CHP units is promoted by legislation but there is large over-capacity in the power generating system which may lead to a decrease in the energy price and elimination of the independent power producers (ISPE *et al.* 2003). The government has promoted an increase in their number but they are incompatible with the dominant producer CEZ a.s (ISPE *et al.* 2003). In Hungary the change in the Electricity Act in 2003 provides better opportunities for CHP units (Sigmond pers. comm.). Unfortunately, the law favours more the introduction of natural gas engines than big combined cycle gas turbines (CCGT) because of the specified efficiency of 65% which cannot be achieved by CCGT in the hot months of the year (Sigmond pers. comm.). In Hungary there are also still market distortions resulting from price regulation and cross-financing among the different users.

In Poland the strict environmental legislation, which sets high taxes for emissions of a number of pollutant gases and encourages cleaner technologies, favours the introduction of CHP technologies (ISPE *et al.* 2003). At the present moment the low availability of natural gas is one of the main hindrances to the introduction of CCGT (ISPE *et al.* 2003). This problem can be overcome in the near future by completing the two projects for natural gas pipelines connecting the country with Norwegian and Russian natural gas reserves. Low electricity prices and overcapacity in the system are another obstacle for CHP in Poland as well as in Slovakia (ISPE *et al.* 2003). In Slovakia in the present macroeconomic situation selling electricity to the grid is not profitable, so CHP units are feasible only for autoproducers' needs (ISPE *et al.* 2003).

Based on the present policies and macroeconomic conditions the 'Prochp' study (ISPE *et al.* 2003) has made calculations concerning the most probable scenario (from among four

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[15] The results obtained for the CHP potential in Poland, Czech Republic, Hungary and Slovakia from these two studies are presented in Figure 17, Annex IV.

scenarios used in the 'future cogen study') (ESD *et al.* 2001) for development of CHP technologies in the Czech Republic, Poland and Slovakia. Among them cogeneration in Poland is expected to be very promising (or in line with the *Heightened Environmental Awareness scenario*, which is the next best after the best – Post Kyoto scenario) (ISPE *et al.* 2003). For Slovakia the development of CHP capacity between the *Present Policies* and *Deregulated Liberalisation Scenarios* (which are the third and the worst case scenarios respectively) is believed to be most probable. The future for CHP technologies is not very promising in the Czech Republic either where the *Deregulated Liberalisation Scenario* is considered to be most probable (ISPE *et al.* 2003).

CHP Summary

The EU target is 18% of electricity to be produced in CHP mode by 2010 (EC 1997), while in the CEE region CHP electricity already constituted 19% in 2001 (ESD *et al.* 2001). This percentage is very promising at present but efforts should be devoted to at least retaining this figure in the future. Among the countries of the Visegrád group the largest share of electricity from CHP plants in total electricity generation is produced in the Czech Republic (about 27%) and the smallest in Hungary (about 14%) (IEA 2002c and 2002d). The share of heat from CHP units in total heat produced is also very high for the four countries, ranging from about 50 to 80%. The Czech Republic and Hungary have the highest and Poland the lowest CHP share in heat production. In recent years public plants have dominated over autoproducers in all countries in focus except Slovakia, for which there is no data. Thus small-scale cogeneration for industrial and residential needs has been flourishing in recent years in the Czech Republic, Hungary and Poland (van Wees 2000a; Sigmond 2002; Bursik 2003).

Combined cycle gas turbines (CCGT) are starting to penetrate into energy markets but still represent a very small percentage of total CHP capacity in the countries in focus, with the exception of Hungary. According to ISPE *et al.* (2003), Poland does not have any CCGT units at all.

Even though the share of CHP is high in the CEE region, special measures should be taken to ensure its survival and further development in liberalised market conditions. At the present moment, policies regulating the CHP sector exist in the four countries in focus, but this does not automatically mean that they successfully promote CHP technologies. Existing regulations obliging distribution companies to buy electricity from CHP units above a certain capacity limit exist in all four countries, but in the Czech Republic and Slovakia this obligation can be avoided on grounds of technical feasibility (ISPE *et al.* 2003). Only in the Czech Republic are there compulsory audits, which should assist in the penetration of CHP technologies, but there are no special funds for their implementation (ISPE *et al.* 2003).

Another powerful economic instrument for the support of the introduction of CHP technologies are the **feed-in tariffs**. Of the four Visegrád countries, they exist for CHP *de facto* only in the Czech Republic and Hungary (ISPE *et al.* 2003; Sigmond 2002). Their positive effect can be identified by the rapid increase in small-scale CHP units in recent years in these two countries (van Wees 2000a; Sigmond 2002).

The potential for the future development of CHP has been studied thoroughly in two projects – 'future cogen' and 'Prochp' (ESD *et al.* 2000; ISPE *et al.* 2003). According to the first of these, the potential is highest when the Kyoto mechanisms for promotion of less carbon intensive technologies are applied. By contrast, the liberalisation of the markets without special attention to CHP might lead to a serious stagnation of its market share. The 'Prochp' study (ISPE *et al.* 2003) is very optimistic about the future of cogeneration in Poland, which is very much influenced by the forecast increase of the share of natural gas in the fuel mix and the present strict environmental legislation. The overcapacity in the Czech energy sector might impede the future increase of CHP capacity and its share might stay at the 2000 level. In the 'Prochp' project the future of cogeneration in Slovakia is also seen to be not very promising.

During the elaboration of the present study it has been found that the statistical data is incomplete and ambiguous. Leading organisations in the energy field, like the International Energy Agency, Europrog and Cogen, present different figures for the same indicators and years. The task of aggregating and making conclusions for this data is further complicated by the fact that in most cases they are also quite old.

5.2.2. District heating (DH)

District heating was very well developed in the countries of the CEE region in the communist period. Most of the multifamily apartment buildings were centrally supplied by large-scale district heating plants or CHP plants. After the changes the demand for total energy in general has fallen, as has been discussed earlier in the report. These two factors led to a very limited possibility for growth in the district heating sector in the CEE countries (ESD *et al.* 2001). At the same time, obsolete equipment, high production and distribution losses, and pollution of the environment leave significant potential for energy efficiency improvements in this field.

Share of DH in Heat Production

Data about the share of district heating in total heat production is presented in Figure 8. It has a significant market share in most of the countries of the region, reaching more than 50% of the households in 1999 in Latvia, Lithuania, Poland and Estonia. In Latvia it is the dominant way of heating, with a 70% share. Among the EU countries the figures are lower with the highest percentage (51%), being achieved in Denmark (Constantinescu 2002). This fact shows both the importance of the DH sector in the countries of the CEE region, and the opportunities for improvement in the environment in the cities by promoting more efficient and cleaner heat production in the DH utilities.

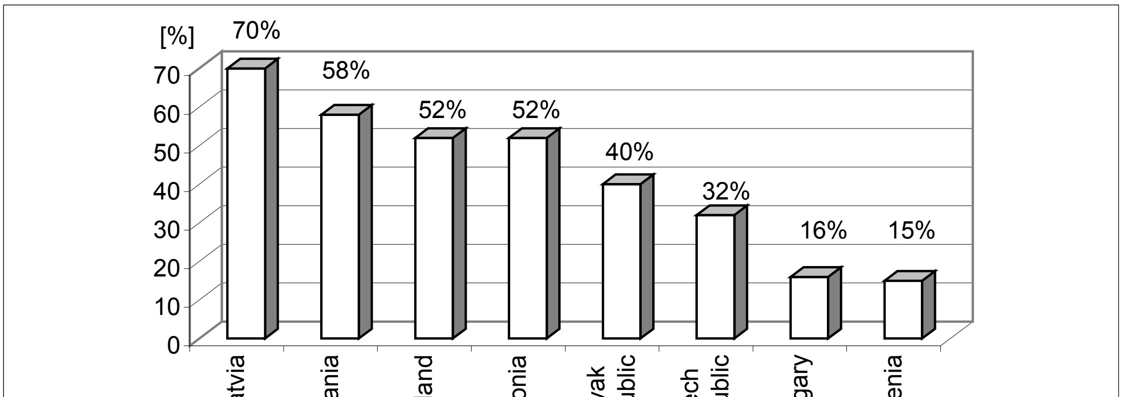

Figure 8. Share of households connected to the district heating network in 1999 in the eight post-socialist accession countries

Sources of data: Cherubin 2003; Euroheat&Power 2001

Data for 1999 for the four Visegrád countries show that in Poland the district heating network is the most developed (Cherubin 2003). It represented 52% of the households in the country in 1999 (Cherubin 2003) and 70% of urban households (Marecki *et al.* 1998). The majority of the DH installations (80%) operate on coal (Euroheat&Power 2001), which has led to a number of negative environmental consequences, especially in the big towns. Second in terms of the share of district heating among the investigated countries is the Slovak Republic with 40% (Cherubin 2003), of which 80% is in the cities (ECB 2002b). The majority of the plants use more environmentally benign natural gas (58%) (Euroheat&Power 2001). Coal is used for about 30% of generation capacity. In the Czech Republic the share of district heating is even smaller - about 30%, and the units operate predominantly on coal (68%) (Cherubin 2003; Euroheat&Power 2001). Other fuels used are natural gas (30%), oil and renewables. In Hungary DH fulfils only 16% of the heat demand of households. In 1999 natural gas was the predominant fuel, with a share of 66%, followed by coal (19%), oil (11%) and renewables (4%) (Euroheat&Power 2001).

Share of CHP in DH

District heating units operating in cogeneration mode can offer more efficient utilisation of the fuel than heat-only boilers (HOB), which explains why CHP units are penetrating increasingly into the EU markets (Euroheat&Power 2001). According to data from Euroheat&Power (2001), in countries like Austria, Denmark, Finland, Germany and the Netherlands, from 68 to 90% of heat is produced in CHP plants, while in Greece it is almost 100%. Although cogeneration has been used since the middle of the twentieth century in the countries of the CEE region, its share is currently not as impressive as in the above-mentioned countries (Constantinescu 2002). Of the four Visegrád countries there is data available only for Poland and Slovakia, which show that about half of district heat is produced in CHP mode (Constantinescu 2002; Euroheat&Power 2001). It is very difficult to obtain exact figures for the other CEE countries[16].

Age of Units in DH

Throughout the CEE region the district heating generation capacity is very old, which causes problems of efficiency, high maintenance expenses and unreliable supply (ESD *et al.* 2001; Gochenour 2001; Brendow 2003). According to data from the Polish Energy Regulation Office (URE 2002), half of the water heating boilers in the CHP units in Poland are between 15 and 24 years old. Another 20% are 25 to 44 years old and only 30% are less than 5 years old. For the Czech Republic data is not so detailed but it is acknowledged that the generation and distribution systems are generally 30 to 60 years old (Maly 2002). Modernisation of some plants was carried out in the 1990s when new large-scale coal fired DH plants were also constructed. The cost of heat production from coal-fired CHP for district heating is lower than that for gas-fired ones. These two facts significantly limit the opportunities for penetration of gas-fuelled plants in the Czech Republic (Maly 2002).

In the Slovak Republic about 90% of the boilers use old technology when producing warm water for distribution to the customers and have an economic life of only 8 years (Sigmond pers. comm.; ECB 2002b). According to the Energy Centre Bratislava (2002b) half of the boilers are more than 10 years old and 16% of them are more than 20 years old. The remaining 10% of the total stock consist of hot-water and steam-boilers, half of which have also passed their economical life of 18 years (ECB 2002b).

Efficiency of Heat Production in DH

Heat for district heating purposes can be produced by heat only boilers (HOB) which generate only heat or by combined heat and power (CHP) units which generate heat and power simultaneously. As mentioned above, the second type has a higher total efficiency. The efficiency of heat production of CHP installations in the CEE region as a whole is 70-

[16] This is due to the fact that district heating entities sell heat not only to households but also for industrial purposes, but this division is not included in the statistical data of the International Energy Agency used in the present study. Considering this, the share of CHP in total heat production (and not in DH), is analysed in detail in section 5.2.1 above.

75% for CHP and 60-80% for HOB, which is lower than has been achieved in Western countries (80-90% for CHP and 90% for HOB) (Gochenour 2001). In general for the countries of the CEE region the overall heat losses are 3-5 times higher, while water losses are 5 to 40 times higher (Gochenour 2001). When considering the annual efficiency of boilers, 50% of them are less efficient than projected, resulting in about 2% losses for the heat produced. The decrease in efficiency is reported to be due to improper fuel mixture, exploitation and overcapacity arising from decreased energy demand and an increased number of disconnections (ECB 2002b).

DH Summary

District heating provides heat to a considerable proportion of households in the countries of the Visegrád group (from 16% to 51%), which provides good grounds for further increasing of the share of this more environmentally benign way of heating. Unfortunately, the available data about the share of cogeneration in DH shows that it is not very high. Some of the countries (Poland and the Czech Republic) rely on coal as a major fuel for district heating purposes, which requires more robust emissions control technologies and creates higher CO_2 emissions per unit of heat produced than natural gas. Various studies have shown that the equipment used for district heating purposes in the CEE region is rather obsolete and needs modification or replacement. As a result of this the efficiency is lower than in Western countries.

The lack of a strategic long-term approach and the failure to integrate the district heating sector into energy policies hinders their adaptation to market conditions in two ways. First, the investment climate is not encouraging and, second, other energy sectors (such as natural gas) are encouraged by price regulations. There is only one country of the four in focus (Hungary) with a special DH law.

5.3. STATUS AND DEVELOPMENT OF POWER GENERATION FROM COAL

5.3.1. Existing Capacity and Age Structure

The high dependence on coal has already been discussed above (Section 3.2. above). Table 19 in Appendix IV shows the installed capacity and the share of coal-fuelled plants for 2000 in the Visegrád four countries. It confirms once again the fact that Poland and the Czech Republic have the highest share of coal in their electricity generating system. Brown coal accounts for one quarter of power production in Poland and Hungary and about half in the Czech Republic, affecting the environment in a negative way.

Most of the units are obsolete and need modernisation or replacement, as can be seen from Figure 9, in which the coal fired units are presented in accordance to their commissioning year[17].

[17] The available data for Poland and Hungary is from 1996 (SEI 1996). For the Czech Republic (DOE 2003c) and Slovakia (ISPE *et al.* 2003) the data is for 2002.

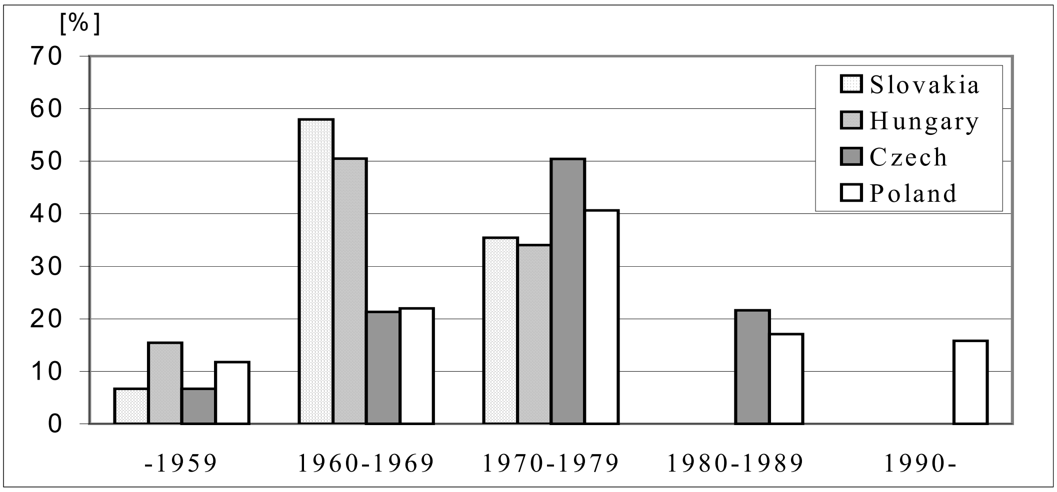

Figure 9. Age structure of units operating in the coal power plants
Source of data: Jedovski 2002; SEI 1996, SKODA Praha a.s. 2003; Istroenergogroup a.s. *et al.* 2003; DOE 2003a,b,c and d

The majority of the coal-fuelled power generating units were commissioned between the 1960s and 1980s, though some were commissioned as long ago as the 1920s. In Hungary and Slovakia more than 50% of the coal-fuelled power plants were built in the 60s. Only Poland has introduced new coal power plants since 1990 (Opel 1, commissioned in 1992 and Opel 2 to 6, commissioned in 1996) (SEI 1996).

The process of modernisation has already been started in the four countries, with the introduction of clean technologies to a number of coal power plants. This is discussed in more detail in the next section.

5.3.2. Introduction of Clean Technologies

The need for a less polluted and healthy environment, the introduction of stricter environmental legislation than during the Communist period and the requirements of the EU for transposing its Directives (particularly the Large Combustion Plants Directive) have driven the process of retrofitting and replacement of the most polluting power units in the four countries in focus. The available information for the units equipped with a fluidised bed combustion (FBC) chamber and flue gas desulphurisation (FGD) technologies is collected in Table 10[18].

[18] For Poland and Hungary the data for the FBC and FGD data is from 2003, and for Slovakia and the Czech Republic from 2001.

Table 10. Share of units equipped with fluidised bed combustion (FBC) chamber and flue gas desulphurisation (FGD) units from the total coal-fuelled capacity in 2003 and 1999 in the Visegrád countries

	Poland		***Czech Republic***[19]		***Hungary***		***Slovak Republic***[20]	
	MWe	% of (1)	MWe	% of (1)	MWe	% of (1)	MWe	% of (1)
Total coal-fuelled capacities in 2003 (1)	26439	100%	7910	100%	1852	100%	1358	100%
FBC units (2)	600	**2.3%**	522	**6.6%**	102	**5%**	317	**23.3%**
FGD (3)	7320	**27.8%**	5910	**74.7%**	600	**32.4%**	440	**32.4%**
FGD in construction (4)	1620	**6.1%**			220	**11.9%**		
Total (2+3+4)		**36.2%**		**81.3%**		**49.3%**		**55.7%**

Sources of data: Agres Enerji Sistemleri San. Ve Tic. a.s. *et al.* 2003a; Istroenergogroup a.s. *et al.* 2003; NV Consultants et. al. 2003; Chmielniak 2003; CSFTA and VBG 1999; DOE 2003b; Roubicek and Kolat 2001; Slovenska narodna reklamna a propagacna agentura s.r.o. 2001; Civin pers. comm.; Fasekas pers. comm.

Power plants in ***Poland*** generally use old and polluting technologies and are the main source of emission of air pollutants in the country (DOE 2003b). The Polish government adopted a plan in 1996 entitled "SO_2 emission reduction in the Polish energy sector" at an estimated cost of $2 billion (WEC 2000). The introduction of FGD and denitrification technologies in the 1990s and the low sulphur content of the most predominantly used brown coal reduced pollution significantly (DOE 2003b), even though at the present moment FBC and FGD are installed or are in construction only for about 40% of the coal-fuelled units (see: Table 10, above). Further, there are plans for development of power generation from brown coal, which is cheaper as it can be extracted in open pit mines but is more polluting (Baniak pers. comm.).

The life cycle of the conventional coal power plants in ***the Czech Republic*** is expected to end between 2008 and 2013. There have been persistent efforts to introduce clean coal technologies, starting with Act No. 309/1991 which set emission levels and required plants to meet them by the end of 1998 (CEZ a.s. 2002). Subsequently, the Czech Power Company - CEZ a.s., which owns three quarters of power generation capacity (DOE 2003c) has invested $2.2 billion for desulphurisation, denitrification and repowering equipment (WEC 2000). The efficiency of already installed electrostatic precipitators for removal of the fly ash from flue gas and the efficiency of denitrifying technologies has also improved (DOE 2003c). Apart from the introduction of clean technologies some of the most obsolete coal-fired power plants owned by CEZ a.s. with a total capacity of 2020MW were phased out by the end of 1998 (CEZ a.s. 2002).

These improvements and the closure of the obsolete units had a significant influence on the energy related emissions discussed in the next section. The emissions of the plants operated by the CEZ a.s. are in line with the legal requirements (CEZ a.s. 2002). Despite the progress made, however, there are still obstacles that hinder the introduction of clean technologies, such as unfinished privatisation, the plans of the government to restrict open pit mining and its plans to introduce an ecological tax which will decrease the competitiveness of fossil fuels (Bursik 2003). The increase in electricity production when the nuclear power plant in Temelin passes the testing period will not lead to the future closure of coal power plants, as was suggested by DOE (2003c), as the electricity produced by it will mainly be exported (Bursik pers. comm.).

