Requirements for energy efficiency projects to be certified as carbon offsets

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1. SYNOPSIS

This paper discusses the key requirements for certification of carbon offsets from energy efficiency projects under the CDM and Annex-I JI provisions of the Kyoto Protocol.

2. ABSTRACT

This paper discusses the key requirements related to certification of carbon offsets, under the joint implementation (JI) and Clean Development Mechanism (CDM) provisions of the Kyoto Protocol, as they relate to the development of energy efficiency projects in developing and transition countries. The essential criteria for securing carbon offset credit include:

- Clear additionality compared to a credible baseline
- Reliable emission reduction potential
- Practicality of monitoring, verification and certification
- Equity and local-currency debt financing at reasonable interest rates
- Institutional capacity for host-country approval and other support

Although the existence of these technical, institutional and financial issues regarding carbon offset projects are often treated as barriers to establishing the JI/CDM process, this paper demonstrates that these problems are soluble at reasonable cost using available methods.

3. BACKGROUND

The UN Framework Convention on Climate Change (UN FCCC) allows for the joint implementation (JI) of measures to mitigate the emissions of GHGs. The concept of JI refers to the execution of emission reduction measures in one country with partial or full financial and/or technical support from another country, potentially fulfilling some of the supporting country's emission-reduction commitment under the UN FCCC.

In December 1997, the Third Conference of the Parties (COP) to the UN FCCC was held in Kyoto, Japan. The Annex I (industrialised) countries agreed for the first time on emission reduction targets, which vary widely. Also, the concept of joint implementation (JI) was endorsed, and the Kyoto Protocol provides for credit against emission reduction commitments in the time frame of 2008-2012. The Kyoto Protocol provides for three "flexibility mechanisms:" emission allowance trading between Annex I (industrialised) countries, JI carbon offsets within Annex I, and the clean development mechanism (CDM), which involves carbon offsets in developing countries. Although specific rules for these mechanisms have been agreed to, they are being discussed and negotiated by the parties to the UNFCCC and the subsidiary bodies to the convention's Secretariat.

Each mechanism has a distinct type of credit that can be traded. JI is based on project-specific "emission reduction units" (ERUs) that must be agreed as additional from what would otherwise occur. The CDM is also a project-specific regime, under which “certified emission reductions” (CERs) can be produced by non-Annex I host countries. International emissions trading would allow transfers of so-called “assigned amount units” (AAUs) based on Parties’ overall inventories.

Energy efficiency (EE) projects offer some of the most attractive opportunities for JI/CDM projects. Because energy efficiency measures are generally close to commercial viability, they offer the prospect of relatively low-cost carbon offsets. The technical efficiency potential in many countries is large and offers benefits in terms of technology transfer and pollution prevention. Thus, carbon offsets under the CDM/JI regimes could become a major source of funding for energy efficiency. Today, this “carbon revenue stream” is extremely uncertain due to the lack of a formal, international market for carbon credits. However, there have been a number of international carbon trades that constitute the beginnings of an offset market (Swisher, *et al.* 1999).

4. STEPS IN THE DEVELOPMENT OF PROJECTS FOR JI/CDM CERTIFICATION

To identify the essential requirements for certification of carbon offsets, let us review the project development process that produces JI/CDM credits. The steps in this process are the following:

