Demand-side energy efficiency and the Kyoto mechanisms: forging the link in countries in transition

Meredydd Evans, Pacific Northwest National Laboratory

1. SYNOPSIS

Relatively few joint implementation projects focus on demand-side energy efficiency, despite its cost-effectiveness. This paper examines why and discusses strategies for better tapping efficiency opportunities in transition economies.

2. ABSTRACT

Energy efficiency can provide a cost-effective means of reducing greenhouse gas emissions. Yet, demand-side energy efficiency is tantalisingly difficult to tap in carbon mitigation projects. Three key factors appear to lie behind this difficulty. First, end-use energy efficiency projects tend to be small and dispersed, which can raise transaction costs. Second, while demand-side projects usually are profitable based on energy savings alone, they may have relatively high costs per ton of carbon when the benefits of energy savings are not taken into account. Carbon investors looking for simple deals with straightforward revenue streams may avoid demand-side projects. Third, energy consumers are often not direct greenhouse gas emitters, particularly when heat and electricity are centrally produced. As a result, few joint implementation projects focus on end-use energy efficiency. Passing up demand-side opportunities ultimately could drive up the cost of carbon mitigation, making it more difficult for nations to reduce their greenhouse gas emissions.

This paper first provides background on flexible mechanisms in transition economies. It then examines the experience with joint implementation in demand-side energy projects in countries in transition and uses this information to assess the barriers to demand-side energy projects as carbon mitigation tools. The article concludes with recommendations on strategies for ensuring that demand-side energy efficiency projects play a role in carbon mitigation mechanisms. New financing mechanisms and stronger partnerships between the various stakeholders are among the strategies considered.

3. BACKGROUND

Energy efficiency can be a highly cost-effective means of reducing greenhouse gas emissions and stabilising their concentration in the atmosphere, central goals of the Framework Convention on Climate Change (FCCC) and the Kyoto Protocol. Under the Kyoto Protocol, most industrialised countries have agreed to limit their carbon emissions in order to mitigate the risk of global climate change. The United States, for example, has agreed to limit emissions by 7 percent compared to 1990, while the European Union as a whole has agreed to reduce its emissions by 8 percent (Kyoto Protocol).[1] Most countries in transition have also agreed to reduce or stabilise emissions and are included on the lists of countries with specific emission obligations (Annex I of the FCCC and Annex B of the Kyoto Protocol).

Countries are encouraged to reduce emissions domestically, though the Kyoto Protocol also provides them with flexibility on where and how they meet their emission targets. Specifically, the Kyoto Protocol allows countries to mitigate emissions abroad or trade emission allowances to meet their emission targets. There are three so-called "flexible mechanisms" for transferring emission credits or allowances: joint implementation, the Clean Development

Mechanism and emission trading (JI, CDM and ET, respectively). This paper focuses on joint implementation, although it will also provide some comparative information on emission trading. Because most countries in transition are not likely to sell emissions through the Clean Development Mechanism, this paper covers it only briefly.

Joint implementation, described in Article 6 of the Protocol, allows two industrialised nations to co-operate on an emission mitigation project and to share in the emission reduction credits that the project generates. In the terminology of the Kyoto Protocol, JI projects generate emission reduction units (ERUs) that are deducted from the emission target of one country and added to the target of another. Only countries that have taken on specific emission reduction obligations are allowed to participate in JI. Under emission trading, on the other hand, a country sells a portion of its emission allowance (called assigned amount units or AAUs) to another country without linking the emissions to a specific mitigation project. Both the seller and buyer must be Annex B parties with set emission targets and they must keep their total emission levels after the sale within their new allowances. The Clean Development Mechanism (CDM) is like JI in that it involves specific mitigation projects, but the host countries are not Annex B parties, so the allocations are added to the investor countries' totals without being subtracted from the host countries' target. For this reason, CDM projects must be certified and involve more scrutiny than JI projects.

Joint implementation has already gone through a pilot phase called activities implemented jointly (AIJ). The pilot phase did not allow crediting between countries, a significant difference from JI as proposed under the Kyoto Protocol. Nonetheless, the AIJ pilot phase does provide the most extensive set of data available on international carbon mitigation projects. This paper reviews the energy-sector experience of AIJ in an attempt to gain insight into the types of projects and barriers that we will likely see when flexibility mechanisms are implemented on a larger scale.