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[19] *The data about the coal-fuelled power plants for the Czech Republic is from 1999 (CSFTA and VBG 1999)*

[20] *for Slovakia the data about the total coal-fuelled capacity, includes power plants which operate simultaneously on coal and heavy oil (577MWe) and coal and natural gas (121MWe), so the percentages might be overestimated.*

In ***Hungary*** half of the coal-fuelled power plants have built-in dust control equipment, which is not very efficient, but only a few of them have efficient equipment for sulphur and nitrogen removal (DOE 2003c; Civin pers. comm.). Coal-fired power plants that do not meet reconstructed new, stricter environmental standards will have to be closed after 2004 or 2005. Thus 13 fossil-fired units of 200MW capacity will be closed (WEC 2000). It is calculated that only the plants that use coal from opencast mining, whose production is cheaper than underground mining, will be able to finance clean coal technologies (WEC 2000).

In Table 11 a summary is given of the transitional arrangements and the estimated environmental financing needs, particularly concerning the compliance with the Directives on the Large Combustion Plants (LCP) and the Integrated Pollution and Prevention Control (IPPC). It can be seen that those countries in focus which have problems in adjusting their energy sectors to the stricter environmental standards of the EU, and particularly to the LCP and the IPPC Directives, also have negotiated longer periods for derogation. This position can be much more fully understood when compared with the costs for complying with the EU environmental standards. It should also be noticed that both the LCP and the IPPC Directives constitute a significant share of the expenses the countries should make. For example, the compliance with the LCP Directive will cost Poland around Euros 3,500 million. The list of plants under derogation concerning SO_2 emission includes 36 generations plants and CHP plants (or 20% of the total capacity of the sector) (Patrycy 2003). The list of plants under derogation concerning NO_x emission includes 24 generations plants and CHP plants (or 24% of the total capacity of the sector) (Patrycy 2003).

Table 11. Relevant transitional arrangements and estimated environmental financing needs in the EU accession countries as a total and for complying with LCP and IPPC directives.

	Transitional arrangements	Total estimated env. financing needs (MEuro)	LCP Directive [% of total needs]	IPPC Directive [% of total needs]
Czech Republic	LCP by 2007.	6,600-9,400	28.2-19.8%	56.4-19.6%
Hungary	LCP by 2004.	4,118-10,000	21.3-8.8%	42.8-17.6%
Estonia	LCP by 2015.	4,406	7.1%	11.1%
Latvia	IPPC by 2010*.	1480,2,360	2.9-1.8%	6.1-3.8%
Lithuania	LCP by 2015.	1,600	4.6%	2.8%
Poland	IPPC by 2010* LCP by 2017.	22,100-42,800	15.6-8.1%	31.3-16.2%
Slovakia	IPPC by 2011*. LCP by 2007.	4,809	16.3%	32.6%
Slovenia	IPPC by 2011*	2,430	7.4%	2.1%
Total costs for the eight countries		47,624-77,886	16.0-9.8%	30.8-18.9%

*instead of 2007 for Member States

Sources of data: EC 2003b; DANCEE and Ministry of the Environment 2001

5.3.3. The Effect of the Introduction of Clean Technologies on SO_2 Emissions in the Visegrád Countries

In the text above the technologies applied to reduce mainly SO_2 emissions and the modernisation work undertaken have been discussed. It is interesting to see how the SO_2 emissions from the sector have changed in order to obtain a better understanding of how successful the improvements have been. To this end, first a comparison was made regarding the share of energy production and transformation sector related SO_2 emissions in total SO_2 emissions in the four countries. Then the emissions of the sector per capita and per unit of produced electricity from coal were derived.

Total SO_2 emissions in the four countries are declining. This is also true for the energy sector related emissions, although in this sector the decline is much smaller. In fact for all countries except Poland the energy sector is becoming the single largest contributor to SO_2 emissions.

The steepest reduction in energy-production-related emissions has been achieved in the Czech Republic where the levels in 2000 were around one eighth of the 1990 figures. Poland and Slovakia cut their emissions by a factor of about two and four, respectively. In Hungary, energy-production-related emissions have been decreasing very slowly (only 30% over the period 1990 – 2000).

Figure 10 shows the trend in per capita SO_2 emissions from the combustion of the energy and transformation sectors. It indicates that the Czech Republic had the biggest problems but that it has managed to reduce emissions significantly. Slovakia follows with a halving of its emissions over the same period, while the emission levels in Hungary and Poland have remained broadly unchanged.

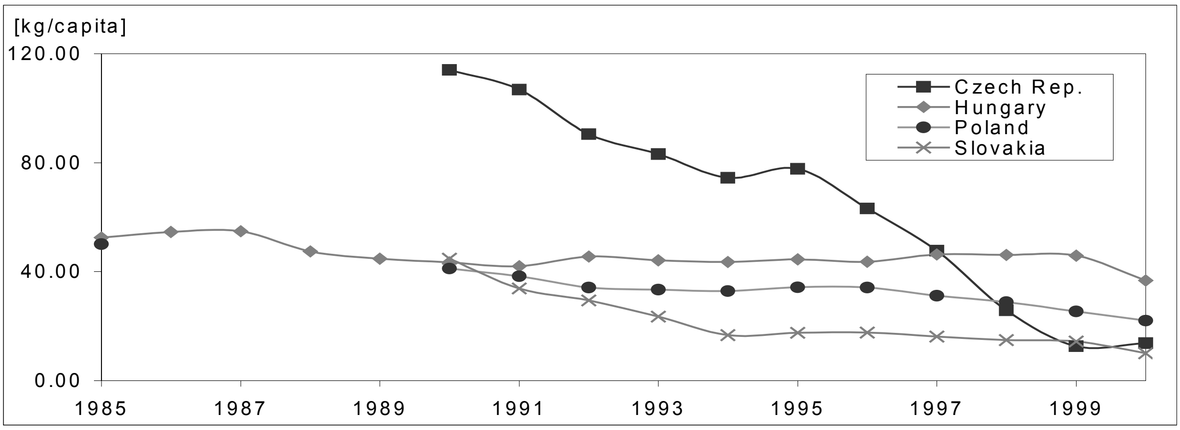


Figure 10. SO_2 emissions per head of population from the energy production and transformation sector

Sources of data: UNECE/EMEP 2002; IEA 2002b

5.3.4. Summary of the status and development of power generation from coal in the four Visegrad countries

Among the countries of the Visegrád group, Poland has the highest share of coal in its electricity production. Even though some plants have been recently constructed, about 70% of them are more than 20 years old. Although Poland is among the countries with the highest volume of total SO_2 emissions (Barrett 2000), its ranking on a per capita or per kWh basis is not the worst of the four countries in focus. This is due to the fact that hard coal, which is predominately used at the moment, has a low sulphur content. Less than half of the units have some desulphurisation equipment and the list of derogations from the Large Combustion Plants Directive is long. The reduction in emissions from 1990 to 2000 is very small compared with that achieved in the Czech Republic and Slovakia.

If we have to state which of the four countries has put most effort into the introduction of clean coal technologies, this is undoubtedly the Czech Republic. There coal is also one of the main fuels for power generation, and of this one third is comprised of higher pollution brown coal. Privatisation is still at an early stage, but this has not prevented the power company, CEZ a.s., from modernising its plants. The modernisation and closure of some power plants has led to exceptionally sharp falls in energy-generation-related SO_2 emissions (by a factor of 8 from 1990 to 2000).

Hungary and Slovakia have far less capacity utilising coal as an energy source than the other two countries in focus, which might imply that it would have been easier for these countries to modernise capacity. However, this has not been the case. There has been some progress, but still about half of the units do not have desulphurisation equipment installed, even though Slovakia managed to reduce its SO_2 emissions per unit of electricity produced in coal-fuelled power plants quite significantly (by a factor of 4). Of the four countries Hungary, which uses mainly brown coal, has the highest figure for SO_2 intensity and progress has been very moderate (only a 40% reduction in the period 1990 to 2000).

5.4. POLICIES PROMOTING CHP AND EFFICIENT FOSSIL GENERATION

5.4.1. Policies and legal framework promoting CHP and barriers

The national energy policies of the four countries are favourable towards the improvement of energy efficiency in general. There are also environmental policies and laws that directly or indirectly encourage the development of CHP units.

In the Energy Acts of the four Visegrád countries provisions that stimulate the development of the CHP technologies are included. Most of the measures envisaged concern obligations for the distribution companies to buy electricity produced in CHP mode, although the technical requirements for the units differ in the four countries.

Another measure for the promotion of CHP units is the increase of the security of investment in their construction. Such provisions are included in the Energy Acts of Hungary, Poland and Slovakia. Security of investment is promoted in Hungary by setting a price formula for heat produced in CHP mode for a 10 year period (Sigmond pers. comm.). This situation provides better competitiveness for the CHP plants within the specified range. In Slovakia there are also provisions in the Energy Act for a more liberal procedure for obtaining preliminary permission for CHP with capacity under 5MWth (ISPE *et al.* 2003). Building new CHP capacity promoted by a 5-year tax-free period of operation after construction (ISPE *et al.* 2003).

In the Czech Republic and Slovakia legislation for compulsory energy audits has been enacted. According to the Czech Energy Management Act of 2000 the cost-effectiveness of the introduction of CHP should be evaluated when new capacity is planned or when old capacity is that produces only heat or only electricity is renovated (IEA 2003c; ISPE *et al.* 2003).

Very important tools for the strengthening of the market position of CHP technologies are the feed-in tariffs for the electricity and heat produced in the CHP mode. There are preferential tariffs in the four Visegrád countries, although the governments have varying approaches towards how they are set. For example in the Czech Republic the feed-in tariffs can be negotiable and different in the different regions but should be equal or higher than the average fixed by the Regulator. In Hungary there have been feed-in tariffs since 1997, but upon the adoption of new rules for their formation in 2001 they became very favourable and generated a rapid increase of the small-scale gas engines (IEA 2003c; Sigmond 2003). In Slovakia the feed-in tariffs for the power generated in CHP mode are very low to provide adequate payment especially in the case of surplus capacity (ISPE *et al.* 2003). Another barrier for CHP in Slovakia is the fast increase of natural gas prices compared to those of electricity which are kept lower for industrial and commercial consumers (ECB 2002b). All these factors have had a negative impact on the CHP sector as a whole in Slovakia.

5.4.2. CHP policy recommendations

CHP technologies provide us with electricity and heat in a more environmentally benign way than conventional thermal plants. As the externalities for energy production are not included in the electricity and heat price, additional support for CHP technologies is needed.

The main conclusion of the 'future cogen' study (ESD *et al.* 2000) is that the continuing high risk associated with investment in CHP technology is the main barrier for its penetration throughout the whole European continent. That is why most of the recommendations in the above-mentioned study are directed towards the establishment of a more stable and predictable economic environment.

Selected recommendations by the authors of this study and other experts are:

- Governments should develop long-term, clear policies promoting cogeneration. The objective of increasing CHP share should be integrated with other energy policies.
- The higher share of CHP in electricity and heat production in the CEE countries should demonstrate the importance of the CHP Directive, which is in preparation, for the accession countries. That it why it should be assured that the interests of these countries are also taken into account in the final version of Directive, along with the interests of the member states.
- Subsidies for energy and heat prices and among the different consumers should be phased out. This is also one of the main requirements in the EU accession process. In the countries in focus there are still a number of market distortions, like cross-financing in Hungary in favour of the gas sector (Sigmond 2002), and very low (5%) VAT for heat from some sources (for small facilities hydropower 0.1 MW, wind 0.075 MW, all solar and biomass units) compared to 22% for electricity in the Czech Republic (IEA 2003c).
- Existing monopolies in the energy sector should be broken down, as they can also be a hindrance for small producers. The monopoly companies can set additional difficulties like high top-up and stand-by charges, as has occurred in Slovakia and in the Czech Republic. The new electricity and gas Directives may improve this situation.
- Legislation that deals only with cogeneration is not present in any of the four countries in focus but is essential for fostering CHP units. Parameters such as power to heat ratio and efficiency should be considered in detail. Moreover a standard European definition of the term 'cogeneration' is also needed (ESD *et al.* 2000).
- Energy market regulators should be made responsible for promoting CHP (ESD *et al.* 2000). This has been partially done in the Czech Republic by the introduction of mandatory energy audits and implementation requirements but has not been very successful, as the necessary financing is not available (van Wees 2000).
- A legal requirement should be established for the distributing companies to buy electricity produced in the CHP mode but with clearer directions about the exceptions.
- Feed-in tariffs for CHP electricity should be introduced in Poland and Slovakia. At present, they exist only in Hungary and the Czech Republic.
- Restrictive practices such as high top-up and stand-by charges (as is the case in Slovakia) should be prohibited.
- Priority dispatching for the power produced by CHP plants should be introduced. At the present moment, when it is based on short-term costs, they have a very low priority, especially when nuclear power is also sold.
- More governmental support for CCGT is needed, as their share is very small in the total CHP capacity in the Visegrád countries, with the exception of Hungary.
- Last but not least, a unified system for the collection of statistical data concerning CHP should be elaborated in the four countries in focus, and publicly available, consistent data should be reported on the status of CHP in accession countries.

5.4.3. Policies Promoting and Barriers to District Heating

In the four Visegrád countries there are national energy strategies and laws aimed at more efficient energy use, and at the liberalisation of markets and prices. In all cases the legislative process is influenced by the accession process and the need for harmonisation with EU legislation, but within these processes, there are different approaches towards district heating.

Of the four countries in focus Hungary is the only one that has a Law on District Heating (adopted in 1998). According to it DH utilities are operated by the municipalities, which must has a majority of shares (51%). They can issue licences for operation to private firms. Municipalities are also responsible for setting the prices for heating, which conflicts with their social policy and results in lower profits for the DH companies (Sigmond pers. comm.). In Poland also the municipalities are the ones, who are responsible for the development of guidance for the local supply of energy (heat, power, gas), according to the Energy Law of 1997.

Various funds have been created to support the renovation of the units in the district heating companies and their consumers. For example in Poland, according to the Act on Support for Thermo-Modernisation Investment (from 1998), credits should be provided for projects with a maximum pay-back time of 7 years in district heating plants up to 11,6MWth, DH networks and buildings connected to them (Cherubin 2003). In Slovakia the Act on the Efficient Utilisation of Energy of 2001 established an Energy Revolving Fund which finances energy efficiency projects (Euroheat&Power 2001), although there is a need for secondary legislation in order for the Slovak energy laws to be implemented (Cherubin 2003).

The lack of integration of district heating in overall energy policies creates unfavourable market conditions for the district heating entities. A typical example in this case is the promotion of the gas sector in some of the countries in focus. Governmental support in the form of subsidies in the past and favourable policies for the gas sector as well as cross-financing among the users in the Czech Republic, Hungary and Slovakia has led to a competitive advantage of individual and central gas heating over DH. For example, the subsidies for prices for heat from district heating in the Czech Republic were removed in 1998 but those of gas and electricity only in 2001 (Gochenour 2001). This created more favourable conditions for individual heating (Gochenour 2001). In Hungary cross-financing for energy and gas prices are disadvantageous for the district heating companies (Cherubin 2003). The prices of central gas heating were reported to be 7.5 Euro/GJ and for district heating 6.4 – 10 Euro/GJ in 2002 (Sigmond 2002). In this case only new gas-fired units for DH can be competitive (Sigmond 2002). In Slovakia the natural gas prices are lower for households and smaller consumers than for the DH companies, which is due to the regulated prices of the heat produced by DH companies (ECB 2002b). This favours individual heating.

Apart from disincentives that make individual heating more favourable there are also strong disincentives to improve the end-use energy efficiency in the Visegrád countries. One of these obstacles is the ‘cost plus’ principle behind the formation of the tariff for heating. The only exception is Hungary where the tariffs are formed using the price cap approach (Bergasse pers. comm.).

Case Study – Polish Government, DH and World Bank (Gochenour 2001)

Various projects and programs aimed at improving DH have been started, but their success depends a lot on government support for this sector. Here, the efforts of the Polish government deserve special mention. Officials started a dialogue at the end of the 1980s with the World Bank about the possibilities for the reconstruction of the energy sector. In 1991, projects for the modernisation of four big DH enterprises in four cities started, worth a total of US $470m and in addition the government developed a policy concerning energy pricing, leading to the phasing out of subsidies in 1998. As a result of improved efficiency and the government efforts, prices for heating of a square meter decreased by 55% from 1991 to 1999. In the four DH companies, energy efficiency increased by 22%, leading to savings of US $55m per year, together with reductions in urban pollution. Meanwhile, the number of customers increased by 12%. This co-operation provided a good start to reform in the DH sector.

5.4.4. DH policy recommendations

Strengthening the market position of the district heating sector requires efforts from the regulator as well as improvements of the services provided. In the four countries of the Visegrád group more efforts should be directed towards the following areas:

- Long-term strategies and policies for the DH sector should be developed and integrated into energy policies. This is essential for the survival of the district heating sector in the Visegrád countries. Of the four, only Hungary has a special district heating law but it still needs improvements to make the DH sector really competitive in the new market situation. On the basis of the present research, and in view of the outcomes of the IEA District Heating Roundtable (IEA 2002e), we would emphasise the following as measures which should be provided in forthcoming legislation:
  - Demand for least energy planning should be introduced. This might increase the efficiency on both the supply and demand side and foster the introduction of CHP technologies as more economical.
  - Prices should be based on the real cost of heating production and on the readings of individual meters in people's apartments. The formation of tariffs should not be based on the cost plus principle, as this is one of the major disincentives for energy efficiency, but rather on the price cap principle.
  - Rules for increase of the participation of the private sector should be established.
  - For better communication between the DH enterprises and their clients housing associations should be formed and their role in shaping the DH services they use strengthened.
- The presently existing market distortions in the form of subsidies, cross-subsidies and tax-distortions, should be eliminated, since they create unfair competition. This should be done cautiously and simultaneously with the removal of distortions in other energy sectors, for example gas prices, in order not to make the individual means of heating more attractive. In this respect the favourable policies towards other energy sectors and fuels should also be reconsidered.
- Obsolete and pollutive equipment and the distribution network need to be retrofitted or replaced, which will require huge investment in most cases. For this reason governments should put more effort into creating funds for modernisation, and into supporting foreign investment and third party participation in district heating.
- The low share of CHP units in DH points out that a more rigorous regulatory framework supporting the penetration of CHP into DH should be created and/or enhanced. Obligations for distribution companies to buy the CHP electricity produced by the DH companies should be set as well as attractive feed-in tariffs (for more information on the feed-in tariffs in the Visegrád four countries see section 5.4.1 above).
- To be consistent with market rules, district heating companies should create more customer-oriented services, including improved billing and information on the opportunities to improve energy efficiency and conserve energy.
- Support for low-income families should be in the form of financing measures that will contribute to the long-term reduction of their energy bills, such as insulation and energy efficiency measures, instead of direct subsidies of their heating costs.
- The role of the regulating authorities has to be strengthened while decoupling their decisions from short-term political interests and ensuring that the decisions concerning the other sectors regulated by them (such as gas prices) do not interfere with the competitiveness of the DH sector.

6. RENEWABLE ENERGY GENERATION

6.1. INTRODUCTION

Renewable energy sources in Central and Eastern Europe and in the region of the Visegrád countries in particular suffer from under-utilisation and significant barriers to their development. While their potential contribution to the energy mix of these countries is high, further institutional, legal and regulatory, and other reforms will be necessary in order to allow renewables to realise their potential. At the same time, CEE countries have a great deal of experience in developing and utilising hydro power as well as biomass. And even while the legacies of the communist period cannot be wiped out overnight, during the transition period CEE countries have promoted renewables through favourable policies. All CEE countries that will accede to the European Union have negotiated targets for renewable energy sources with the EU, albeit non-binding and possibly overly ambitious ones. Further rationally planned and well integrated policy choices can lead to a steady development of renewable energy sources in the region in the years ahead.

As the largest Eastern European states set to enter the EU in 2004, the Visegrád countries of Hungary, Poland, the Czech Republic and the Slovak Republic offer revealing cases of the challenges and opportunities for renewables in the region. Legal/regulatory and institutional reform in regard to renewable energy has made incremental progress in the Visegrád countries since 1989. These countries have new laws for renewables and have set ambitious targets for renewables for 2010. However, fossil fuel and nuclear sources remain dominant in the region. Over-capacity of electricity from these sources keeps renewables in a marginal position. Further legal and regulatory reform is needed. The Visegrád countries need to develop integrated renewable energy action plans that *link clear objectives with time-tables, funding schemes, and other policy instruments that will help achieve them.* Moreover, Visegrád countries should locate responsibility for renewable energy promotion in ministries of the environment rather than other ministries where this responsibility typically rests, such as ministries of the economy. Also, the Visegrád countries have overly centralised decision making and resource allocation systems in regard to renewable energy. These should be decentralised so that more resources are put in the hands of municipalities where locally appropriate RES projects should be developed.