- Project identification and design: the selection of a project that could earn JI/CDM credits includes the analysis of the net carbon emissions for the project design and its baseline.
- Baseline definition and analysis: The key criterion of additionality depends on a clear, consistent definition of the counterfactual conditions without the project, i.e., the baseline.
- Host country registration and approval: International acceptance of a JI/CDM project first requires approval at the national level, indicating consistency with domestic laws and policy.
- Third-party validation of project design and baseline: To ensure that later verification of performance will provide certified credits, the project design and especially the baseline needs validation by an independent third-party before project implementation (World Bank 1999). Although validation is an additional cost, it increases confidence that a project, once validated, will eventually be certified, thus reducing the risk and cost of JI certification.
- Financial structuring: The financial terms are arranged and contracted. Project investors, which provide capital investment in the form of debt or equity, may or may not be carbon buyers, which pay for certified offsets on delivery. For the investors, offset sales represent a future revenue stream. Discussions with potential investors may occur throughout the project development process.
- Implementation and operation: The project is built, commissioned and begins operation.
- Performance monitoring: Project performance, including baseline conditions and other parameters, is measured in the commissioning process and during on-going project operation.
- Third-party verification of project performance: An independent third-party verifies measured project performance against the validated design and baseline to approve certification.
- Certification of carbon offset credit for JI/CDM: Based on host-country approval, validated project design and baseline, and verified project performance, JI/CDM credits are certified.

Based on experience with these steps, we discuss the essential requirements for certification below.

5. BASELINES AND ADDITIONALITY

For the CDM and Annex I JI, the Kyoto Protocol established few rules other than that reductions must be additional. *Additionality* refers to the essential criterion that an offset project represents actions that would not have occurred otherwise. Because carbon offsets represent emission reductions, they are quantified as differences that can only be measured relative to a *baseline.* Thus, the establishment of the baseline is the key step in determining the extent to which a carbon offset project satisfies the requirement of additionality under the JI carbon-offset trading regime.

The UNFCCC says little about the additionality of carbon-offset projects under its JI provisions. Under Articles 6 and 12 of the Kyoto Protocol, it specifically states that projects must result in emission reductions that are additional to any that would otherwise occur. The Kyoto Protocol does not address the financing of JI/CDM projects, the source of such finance, or the intentions and alternatives to such finance. The criterion of additionality refers to *emission reductions only*, and it requires that the reductions only satisfy the condition that they would not occur in the absence of the JI/CDM project.

Despite this rather clear definition, there remains a great deal of controversy about the nature of the additionality criterion for JI and the CDM. This controversy probably stems from the language in Article 4.3 of the UNFCCC, which calls for the Annex I countries to finance the incremental costs of the developing countries participation in the Convention. This article deals mostly with providing emission inventories and other information, and with activities of the Convention’s “financial mechanism,” which became the Global Environment Facility (GEF).

Neverthelss, this provision appears to be the justification for the criterion of *financial additionality*, which has been applied to JI project proposals by, among others, the U.S. Initiative on Joint Implementation (USIJI). Financial additionality refers to the financial flows of an offset project, posing the question of whether the expenditures involved would have been made without the offset project. This question addresses the motivation for choosing the carbon offset project.

Regarding the motivation for choosing an offset project, the issue that is sometimes raised with regard to financial additionality is the treatment of projects that are to any extent “profitable” for the investors. The argument is simply that if a project is profitable to its sponsors, they could be expected to implement the project without the need for carbon offsets and fail the additionality test.

This condition requires examination of the economics of project finance. For example, a JI/CDM project with a modest cost per ton of emission reduction, on a net-present-value basis, would generally produce revenues that, over the life of the project, could exceed the corresponding investment, on an *un-discounted* basis. However, a project that earns a very low rate of return would not be considered commercially financable under any normal conditions, and thus additional funding would be needed to make it viable.

The analysis becomes more difficult, however, when a project’s rate of return is high enough that it might be financable *under certain conditions*. Such conditions generally involve relatively low risks, which could make a project attractive to investors at relatively modest rates of return. This might be the case for a conventional fossil-fuel power station with relatively low risk and corresponding modest rate of return for a project that is “already profitable.”

There are, however, many sources of risk for the types of projects, technologies and locations likely to be involved in carbon offset investments. In particular, small renewable energy projects in developing countries face risks of size, location, technology, dispersed customer bases, lack of credit-worthy customers, etc. In a commercial environment, these risks drive the required rates of return for commercial finance higher than those required for conventional energy project investments.