Climate negotiators have not yet finalised the rules and modalities for the flexibility mechanisms under the Kyoto Protocol. The rules will have a significant impact on how frequently these mechanisms are used and how effective they are in curbing emissions. In fact, the remaining differences in opinion among signatories are great. Some nations feel that flexible mechanisms should be limited so that countries make the majority of their required emission reductions at home. The European Union and many developing nations fall into this camp. Other countries, such as the U.S., Russia, Japan, and Norway, feel that flexible mechanisms should not be restricted because they allow countries to meet their obligations by reducing emissions where the costs are lowest. According to this line of argument, the lower the costs, the more feasible it will be to make large-scale reductions.

This debate is particularly controversial because of the past emission reductions that countries have made. Transition economies have seen their emissions decline by as much as 40 percent in the 1990s (Evans *et al.* 2000). These declines are primarily due to economic stagnation and restructuring rather than because of explicit carbon mitigation policies.

Most climate negotiators and experts agree, though, that there are still many low-cost opportunities for future emission reductions in the formerly planned economies. In fact, the majority of AIJ energy projects took place in countries in transition (Schwarze 2000). The inefficiencies of the past socialist system often lie at the root of these opportunities. Under socialism, these countries focused economic development in heavy industry, where emissions are typically high per unit of economic output. Energy was subsidised, so families and factories had little incentive to use it sparingly. While the economic reforms of the past ten years have improved the situation, many inefficiencies, and hence opportunities for mitigation, remain. In Russian residential buildings, for example, heat is often unmetered and controls may be non-existent, so residents have little financial incentive or immediate means to limit their heat use. Manufacturers may have more control over their energy use, but financing for energy efficiency is hard to find given the risky commercial environment in most countries in the region. JI and ET could provide a useful source of financing and incentives for reducing emissions.

4. METHODOLOGY

The goal of this study is to shed light on the potential benefits and difficulties of pursuing demand-side energy efficiency through the flexible mechanisms. The core of this study is an analysis of the only hard evidence we have to date on how flexible mechanisms will act on the international stage. The paper reviews 76 energy-sector AIJ projects in the countries in transition and compares demand-side energy efficiency projects to several categories of supply-side energy projects including energy efficiency, fuel switching and renewable energy. The projects in this review are all registered with the FCCC and have been approved by both the host and investor countries; the review also separates projects that have been implemented and those still under development. In some cases, it is not clear from the FCCC database if a project has been implemented. For these cases, the author has reviewed other sources of project information, including national joint implementation program descriptions, the Joint Implementation Quarterly, and information from individual experts in the region (JIQ; SWAPP 2001; USIJI 2001; Gritsevich 2001; Peeva 2001; Doukov 1999). Based on the experience to date under the pilot phase of AIJ, the paper then analyzes several strategies for reducing the barriers to demand-side mitigation opportunities, concluding with recommendations.

5. ENERGY EFFICIENCY AND THE KYOTO MECHANISMS

Energy efficiency projects are particularly appealing mitigation options because they often offer "no regrets": they pay for themselves through energy savings alone. Many other mitigation options, such as afforestation, may not be profitable without attributing an economic value to the carbon they mitigation (Schwarze 2000; Swisher and Villavicencio 1995).

Both demand and supply side energy projects can profitably reduce greenhouse gas emissions. This paper focuses on demand-side energy efficiency for several reasons:

- Demand-side energy efficiency projects tend to be highly cost-effective, particularly in countries in transition (Mastepanov *et al.* 2001; Chandler *et al.* 1996; Schwarze 2000). The lower the cost of mitigation, the more feasible it becomes. Ultimately, this may mean that countries can accept more aggressive mitigation targets.
- The more options we have available for limiting emissions, the cheaper emission mitigation becomes. Countries and companies then can focus their limited resources on the opportunities that reduce emissions by the greatest number of tons per dollar invested.
- Energy demand is what drives the production of energy, so in most industrialised countries, a significant portion of the mitigation potential lies in demand-side energy efficiency. In fact, most countries rank demand-side energy efficiency as a top priority in their climate policy.
- Demand-side energy efficiency has numerous benefits outside of climate mitigation. These include job creation, increased economic competitiveness, reduced energy imports, and local environmental protection.