In the heating sector prospects for renewable sources of energy are great. Biomass accounts for a significant portion of the heating energy produced in the region, and vast biomass resources, especially wood-waste and straw, remain untapped. Biomass is likely to be the fastest growing renewable energy source in the Visegrád region for the foreseeable future. Other renewable energy sources will, however, also play some role in the region. Most significant among these are wind and hydro, though some biogas and geothermal energy may also be developed.

6.2. STATUS OF RENEWABLE ENERGY IN THE VISEGRÁD COUNTRIES

Use of renewables in the Visegrád countries is low relative to fossil and nuclear energy and far below their potential. Renewables have difficulty competing with fossil and nuclear sources, a situation exacerbated in the Czech Republic and the Slovak Republic with the commissioning of new nuclear stations. Except in Hungary overcapacity is a significant barrier to renewables.

Except in the Slovak Republic, renewable energy in the Visegrád countries is dominated by biomass. The Slovak Republic has significant large hydropower capacity, accounting for over 15% of the country's electricity production in 2000 (IEA 2002h) and over 55% of all energy produced by renewable sources (Istroenergogroup a.s. *et al.* 2003). In Hungary, Poland, and the Czech Republic biomass energy sources, primarily for heating but also for electricity generation from co-generation heating plants (CHPs), account for most of renewable energy. In Poland and Hungary biomass has a share of over 90% of renewable energy production and in the Czech Republic the figure is nearly 80%. Other sources of renewable energy such as wind and geothermal energy make small contributions to the energy mix.

Renewables account for 227 PJ in the Visegrád countries compared with 7227 PJ TPES, or 3.14% of TPES. Of the energy from renewables, 195 PJ is supplied by biomass and waste sources while 0.32 PJ, or less than 0.5% of TPES, is supplied by other renewable sources such as wind, geothermal, and hydropower. Renewables, including large hydro, provide approximately 7.3 TWh of electricity to the region out of a total of 282 TWh, or 2.6% of all electricity.

Table 12 below shows the distribution of renewable energy production among the Visegrád countries. Renewables have a moderate share of the TPES in all Visegrád countries, with Poland leading at 4.2%. The Slovak Republic is the exception in this group of countries in having a significant large hydropower capacity, which accounts for over 15% of that country's electricity production and the bulk of the share that renewables have in its TPES.

Table 12. Selected Renewables Indicators by Country for 2000

	Czech Republic	Hungary	Poland	Slovakia
TPES 2000 (PJ)	1691	1037	3767	731
Renewables/TPES(%)	1.9%	1.6%	4.2%	2.8%
Share of renewables minus combustible renewables and waste in TPES	0.4%	0.1%	0.2%	2.3%
Total Electricity Generation (TWh)	72.9	35.0	143.2	30.4
Renew./Total Electricity (%) (includes large hydropower)	3.1%	0.8%	1.6%	15.2%

Sources of data: IEA 2002h; REEEP 2003

Hydropower provides 2500 MW in the Slovak Republic (DOE 2003a), 282 MW in the Czech Republic, 790 MW (160 MW from small sources) of power in Poland (Agres Enerji Sistemleri San. Ve Tic. a.s. *et al.* 2003b), and 44 MW in Hungary (NV Consultants *et al.* 2003). Two hundred and fifty locations for additional small hydro projects have been identified in the Slovak Republic, which, if developed, could bring the total small hydro power capacity of the country to 93 MW (Istroenergogroup a.s. *et al.* 2003). Many Polish hydroelectric facilities are inefficient and the output of existing stations could be increased by 20-30% through technical modifications of the generators and other equipment (Agres Enerji Sistemleri San. Ve Tic. a.s. *et al.* 2003b).

With regard to the utilisation of biofuels, the Czech Republic is a forerunner among the accession countries, with a 70,000 tons/year capacity in place already. The other countries will need to exert substantial efforts to comply with the new Biofuels Directive.

6.3. TECHNICAL AND ECONOMIC POTENTIAL

Estimates of the technical and economic potential of renewables vary widely, in part because the information needed is often missing. For instance, with the exception of Poland the Visegrád countries lack reliable wind maps necessary for potentials calculations and informed investor decisions. However, various analyses do give general indications of the potential for renewables in the region. Though other sources of renewables should not be discounted, biomass, wind, and small hydro power energy sources provide the greatest technical and economic potential. Table 13 below summarises the findings of Black &

Veatch regarding the technical potentials of renewable resources, included in their report to the EBRD (Black & Veatch Corporation 2003).

Table 13. Estimated Renewable Energy by 2020, Technical Potential

	Wind MWe	Geo. MWe	Biomass MWe	Hydro MWe	Total MWe	Jan. 2000 Installed Capacity (All Sources) MWe
Czech Republic	2200	0	819	285	3,304	14,076
Estonia	500	0	248	0	748	3,381
Hungary	500	0	983	357	1,840	7,842
Latvia	550	0	325	428	1,303	NA
Lithuania	500	0	318	214	1,032	5,755
Poland	4,000	0	4,160	999	9,159	30,732
Slovakia	250	0	273	499	1,023	7,752
Slovenia	100	10	135	642	887	NA

Source: Black & Veatch Corporation 2003

Comprehensive estimates for the economic potentials of renewables are not available for the Visegrád countries, but existing studies indicate that biomass will be the leading renewable energy resource for the foreseeable future. Wood waste and straw are underutilised and offer the greatest potential for growth in renewables in the region. More comprehensive analysis of the economic potential of renewable energy sources is needed, as this is expected to diverge greatly from the technical potential. For instance, van Wees *et al.* (2002) estimate that the technical potential for renewable energy in the Czech Republic is about 5.6% of the Total Primary Energy Production by 2010, in contrast with a current share of 1.9%. Accounting for economic limitations, however, the actual, or economic potential is 3.6% of TPEP by 2010, significantly lower than the 6% target the Czech Republic has negotiated with the European Union.

Wind generated electricity may thrive if appropriate laws and regulations are passed, although the absence of reliable wind data for most of the region impedes accurate estimates. Black & Veatch (2003) estimates that 30% of the Polish land surface is economically suitable for wind power and 5% is very favourable. Poland aims to have 1600 MW of wind power installed by 2010 (Agres Enerji Sistemleri San. Ve Tic. a.s. *et al.* 2003b).

Much of the Visegrád region has great mountainous areas that indicate a significant potential for hydropower development. The Energy Centre of Bratislava (2002a) estimates that small hydropower has an available potential of about 3 PJ in Slovakia. The Czech Republic can double its small hydropower capacity (Bechberger 2003), with an additional 220 MW of capacity that could be built (Agres Enerji Sistemleri San. Ve Tic. a.s. *et al.* 2003a). Poland can increase the efficiency of its existing hydropower stations (The Council of Ministers 2000).

The cost curve of economically viable renewable electricity supply in Hungary can be found in Figure 16 in Appendix IV. It is taken from a recent study by External Kft (2002) carried out for the Hungarian Energy Office. The curve demonstrates that only a limited potential of renewable electricity is cost-efficient in Hungary (up to around 400 MW): mainly small hydropower, waste-to-energy, wastewater treatment and some wind. Since many of these investments will take place over a long period of time, it is clear that economically viable renewable electricity capacity can be expanded in Hungary only in the medium term.

6.4. BARRIERS TO RENEWABLE ENERGY DEVELOPMENT IN CEE

Although most countries in Central and Eastern Europe officially support renewable energy sources, progress towards implementing that commitment has been slow and uneven. As experience in Western Europe, North America, and elsewhere has shown, renewable energy requires favourable institutional and regulatory conditions in order to thrive. These take time and resources to develop. Moreover, the general levels of political stability and wealth in a country are key determinants in the development of renewable energy (Black & Veatch Coorporation 2003). The EBRD has identified a number of specific barriers to the development of renewable energy throughout Central and East Europe, although, as will be discussed below, not all of these barriers apply to all countries in the region, and the Visegrád Four are in a relatively favourable position vis-à-vis other countries in the region. The key barriers cited by the EBRD include (Black & Veatch Coorporation 2003: Chapter 7):

- Lack of high quality resource data for developers;
- Lack of local equipment and operations & management suppliers;
- Lack of mandatory buy-back policies with feed-in tariffs at a sufficiently high level;
- A general absence of awareness of and information about renewables ;
- The general perception among government and local investors that renewable energy is "risky";
- A relatively low level of economic development, leading to:
  - Pressures to keep energy prices low through governmental subsidies;
  - Lack of creditworthiness of local investors;
  - Lack of sponsor equity;
  - Lack of long-term financing;
  - Underdevelopment of the private sector;
  - Inability of consumers to pay market rates for electricity and heating;
- The socialist era legacy of inefficient and unresponsive bureaucracies;
- Strong fossil fuel and, in some cases, nuclear lobbies, and the associated overcapacity;
- Lack of public support and demand.

6.4.1. Governmental Policy and Capacity and Regulatory Uncertainty

The Visegrád countries have set targets for renewable energy development but have not established adequate regulatory and legal frameworks to meet these targets. Sectoral targets have not been set and there is no overall strategy and commitment to aggressively develop renewables. New energy laws and policies in the Visegrád countries are general and lack implementation strategies. Moreover, the ministries that have the primary responsibility for renewable energy policy at the national level have no traditional commitment to these energy sources or to environmental and sustainability considerations.

The lack of an overall strategy is reflected in incentive structures that are scattered and not well linked with each other. None of the countries has done an integrated assessment of the technological and economic potentials of renewables in specific sectors, adopted sectoral targets, and tied those targets to financial schemes and appropriate regulatory frameworks that include streamlined permitting processes. Instead, permitting tends to be complicated and confusing, involving multiple agencies that are not well co-operate well (Gierulski 2002; Viglasky 2003). This tends also to be the case at the policy-making level, where several ministries are typically involved in the debate over renewable energy but do not co-ordinate well with each other. For instance in Hungary the Ministry of Economy and Transport and the three other ministries that share a degree of responsibility for renewable energy policy and regulation do not have a formal interministerial structure to co-ordinate and integrate their actions (Ürge-Vorsatz *et al.* 2003).

The lack of governmental commitment to renewable energy in the Visegrád countries is also demonstrated by the limited administrative resources they assign to renewables. For instance, in the Czech Republic as of 1999 only four public employees were responsible for renewable energy policy, well short of the minimum necessary to develop and implement an effective action plan to meet the National Energy Policy's renewable energy target of 6% of TPEP by 2010 (SRC International CS s.r.o. 1999).

Another serious problem in the region is regulatory uncertainty. In the Czech Republic, for instance, there is uncertainty regarding the legality of feed-in tariffs set by the Energy Regulatory Office (ERO), established in 2001 under the Energy Act. In Slovakia feed-in tariffs are quite low and vary from region to region and utility to utility, producing uncertainty in pricing as well as creating a climate of unpredictability in rule-making (Viglasky 2003). In Poland a change from a feed-in tariff system to a quota system undermined the confidence of renewable energy producers and put an additional burden on an already struggling industry (Reiche 2003). Another damaging regulatory failure common in the region is the lack of penalties associated with violations of the laws and regulations intended to promote renewables. For instance, Poland has no penalty for utilities that fail to buy the legal minimum amount of electricity produced by renewable sources, leading to chronic violations of the law and a disincentive to potential developers to go ahead with projects (Agres Enerji Sistemleri San. Ve Tic. a.s. *et al.* 2003b). A similar situation exists in the Czech Republic, where, in addition, funds have not yet been allocated to implement the Energy Management Act, allowing violators of the Act to go not only unpunished, but undetected (van Wees *et al.* 2002).

6.4.2. Structural Barriers and Overcapacity

The greatest structural barrier to renewable energy development in the Czech Republic, the Slovak Republic, and Poland is the vast oversupply of cheap electricity produced from coal and nuclear power. Hungary is an importer of electricity and therefore does not experience this barrier in the same way. However, neighbouring countries in effect export the barrier to renewables imposed by overcapacity to Hungary by supplying Hungary with cheap electricity produced from nuclear, coal, and large hydro stations. In Poland the maximum power demand in 2001 was 66% of installed capacity (Reiche 2003). The commitment of both the Czech and Slovak Republics to nuclear power will ensure a long-term overcapacity that will keep renewables in the background for the foreseeable future, barring a strong governmental policy shift to promote these sources more aggressively through an integrated policy and financial framework.

As discussed in the section on nuclear power in this report, over-capacity of electricity from nuclear power is a barrier to RES development in several countries in the region. In the Czech Republic the Temelin nuclear station, leading to as much as a 50% over-capacity of electricity for about a decade, will significantly diminish the prospects for commercially viable renewable energy development during this period (van Wees *et al.* 2002). The situation is similar in Slovakia.

6.4.3. Financial and Market Barriers

The most significant financial barrier to renewable energy development in the Visegrád countries is the inadequate level of support provided by governments and the unavailability of commercial loans and venture capital to support projects. For instance, the national energy policy of the Czech Republic estimates that 120 million euros are needed annually to meet its targets, though only about 16 million euros were provided through various governmental programmes in 2001 (Bechberger 2003). Moreover, Czech investors in the energy sector often have poor creditworthiness and banks have limited experience funding renewable energy projects. This situation is mirrored throughout the region (Viglasky 2003; Ürge-Vorsatz *et al.* 2003; Reiche 2003). In combination, these factors cause commercial loans to have high interest rates, leaving only the government and international institutions as viable sources of funding for all but very small projects. As the governmental financial support is weak, though not absent, only international institutions are in a position to provide significant funding for renewable energy projects. Organisations such as the EBRD and World Bank are in a position to take the lead in promoting renewable energy development in the Visegrád countries, and throughout the former-socialist region.

An often cited impediment to renewable energy support is that RES is "expensive", and thus economies still struggling with economic problems and reforms cannot "afford" it. However, it is important to recognize that, as shown in other parts of this report, traditional energy sectors (natural gas, coal and nuclear) continue to receive substantial amounts of direct, cross- and indirect subsidies, without any reference to the conditions of the economy. Therefore, it is important to assess and rank these various subsidies from their financial, social and environmental implications on a fair, comparable basis.

6.4.4. Informational and Social Barriers

Reliable statistics on the current use of renewable energy sources in the Visegrád countries are also lacking. For instance figures for the Czech Republic differ by as much as a factor of 2, depending on which government agency is giving the estimate (van Wees *et al.* 2002). In addition to the absence of crucial information, renewable sources of energy also face so called "cognitive" barriers in the region, including a general lack of understanding by major stakeholders of the potential contributions they can make to the energy mix and a common view that renewables are "alternative" energy sources that are inherently economically risky and technologically unreliable.

Case Study: Electricity disclosure – will it transform the CEE electricity markets?

As often emphasised in this report, one of the key impediments to a wider proliferation of sustainable energy pathways in the CEE region is the lack of environmental awareness of the population. This is especially true for energy-related environmental awareness and climate change literacy. For instance, according to a representative Europe-wide survey carried out under the 4CE (Carbon consciousness and consumer choice in electricity) project funded by the EU's Altener program, 80% of Hungarians and 78% of Poles attributed climate change to "a hole in the Earth's atmosphere", and 48% of Hungarians and 32% of Poles believe that nuclear power production emits carbon-dioxide to the atmosphere. Thus, increasing energy-related environmental literacy and awareness is a key priority in these countries before any substantial bottom-up pressure can be put on governments by their constituencies.

One important step in this direction is the "disclosure" clause of the new Electricity Directive (2003/54/EC) which requires suppliers to inform their consumers on the sources and environmental emissions of their electricity. While the 4CE research found it unlikely that as a result of disclosure the demand for green and low-carbon electricity will be raised in a revolutionary way in the short-term, disclosure will have a significant educational role. Since it is very difficult to educate the adult population by other means, disclosure represents a unique opportunity in this region, as supported by the study. In the long-term, after environmental awareness has increased and CEE consumers become comfortable with the concept of a liberalised market and switching suppliers, it is also possible that disclosure will gradually foster a moderate market transformation to environmentally friendly power sources.

6.5. CURRENT POLICIES TO PROMOTE RENEWABLE ENERGY

6.5.1. Targets

As discussed above, the barriers to the rapid development of renewable energy sources in the CEE countries are significant and will be very difficult to overcome in the short to medium term. However, all of these countries have taken steps during the transition period to promote renewable energy, and have seen some modest successes. Significantly, all of the CEE countries have negotiated targets for renewables with the European Union, and while it is true that the barriers to renewables (including the lack of integrated strategies for achieving policy objectives) cast doubt upon whether the targets can be achieved, the targets do constitute an open and verifiable commitment to the EU that will serve as a guidepost for analysts and promoters of renewable energy and as a force that can act as a catalyst for governmental action under EU, NGO and other sources of pressure.

The new accession countries have prepared themselves to comply with the EU's Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market (EC 2001), which should help guide policy in the future and provide guidelines for reform for these countries in their efforts to meet the targets. In order to realise these targets the new member states must develop more strategic policies and programmes. The European Commission and other EU institutions can be instrumental in achieving this aim. The targets are summarised in Table 14 below.

Table 14 National indicative targets for the contribution of electricity from renewables to total electricity consumption by 2010

Country	RES-E (%) 1999	RES-E (%) 2010
Czech Republic	3.8%	8.0%
Estonia	0.2%	5.1%
Hungary	0.7%	3.6%
Latvia	42.4%	49.3%
Lithuania	3.3%	7.0%
Poland	1.6%	7.5%
Slovenia	29.9%	33.6%
Slovakia	17.9%	31.0%
European Community	**12.9%**	**21.0%**

Source of data: Annex to the Directive 2001/77/EC (EC 2001)

6.5.2. Specific policies

Specific policies established in the Visegrád countries during the transition period range from providing grants and low interest loans to investors, tax relief for commercial and residential projects, feed-in tariffs, and minimum obligations for utilities to buy energy produced from renewable sources. Each country has developed a different mix of policy tools, although, as discussed above, no country has yet developed an integrated policy with complementary tools designed specifically to meet sector targets. Instead, targets for renewables are general, pertaining to the economy as a whole, and are not closely linked with specific policy instruments (with the exception of Poland's regulation requiring utilities to buy specified minimum percentages of electricity from renewable sources[21]). Table 15 below shows the year-by-year targets for renewables in the Polish energy policy. Notably, the greatest

[21] As discussed above, utilities violate this regulation without fear of being penalized, casting some doubt upon the seriousness of the Polish authorities to use minimum obligations as a key instrument to achieve the policy target.

increases in renewables are expected during the period from 2007 to 2010, meaning that planning for and construction of generating capacity must begin now in order to come on-line in time to meet the targets.

Table 15. Obligation for suppliers to purchase electricity from renewable sources as envisaged by the Polish Ministry of Economy in 2000

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Share of Green Electricity %	2.4%	2.5%	2.65%	2.85%	3.1%	3.6%	4.2%	5%	6%	7.5%

Source: Polish Ministry of Economy in 2000, cited in Reiche 2003

An overview of the major policy instruments in use throughout the region is summarised in Table 24, Appendix IV.

Incentives to promote RES include mandatory purchases of electricity from renewables and preference for hooking new renewable sources up to the electricity grid. Feed-in tariffs exist in the Czech Republic, Hungary, and Slovakia, though they may be too low to provide strong incentives to develop more sources. The Czech Republic is an exception to this trend, having established competitive tariffs (Black & Veatch Corporation 2003: Ch. 5-6). Hungary has feed-in tariffs at an across-the-board rate of 9.26 eurocents for renewables for peak times and 5.78 eurocents for off-peak times. While this rate may suffice for the most competitive renewable sources, many will be shut out of the market if the tariff is not raised in the future.

Reduction of VAT for renewable energy is also a common incentive. For instance, the Czech Republic has reduced the VAT rate from 22% to 5% for small facilities (hydropower 0.1 MW, wind 0.075 MW, all solar and biomass units) (IEA 2003c), while Hungary has reduced VAT for some renewables from 25% to 12 % (Reiche 2003).

Slovakia has an accelerated permitting process for small renewable energy projects and projects under 5 MW require no license. Streamlining or eliminating permitting and licensing procedures should spur innovation and entrepreneurial projects in the renewable energy field.