Table 1. The hierarchy of the economic viability of carbon offsets projects

· Projects with negative rates of return	_ Clearly not viable without concessional financing resources or carbon offsets available _ Offset cost per mtC would be expensive
· Projects with rates of return below normal market threshold	_ Probably not viable without concessional financing resources or carbon offsets available _ Offset cost per mtC would be moderate
· Projects with rates of return above normal market threshold, but below risk premium for project type, technology, country	_ Marginal with private finance only, viable with concessional finance or carbon offsets available _ Offset cost per mtC would be inexpensive
· Projects with rates of return above normal market threshold, including applicable risk premium	_ Viable with private finance only; concessional finance unnecessary _ Carbon offsets precluded by lack of additionality

Additional funding may be necessary to raise a riskier (in conventional financial terms) offset project to a high enough rate of return to make it viable, while other more familiar (and safer) projects may be viable at lower rates of return (see Table 1). This relationship is implicit to the perspective of risk-return analysis that determines most commercial financing decisions. To those unfamiliar with such analysis, however, it may appear that projects that are "already profitable" are demanding both incremental financing and offset credit.

To summarise, financial analysis can be one method for establishing *environmental additionality*, *i.e.*, emissions that "would otherwise occur" under the provisions of Articles 6 and 12 of the Kyoto Protocol, but "financial additionality" is not a relevant criterion for evaluating JI projects.

6. BASELINES FOR ENERGY-EFFICIENCY PROJECTS

For EE projects in existing buildings or facilities, the "before" case is the baseline. The project case is the "after," or post-installation case. In new construction projects, the baseline case is counter-factual, in that it cannot be directly observed before installation of the EE measures. New construction by definition will not have pre-retrofit information for use in calculating energy savings. Thus, baseline energy use has to be determined by methods other than direct pre-installation inspections or measurements. Where Minimum Energy Performance Standards (MEPS) are in effect, energy savings can be calculated as the difference between the MEPS energy performance level and the actual performance.

In other cases, however, comparable performance levels must be determined for the individual end-use that is being assessed. Such standards should be: 1) consistent with sufficiently "good practice" under the status quo that they avoid rewarding performance that would be achieved regardless, and 2) sufficiently less than the state-of-the-art to leave opportunities for investments that move the energy system in the direction of sustainable development. The technical analysis needed to select the proper level for this type of standard could build on existing work and should not involve prohibitive costs. Supporting such analysis and facilitating international agreement on standards should be a high-priority policy measure related to JI and CDM (Swisher 1999).

7. ENERGY EFFICIENCY PROJECT PERFORMANCE

Certification of carbon offsets based on emission reductions from JI projects requires a carbon-accounting procedure that accounts for the difference between emissions from providing energy services without the project and emissions with the project. For an energy-efficiency (EE) project, it is necessary to assess the baseline energy consumption, and to measure energy use after the EE project is implemented (the “project” case). Energy savings are then multiplied by the appropriate carbon intensity for the associated fuels or electricity saved to determine net GHG reduction:

$$R_{net} = E_r C_r - E_p C_p \qquad [1]$$

where:

Er = Energy produced in baseline case
Cr = Carbon intensity of energy in baseline case
Ep = Energy produced in EE project case
Cp = Carbon intensity of energy in EE project case

Table 2 characterises the comparisons that are needed to assess the performance of energy projects and the quantities that need to be measured, depending on the type of project (Swisher 1997).