The point of this paper is not to argue that demand-side energy efficiency should be the only means of mitigating emissions, but rather that it can play an important role in the larger menu of options. While the benefits of demand-side energy efficiency are significant, there are several barriers that could have a particularly large effect on demand-side energy efficiency. The distributed nature of demand-side energy efficiency opportunities makes these opportunities difficult to tap and can raise transaction costs, particularly in the context of joint implementation. Carbon buyers may find it difficult to access the financial benefit of energy savings at a site they do not control. While in theory, the market should take into account the lower cost of providing carbon credits from demand-side energy efficiency, this may not be happening in all transactions, effectively driving up the cost of mitigation per ton of carbon. Finally, an inherent separation exists between energy consumers and the emissions associated with energy production, as is often the case with electricity and district heating. End users may not directly emit emissions, which may make it more difficult to attribute emission reductions to them.

6. MITIGATION IN THE ENERGY SECTOR UNDER THE AIJ PILOT PHASE

The experience with the pilot phase of AIJ shows that most energy sector projects focus on supply rather than demand. In fact, of the 65 energy-sector AIJ projects implemented in countries in transition, only 10 relate to demand-side energy improvements. A large majority of the 65 projects are small Swedish projects implemented in the Baltics. Of the 17 remaining projects not sponsored by Sweden, four are in demand-side energy. Not surprisingly, supply-side projects also account for the majority of investments and anticipated emission reductions under these projects, as shown in Table 1.

Table 1. Summary of Energy Sector AIJ Projects in Countries in Transition[2]

Project Type	Number	Total Cost	Emission Reductions ($t\ CO_2$)
Demand-Side Energy	10	$96.9 million	230,000[3]
Demand-Side Energy without Cement Project	8	$4.3 million	213,000
Mixed Demand and Supply-Side Energy	2	$1.2 million	55,000
Supply-Side Energy	53	$147.0 million	16,000,000
Total	65	$245.1 million	16,285,000

Carbon costs

Carbon costs are difficult to calculate because most AIJ projects do not provide complete information on costs and benefits. Thus projects with large benefits may not look appealing. The energy projects reviewed in this study reveal a mixed story on cost per ton of mitigated carbon emissions. Demand-side energy projects in this sample have high costs when the benefits are not calculated: $407 per ton of CO_2, compared to an average of $9 a ton for other energy-sector projects. Of the $97 million invested in demand-side AIJ projects, fully $89 million came from one project that was completely profitable based on energy savings and other modernisation benefits alone. The project, involving French investment at a Czech cement factory, actually was implemented before the developers applied for AIJ status. This project appears to have a cost of over $5,000 per ton of carbon dioxide based on FCCC Secretariat data, which do not typically include other revenue streams for a project. When this project is eliminated from the set, the average cost comes down to $20 per ton of carbon dioxide, which is still high, though much closer to the average for supply-side projects. Most of the remaining projects are small Swedish demonstration projects, which may have had relatively high transaction costs. The Swedish projects are also primarily paid for through loans that the host municipalities must repay. These loans appear to be cost-effective for the borrowers based on energy savings alone.[4]

Additionality, or the requirement that JI projects produce emission reductions that would not have otherwise occurred, can also penalise cost-effective projects. The Framework Convention and Kyoto Protocol offer vague guidance on whether cost-effective projects meet the financial additionality requirement. The U.S. government, for example, typically requested information to demonstrate that projects would not have been financed and implemented without AIJ status. The U.S. did not reject projects solely because they were cost-effective, but the requirement to provide information on financial additionality increased transaction costs for many projects. This requirement, even though it is not defined precisely, may have discouraged some project developers against requesting AIJ status for their projects.

Another possible explanation for the high costs per ton is that demand-side energy projects tend to have a shorter administrative life than supply-side projects. In other words, the investors agreed on a shorter period in which to count emissions; emissions mitigated after this period are not reported.

This problem of costs is important, though. If costs per ton of carbon for demand-side energy efficiency projects were in fact so high, surely no one would invest in them. From the investor perspective, these issues that can be explained one project at a time may in fact be major barriers in the aggregate. In the case of the cement factory, the

French company was easily able to incorporate the other project revenue streams because it owned the Czech factory. Another carbon mitigation investor may have had little interest in this project if it could not capture the benefit of the saved energy. Thus, the project may not have been implemented, even if total profitability was higher than for other types of mitigation projects. High transaction costs for demand-side energy projects are likely to remain a recurring problem because many such projects are small and dispersed in numerous homes and facilities.