6.6. RECOMMENDATIONS

Areas urgently in need of action include at least four categories: legal and regulatory reform, institutional reform, demonstration projects, and region-wide networking and synergy strategies.

Legal Reform

The Visegrád countries should focus on developing:

- Renewable energy development strategies that are integrated with environmental, transportation, and other relevant sectoral strategies.
- Renewable energy development strategies that are specific and in which targets are clearly linked with policy instruments and have interim timetables and means of achieving them.
- Renewable energy action plans that catalyse and integrate the efforts of governmental and non-governmental actors.
- Regulatory structures that are appropriate for their conditions, with special emphasis on establishing adequate feed-in tariffs and purchasing obligations.
- Enforcement mechanisms in case of non-compliance.

Institutional Reform

Visegrád countries should:

- Establish interministerial linkages such as permanent committees responsible for co-ordination.
- Create an institutional framework that places ministries of the environment in the lead or at least in an equal position vis-à-vis other ministries in the area of renewable energy policy.
- Develop transparent and collaborative policy making processes in order to bring a greater range of stakeholders into the decision-making circle in the energy sector, and reduce the disproportionate influence of traditional energy lobbies.
- Decentralise the allocation of resources and decision making authority over renewable energy projects, empowering municipalities to act proactively in their jurisdictions.
- Invest in the capacities of public authorities necessary to implement renewable energy policies, strategies, and action plans.

Demonstration Projects

Visegrád countries should:

- Fund and promote high-profile demonstration projects intended to show the economic and other benefits of renewable technologies and educate the public and potential developers about their advantages.
- Work with international funding organisations such as the EBRD and the World Bank to fund and promote high-profile demonstration projects.
- Focus scarce funding for demonstration projects on renewable energy sources and technologies with the greatest potential in their countries.

Region-wide Networking and Synergy Strategies

Visegrád countries should help to:

- Establish a regional network with a secretariat that supports the development of renewable energy sources.
- Empower the secretariat to develop model legislation, facilitate regional information sharing, serve as an information clearinghouse, promote renewables among the public, etc.

7. NUCLEAR POWER IN EASTERN EUROPE

The EE/FSU region accounted in 1999 for 13 percent of the world's nuclear power generation, but is projected to account for 11 percent in 2020 (IEA 2002i). Many of the nuclear plants in operation or under construction in the EE/FSU region have been criticised as inherently unsafe according to Western standards (GRS 2000). Several plants are currently scheduled for early shut down, and some of those under construction may never become operational.

Since the Chernobyl accident, nearly $2 billion has been provided by the Group of Seven nations for safety measures at a number of nuclear reactors in the EE/FSU region. The main aim was to reduce the likelihood of a nuclear accident, and another goal was to shut down the least safe nuclear reactors.

At the beginning of 2003 the EE/FSU region had 68 reactors operating, ten under construction, and 20 nuclear power plants had been shut down (IAEA 2003). Twenty-five are considered by the donor countries to be operating at standards below those acceptable in the West (GRS 1992). Soviet-designed reactors are variations on two basic designs: the RBMK – a boiling water, graphite-moderated, channel reactor, and the VVER – a pressurized light water reactor (NEI 1997).

The first generation of reactors are the pressurised water reactors VVER-440 Model V230 and operate at five plant sites in four countries: Armenia, Bulgaria, Russia and Slovakia. The second generation - the VVER-440 Model V213 – operates at six plant sites in five countries: the Czech Republic, Hungary, Russia, Slovakia and Ukraine. The third generation are the VVER-1000 designs, which operate at ten plant sites in four countries: the Czech Republic, Bulgaria, Russia and Ukraine (NEI 2002). There are also two Western design reactors in operation and one under construction in CEE countries (Krsko in Slovenia and Cernavoda in Romania).

RBMK reactors belong to the high-risk category of reactors, but only the remaining Chernobyl RBMK units 1 and 3 have been deactivated until now. In total 17 RBMK units were built, of which 13 are still in operation (11 in Russia and 2 in Lithuania).

Table 16. Nuclear power plants in Central Eastern Europe by country

Reactor	Design Type	Net capacity in MW	Construction Start	Commercial Operation Start	Shut down date or scheduled
Bulgaria					
Kozloduy 1	VVER 440/230	408	1970	1974	2002
Kozloduy 2	VVER 440/230	408	1970	1975	2002
Kozloduy 3	VVER 440/230	408	1973	1980	2006
Kozloduy 4	VVER 440/230	408	1973	1982	2008
Kozloduy 5	VVER 1000/320	953	1980	1987	
Kozloduy 6	VVER 1000/320	953	1982	1991	
Czech Republic					
Dukovany 1	VVER 440/213	411	1978	1985	
Dukovany 2	VVER 440/213	411	1978	1986	
Dukovany 3	VVER 440/213	411	1978	1986	
Dukovany 4	VVER 440/213	411	1978	1987	
Temelin 1	VVER 1000/320	912	1983	2000*	
Temelin 2	VVER 1000/320	912	1983	2002*	
Hungary					
Paks 1	VVER 440/213	437	1974	1982	
Paks 2	VVER 440/213	441	1974	1984	
Paks 3	VVER 440/213	433	1979	1986	
Paks 4	VVER 440/213	444	1979	1987	

Reactor	Design Type	Net capacity in MW	Construction Start	Commercial Operation Start	Shut down date or scheduled
Lithuania					
Ignalina 1	RBMK 1500	1185	1977	1983	2005
Ignalina 2	RBMK 1500	1185	1978	1987	2009
Romania					
Cernavoda 1	Candu 700	655	1979	1996	
Cernavoda 2	Candu 700	655	1980		
Slovakia					
Bohunice V1-1	VVER 440/230	408	1972	1978	2006
Bohunice V1-2	VVER 440/230	408	1972	1980	2008
Bohunice V2-1	VVER 440/213	408	1976	1984	
Bohunice V2-2	VVER 440/213	408	1976	1985	
Mochovce 1	VVER 440/213	388	1982	1998	
Mochovce 2	VVER 440/213	388	1985	1999	
Mochovce 3	VVER 440/213	388			
Mochovce 4	VVER 440/213	388			
Slovenia					
Krsko	PWR 640	676	1974	1981	

* Start of testing operation

Source: IAEA 2003, PRIS Database

In the accession process to the European Union, phasing out nuclear power has become a hot issue. Nuclear safety does not fall under the *acquis communautaire*, as nuclear safety standards are the competence of national governments.

In July 1997 the European Commission published Agenda 2000, which laid out the proposal for the enlargement of the European Union. This document made clear both the importance that the Commission placed on nuclear safety and the timetable according to which action should be taken.

> *"The problem of nuclear safety in some candidate countries causes serious concerns to the EU, even independently of enlargement, and should be urgently and effectively addressed. It is imperative that solutions, including closure where required, be found to these issues in accordance with the Community nuclear acquis and a "nuclear safety culture" as established in the western world as soon as possible and even before accession. Public opinion is likely to be increasingly sensitive to nuclear safety as a consequence of some nuclear power plant problems in acceding countries, and this could affect major community policy developments in this field"* (EC 1997, p. 46)

Although the European Commission put forward proposals in November 2002 to introduce nuclear safety principles, the first step along the legislative road to the introduction of EU nuclear safety standards is still missing (Froggatt 2003). Despite this, Agenda 2000 called for an increase in nuclear safety to a standard dependent on the original reactor design.

At the end of April 2002 the EU's Vice-President de Palacio announced in the European Parliament that the time had come for *"common [nuclear] standards and control mechanisms which will guarantee the application of the same criteria and methods in the whole of enlarged Europe"*. In November 2002 the Commission's college finally discussed and adopted what became known as the 'nuclear package' (EC 2002a), which encompassed legislation on safety standards, uranium imports, and radioactive waste management strategies.

At the EU summit in Helsinki in December 1999 Bulgaria, Lithuania and Slovakia were formally invited to begin negotiating entry into the EU. The closure of the high-risk reactors was therefore an issue that needed to be resolved in the months leading up to the summit. Bi-lateral negotiations took place between the Commission and the countries concerned. As a result of these negotiations the following dates were agreed to:

Bulgaria: Closure of Units 1 and 2 in 2003. Closure of Units 3 and 4 in 2006

Lithuania: Closure of Unit 1 by 2005. Closure of Unit 2 by 2009.

Slovakia: Closure of Bohunice V-1 (2 units) between 2006-8.

Thus, as part of the accession agreements, eight reactors with a total capacity of about 5,000 MW are destined to close within the next decade.[22] In the ten East European countries currently preparing for entry to the EU, there are three reactors under construction: Cernavoda 2 (Romania) and Mochovce 3 and 4 (Slovakia). Temelin 1 and 2 (Czech Republic) are in test operation. But all the accession countries' entry into the EU has been jeopardised by the concerns associated with their nuclear power industries.

In October 2002, Lithuania's parliament (Seimas) approved a revised energy strategy calling for unit 2 of the Ignalina nuclear power plant to be closed in 2009, and for the closure of unit 1 by the end of 2005. This is in line with the revised energy strategy by the Lithuanian government earlier this year and confirms the premature closure of unit 2 in 2009, thus paving the way for Lithuania to join the EU in the 'first wave' of new member states in 2004. However, the strategy states that Lithuania will not close Ignalina-2 in 2009 if there is "insufficient foreign aid" available, and if "an unbearable burden for the national economy" would occur as a result of closure of the Ignalina nuclear units. Lithuania was promised € 405 million from the European Commission and twelve other nations in grants to help ease the financial burden of shutting down its RBMK Ignalina nuclear power plant (Baltenergy 2002). In 2002 two major investments, an interim storage facility for spent nuclear fuel and a steam/heat plant in Visaginas, were started.

Similar efforts are being undertaken to close down nuclear power plants in Bulgaria and Slovakia. In November 1999 the Bulgarian Government announced its commitment to close Kozloduy units 1 and 2 before 2003, and units 3 and 4 before 2008 and 2010. The EU committed € 211 million to help Bulgaria to close Kozloduy units 1 and 2 and for energy efficiency programs. In December 2002 unit 1 and 2 at the Kozloduy nuclear power plant were closed to conform to the accession agreements. The closure of blocks 3 and 4 is still very problematic. The government reaffirmed that it will close them and the Chapter on Energy in the negotiations has been closed. In 2003 there was a court ruling stating that it is not in the government's prerogative to take such a decision but this ruling did not have any effect. In April 2000 the European Commission approved a € 212.5 million loan for the upgrading of the two VVER 1000 reactors at Kozloduy, units 5 and 6. This was the first loan awarded by Euratom for over a decade and its first ever in Central Europe.

Outside of Russia, Bohunice in Slovakia was the first nuclear power plant within Eastern Europe and the NIS. In 1958 construction started on the A-1 reactor. This was a gas cooled heavy water reactor that began commercial operation in 1972, but was closed in 1977 following a partial meltdown of the core. In the 1990s decommissioning began at the plant, which it is estimated will cost 12 billion Sk (€ 270 million). In Slovakia, units 1 and 2 of Mochovce were put onto the grid as late as 1998 and 1999. Mochovce was originally intended to have four VVER 440/213s on site, and units 3 and 4 are still counted as "under construction". The two oldest VVER 440/230 reactors in Bohunice will be closed down. As part of the accession process negotiated in the run up to the Helsinki EU Summit in 1999, agreement was reached on the closure of the Bohunice V-1 units 1 and 2 by 2006 and 2008 respectively, although the original schedule was that they would be shut down before 2000. However, even these dates look uncertain. In July 2001, the Slovak Nuclear Regulatory Authority agreed to the further operation of the V-1 once the large back fitting program was finished, stating that the V-1's operational safety "is good, comparable with nuclear units of the same vintage operated in the developed Europe countries". Subsequently, the regulator awarded, in 2001, a ten-year operating licence for the first V-1 unit as opposed to the normal

[22] With the exception of Ignalina unit 2, past agreements should have led to a closure of all these reactors by 2000.

annual license previously awarded. The IAEA made several missions to and consultations with Bohunice during 2000-01 and backed the Slovak government in its decision to keep the plants operating. The European Union has offered €156 million for the decommissioning of Bohunice V-1.

The financing of the decommissioning of nuclear reactors in Central and Eastern Europe is a key issue, as is investing in the alternative energy sources to enable closure and measures to reduce the direct social impacts. This is why the EBRD was asked in June 2000 to administer three international funds to support the closure of the reactors in accession countries. The EU has firmly committed a minimum of € 310 million. Additional donor money - € 50 million - was given by EU member states and Norway and Finland in April 2002. Table 17 below shows the funds pledged to date, along with additional funds pledged at the end of 2002 by the European Commission.

Table 17. EBRD Administered International Decommissioning Support Funds

Country	Reactors	Decommissioning Fund	Current EC contribution	Additional EC Commitment
Bulgaria	Kozloduy 1-4	€ 96 million	€ 85 million	€ 105 million
Lithuania	Ignalina 1 and 2	€ 145 million	€ 115 million	€ 260 million
Slovakia	Bohunice V-1	€ 116 million	€ 110 million	€ 40 million

Source: EBRD 2002

The Czech Republic currently operates four VVER-440/213 reactors (4 x 440 MW) at Dukovany NPP, and is proceeding with the test operation of another two VVER-1000/320 reactors (2 x 1000 MW) at Temelin NPP. As the electricity generated in Temelin is destined for power export, the Czech Republic is facing severe problems with its neighbours Austria and Germany. Under pressure from growing opposition against Temelin in Austria and Germany, the Czech government made an agreement with the EU and Austria (the so-called Melk-agreement), in which the Czech Republic promised to make certain safety improvements. Halfway through 2002, the Czech Republic was criticised by the EU for not fulfilling two of those improvements. These improvements – separation of primary cooling circuit tubes at the reactor and replacement of faulty valves – have to be implemented before Czech entry into the EU.

Hungary has four VVER 440/213 reactors at one operating nuclear power plant at Paks. The Hungarian Atomic Energy Agency (HAEA) awarded licenses for Paks for ten-year periods, the most recent operating permits to Paks units 1 and 2 being awarded in 1997 and to units 3 and 4 in 2000. These reactors are being subjected to a €250 million upgrading program, which in addition to increasing the safety is also expected to increase power production by 10-15%. Although the operators of Paks have not yet applied, it is anticipated that the upgrading program will also allow the reactors' lives to be extended by a further ten years.

After the closure of the disputed nuclear units the EU accession countries might face shortages in their domestic electricity supply (e.g. in Lithuania) or a decrease of revenue from electricity exports (e.g. in Bulgaria). Taking into account the high cost of commissioning new nuclear units it is surprising that leading politicians from these countries still argue that their countries should build new nuclear plants to compensate for the closed ones. It is difficult to judge whether these plans will be acted upon or whether the politicians are just gaining short-term political dividends. As has been discussed above Lithuania is very heavily dependent on nuclear power for its electricity needs, and the idea of building a new nuclear power plant to replace Ignalina NPP is gaining increasing public support. In May, 2003 the president, Rolandas Paksas, asked for the support of the French President Jacques Chirac who expressed a willingness to cooperate on this matter (RFE/RL 2003). The president hopes that a decision on this issue will be made by 2005 (Latvidan Sia 2003). Led by the idea of an 'energy center' in the Balkans, certain groups in Bulgarian society have brought ideas for the completion of the construction of NPP Belene onto the political agenda. The building of two

VVER 1000 units started in mid-80 but was shelved in 1992 after the protests of the local community. Reports insist that the project will be resumed. Among the possible partners to have expressed interest in its completion are Skoda, AtomStroyExport, Westinghouse, Franceatome ANP, and Atomic Energy of Canada (Kovachev 2003). The project might be tendered in the middle of 2004. On the other hand the recent temporary suspension of Turkish electricity imports from Bulgaria, the investments in the modernisation of some of the existing coal-fuelled power plants and plans for the construction of new coal- and hydro-fuelled power plants impose questions about the feasibility of financing Belene NPP (the estimated cost for its construction is about USD 3 billion) (Bergasse pers. comm.). Regarding the electricity needs of Slovakia, the completion of units 1 and 2 of the Mochovce nuclear power plant solved the problem of the possible lack of capacity after the closure of Bohunice V1 (the two new reactors have the same capacity as the two old ones) (Lee 1997). Additionally, in the draft project pipeline for Bohunice the International Decommissioning Support Funds (IDSF) include refurbishment and construction of a combined cycle plant to compensate for loss of electricity generation after the shutdown of Bohunice V-1, even though the decommissioning of two V1 units is still delayed.

7.1. SUMMARY AND RECOMMENDATIONS

Phasing out nuclear power was on the agenda of several member states of the European Union even before the Chernobyl accident. Austria and Denmark cancelled their nuclear programs in 1978 and 1985, respectively, while Italy, the Netherlands, Belgium, Sweden and Germany have started to shut down nuclear power plants or have already completed their shutdown. Spain has a nuclear moratorium – as has Switzerland. In the Eastern European accession countries different political approaches towards the future of the nuclear industry can be seen. Only Poland has abandoned the construction of a nuclear plant, whilst nuclear programs have continued in the other accession countries even after the political changes.

In the accession process to the European Union, phasing out nuclear power became an important issue, along with the financing of the decommissioning process. Agreements to shut down high-risk nuclear power plants have been reached with Lithuania, Slovakia and Bulgaria. Further investment in alternative energy sources and funding to enable closure and measures to reduce the direct social impacts was offered.

Based on their access to renewable energy sources and natural gas, the accession countries should develop an energy strategy, in which the priority is placed on improving energy efficiency on the supply side and on reducing the energy demand of industrial customers and private households. Gas fired combined cycle plants in combination with renewable energy technology should substitute nuclear capacity in the next few decades. In line with EU policy, activities geared towards increasing end-use efficiency such as insulation improvements for old buildings and exchange of heating systems are recommended.

8. SUSTAINABLE ENERGY POLICY

All chapters of this report have included a section on the field-relevant summary of policies prevailing in the area of sustainable energy, and recommendations on how these could be improved. In this chapter we discuss selected cross-cutting policy fields, including the role of the Kyoto flexibility mechanisms and financing for sustainable energy pathways.

8.1. THE ROLE OF THE KYOTO FLEXIBILITY MECHANISMS IN PROMOTING SUSTAINABLE ENERGY PATHWAYS

This section aims to explore the effect flexible mechanisms under the Kyoto Protocol (KP) may have on a sustainable energy pathway in CEE accession countries. All the 8 countries subject to this study are Annex I countries that have ratified the KP. These countries are chief candidates for hosting Joint Implementation (JI) projects and for participating in Emission Trading (ET) schemes, which can promote the implementation of energy efficiency, renewable energy, and fuel switching projects. This section reviews the potential of and barriers to JI, and the conditions under which ET can influence the energy use of the selling country. JI is still at a very early stage and the details of the EU emissions trading scheme are under preparation, thus the evaluation of their future impact is difficult. Nonetheless, this study suggests that **the flexibility mechanisms may play a positive but rather limited role in the sustainable energy development of the region**.

8.1.1. Historical and present carbon emissions

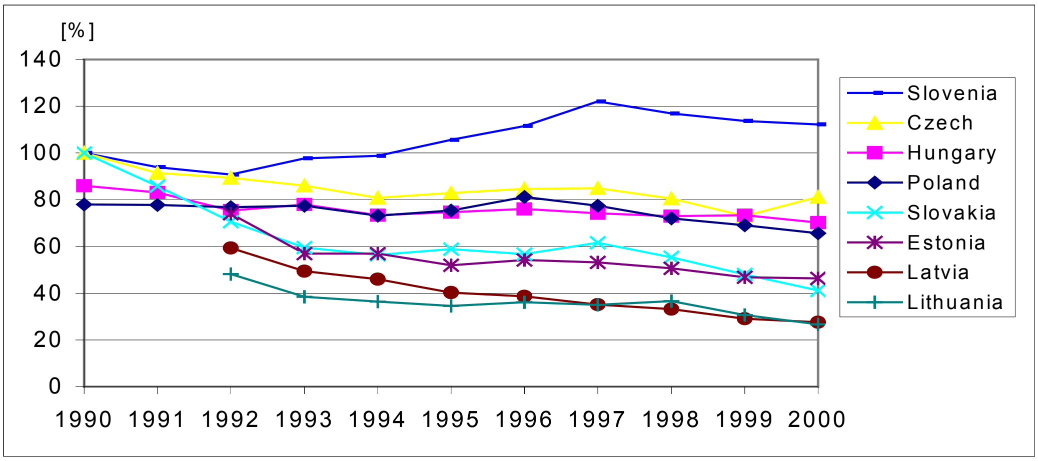


Figure 11. CO2 emissions of the 8 accession countries between 1990 and 2000 compared to base year (1990*)

*except Hungary (1985-1987) and Poland (1988)

Source: IEA 2002f

According to Figure 11, all focus countries experienced a decline of CO_2 emissions from fuel combustion in the early-mid 90`s, principally due to the economic recession. In the Baltic States and Slovakia emissions of CO_2 are presently around 30-40% of the base year and are still gradually declining (Figure 11). The emissions in 1999 and projections for 2010 compared to the Kyoto target are given in Table 18.

Table 18 CO_2 emissions in 1999 and projections for 2010 compared to the Kyoto target

	CO_2 emissions as % of target in 1999	2010 projections: Difference to target
Poland	75.1%	-39.7% to -112.7%
Hungary	78.1%	-2.5%
Czech Republic	79.5%	-1.8% to -11.8%

	CO_2 emissions as % of target in 1999	2010 projections: Difference to target
Slovakia	52.2%	+0.3% to -2.1%
Estonia	27.3%	-20.4%
Latvia	34.9%	-12.7%
Lithuania	46.1%	+11.7% to -5.2%
Slovenia	123.7%	n.a.

Source: Calculated from national communications for Baltic States and data from IEA 2002f for other states. Projections adapted from Armenteros and Michaelowa 2002.

As demonstrated by the table, the fulfilment of the Kyoto commitments will not cause major difficulties for most countries. An exception is Slovenia, which has already exceeded its 1990 baseline emission levels, and Lithuania may face problems following the substitution of its nuclear power plant by other sources. For Hungary projections forecast that in the BAU scenario overall emissions will exceed that of the target value by 2010 (3rd National Communication).

8.1.2. Potentials for Joint Implementation

For JI projects, emission reduction should be granted only to those projects which are additional. The determination of the baseline and the additionality of a project are highly complex tasks (Probase 2002). However, these are the most critical factors determining the eligibility of a project and the strictness in applying their rules influences the magnitude of the impact of JI on the energy sector.

The overall impact of JI projects on CEE energy sectors depends on their number and volume. These will be a function of the emission reduction potentials, administrative and institutional capacity, climate policies and investment climate. In the following sections, we provide a brief insight into some of these issues.

Scope for JI. Energy and carbon intensities reflecting energy efficiency and fuel switch potentials are good indicators for the scope of JI projects. In the sections above we have devoted considerable attention to energy efficiency and renewable energy potentials and energy intensities. Regarding carbon intensities, Estonia, the Czech Republic and Poland perform poorly due to their heavy reliance on oil-shale or coal, creating a significant window for fuel switch projects.

Options for low cost mitigation. "While marginal abatement costs in the EU15 are often estimated to be in the triple digit $/t CO2 range, those in accession countries will often be negative or in the low single or double digit-ranges" (Armenteros and Michaelowa 2002). These lower comparative mitigation costs are thus an important factor making the region attractive for JI projects.

The country studies performed by Maly *et al.* (2002) explored the options for low cost GHG reduction in CEE. They suggested that the best options lay in the following sectors:

- fuel switch to biomass for Slovakia and the Czech Republic;
- improvement of energy efficiency and promotion of renewables in Poland;
- improvement of energy efficiency of the thermal insulation of the housing stock and modernising the district heating (DH) and power generation sectors in Lithuania;
- improvement of demand side energy efficiency in residential and commercial sectors in Slovenia.

Energy efficiency measures. Demand-side energy efficiency (DSEE) measures are among the top priorities in the climate policy of most countries. The ENVIROS study (Maly *et al.* 2002) has pointed out the high potential for improvement on both the supply and demand sides. According to Evans (2001b), in spite of the great potentials for DSEE, it is unlikely that many JI projects will be conceived. This suggestion was based on an analysis of 65

Activities Implemented Jointly (AIJ) projects from the energy sector in countries in transition. The analysis pointed out that although DSEE projects are usually cost-effective by themselves, high transaction costs, the difficulties of trapping benefits of energy savings by external investors, along with the disconnection between end user energy savings and the emissions associated with energy production hinder their implementation as JI projects. Bundling of projects can help overcome the high transaction cost (Evans 2001b).

Renewable energy. Joint Implementation can be seen as a tool fostering the creation of markets for renewable energies. As described above, there are great prospects for renewable energy (RE) in most focus countries, mainly for biomass projects (Maly *et al.* 2002: Poland, Slovakia). Boiler conversion to biomass may be one of the most cost efficient options, a finding supported by the pilot phase of JI: out of 73 projects, 27 were small boiler conversion to biomass Activities Implemented Jointly (AIJ) projects (see Table 25, Appendix IV). In his study on Swedish AIJ implemented in the Baltic States, Springer (2002) found that switching to bio-fuels achieved greater reductions of GHG emissions than energy efficiency projects.

Fuel switch. Some countries like Hungary limit fuel switch to fossil fuel projects to 15% of all carbon mitigation projects that can be covered by JI (draft regulation for JI 2003). In addition, developing new energy sources in the framework of JI may be complicated. Slovakia, for example, is interested only in direct reductions, thus does not consider some renewable energy projects eligible for JI (Point Carbon and Vertis Environmental Finance Ltd. 2003b).

The impact of EU Accession on JI potentials. With the enforcement of the environmental standards of the *Acquis, the scope for JI activities will inevitably be reduced*. Project baselines, eligibility and thus feasibility will be decreased, as part of the abatement will be mandatory. However, the extent of this reduction will vary depending on transitional arrangements: a country's emission baseline decreases when environmental standards become obligatory (Probase 2002); it also depends on the strictness in best available technology determination (Armenteros and Michaelowa 2002), early actions (Gaast 2001) and eligibility for Track-1 JI. Nondek *et al.* (2001) have calculated that the true JI potential of the Czech Republic taking into account accession in 2010 will be only about 4% of the "technical" potential that they estimated from emission reduction measures adopted between 1995-2000.

EU CO2 emission trading will also reduce the scope for JI activities. Accession countries will need to join the EU ET scheme covering a substantial fraction of the relevant industries and energy sector. This means that the participants in JI projects and EU ET may often be the same. The opportunities for JI projects will be reduced as the majority of entities will be involved in ET, unless it is integrated into the European ET Directive making participation in the EU ET possible through JI. Since the "linking directive" is in a preliminary draft format at the time of writing of this report, it is difficult to comment on this issue. However, some national governments are concerned about the draft valid in October 2003, as they are concerned that in its present form it will discourage foreign investment in emissions reduction projects, especially by non-European investors, and will directly eliminate one of the important financial sources of technological restructuring in the energy sectors of CEE countries without offering a comparable substitute mechanism (Feiler pers. comm.).

Ranking – potentials for short and medium term JI. Two recent reports ranked CEECs according to their attractiveness for JI investments. Both studies found Slovakia and Romania to have the best prospects for JI. However, Slovakia stated that it gives preference to ET. In the ranking of Point Carbon and Vertis Environmental Finance Ltd. (2003a) the Czech Republic, Poland and Hungary follow in that order. The main drawback of Poland is the lack of political commitment to perform JI. The EBRD (Fankhauser and Lavric 2003) report suggested that the Czech Republic, Hungary and Estonia have good short-term potentials for JI investments, as they have the least risky business environment. Poland, Latvia and Lithuania are considered moderately attractive. The future of its nuclear PP will determine the scope of JI in Lithuania. The nuclear PP will most likely be replaced by thermal PP, which will increase the baseline carbon emissions and carbon intensities of the country, thereby increasing the scope of JI.

Planned and ongoing JI activities. Reliable and comprehensive information on accepted projects is hard to obtain. In April 2003, Hungary had 1 agreed and 4 proposed, Slovakia 1 agreed and 1 proposed, Poland and the Czech Republic had one agreed, and Estonia 1 proposed project with ERUPT (JIQ 2003). Estonia and Finland have a mutual agreement and 4 JI projects are under preparation (Estonian Ministry of the Environment 2002). On the Polish UNFCCC Executive Bureau web site 5 JI projects are mentioned, but there is a lack of political commitment since the government changed in 2001, which halted the process. In the policies of the Baltic States and Hungary priority is given to JI over ET (Maly *et al.* 2002). The Czech Republic set aside 1 or 2 million tons of $CO_{2\ eq}$ annually for JI projects in the first commitment period and is planning to sign an agreement with the World Bank Prototype Carbon Fund (PCF) to reduce a total of 0.65 Mt $CO_{2\ eq}$ by 2012 (Fiala pers. comm.). Slovakia will allow 10 Mt $CO_{2\ eq}$ for international transfers of ERUs and AAUs during the first commitment period (Point Carbon and Vertis Environmental Finance Ltd. 2003b). Hungary is committed to be involved in JI to 2 Mt $CO_{2\ eq}$ per year. The smallest project eligible has to reduce a minimum of 0.01 Mt $CO_{2\ eq}$ anually (Ministry for Environment 2003), while the Czech Republic requires a minimum of 1 Mt of annual reduction. These regulations encourage bundling of smaller projects.

8.1.3. Potentials for sustainable energy promotion through emission trading

The focus countries will probably have considerable surplus emission reduction credits even in the absence of mitigation measures. Thus, it is unclear how much emission trading will support EE, RES or fuel switch measures. Emission reduction credits under the Kyoto Protocol can be traded on the international carbon market. One of the few ways in which ET can support sustainable energy development is the targeted investment of the revenues from ET (if any) into the development of renewables and energy efficiency (Evans 2001a).

The EU Emission Trading Directive and its regional relevance is discussed elsewhere in this report.

8.1.4. Conclusion and recommendations

In spite of the good potentials and a sound investment climate, JI opportunities are not abundant among Candidate countries. Along with high transaction costs, both investors and host must take relatively high investment risks. Moreover, EU accession and the involvement in EU ET further decrease the scope for JI. Nonetheless, implemented JI projects will assist the development of sustainable energy paths, principally through boosting renewable, especially biomass projects. The role of ET is more controversial, due to questions about whether it can promote energy efficiency, facilitate fuel switch and support renewable proliferation indirectly.

In line with some government recommendations, the authors of this report also see it as crucial that the "linking directive" allows for the continued availability of project mechanisms in areas covered by the ETS, and ensures the availability of ERUs for demand-side energy efficiency measures and RES projects within the sectors covered by Directive. It is suggested that instead of entire energy installations, only those reductions would not receive allowances that are the result of JI, as the latter are eligible for ERUs.

8.2. THE IMPACT OF EU ACCESSION AND STRUCTURAL CHANGES ON SUSTAINABLE ENERGY POLICY

Other chapters discussing various sectoral issues and policies have covered the impact of EU accession and structural changes on sustainable energy policy. In this section cross-cutting issues are discussed.

As noted several times in this report, EU accession, including the adoption of the *acquis communautaire*, represents the most important milestone in accession countries towards the adoption of sustainable energy policy goals. However, the adoption of legislation may not itself be sufficient. While the legislation may set ambitious targets and goals, implementation and enforcement are going to be crucial issues. Beyond transposing the directives into national legislation, it is also essential to develop and put into place the necessary action plans which form the roadways towards implementation. It is also crucial to develop the required institutional framework, develop skilled capacity, and devote substantial resources to the proper implementation of the acts.

It is not sufficient to have separate acts and laws promoting sustainable energy pathways. Sustainable energy transitions require, perhaps more than any other policy field, an integrated approach: environmental, urban and rural planning, regional development, social and fiscal policies all need to recognise the importance of sustainable energy pathways, and need to incorporate elements of them. As well as adding new institutional capacities, which may be costly and therefore difficult, is also important to strengthen the organisational framework of governmental, regional and local institutions capable of implementing the adopted legislation (Wnuk 2002). There is significant scope for future action in this field in accession countries, where energy policies and institutional frameworks are still fragmented and sometimes torn between the goals of various policy fields, and EU-level policies may facilitate this process.

Regarding the concrete impact of EU accession on sustainable energy pathways, there has been little quantitative analysis. There should be further research carried out to deepen our quantitative understanding of the implications of increased energy efficiency, CHP, and RES as a result of EU accession on the national economies of the accession countries (Wnuk 2002), including the social and employment aspects.

8.3. FINANCING SUSTAINABLE ENERGY PATHWAYS

Clearly the largest challenge to the implementation of sustainable energy pathways is the question of where the funding/financing can come from. It is not the purpose of this document to provide a comprehensive review of financing/funding mechanisms in the CEE region (this alone could fill at least such a report); rather, it will give advice on how EU sources could further enhance the proliferation of such paths, and highlight a few best practices for financing mechanisms which have proven effective in the region for the facilitation of sustainable energy initiatives/projects.

8.3.1. EU support and financing instruments in the field of sustainable energy available for CEE

Accession countries have been eligible for certain EU R&D funding sources, such as Save, Altener, Thermie, Synergy, and the Framework Programmes for a number of years already. When they become full members of the EU, the number and size of accessible EU funding opportunities for the CEE countries will substantially increase, and not only in the field of R&D, but also for the implementation of certain types of initiatives.

However, there are some concerns related to these increased funding opportunities. First, as full members, many of the EU sources will require a substantial amount of local funding to match that from the EU (often as high as 50%). Governments, municipalities and the private sector in accession countries will need to allocate considerable resources in order to mobilise EU-Euros. It is highly questionable whether CEE governments and municipalities, already typically highly indebted, are willing and able to set aside such a magnitude of resources in this field. It is recommended that the EU pays special attention to this issue, and helps the new MSs in this process.

Another concern is the target areas where the majority of the structural, regional and social funds are going to be utilised. Often project proposals will be submitted by regional authorities, which may prioritise short-term infrastructure development needs (such as highways and traditional energy infrastructure developments) rather than more sustainable, long-term solutions (reinforcement or development of public transport and rail shipping, renewable energy, etc.). This is a very unfortunate situation since these funds could make a significant difference towards sustainable energy developments.

Therefore, it is very important to assess the sustainability impact of the projects on the energy sectors to be funded by these sources. Then, a rethinking of the distribution mechanisms should be initiated about how to better adapt them to the *long-term needs* of the accession countries, and therefore the enlarged EU. It would be a major step forward if sustainable energy initiatives could become priority areas for these funds as opposed to development projects stalling sustainable development in energy pathways for decades. This could include earmarking some of the funds for projects promoting RES, DH, CHP and energy efficiency; and targeting some social funds to increase awareness of and literacy concerning climate change, energy efficiency and conservation measures, importance of renewable energy, as well as to retain employees losing their jobs in traditional energy professions (such as coal mining) so that they can engage in new areas such as energy efficiency/RE.

8.3.2. Best practices and case studies

In this section we will highlight a few, selected case studies and best practices which the authors believe can be especially relevant for the funding/financing of sustainable energy pathways in the region, and can be relevant for European level instruments as well.

It is important to recognise that the countries under discussion have severe budget constraints, and have many other immediate economic goals on their public agendas, so it is unlikely that large amounts of local public funding will be available in the near future for the implementation of sustainable energy pathways. In addition, multilateral and international aid in this area, such as that from USAID, Phare, etc, sources which were prevalent after the fall of the communism, are gradually being discontinued with EU accession. Therefore, alternative ways of financing and funding, such as the involvement of private capital, will become increasingly important in the region.

In the following sections we describe the prospects of public-private partnerships for financing sustainable energy investments, and a successful program from the IFC/GEF (International Finance Corporation/Global Environment Facility), which could stand as a positive example for potential future EU funds in the field.

Prospects for Public-Private Partnerships

Public-private partnerships (PPP) can be an ideal means of implementing sustainable energy projects in the capital-short public sector. Such cooperation is becoming increasingly common in the present EU member states, and there are some positive examples from the accession countries as well. However, there are strong barriers in this region hampering this important instrument. Such barriers include but are not limited to the following:

- There is a strong resistance towards the involvement of private businesses in the public sphere. The perception is that it is not right if private enterprises make large profits from limited public funds. However, if the private sector can offer additional capital, expertise, skills and experience, the result could be a win-win situation.
- A typical vehicle for public-private partnership in the field of energy efficiency is through performance contracting, or the involvement of ESCOs. However, present legislation in many countries is not favourable towards the concept of performance contracting or the participation of ESCOs.
- Present public procurement laws can hamper, or at least can often make third party financing difficult to apply.
- There is little understanding and limited experience of the concept of performance contracting in the public sector in the region. Education of relevant public officials and higher visibility of successful projects can make a major difference in overcoming this mainly psychological barrier.
- The lack of energy use data and monitoring make it difficult to establish baselines and estimate savings potentials, and therefore to develop reliable, mutually acceptable payment arrangements.

Therefore, the **following policy instruments/measures can be recommended** in this field:

- Since one of the key barriers is the lack of awareness, understanding and relevant education, higher visibility of implemented projects, a clearinghouse of relevant information, model contracts, and the training of relevant officers, bankers and businesses can make a significant difference in the field. These tasks are best implemented under international collaborative arrangements; therefore EU efforts and funds directed to these areas are ideal means to achieve these goals. On the positive side, there are already EU projects supported in this area.
- Since local capital and experience may not be sufficient in the area in the near future, it is important to facilitate the mobilisation of foreign (such as EU) capital and businesses in accession country public sectors. This requires the establishment of fora where the two sides can meet and evaluate the options for partnerships. Again, the EU can play an instrumental role in this direction as well.
- Public procurement legislation will need to change to accommodate several existing and incoming directives. However, there is a remaining need to evaluate public procurement laws in accession countries from the perspective of their accommodation of public-private partnerships, i.e. performance contracting and third party financing, as well as energy efficiency and perhaps renewable energy provisions.

The Energy Efficiency Finance Programs of the IFC/GEF

The International Finance Corporation has recognised that, contrary to the general perception, the key barrier to the involvement of third party financing (TPF) in the region is NOT the lack of funds, lack of bank loans, high interest rates, or the lack of bankable project opportunities. According to their view (Circene and Dasek 2003), the two key barriers are the perception of high credit risk by financial institutions, and the poor capacity of the parties involved to prepare and present bankable projects. Solutions could include the sharing of risk by providing partial guarantees for loans, and providing targeted technical assistance to financial institutions, ESCOs, and end-users.

Therefore, the IFC launched in 1997 the first phase of its Hungarian Energy Efficiency Co-financing Program (HEECP) with 5M USD from the GEF. Encouraged by the success of the program, phase two was launched in 2001, funded by the IFC, GEF, and bilaterals. Recognising the important role of the program in Hungary, a regional program was launched in 2002, with the title “Commercialising Energy Efficiency Finance”, or CEEF, covering the Czech Republic, Latvia, Lithuania, Estonia and Slovakia. The USD 18M grant from the GEF is complemented by app. USD 30 – 75M in guarantees from the IFC, and over USD 1M as technical assistance from various countries.

The program envisages leveraging USD 225M in private capital investment in EE projects in the five countries, and a reduction of 7.4M tons of CO_2.

The success of the HEECP program highlights that the mechanisms applied by these two programs can overcome important barriers to TPF in sustainable energy projects. *Therefore, they can serve as models for future EU (EBRD, EIB) loans and financial assistance in the field for accession countries.*

9. IMPLICATIONS OF SUSTAINABLE ENERGY PATHWAYS

The transition from centrally planned to market economies has had a significant social impact. The increase in energy prices and the lifting of direct subsidies were among the factors that had a negative impact on the affordability of energy services for a large share of the population, with low income groups particularly hard hit. In the following section some of the social aspects of energy restructuring will be discussed.

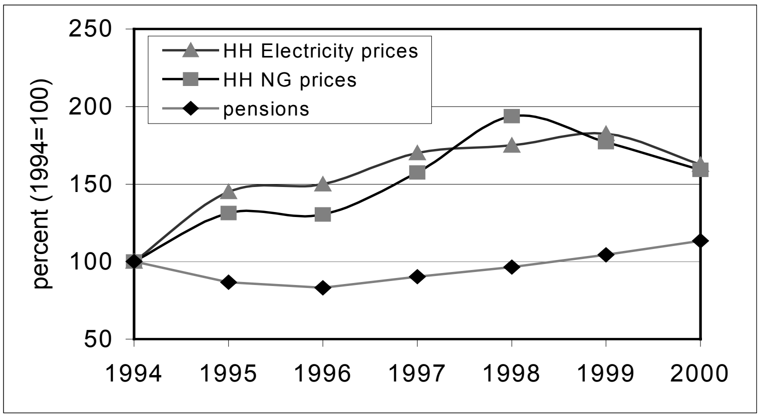
9.1. FUEL POVERTY AND LOW-INCOME CONSUMERS

Income inequality and poverty has increased in transition countries since 1989. As an illustration of how much poverty has increased consider that "in 1998 one of every 20 people in transition economies had per capita incomes below US$ 1 a day, up from fewer than 60 a decade before" (World Bank 2002, 6). Inequality is also growing. Table 26 in Appendix IV shows an increase in the Gini coefficient[23] for all countries (Fox 2002). Inequality tended to increase more in those countries where reform was slower.