Implementation rates and project size

Implementation rates are similar for both demand and supply side projects, at 83 and 85 percent, respectively. Interestingly, there is significant variation within the supply side projects, so that all 28 renewable energy projects have been implemented, but less than half of the fuel switching and fugitive gas capture projects have been realised.

The average size of the demand-side energy projects is actually larger than that of the supply-side energy projects, but primarily because of the effects of the French-Czech cement project on the demand side and the numerous small Swedish renewable energy projects on the supply side. A large portion of the total investment in supply-side projects is also concentrated in three or four projects. This does not have the same intense effect on the overall supply data as it does for the demand-side projects, both because the total data set is larger and the drop in project size is more gradual.

Project types

The majority of demand-side energy projects under AIJ are in buildings, though there are also projects in industry, agriculture, and transportation (see Table 3). Buildings typically offer many highly cost-effective opportunities to save energy, particularly as heat subsidies are removed. Studies in Poland, Ukraine, and Russia have all shown that such projects actually can have negative costs, even without assigning value to the carbon mitigation (Chandler 2000; Rojek and Parczewski 2000; FEWE and PNNL 2000; Michalik *et al.* 1994; Raptsun *et al.* 1997; Mastepanov *et al.* 2001). Projects in industry can also be very profitable. One coke manufacturer in Ukraine, for example, found that insulating its high-temperature, high-pressure steam lines could provide a return of over 1,000 percent (Brown *et al.* 1999). One key to tapping the carbon value of such projects may be to develop new financial mechanisms to capture the value from all aspects of a project. Specialised investments funds may be one such mechanism.

The majority of supply-side AIJ projects are in renewable energy, including 26 sponsored by Sweden. Fuel switching, though, accounts for the greatest volume of supply-side investments and emission reductions. Supply-side energy efficiency measures are also a significant portion of the total. In addition, one fugitive gas capture project has been implemented. This last result is somewhat surprising because numerous studies have demonstrated that such projects are among the most cost-effective mitigation options when full costs and benefits are considered (Schwarze 2000; Popov 2000). Table 2 provides more information on these project categories.

Table 2. Supply-Side AIJ Projects Implemented in Central and Eastern Europe

Category	Projects	Total Cost	Emission Reductions (t CO_2)	Gross Cost per Ton of CO_2
Energy Efficiency	20	$21 million	4,926,000	$4
Fuel Switching	3	$106 million	8,580,000	$12
Fugitive Gas	1	$1.5 million	255,000	$6
Renewable Energy	28	$17 million	2,091,000	$8

Many projects could reasonably be considered in one or more categories. For example, several Swedish projects involve switching boilers from fuel oil to wood waste. Such projects are counted in the FCCC database variously as either renewable energy, fuel switching, or energy efficiency. Some projects in the database also have more than one element, for example, fuel switching, and energy efficiency improvements. For the sake of simplicity and replicability, this study categorises supply-side energy projects as they are grouped by the FCCC Secretariat, which in turn is based on data from project developers and the methodology of the Intergovernmental Panel on Climate Change.

Table 3. Demand-Side Energy Projects Implemented in Transition Economies during the AIJ Pilot Phase

Project Description	Host Country	Investor Country	Cost	Tons of CO_2 mitigated	Gross Cost per t CO_2
CO_2 Recovery in Brewery	Croatia	Belgium	$792,000	50,250	$16
Mustamae Residential II	Estonia	Sweden	$633,000	4,670	$136
Mustamae Residential III	Estonia	Sweden	$475,000	3,540	$134
Keila Schools	Latvia	Sweden	$185,000	830	$222
Saldus Hospital	Latvia	Sweden	$283,000	1,430	198
Horticulture in Tyumen[5]	Russia	Netherlands	$3,387,000	NA	NA
Cement Factory in Cizkovice	Czech Republic	France	$89,233,000	16,800	$5,311
Mustamae-Vilde Residential	Estonia	Sweden	$465,000	3,800	$122
Fuel Switching in Buses[6]	Hungary	Netherlands	$1,300,000	148,000	$9

7. AIJ EXPERIENCE AND LESSONS LEARNED

Based on the experience with AIJ to date, it is clear that demand-side energy projects are neither as numerous, nor have they attracted as much investment as supply-side projects. Demand-side energy projects appear to be at a disadvantage either because of their nature or because of some barriers in the system. Three possible reasons for this disparity include:

- The disconnect between emission reductions and an end user's energy savings.
- Higher costs for demand-side energy efficiency projects because the revenue from energy savings is difficult for an external carbon investor to capture.
- Higher transaction costs for demand-side projects, which tend to be small and distributed.