The combination of increased energy prices, poverty and inequality has led to a situation where the poor often cannot afford to pay for their basic utility services[24]. In the countries in question many households are fuel poor. For example in Slovakia in 2002 households spent 11% on their energy bills on average and this percentage was about 18 to 19% for the poor (Voll and Juris 2002). In Poland average household expenses on fuel are also around 10% of disposable income (ARE s.a. 2002). For a trend in the Share of disposable income spent on fuel by households in Poland and Slovakia, see Figure 19 in Appendix IV.

Some social groups have been worse affected by these changes than others. For instance, Figure 12 demonstrates that Hungarian pensioners have been hit exceptionally hard by rising energy prices, because energy prices have risen much faster than pensions.

Figure 12. Comparison between pensions and the prices of natural gas and electricity for households (HH) in Hungary, 1994 – 2000



Sources of data: EC 2002; Drucker pers. comm.

The **nonpayment of utility bills** used to be one of the major problems of the post-communist countries. The reasons behind this phenomenon are complex. Some consumers were unable to pay their bills but also there was and still is a lack of proper metering, dissatisfaction with the service, cash flow problems in the budgetary organisations and lack of general payment discipline (ERRA/LGI 2002). The governments and distribution companies have adopted a

[23] Gini Coefficient measures the degree of inequality in the distribution of income in a society and ranges from 0 (perfect equality) to 1 (total inequality)

[24] According to the UK definition (Ministerial Group on Fuel Poverty 2001) of fuel poverty is as follows: "a household is in fuel poverty if, in order to maintain a satisfactory heating regime, it would be required to spend more than 10% of its income on household fuel use".

range of mechanisms to solve the problems with arrears and nowadays it is not so acute a problem in the CEE countries as it used to be. One of the successful methods applied was cutting the electricity of nonpayers during mild winter periods (ERRA/LGI 2002). In Poland and Estonia the selling of assets is a common practice which in Poland for example may contribute a recovery of about 90% of the losses from nonpayment (ERRA/LGI 2002).

9.2. SOCIAL ENERGY SUBSIDIES

Because of the rise in energy prices, which has led to an increase in fuel poverty as discussed above, establishing an adequate safety net that provides basic utility services has become important in the post-communist countries. There are two basic policy approaches to address these issues: (1) to develop a targeted social safety net program which will help low income families to satisfy their basic needs and to pay for their basic utility services and (2) to use energy sector regulatory mechanisms to subsidise energy supply. The first option is not commonly used in the region. The second, as was mentioned above, creates distortions in the markets and instead of improving efficiency it might lead to inefficient energy consumption. On the other hand it is one of the few mechanisms in the CEE countries that can support the low-income groups within the population. That is why special attention should be placed on applying such assistance in a way that will not only cover the energy bills of low-income people but will also lead to a long-term decrease of their energy consumption (such as support for purchasing of CFL bulbs, improvement of insulation). Unfortunately, programs that help the low-income consumers in the long-term were not identified in the present research. Some of the practices of the governments to assist these consumers are summarized in the following case studies.

Hungary: In 1997 the "Energy Fund" was introduced simultaneously with the rise in prices, to maintain the solvency of the most seriously affected groups in society. Besides the government various domestic power plants, power suppliers, MOL, the oil and gas company, associations of the municipalities and consumer protection associations also participated in the creation of this fund. The demand for this subsidy was great since 400,000 applications were submitted, of which 330,000 received a subsidy. After this one-time subsidy, the government adopted more complicated subsidy structures. Municipalities receive money from the central budget and pay based on targeted programs, for example to families with children (ERRA 2000).

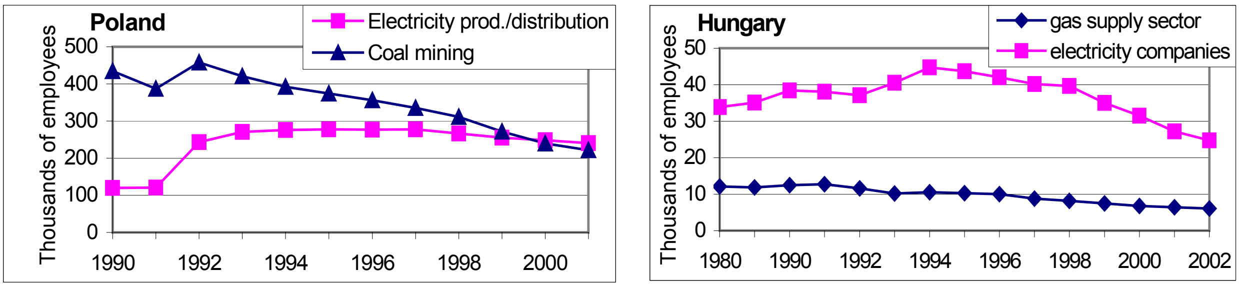
Lithuania: no low-income household energy problems are addressed by Lithuanian legislation except for heating, which is subsidised by the state and municipal budget for residential consumers if their bill represents more than 25% (heat) and 5% (hot water) of their income (ERRA 2000).

In **Slovakia** since 2000 there is a targeted subsidy program called the Housing Allowance (HA). The aim of this program is to help low income consumers to meet their rental and utility expenses. The Housing Allowance program fails to perform its goal efficiently for a number of reasons (Voll and Juris 2002). To name a few of the most important: the HA is set at the level of housing expenses of a rental apartment, thereby excluding many otherwise eligible families, e.g. those living in their own houses; the HA subsidy creates a disincentive for energy conservation by clouding the relationship between rental and utility expenses; and other important shortcomings having to do with other eligibility criteria and likely problems with financing the subsidy from the state budget (Voll and Juris 2002).

9.3. UNEMPLOYMENT

Restructuring results in competition, and privately owned energy producers will look for profit maximising and cost cutting opportunities like any other competitive producers. This can result in layoffs due to overmanning and to the need for more qualified employees (Krishnaswamy and Studdings 2003). Based on the scarce statistical data about energy sector employment in the CEE region it can be stated that in general employment is decreasing. For example Frogatt and Takacs (2002) point out that for the Czech Republic in the period 1995-2001 the number of jobs in the energy sector decreased by 30%. In Poland the number of people working in the mining sector almost halved in the period 1990 – 2001 (see Figure 13, below). The main reason for this can be found in the higher costs that need to be paid for the existing coal-fuelled power plants to be retrofitted in order to meet the national environmental standards as well as the future requirements of the Large Combustion Plants Directive (as discussed in section 5.3.2, page 33). On the other hand employment in the electricity sector, while experiencing some fluctuation, has kept relatively constant (although slightly decreasing) for Poland and Hungary in recent years. As can be seen in the graph, there was a doubling of the people working in the electricity generating sector after 1991 in Poland, which started to decline after 1997.

Figure 13. Employment in the electricity and coal mining sectors in Poland and in the electricity and gas supply sectors in Hungary



Sources of data: ARE s.a. 2002; Hungarian Energy Office 2003

The two figures above are in line with the development of the unemployment rate in the electricity, gas and water supply sectors in the last decade, which is presented in Figure 19 in Appendix IV. In 2001 the countries which had the largest share of unemployment in these two sectors were Slovakia, Lithuania and Latvia. Hungary had the lowest rate (one-quarter of that in the above mentioned three countries) among the seven investigated countries.

To find a long-term solution to the problem of unemployment in the energy sector, new, more environmentally friendly jobs should be considered. For example, an EU-wide study researching the impact of the introduction of renewables on employment predicts that there will be a net gain of jobs from the introduction of renewables in the EU, namely 900,000 new jobs by 2020 (Ecotec Ltd. 1999). In the accession countries there is little information on the extent of the impact of a sustainable energy pathway in the CEE region. However, from the existing evidence and by projecting the EU results it can be inferred that increasing the share of renewables will have a positive impact on the labour market in all countries.

Case Study: Potential for Employment in Renewable Energy Sector in Poland

Calculating with the set goal of reaching 7.5% renewables by 2010 and 14% by 2020, thus doubling their share in TPES, increased production of renewable energy will create new jobs (ESD 2001). The Safire model predicts that more than 30,000 new jobs will be created in the renewable energy sector in Poland by 2010. However, one should also take into account a shrinking number of jobs in industry utilising traditional energy sources. Nevertheless, compared with utilisation of conventional energy sources, renewable technologies are more labour intensive. For example, while for a traditional coal-fired power plant a factor of 0.01-0.1 job/GWh can be assumed, the same factor is 0.1-0.9 jobs/GWh for renewable technologies. Moreover, certain technologies, such as wind, solar and hydropower create jobs in the power equipment manufacturing sector. Therefore the net effect on employment in Poland of introducing renewable energy will be positive (ESD 2001).

Policies aiming at increasing the share of renewables will have another positive aspect, namely the use of biomass as an energy source will create more jobs in the rural areas. This aspect is very important in the light of the EU quotas for agriculture that the accession countries have to meet. The land which has to be set aside because of these obligations could be cultivated with energy crops. Plants that need less intensive agricultural practices and can be used as an energy source while creating jobs in the rural areas should be cultivated. For environmental reasons this approach provides solutions for several problems at the same time, including employment, regional development, and providing an alternative for laid-off energy and agriculture sector employees (mining, coal power, etc).

9.4. SOCIAL PROBLEMS IN DISTRICT HEATING

One of the most problematic areas in terms of subsidy removal and adoption of market mechanisms while keeping prices affordable for consumers is the district heating sector. Households connected to these systems are now facing the combined impact of much higher international energy prices as a result of the opening up of the energy markets and the accentuation of energy wastage as these often inherently inefficient systems age. Thus being connected to district heating sometimes has become an expensive treat, especially for the poor. For example in 1996 in the Baltic states an average family connected to district heating paid 20 to 40 % of their disposable income to cover utility expenses (Gochenour 2001). The share of these expenses is even higher for the poor.

In the past few years many people have started to disconnect from DH. This problem is very serious in the Slovak Republic as in some towns about one third of clients have given up the service (KWI AEC and ECN 2002). The reasons mentioned in the study of KWI AEC and ECN (2002) are dissatisfaction with the service provided, low natural gas prices and lack of transparency in the billing. In this case the price for the remaining consumers becomes higher thus worsening the situation still further. The problem of disconnecting can be solved by the introduction of legislative acts, as was done in Hungary in Poland. According to the Hungarian Law on District Heating of 1998 all the flat owners in a building should agree if someone wants to disconnect.

Case Study: Distorted gas prices in favour of individual heating in Czech Republic, Hungary and Slovakia

The governmental support for the gas sector in the form of subsidies in the past and favourable policies as well as cross-financing among users in the Czech Republic, Hungary and Slovakia has led to a competitive advantage for individual and central gas heating over district heating. For example, the subsidy on the price of heat from district heating in the Czech Republic was removed in 1998 but the subsidies for gas and electricity were only withdrawn in 2001. This created more favourable conditions for individual heating (Gochenour 2001). In Hungary cross-financing for household gas prices are disadvantageous for the district heating companies (Cherubin 2003). In Slovakia the natural gas prices are lower for households and smaller consumers than for the DH companies (ECB 2002b).

Apart from preventing people from giving up district heating services governments should take account of the social value DH provides and help in some way the low-income consumers. For Poland it was found that about 11% of the customers of DH fell into the low-income category, compared to the EU where this figure is only 4% (Cherubin 2003). Subsidies and cross-financing are considered an inappropriate way of solving the problems of this group of people and the DH sector as a whole as this does not create incentives for more efficient energy consumption and results in market distortions (IEA 2002e). Measures to cut the energy consumption of the consumers should be considered and funds that support the poorest segment of the society in improving energy efficiency should be established.

Case study - Metering in Budapest

Lack of district heating metering is another problem in the CEE region. According to a World Bank report (Gochenour 2001), almost all of the buildings supplied by DH in the cities in Poland, the Czech Republic and Hungary have DH meters, but the experience from some CEE cities does not prove this to be precisely the case. For instance in Budapest, which constitutes 30% of the households provided with DH in Hungary, the meters are rarely taken into account in calculating the bills because of a lack of will on the part of consumers and the DH companies themselves (Sigmond pers. comm.). This situation is now changing as since July 2003, it is obligatory to use meter readings in billing (Sigmond 2002). Still, this metering is compulsory only at the level of the local substations, which in many cases deliver heat to up to 1000 dwellings. This makes the dividing of the consumption among the users a very difficult and imprecise task. Individual metering at the household level can be introduced only if the consumers pay the additional cost of the necessary equipment and only if the heat delivery pipelines to the apartments are installed horizontally, which is mostly not the case in Budapest (Sigmond pers. comm.).

This example demonstrates that there are a lot of problems still to be addressed in the sphere of district heating, and even when there are efforts to improve the present situation the change can be accomplished only very slowly and needs a considerable amount of investment.

9.5. SUMMARY AND RECOMMENDATIONS

The transition from regulated and heavily subsidised energy prices to market-based tariffs has increased the economic burden on the population of the countries of the CEE region. Due to increased inequity and poverty, and in particular fuel poverty during the transition period, governments have adopted various mechanisms to ease the burden especially on the low-income segment of consumers. The most commonly used method in the EU accession countries has been subsidies targeted at the poorest consumers, most commonly by covering part of their energy bill. This method can be considered only a temporary solution of the problem as it does not contribute to decreasing consumption and hence declining energy bills. An alternative to this approach is the creation of specially targeted assistance programs providing funds for improving household energy efficiency. In this way the burden on consumers will be less, as the energy bill will decrease. In order for this to be accomplished supporting mechanisms to improve energy efficiency aimed at low-income people should be established either at a national or municipal level. Consumers can be helped in a variety of ways, ranging from direct assistance, such as assistance in loan payments, to more elaborate packages (Aistars 2002). These initiatives and other measures for reducing energy consumption that can be accomplished at a very low price should be widely advertised. In order for such programs to be more successful, cooperation between governments, municipal authorities, NGOs working in this field, and owners' co-operatives should be established.

The other major social issue connected to energy reforms is employment. Employment in the CEE energy sector is declining. When obsolete power and heat plants which are unable to meet the EU or national environmental standards and/or are inefficient from an economic prospective are closed, alternative employment opportunities should be created. This will also be true for the people now engaged in agriculture who will lose their occupations if production and export levels have to be reduced because of EU quotas. An alternative could be employment in the renewable energy and energy efficiency sectors, which also have the advantage of creating regionally based occupations. For this reason the governments should develop favourable conditions for renewables (see recommendations in section 6.6. , page 48) and the introduction of energy efficient technologies. This will contribute to the increase of the sustainability of the energy path from both the environmental and social perspectives.

PART THREE: SUMMARY AND RECOMMENDATIONS:

10. EU ACCESSION AND THE POSSIBILITIES FOR SUSTAINABLE ENERGY TRANSITIONS IN CEE: SUMMARY

10.1. GENERAL SUMMARY

The analyses in this report have demonstrated that EU candidate countries have undergone profound and often painful structural changes as a result of the accession process. Considering the relatively short period since the start of the economic transitions, they can also document considerable improvements in their efforts and achievements towards more sustainable energy sectors. It is very important to understand that the 8 post-communist accession countries are very diverse in terms of their wealth and the depth of their economic recession; the dynamics of their market and energy sectors reforms; their achievements in cutting energy intensities and relying on renewables; and the introduction of sustainable energy policies. However, it is clear that there is still considerable need for further improvement even in the most advanced of the accession countries, and that there still exists an important gap between the levels of energy sector sustainability of present and future EU member states, as well as between the ambitions and commitment of their energy policies to promote sustainable energy pathways in comparison with present MSs.

At the same time, many aspects of sustainable energy pathways are extremely beneficial for these countries from other perspectives as well. For instance, further **improvements in energy efficiency** in these countries, among many other generally applicable benefits, **can ease the burden of paying energy bills after drastic tariff hikes**; can **improve economic competitiveness** and release capital for other investments; will reduce the in places serious environmental implications of energy production; and will **decrease energy dependence on foreign imports** (often coming from a single source) and thus **increase sovereignty**. Along similar lines, promoting renewable energy generation, among other benefits, can help countries with nuclear reactors due to be shut down in replacing generation capacity; can improve energy sovereignty; can boost local and regional development in less developed areas; and could relieve some of the social burden of EU-imposed agricultural land set-asides and increasing unemployment in the coal industry due to the shutting down of obsolete facilities, through offering regional employment opportunities and an alternative use of land (biomass).

Perhaps one of the most important barriers to more ambitious efforts towards sustainable energy paths in these countries is rooted in the low level of environmental awareness and the relatively low priority of environmental goals on personal and political agendas. Due to the economic recession and the low social and financial security of the population compared to that enjoyed under the socialist regime, people attach little importance to the sustainability of development and environmental progress, as compared to economic, financial and social improvements. Therefore, if their constituency does not place a large emphasis on these issues, it is unreasonable to expect governments to be aggressive about environmental and sustainability objectives beyond levels required by international commitments and the EU.

There are two ways to break out of this vicious circle (no demand from voters – no actions by governments – no increase in awareness). One of them is to consciously and aggressively **improve the environmental awareness of the population** through education and information programs. With a gradual change in public thinking and moral values, combined with further economic and social stabilisation, voters may exert more pressure on their political representatives to act in the direction of more sustainable development. However, due to the considerable inertia in people's attitudes and thinking, this path is going to take a long time.

The second option to influence CEE governments in adopting environmentally more ambitious policies is the top-down way: external pressure. The EU accession process has demonstrated that the EU is a (if not the) key force in shaping energy policies of CEE countries.

Therefore, **in the short-term EU-level policy-making to promote sustainable energy pathways in accession countries will remain essential, as opposed to national initiatives in this direction (such as in present MSs)**.

However, the key issue is the effective implementation of EU-level energy policy in these countries. For instance, with regard to the Directives related to energy: the formal transposition of directives into national legislation has often proved insufficient in CEE countries to ensure their effective implementation. Appropriate secondary legislation, clear and measurable action plans, and adequate institutional and financial resources for their implementation need to be established (see below).

While the situation is very different in the different countries, and the present report's scope has not extended to all 8 CEE accession countries, the most important policy-relevant conclusions based on the analysis of four Visegrád countries are summarised in the following section.

10.2. SUMMARY OF KEY RECOMMENDATIONS

This section summarises the key recommendations of this report. For more extended recommendations in the specific fields, please refer to the individual sections of the report.

10.2.1. Overarching recommendations

- As discussed above, the low level of environmental awareness is one of the key barriers to national government-level initiatives to foster sustainable development. Therefore, **increasing environmental awareness, environmental education targeting all groups of the population, and transforming the value systems of the inhabitants** are steps which would be instrumental towards the introduction of sustainable energy pathways as well. There should be a more concerned effort on the part of the EU to improve awareness and to transfer the environmental values (more) established among the societies in present MSs to the accession countries. A good example of such an EU-level measure is the disclosure clause of the new electricity market directive.
- Since these governments are typically cash-strapped and constantly fight with high budget deficits; and since taxes are typically already extremely high, and energy prices have already been raised significantly, it is difficult to expect a drastic increase in public (revenues and thus) spending on sustainable energy transformations. Therefore, **market-based instruments** and **private sector actors** to promote such pathways **should receive a special emphasis** as vehicles towards sustainable transformation in this region, and should be supported by all possible means, such as the legal framework, incentives, and designated programs. Such instruments and actors include performance contracting and ESCOs, market transformation and information/labelling programs, as well as corporate social responsibility programmes. However, it is important to recognise that market-based instruments do not have strong traditions in these countries and face significant cultural and

institutional barriers, thus their facilitation requires innovative policy-making. The case studies described in this report demonstrate that this is possible.

- While CEE governments are spending considerable (but far from sufficient) amounts on supporting sustainable energy projects (RES, energy efficiency and cogeneration), mainly as a result of the accession process, there is very little current, public information available on the status, potentials and cost-effectiveness in these sectors as indicated in several sections of this report. Since good data collection and research form the basic foundations for sound, effective policies, it is very important that these countries devote **substantially more effort to energy data collection** (especially in the areas of end-use, renewables, and CHP); and to **research** related to the current status of **sustainable energy activities** (such as reliable figures on CHP shares; indicators of end-use energy efficiency, etc.), and to **potentials, costs and priorities** (such as detailed RES, CHP, and energy and carbon conservation potentials and the respective cost curves). While this is mainly a national responsibility, the EU could and should encourage/support/facilitate a harmonised approach to such activities across the CEE region. For instance, it is worth considering making such research areas a priority in EU R&D funding, even though they are not as important for present MSs.
- Since many efforts contributing to the sustainability of the energy sector are rooted at the community level, regional-, municipal- and community-based initiatives should be encouraged more. Currently most measures in CEE originate at the national level (required by the EU…), and regional/local governments lack the financial and legislative power to promote sustainable energy projects. **Municipalities and regional governments should be granted greater financial and legislative independence to be able to engage in local- and community-level renewable energy and energy efficiency initiatives**. The environmental and energy authorities should enhance their cooperation with the municipalities in order to promote sustainable energy solutions at the local level. In addition, there needs to be a more concerted effort to coordinate regional initiatives and to establish the exchange of experience, such as through the formation of networks, and greater co-operation with existing networks in Member States is needed. The EU should support capacity building in municipalities in order to allow them to play the above mentioned role.
- EU-level instruments and policies should **facilitate and promote the integration of sustainable energy objectives into other sectoral policies**, such as social, economic and fiscal policies, agricultural, industrial, transport, regional development, and urban planning policy regimes. Therefore, EU support programs should incorporate requirements related to improving energy efficiency and the environment in the various economic areas and facilitate monitoring of such improvements.
- Policy monitoring and post-implementation evaluation capacities, which are generally underdeveloped in the region, should be strengthened.

10.2.2. Recommendations related to the energy restructuring process and EU accession-related energy sector changes

- While the adoption of the *acquis communautaire* should bring major improvements in the sustainability of the energy sectors of accession countries, it has been shown that complying with the *acquis* by transposing then into national legislation is often not sufficient. The national legislation has not always been in the most effective form; framework legislation is often not translated into action plans and concrete acts; institutions and procedures are not always established to implement and enforce the acquis; and the necessary resources are often lacking for the implementation of particular legislative acts. **Beyond the legal transposition**, the EU should both **require and support adequate implementation and enforcement** as well, and encourage the establishment of the proper institutional background. The revision of some of the existing energy policy documents written several years ago would also be timely in several candidate countries.

- With the accession process and after full membership the candidate countries will have access to a large number of EU Funds (regional, social and structural development, R&D, etc). However, this fact alone is not sufficient guarantee that these funds will be used in the best way. First, many of the funds require substantial (typically 50%) local co-funding. Since currently very limited national or municipal resources are available for the promotion of sustainable energy projects and R&D, there is much concern that CEE project partners will not always be able to engage in EU-level winning projects due to the lack of available co-funding. **The EU should evaluate and make sure that adequate amounts of funding are set aside at the national and local levels to match EU resources.**

- Pre- and post-accession development funds (the regional, social and structural funds) will determine development pathways in these countries in a significant way. Since many areas covered by these funds has a profound impact on the sustainability of these energy sectors as well, it is crucial to evaluate the distribution of these funds from a sustainable energy perspective. **The authors of this report strongly recommend that the EP initiates a study which evaluates the current plans under these funds, as well as how (more of) these funds could be used (more effectively) to promote the goals highlighted in this report.**

- Energy sector restructuring, and in particular the lifting of energy subsidies and the introduction of market prices, have imposed a large burden on the population, increasing fuel poverty and making energy prices a highly politicised issue. And since making energy prices reflect true costs (direct and, in an ideal case, external costs) is a key priority of any sustainable energy policy regime, this process should not be compromised by continuing (cross-) subsidisation. The social burden should be eased by targeted assistance to the most vulnerable groups. The most highly recommended solution is to **use the funds for social compensation for the improvement of energy efficiency**, thereby investing in long-term solutions to reduce energy bills.

- In democratic societies, but especially in liberalised markets, consumer associations play a crucial role in assuring that social/consumer interests influence the directions in which markets are going. In CEE, consumer associations in the energy sector, especially those representing residential consumers, are few, and typically weak. **The EU could play a more pro-active role in facilitating/promoting/supporting the existence and establishment of consumer associations in these countries**.

10.2.3. Sector-specific recommendations

- While it is difficult, if not impossible, to prioritise among the different areas of sustainable energy policy analysed in this report, perhaps one issue can be generally concluded. The (further) **improvement of energy efficiency** can typically be regarded as the **highest priority goal for sustainable energy pathways**. This is due to the still high prevailing energy intensities, the economic and other side-benefits of improved energy efficiency for the region outlined above; the gap to EU levels of specific energy consumption figures in production, the profitability of many such investments, and the relatively lower costs of such measures compared to some other areas, such as renewable energy.

- Economic and energy market reforms alone will not close the energy intensity gap with the present EU MSs. Concerted efforts and targeted policies are needed to achieve further improvements, mainly in end-use energy efficiency. Governments should devote a much higher level of resources (financial, human and institutional) to this area, considering the importance of the economic and social gains that can also be made. Energy efficiency agencies should be established where they do not yet exist, and should be staffed adequately (currently institutional and human capacity in these fields is much lower than in present MSs).
- All accession countries have committed themselves to ambitious renewable energy targets by 2010. However, in most cases it is questionable whether the policies currently in place can deliver these ambitious changes.
- Whereas renewable energy resources vary from country to country, one of the most promising fuels in this region is **biomass**. In general, biomass potentials are very high; and while there is a range of opinions about its cost-effectiveness, some authors consider certain biomass technologies cost-effective replacements for fossil fuels in some applications. Beyond its high potentials and cost-competitiveness in some cases, biomass also offers an important opportunity from a social perspective: **the biomass sector and industry might provide promising answers to important social and rural problems created by EU accession**. For instance, agricultural land to be set aside could be used for the biomass industry; employees to be laid off from the coal sector (both power production and mining) could be retrained to work in the renewable industry. The advantage of biomass and other renewables is that they provide opportunities for rural employment, thereby fostering regional development. Therefore, support (EU or national) for the biomass sector in these countries should consider not only the environmental and energy security benefits, but also the employment, regional development, and other social gains.
- **District heating**, as a potentially appealing heating option from a sustainability perspective, has a much higher share in the accession countries than in present MSs. Since there are many problems with DH systems in the region, this area should receive much higher attention at EU levels. For instance, the present draft of the CHP directive is being formulated primarily for existing MSs, while it will probably have a major impact on the accession countries. Furthermore, the absence of any EU-level legislation or policy on district heating *per se* means there are no accession funds available for district heating, as there are for water sanitation, for example.
- **Public procurement legislation** will need to change to accommodate several existing and incoming directives. However, there is a remaining need to evaluate public procurement laws in accession countries from the perspective of their **accommodation of public-private partnerships**, i.e. **performance contracting and third party financing**, as well as their **energy efficiency** and perhaps **renewable energy provisions**.
- The vast majority of accession countries will meet their Kyoto requirements without any significant efforts – thus the KP presently does not play the important role in forcing sustainable energy transitions in the CEE region that it does in the present MSs. However, the Kyoto flexibility mechanisms may provide a key supplementary financing source for sustainable energy projects in accession countries. Thus, it is indispensable that the EU ETS does not restrict these mechanisms, or jeopardise their international viability. Since the draft of the so-called "**linking directive**" at the time of writing this report excludes all JI/CDM projects in the sectors covered by the ETS, it is suggested that the **draft should be revised to prohibit (from receiving allowances) not entire energy installations, but only those reductions that are a result of JI** .

PART FOUR: APPENDICES

APPENDIX I: ACKNOWLEDGEMENTS

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APPENDIX III: METHODOLOGY

Due to the limited time available for the preparation of the study, primarily secondary research methods were used. The work relied on the following key methods:

1. Review of key studies in the field

   An extensive research effort was conducted through internet, library and personal network research to identify any major studies which have been authored in relation to the aims of the present study, either on a national or regional level. Institutions active in the field on a regional level (involving more than one CEE accession country) were contacted and relevant studies were requested. All major international institutions conducting work in the field were asked for relevant materials and

2. Country studies

   In order for the issues to be covered in more depth, three countries were selected to be analysed regarding our research questions. Since, unfortunately, the Hungarian partner did deliver his contracted work, Slovakia was chosen instead, as a replacement which could still be covered at very short notice. The authors of this study have filled in the publicly available information on Hungary, and thus the study managed to have a coverage of all four Visegrád countries.

3. Stakeholder interviews

   To complement the information available from written sources, and to find out the attitudes of various stakeholders, several stakeholder interviews were conducted on a one-on-one basis in each focus country.

4. Consultations with experts

The authors of the report made an effort to establish contact with all key institutions active in the field, which took several forms. First, the members of the project team made an effort to attend several relevant international meetings, workshops and conferences to identify further experts in the field, and attend relevant talks. Second, the expert network of the authors was contacted (mainly through email) and offered an opportunity to contribute to the project by providing an input to the recommendations to the European Parliament, based on their work in the field. Third, information and relevant reports were solicited in newsletters targeted at the CEE sustainable energy community. Several good working relationships were formed with leading organisations, for instance with the International Energy Agency, who regularly updated us on their current activities related to the region and kindly provided us with the newest reports/books published.

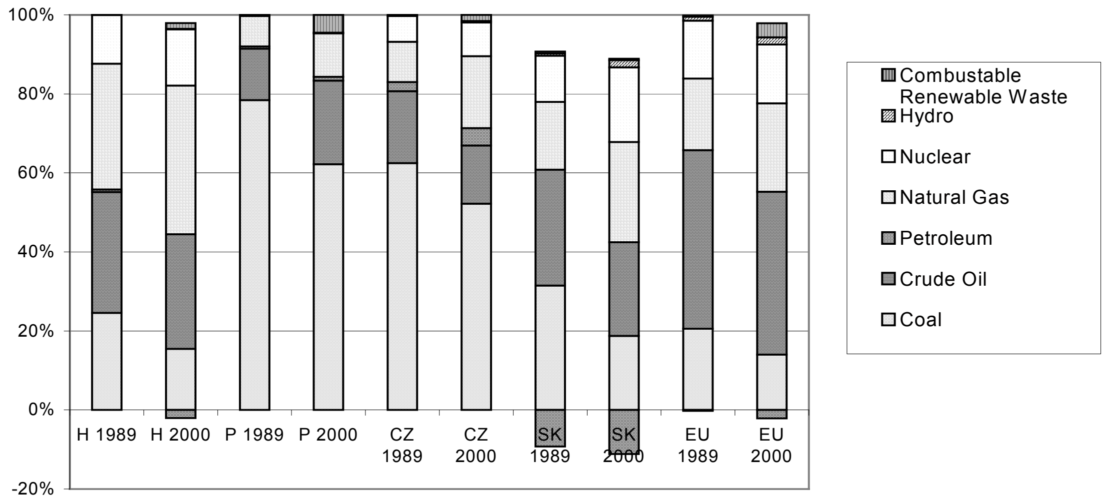


Figure 14. Development of the Total Primary Energy Supply by fuel type in the Visegrád countries

Sources of data: IEA 1999a, 1999b, 2001c, 2001b, 2002d and 2002c

Table 19. Selected energy indicators for the share of fuel sources in power generation in CEE countries in 2002

		LT	LV	ES	PL	SK	CZ	HU	SL	EU-A	EU
Hydro	Installed Capacity (GW)	0.7	1.5	0	2.3	2.5	2.0	0.1	0.9	10	121.1
	Gross Production (TWh)	0.8	**2.9**	0	4.2	4.9	2.5	0.2	4.1	20	366.9
Nuclear	Installed Capacity (GW)	2.4	0	0	0	2.4	3.5	1.8	0.7	10	122.8
	Gross Production (TWh)	**12.9**	0	0	0	**18.0**	18.7	12.8	**5.3**	**62**	**893.3**
Fossil	Installed Capacity (GW)	2.6	0.6	3.2	28.5	3.2	10.4	6.5	1.2	56	331.3
	Gross Production (TWh)	2.4	1.0	**9.0**	**141.0**	10.0	**55.1**	**22.4**	3.3	248.0	1 363.0
	from which (%):										
	Oil	34%	28%	3%	1%	1%	1%	20%	2%		15%
	Gas	66%	72%	4%	2%	36%	7%	39%	3%		35%
	Coal	0%	0%	93%[25]	97%	63%	92%	41%	94%		50%

Source: Laponche *et al.* 2002

[25] Oil shale in Estonia is counted under the category "coal".

Table 20. Competitive indicators of the CEE power generating and retail markets, 2003

Country	Number of GenCos with installed capacity > above		Number of GenCos with significant market share		Number of suppliers for	
	50 MW	100 MW	50%	75%	tariff (captive) consumers	eligible consumers
Czech Republic	26	11	1	2	8+1	8+1
Estonia	1	1	1	1	1	1
Hungary	12	10	2	4	6	3
Latvia	1	1	1	1	1	0
Lithuania	6	5	1	1	2	5
Poland	54	39	4	8	293	33
Slovakia	6	5	1	1	3	4
Slovenia		8	3	4	5	5

Sources of data: Szorenyi 2003; Energy Agency of the Republic of Slovenia 2002

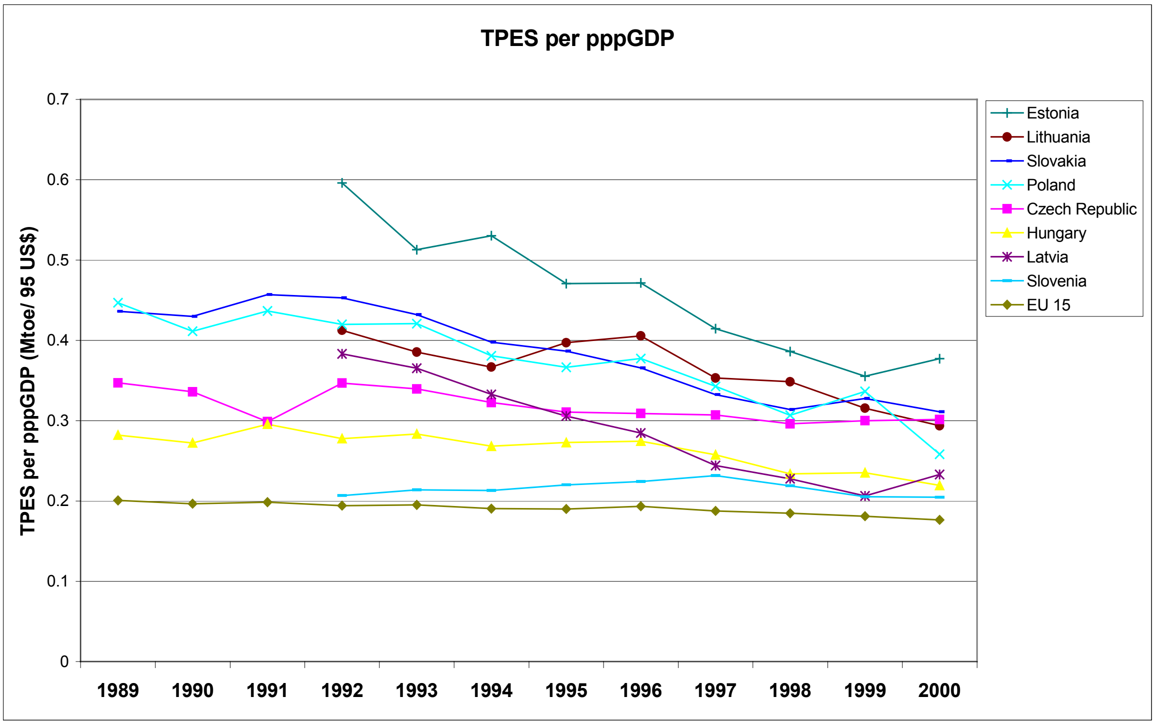


Figure 15 The development of energy intensities (measured in PPP) in CEE, 1989 – 2000
Sources of data: IEA 1999a, 1999b, 2001b, 2001c; 2002c, 2002d

Table 21 Historical Energy Prices in V4 Countries
*Natural gas prices in USD/10^7 kcal (GCV)
**Electricity prices in USD/MWh

Residential sector - natural gas prices *	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Czech Republic	95.4	111.4	125.5	131.6	128.7	177.3	185.1	214.1	233.0	
Poland	153.9	159.5	208.7	236.1	227.7	248.3	244.3	247.5	304.0	
Slovakia	75.8	72.3	81.3	80.1	75.3	73.3	77.9	108.6	115.4	125.8

Residential sector - natural gas prices *	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Hungary	117.0	104.5	137.2	136.3	164.6	202.5	185.0	166.3	183.0	215.7
OECD-EU	399.6	411.7	441.1	437.8	423.4	423.0	399.0	328.2		
OECD	333.4	345.4	361.9	367.2	362.7	359.2	351.7	340.9		

Residential sector – electricity prices **	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Czech Republic	29	32	37	38	37	50	51	54	60	
Poland	46	49	62	65	62	67	65	65	79	
Slovakia	30	29	31	31	29	28	35	50	63	
Hungary	43	40	58	60	68	70	73	65	68	80
OECD-EU	130	134	149	146	131	130	123	107		
OECD	111	116	127	121	113	109	110	105		

Industrial sector - natural gas prices *	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Czech Republic	131.4	137.2	157.5	164.1	152.2	159.8	142.8	147.6	155.9	
Poland	115.9	115.4	129.7	138.4	130.6	132.0	121.8	133.0	173.3	
Slovakia	114.9	113.7	127.7	124.4	118.6	124.7	106.7	101.8	106.6	132.8
Hungary	127.9	111.9	105.6	105.8	145.0	144.8	134.9	124.9	158.5	189.0
OECD-EU	149.2	150.9	166.4	164.2	159.3	150.5	134.6	157.7		
OECD	130.7	131.4	130.1	143.6	147.6	133.5	129.5	168.6		

Industrial sector – electricity prices **	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Czech Republic	52	56	61	59	52	52	48	43	43	
Poland	33	35	40	40	36	37	37	37	45	
Slovakia	47	45	49	49	49	49	41	42	43	
Hungary	53	46	45	48	54	56	55	49	51	60
OECD-EU	72	71	76	74	65	65	60	52		
OECD	72	73	79	74	69	65	63	47		

Source of data: IEA 2002j

Table 22. Summary of energy efficiency related policy instruments in the Visegrád countries, 2003

	Hungary		**Czech**		**Poland**		**Slovak Republic**	
Types of taxes on electricity	VAT	12% (1)	VAT	22%	VAT Excise tax	22% 4.65Euro/MWh	VAT	14 % (1)
Types of taxes on gas	VAT	12% (1)	VAT	22%	VAT	22%	VAT	14 % (1)
Types of taxes on heat	VAT	12% (1)	VAT	22%	VAT	22%	VAT	14 % (1)
Tax incentives for EE	NO (2)		YES (Lower VAT - 5 % - on certain EE goods and services until the end of 2003)		NO		YES (Tax exemptions) But disincentive extra fee for electricity produced in CHP for backing electricity supply (2, 3)	
Performance standards in industry	YES (qualitative standards for supply industry and other planned in the future) (3,4)		NO		YES (minimum efficiency standards apply for some industrial equipment inc. motors, welding and bonding, etc.) (4)		YES (As in Large Combustion Plants Directive) (4)	
EE building codes	YES (only for insulation, updated in 1994, but not sufficiently enforced)		Yes, but specified insulation standards are insufficient (2)		YES (1,2)		YES (5)	
Appliance labelling	YES (In accordance with the EU directive) (5)		YES (washing machines; tumble dryers; combined washing and drying machines; refrigerators, freezers and their combinations; dishwashers; electric ovens; electric devices for heating waster; lighting systems)		YES (For almost all of the household appliances. Some labels have to follow EU regulations) (3)		YES (Refrigerators/freezers, washing machines, washer dryers, tumble dryers, dishwashers, lamps) (6)	
Other performance labelling	NO (4)		YES (for many technical components in the energy production and distribution sector) (1)		YES (Heating boilers, electric engines)		YES (Air conditioners, electric ovens are planned to be labeled) (6)	
EE provisions in public procurement	NO (3)		NO		NO (2)		YES (2)	
Preferential loan schemes for EE	YES (6)		YES		YES		NO (In the past - yes. Now a new scheme is waiting for approval) (3)	

	Hungary	Czech	Poland	Slovak Republic
Provisions on performance contracting/ facility management	NO (2)	YES (obligatory energy audits in buildings and production sites and all facilities consuming energy above a specified limit, and mandatory implementation of low-cost audit recommendations) (1,2)	No information available	NO (7)
Mechanisms to support ESCOs	YES (good environment for establishing a business and a guaranteeing fund) (2,7 and 8)	NO	YES (Energy delivery contracting, Performance contracting) (2)	NO (7)
Existing utility DSM programs	Only ripple control (not real DSM) (3)	NO	NO (but in 2000 tariffs could include DSM costs) (4)	NO (2), but they used to be run by Slovenske Electrarne (7, 8)
Public benefit charges	NO (4)	NO	NO (2)	NO (Planned for brown coal) (8)
Subsidy programs	Yes (according to the National Energy Program) (6) (7)	YES (State Program for Energy Efficiency was launched in 1998 but the budget was significantly reduced. The government spent 10 mln € instead of planned 26 mln Euro in 2000, and continued to reduce it down to 5 million Euro instead of planned increase to 37 million Euro in 2001)	NO (2)	NO (8)
Research and development for EE	YES (governmental support - 12013 mln Ft (46 mln 2002 Euro) for the period from 1997 to 2003) (6)	YES (CZK 4.2 Billion / year (17 mln 2002 Euro) for the period from 2002-2005. According to the National Programme of Energy Conservation and the Promotion of Renewable and secondary Energy Sources) (1)	Not available	YES (governmental support – 296mln SKK (7.4 mln 2002 Euro) for EE and renewable energy sources for the period 1992 to 2001) (3)

Sources of data:
Hungary: (1) Barka pers. comm.; (2) Kovacsics pers. comm.; (3) Szorenyi pers. comm.; (4) Pal pers. comm.; (4) CLASP 2000; (5) Poos pers. comm.; (6) Elek pers. comm.; (7) Energy Charter Secretariat 2001;
Czech Republic: (1) IEA 2003c; (2) IEA 2002a;
Poland: (1) Robakiewicz 2003; (2) Koj pers. comm.; (3) Ministry of Economy 2001; (4) Energy Charter Secretariat 2000;
Slovak Republic: (1) Strelka pers. comm.; (2) Bella, pers. comm.; (3) ECB 2002a; (4) Rousek pers. comm.; (5) Hadzhiivanov pers. comm.; (6) CIT 2002; (7)Energy Charter Secretariat 1999; (8) Energy Charter Secretariat 2003.