The separation between energy use and emissions in demand-side projects does not appear to have had a major effect on AIJ projects to date, in that there is little evidence that investors have avoided such projects for this reason. However, this may prove to be an increasingly difficult problem in the future, particularly as countries develop more specific rules on tradable carbon projects.[7] Countries will want to be sure that if they sell credits from an emission mitigation project, emissions were in fact reduced because ultimately countries are responsible for their international obligations. For example, the Czech Republic might decide to implement a large new project for efficient use of electricity in buildings. While the power supplier would see demand drop, it may decide to export the spare power to keep sales up. The Czech Republic would still be responsible for the emissions from the exported power, though its emission allowance would now be lower. Thus, it is possible that some countries will require that the organisation responsible for the emissions be included in the project. In Canada, for example, the Greenhouse Gas Emission Reduction Trading Pilot (GERT) considered such a rule, but decided against it. The Canadian Greenhouse Gas Management Consortium (GEMCo), which develops and implements many Canadian projects under GERT, does require actual emission offsets, including the agreement of the emission "owner" (Donnelly 2000; GERT 2000). Such rules may become more widespread particularly if countries implement domestic emission trading systems. While emission trading would be good for demand-side energy projects because it would significantly lower transaction costs compared to JI, individuals developing demand-side energy projects to mitigate emissions would likely need to involve the emitter in order to have something in the end to trade.

Because investors may not have an easy way of tapping the revenue from energy savings, it is likely that high gross costs have been a detriment to demand-side energy projects. Additionality rules for AIJ projects may have steered investors away from highly cost effective projects, or from applying for AIJ status for those projects. The case is less clear for transaction costs because most demand-side AIJ projects have been large. In general, though, demand-side opportunities are small and distributed by nature, so it is possible that investors have avoided the smaller projects because of their transaction costs.

8. TAPPING DEMAND-SIDE ENERGY OPPORTUNITIES

Combining numerous small projects into larger projects might help bring down transaction costs. Revolving loan funds might also help promote demand-side energy projects by streamlining financing and allowing facility owners to obtain loans that they would repay with energy savings. Such funds could also be linked to investment funds, which would buy the carbon credit a project generates at a fair market rate. In this way, a carbon investor's costs would be limited, but yet projects could still move forward because they would have all the necessary financing. Several carbon funds or investor groups already exist, though most look at carbon projects primarily from the perspective of carbon costs, not net costs. Creating combined mechanisms with both an investment fund and a revolving loan fund would likely require creative new partnerships.

Such partnerships would need to involve investors seeking carbon credits, commercial banks, energy consumers, and local utilities. The carbon investors could provide equity in exchange for the rights to carbon credits (through joint implementation or emission trading). Commercial banks, either local or foreign, could provide loans that would allow end users to implement their energy efficiency projects and profit from the energy savings. Local utilities could provide the carbon credit in exchange for a portion of the equity. If local utilities in transition economies had fixed emission allowances or caps, they might even have an incentive to promote such transactions by providing some of the financing or organising the projects through demand-side management programs. Utilities might also have a stronger incentive to establish energy service companies that would allow them to provide a full range of energy services, from traditional energy supply to energy efficiency, in order to best meet customer needs.

Most likely, though, such transactions would need a catalyst because it would be difficult for all these disparate entities to find each other and understand the scope of the opportunity. This catalyst could be a local organisation such as an energy efficiency center, or an energy service company that served as a matchmaker, putting the necessary pieces of the deal together.

Host governments might also want to stimulate such transactions because of the multiple domestic benefits the investment would provide. Host governments should be careful not to limit the private sector's role in matchmaking, but rather promote carbon mitigation in other ways. For example, host governments likely will have access to revenue from emission trading that they could use to support such activities. A recent study by the Polish Foundation for Energy Efficiency found that government-controlled revenue from emission trading could be more effectively invested in carbon mitigation through loan guarantee funds rather than direct subsidies (Rojek and Parczewski 2000; FEWE and PNNL 2000). (Loan guarantee funds provide significant leverage, which multiplies the effect of the initial investment). Such a loan guarantee fund might encourage private commercial banks to get involved in carbon mitigation projects by lowering the risk of default.