Type of energy saving potential	Definition
Technical potential	The maximum possible savings without considering any economic limitations (Maly 1999) and (ECB 2002a). It is an indicator of possible improvement and not usually an achievable target.
Economic potential	The part of the technical potential in which the cost of investments is lower than the resulting benefits (Maly 1999 and ECB 2002a). In calculating the economic potential the social and macro-economical background is considered.
Market potential	Reflects the micro-economic situation or the willingness of the investors to invest in energy efficiency (Maly 1999 and ECB 2002a). It depends on the assumptions about expected risk and the pay-back time.
Achievable potential	Calculated in some studies (OECD 1997) instead of market potential. The term accounts for the barriers to investment in energy efficiency and is also a fraction of the economic potential.

Table 23. Definitions of energy savings potentials

Supplementary box for section 4.1.

Some Individual Measures for Improving Energy Efficiency

There are measures that can be realised at relatively low cost and can lead to a large reduction of energy consumption. In the text below some of the measures that are calculated to be the most economic and energy-saving on the basis of the available studies are discussed.

Studies on the possibilities for improving the of efficiency of the ***residential sector*** in the Czech Republic, Slovakia and Hungary show that there is significant economic potential for the improvement of heating systems, for example in the improved efficiency of heat generation and reduced heat losses in distribution (Maly 1999; ECB 2002a; GKI-EGI 1998). For instance, in the Czech Republic the economic potential for savings of primary energy use under this measure is 100 and 130 PJ/year using 5% and 10% discount rates (Maly 1999). For Slovakia increasing the share of central heating while replacing intermittently fired coal and wood stoves is also seen as one of the most efficient ways to reduce energy consumption at a low cost (ECB 2002a). Other measures that can improve energy efficiency with less investment are better energy management and metering. Improved management will bring savings of 64 PJ/year in the Czech residential sector (for 5% and 10% discount rates) (Maly 1999). For Hungary it has been calculated that if the capital investment return is from half a year to three years, then the measures with the greatest potential for decreasing energy consumption are hot water savings from sinks and shower heads (7 PJ/year), restriction of leakage (4.5 PJ/year), and more precise metering (3.4 PJ/year) (GKI-EGI 1998). Another measure is the utilisation of waste heat, which can contribute up to 26PJ/year decrease of primary energy use in the Czech Republic (for 5% and 10% discount rates) (Maly 1999). Other replacements with a lower economic potential are the thermal insulation of buildings and increased appliance efficiency (Maly 1999). For example in Hungary the highest energy savings can be realised by retrofitting windows (27 PJ/year), but the return on the investment will take about 17 years (GKI-EGI 1998).

It should be mentioned that in the GKI-EGI (1998) study for Hungary measures like improvement of energy awareness through campaigns and labelling were also discussed. The pay-back time is very short (about 0.4 years) for advertising electricity conservation measures and the energy savings potential (4.4 PJ per year) relatively high.

An examination of the opportunities for improving oenergy efficiency in the Hungarian ***industrial sector*** has shown that more significant opportunities for energy saving appear not in the energy intensive fields, but by decreasing the relatively high consumption of the auxiliary areas (space heating, kitchens etc.) (GKI-EGI 1998). It is important that some of the upgrades in this field can be implemented at insignificant cost, or in some cases through behavioural changes. Unfortunately, the possibilities for decreasing the specific energy demand of energy intensive products in Hungary (responsible for more than half of industrial energy demand) are rather modest. To achieve major savings the technologies should be modernised or replaced at significant cost. The GKI-EGI study has shown that the highest energy savings can be accomplished if CHP units are introduced. This will lead to a decrease in energy consumption of 30PJ per year but the pay-back time is one of the highest (6.2 years) among the suggested measures. Other measures include the elimination of over-centralised heat distribution systems, renovation of technological systems and the upgrading of space heating of industrial buildings. These measures will result in total savings of about 50PJ per year and the average pay-back time is 5.3 years. Similar conclusions were made by the Energy Centre Bratislava (ECB 2002a) concerning the energy efficiency potential in Slovakian industry. According to it the reduction of the heat losses in buildings, better utilisation of daylight, replacement of obsolete equipment, heat recovery and introduction of energy management have the biggest potential for energy savings.

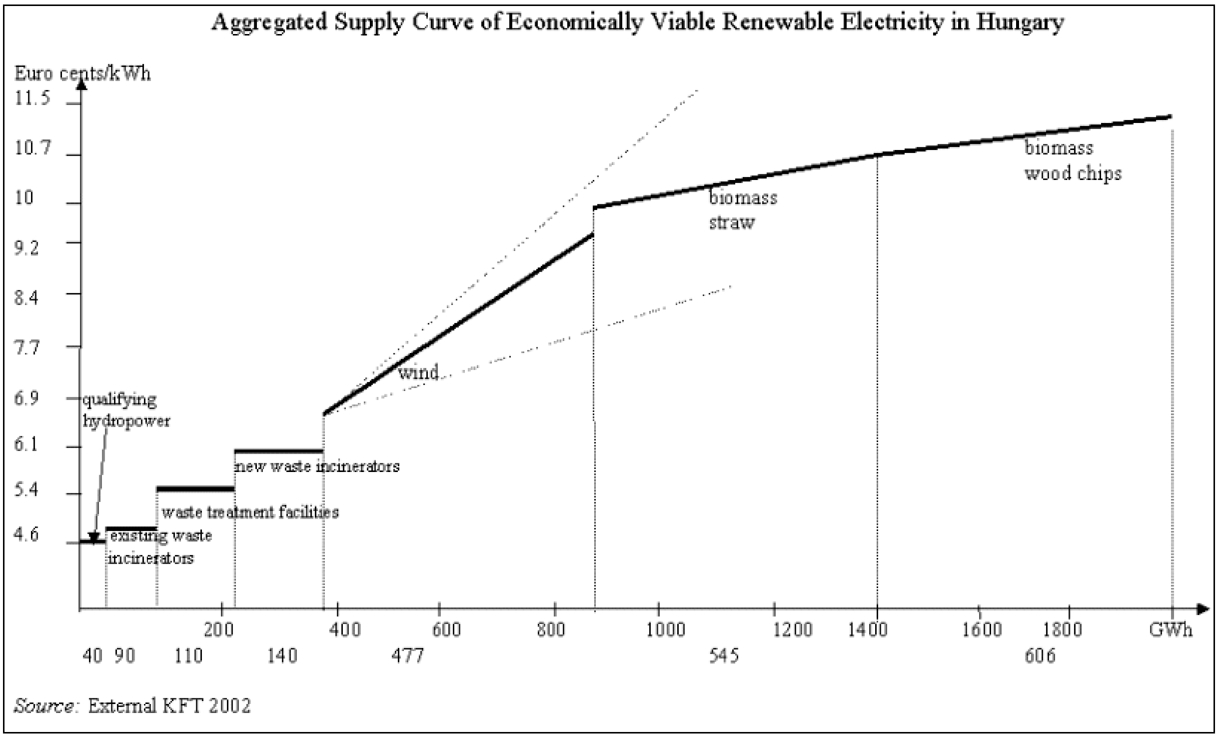


Figure 16 Aggregated supply curve of economically viable renewable electricity potentials in Hungary

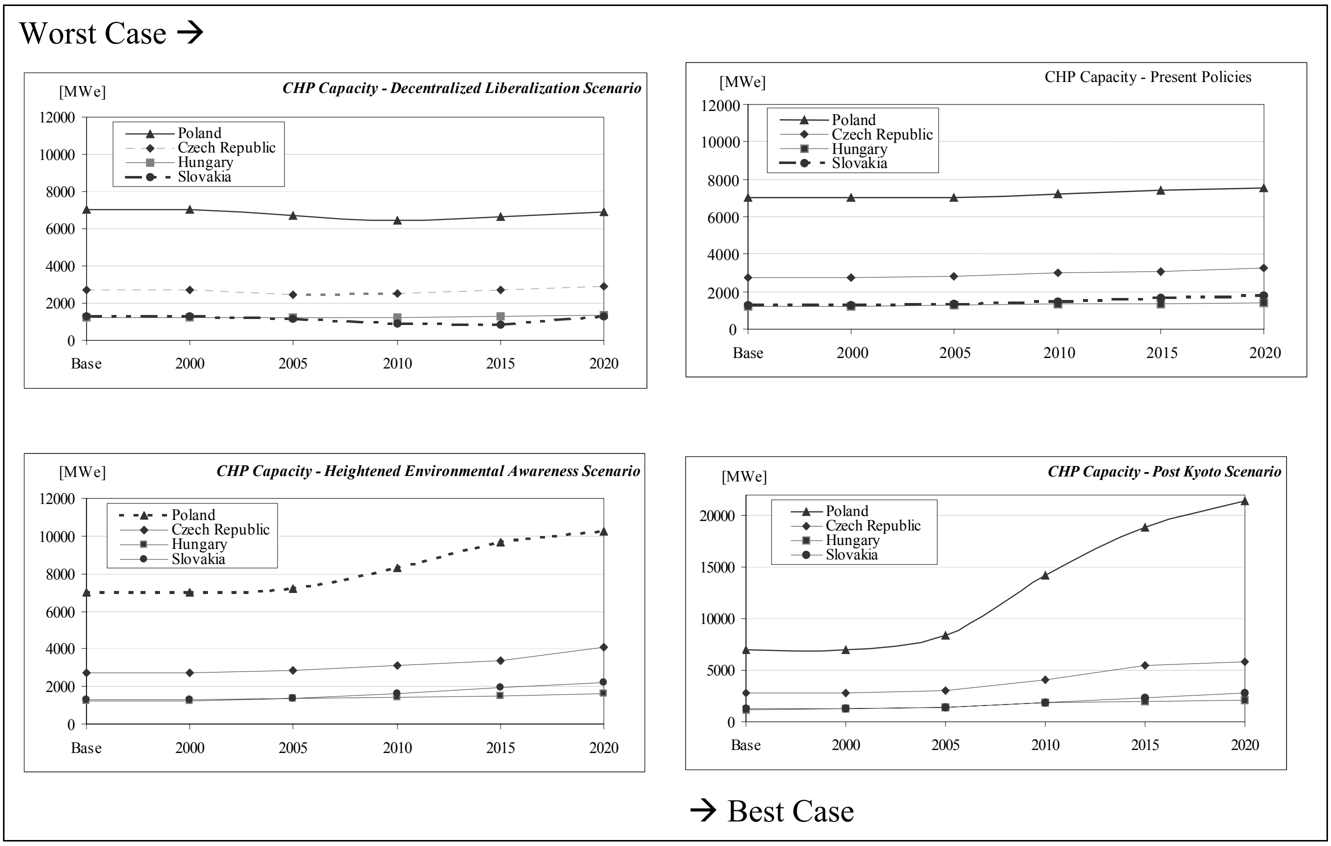


Figure 17. Potential for large and small-scale CHP in the Visegrád countries according to the four scenarios of the 'future cogen' study

* The most probable scenario according to the 'Prochp study' (ESD *et al.* 2001) is shown on the graph with a dashed line.

Sources of data: ESD *et al.* 2001; ISPE *et al.* 2003

Table 24. Policy instruments promoting renewables in place in 2003 in the Visegrád countries

	Poland	Slovak Republic	Czech Republic	Hungary
Feed-in tariff	NO (1)	YES (4) No minimum price, it does not encourage small suppliers to promote RES	YES	YES
Green Certificate System	NO (1)	NO (6)	NO	NO (expected no earlier than 2005)
National targets	YES 7.5% RE from TPEP* in 2010 14% RE from TPEP* in 2020	YES (5) 9.4 TWh in electricity production by 2012	YES (7) 5%-6% RE from TPES in 2010 8-10% RE from TPES in 2020	YES 5 % RE from TPES in 2010 Possibility of reaching 7.2% was investigated but not set as a target 3.5 % RE from electricity in 2010
Obligations/ Quotas	YES Distribution companies are obliged to buy RE. Quotas in place.	YES (4) Distribution companies are obliged to take RE into grid. NO quotas	YES Distribution companies are obliged to buy RE. NO quotas	YES Distribution companies are obliged to buy RE. NO quotas
Carbon tax	NO but there is a fee for CO2 emissions (2,3)	NO (4)	NO (2)	NO (2)
Subsidies/ preferential loans/rebates/tax reductions	YES Subsidies and preferential loans.	NO (6) Not at the moment; in the past, tax exemptions; new programs in the future.	YES Subsidies, preferential loans, tax exemptions, low VAT for small RES facilities for heat and for final consumers of biomass fuel and heat.	YES Subsidies, preferential loans.

	Poland	Slovak Republic	Czech Republic	Hungary
Other relevant taxes	NO (1)	YES (4) For RE equipment VAT is 20%, while for Electricity, natural gas, heating - VAT is 14%.	No information available	YES 0% tax on biodiesel and bioethanol production on the basis of the excise tax.
Green electricity tariffs	NO (1)	NO (4)	NO	NO
Voluntary Agreements	NO (1)	NO (5)	NO (2)	NO
Research and Development for RES	Not available	YES (7) State program "EE and RES" (not only R&D) 1995-98 – 29.51 Mln SKK	YES The ministry for the Environment has been organising a tender for a large project on the potential of RES till 2030. First outputs ready by December, 2003.	YES Exact figures are not available
Other policies	No information available	NO (5)	Law on the support of energy production from renewables is under preparation. Implementation of the ES/77/2001 directive	No information available

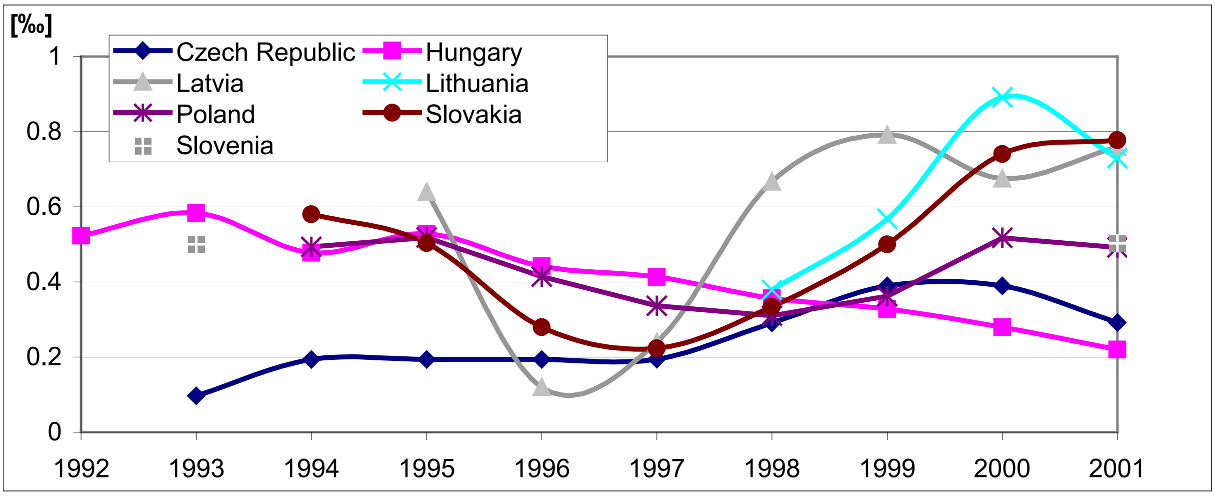
TPEP – total primary energy production
Sources of data: (1) Gierulski 2002; (2) Energy Charter Secretariat 2003; (3) Fiedor pers. comm.; (4) Hecl pers. comm.; (5) Marias pers. comm.; (6) Bella pers. comm.; (7) IEA 2003c

Table 25 Inventory of AIJ projects in CEE countries

	Energy efficiency	Renewable	Fuel switch	Total number of AIJ
Hungary	1	0	2	3
Poland	2	0	1	6
Czech Republic	1	0	2	4
Slovakia	0	1	2	5
Latvia	10	13	1	25
Estonia	13	7	0	21
Lithuania	2	7	0	9
Slovenia	0	0	0	0
Total	**29**	**28**	**8**	**73**

Source of data: UNFCCC 2002

Figure 19 Unemployment rate (as one in thousand (‰) of the population) in the electricity, gas and water supply sectors in selected accession countries



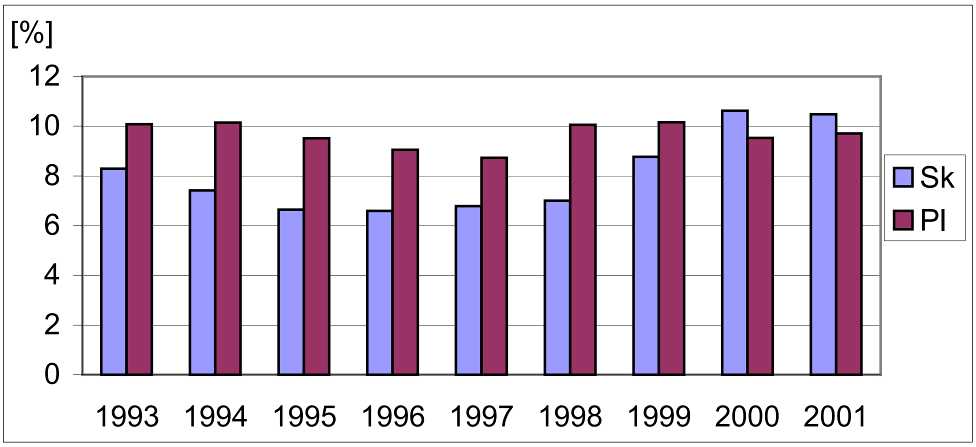
Source of data: ILO 2002

Table 26. Evaluation of Income Inequality during the Transition

Country	Gini Coefficient for Income Per Capita		
	1987-90	1993-94	1996-99
Czech Republic	0.19	0.23	0.25
Estonia	0.24	0.35	0.37
Hungary	0.21	0.23	0.25
Latvia	0.24	0.31	0.32
Lithuania	0.23	0.33	0.34
Poland	0.28	0.28	0.33
Slovenia	0.22	0.28	0.33
Slovakia	--	--	--

Source of data: Fox 2002

Figure 19. Share of disposable income spent on fuel by households in Poland (Pl) and Slovakia (Sk)



Sources of data : ARE s.a. 2002; Statistical Office of the Slovak Republic 2002; Voll and Juris 2002