Governments also have many other tools that they could use to promote demand-side energy projects. For example, host governments could encourage utilities to collaborate on demand-side management projects, either through regulation and rates, if the industry were still regulated, or through more a more flexible approach like allowing the utilities to get involved in international emission trading. Countries could also allow housing co-operatives and other groups of energy consumers to sell emissions if they reduce energy use by establishing a carbon reserve for such projects. (In any event, countries will need to reserve some of their carbon allowances to cover the emissions associated with this energy use, so the cost should not be too great as long as the reserve were properly managed). Another policy tool would be to provide incentives for end users with emissions, such as factories and possibly rural homeowners, to reduce emissions through energy efficiency. The incentives for such projects could include loan guarantees and access to tradable carbon credits.

Finally, in designing their national joint implementation programs, host governments could explicitly allow and encourage demand-side energy projects. They could also establish average emission rates, based on locality or other circumstances. Such emission rate data could simplify the process of setting baselines for demand-side mitigation projects, which in turn would lower costs for developing AIJ projects.

9. CONCLUSIONS

Several approaches are likely necessary to successfully promote demand-side energy efficiency as a carbon mitigation strategy in transition economies. These approaches can target different barriers and different constituents. Partnership will be important to catalysing such projects. This partnership may take on various forms. Public and private entities will need to collaborate to develop the infrastructure and rules necessary for joint implementation and emission trading. Emitters and energy consumers will need to partner to facilitate crediting of demand-side measures. Financial organisations, project developers, and energy consumers will need to work together in new ways to structure the financing and assemble the components of a successful carbon mitigation project. While these suggestions are aimed at demand-side energy projects in particular, they will also help promote all types of carbon mitigation projects for which the incentives and infrastructure are still immature.

Finding creative new ways of tapping the mitigation potential of transition economies is important for several reasons. The investment from transactions will help promote economic development in countries that have seen significant economic decline in the past decade, yet this development by nature will be environmentally friendly. The carbon mitigation opportunities in transition economies are considerable. Successfully tapping them will not just lower the costs of mitigation globally, but will also make it feasible for countries to meet current and future emission commitments. In summary, finding better ways to link carbon investors and incentives to demand-side energy projects can play an important role in global mitigation and climate protection as a whole.

10. BIBLIOGRAPHY

Bandsma, Jan. 1999. “Activities Implemented Jointly: The national programs of the U.S. and the Netherlands analysed and compared.” Rijksuniversiteit Groningen, Groningen, the Netherlands.

Brown, Daryl, Volodymir Derij, Meredydd Evans, Vladimir Laskarevsky, Steven Parker, Andrew Popelka, Sriram Somasundaram. 1999. *Cogeneration and energy efficiency at Avdeevka: Recommendations and energy audit report for Avdeevka Coke Chemical Plant.* Pacific Northwest National Laboratory. Washington, DC, USA.

Chandler, William U. 2000. *Energy and Environment in the Transition Economies*. Westview Press. Boulder, Colorado, USA.

Chandler, William U., Meredydd Evans and Alexander Kolesov. 1996. “Climate Change Mitigation: A Review of Cost Estimates and Methodologies for the Post-Planned Economies.” *Energy Policy.* Volume 24, Issue 10-11, October 1996.

Donnelly, Aldyen. 2000. Presentation on the Greenhouse Gas Management Consortium at the Earth Technology Forum. October, Washington, DC, USA.

Doukov, Dimitar. 1999. “Joint Implementation and its pilot phase in Bulgaria.” *Capacity for Climate Protection in Eastern Europe.* Regional Environment Center. Szentendre, Hungary. At www.rec.org/Climate/Case Studies.

Evans, Meredydd, Susan Legro and Ilya Popov. 2000. “The Climate for Joint Implementation: Case Studies from Russia, Ukraine and Poland.” *Mitigation and Adaptation Strategies for Global Change.* Vol. 5, No. 4.

Foundation for Energy Efficiency (FEWE) and Pacific Northwest National Laboratory (PNNL). 2000. “An Economic Analysis of Poland's Opportunities to Mitigation Climate Change: The Role of the Flexibility Mechanisms.” Washington, DC, USA.

Greenhouse Gas Emission Reduction Trading Pilot (GERT). 2000. Website at www.gert.org/

Gritsevich, Inna. (Senior Researcher at Russian Center for Energy Efficiency). 2001. Personal communication to the author, Jan. 18.

Joint Implementation Quarterly (JIQ). Issues 1/2 (1995), 2/1 (1996), 3/2 (1997), and 5/4 (1999) at www.northsea.nl/jiq.

Kyoto Protocol to the Convention on Climate Change. 1997. Climate Change Secretariat. Bonn, Germany.

Mastepanov, A., O. Pluzhnikov, and V. Gavrilov. 2001. "Post Kyoto Energy Strategy of the Russian Federation, Outlooks and Prerequisites of the Kyoto Mechanisms Implementation in the Country." *Climate Policy*. Issue 1.

Michalik, Janusz, Slawomir Pasierb, Jerzy Piszczek, Michal Pyka, and Jan Surowka. 1994. *Evaluation of the Feasibility and Profitability of Implementing New Energy Conservation Technologies in Poland.* Polish Foundation for Energy Efficiency (FEWE). Katowice, Poland.

Peeva, Valia. (Senior Researcher at Bulgarian Foundation for Energy Efficiency). 2001. Personal communication to the author, Jan. 19.

Popov, Ilya. 2000. *A Foundation for Climate Accountability: Monitoring Greenhouse Gas Emissions in Russia. The Natural Gas Sector Example.* (Thesis). Brown University. Providence, Rhode Island, USA.

Raptsun, Mykola *et al.* 1997. *Country Study on Climate Change in Ukraine.* Agency for Rational Energy Use and Ecology (ARENA-ECO). Kiev, Ukraine.

Rojek, Milosz and Zygmut Parczewski. 2000. "A macroeconomic evaluation of the potential use of funds from GHG emission trading to implement a sustainable development scenario and further reduce GHG emissions." Polish Foundation for Energy Efficiency (FEWE). Katowice and Warsaw, Poland.

Schwarze, Reimund. 2000. "Activities Implemented Jointly: Another look at the facts." Stanford University, Stanford, California, USA.

Swisher, Joel and Arturo Villavicencio. 1995. "The UNEP Greenhouse Gas Abatement Costing Study." *The Feasibility of Joint Implementation*. ed. Catrinus Jepma. Kluwer Academic Publishers. Dordrecht, The Netherlands.

Swiss AIJ Pilot Program. 2001. Website: www.admin.ch/swissaij/

U.S. Initiative for Joint Implementation (USIJI). 2001. Website: www.gcrio.org/usiji/

11. GLOSSARY

AAU	Assigned Amount Unit; one ton of the emission allowance of a country committing to limit emissions under the Kyoto Protocol
AIJ	Activities Implemented Jointly; the pilot phase of joint implementation to reduce greenhouse gas emissions under the Framework Convention on Climate Change
CDM	Clean Development Mechanism; a mechanism defined in the Kyoto Protocol to allow developed and developing countries to co-operate on emission reduction projects where the emission credits for these projects would be transferred to the developed country
ERU	Emission Reduction Unit; the term used for a ton of transferable emission reductions generated through a joint implementation project
ET	Emission trading; a flexible mechanism under the Kyoto Protocol whereby two countries committing to limit emissions can trade assigned amount units
FCCC	Framework Convention on Climate Change
GEMCo	Canadian Greenhouse Gas Management Consortium
GERT	Greenhouse Gas Emission Reduction Trading Pilot (a Canadian program)
JI	Joint implementation; a mechanism under which two nations jointly implement a project to reduce greenhouse gas emissions; both nations must have emission limitations under the Kyoto Protocol, and the investor nation receives emission reduction units deducted from the host nation's total emission allowance

12. END NOTES

[1] There are, however, significant differences in emission targets for different European Union members and some members are allowed to increase emissions compared to their 1990 baselines. It is also important to note that no major industrial nation has yet ratified the Kyoto Protocol.

[2] Data for this chart and the others in this section come from the AIJ Unified Project Reporting Format reports for each project on the FCCC Secretariat website (www.unfccc.de), and in some cases from additional sources including the JI Quarterly and the Regional Environment Center. This table shows only implemented projects.

[3] Does not include emissions from Tyumen horticulture project as emission reduction data were reported for this project.

[4] This paper does not provide a more thorough analysis of investor versus host country costs because many projects either do not separate costs out in this way, or they use differing definitions for JI versus non-JI components of a project.

[5] This project is not included in the totals because only incomplete data are available.

[6] The FCCC Secretariat categorizes this project as fuel switching, not as energy efficiency.

[7] Renewable energy projects will face the same problem, unless they directly replace existing power capacity or an existing utility develops the project.