Table 2. Performance comparisons and measurements required for monitoring and verification of carbon offsets in energy projects

Energy Technology	Comparison (between baseline and project case)	Required Measurements
Renewable (solar-wind-hydro-geo) energy supply	Baseline: fossil fuel supply Project: renewable energy system (generally electric)	Baseline: carbon fuel intensity Project: energy supplied
Biomass energy conversion	Baseline: fossil fuel supply Project: biomass production and conversion to fuel/electricity	Baseline: carbon fuel intensity Project: energy supplied and net terrestrial carbon storage
Fuel-switching (supply-side)	Baseline: fossil fuel supply Project: cleaner fuel supply (coal to natural gas, for example)	Baseline: carbon fuel intensity Project: energy supplied and change in carbon intensity
Fuel-switching (demand-side)	Baseline: fuel or electric energy end-use Project: change between fuels or between fuel and electricity	Baseline: carbon fuel intensity Project: energy use, change in efficiency and carbon intensity
Energy-efficiency measures (EEM)	Baseline: fuel or electric energy end-use Project: more efficient end-use technology	Baseline: energy end-use and carbon fuel intensity Project: change in energy use

8. MONITORING AND VERIFICATION OF ENERGY EFFICIENCY PERFORMANCE

There are also technical issues regarding monitoring and verification (M&V) of carbon offsets in energy efficiency projects. As shown in Table 2, EE projects can be relatively simple in that they require monitoring only the project energy savings rates, once the baseline energy use and carbon intensity has been determined.

Nevertheless, projects involving EE at the end-use level may require complex protocols for M&V. Assuming that the baseline carbon intensity has been determined, the principal issue in EE projects is the net energy savings compared to the baseline energy use. The actual measurement of baseline energy use (in existing facilities), post-installation energy use, and energy savings can be determined using one or more of the following techniques.

- Engineering calculations
- Utility meter billing analysis
- Computer simulation analysis
- Metering and monitoring

A relatively detailed approach to monitoring requires measuring equipment-usage and energy-service levels to compare baseline and actual energy use in a dynamic way. A great deal of work has been performed in several countries, for example in support of North American utility demand-side management (DSM) programs, to develop measurement methods. Some results of this DSM evaluation work can be adapted to carbon offset projects, provided that the common errors observed in DSM evaluations can be corrected. These include unrealistic estimates of operating hours for lighting and other building systems, discrepancies between calculated and measured values, manipulation of monitoring protocols by parties with an interest in the results, etc.

U.S. Department of Energy's (DoE) North American Energy Measurement and Verification Protocol (NEMVP), published in 1996, addresses these issues, which are clearly relevant to offsets. The DoE's International Performance Measurement and Verification Protocol (IPMVP), published in 1997 and recently updated, expands on the NEMVP with more emphasis on projects implemented outside the traditional North American DSM framework (US DoE 1997).

The basic aspects of energy-efficiency performance verification include the following:

- Verification of the accuracy of baseline conditions,
- Verification of the proper installation and operation of new equipment or systems, and
- Verification of the quantity of energy savings that occur during the life of the measure.

For each site or project, the baseline and project energy use can be estimated using a combination of metering, billing analysis, engineering calculations and/or computer simulations. After a project is completed, the energy savings for the first year should be projected. First year savings should be based on these projected savings values. For subsequent years, savings values should be updated using data obtained and analysed in each year of operation. Previous projections should be reconciled with new results, and future savings should be recalculated based on this information.

Definitions of site-specific M&V plans should include consideration of accuracy requirements and the importance of *relating monitoring costs and accuracy to the value of the energy savings*. The confidence level that is appropriate for establishing energy savings is a function of the value of the project and the cost-effectiveness of increasing or decreasing confidence in the measurement. The costs can be significant, but manageable in the context of an overall project budget. Typical building end-use monitoring, based on a statistical sample of similar end-use functions (for example, fluorescent lighting), would tend to cost on the order of Euro 1/m^2, while more detailed monitoring required for building diagnostics and re-commissioning would tend to cost on the order of Euro 2/m^2 (Swisher and Wang, 1997).

For building EE projects in particular, it is advisable to monitor variables affecting energy demand, such as outdoor/indoor temperatures, conditioned floor space, and changes in production or staffing levels. These exogenous parameters can influence the total facility energy consumption, and therefore they must be accounted for in order to reach an accurate estimate of net savings.

Figure 1. Hypothetical Projected vs. Actual Energy Savings

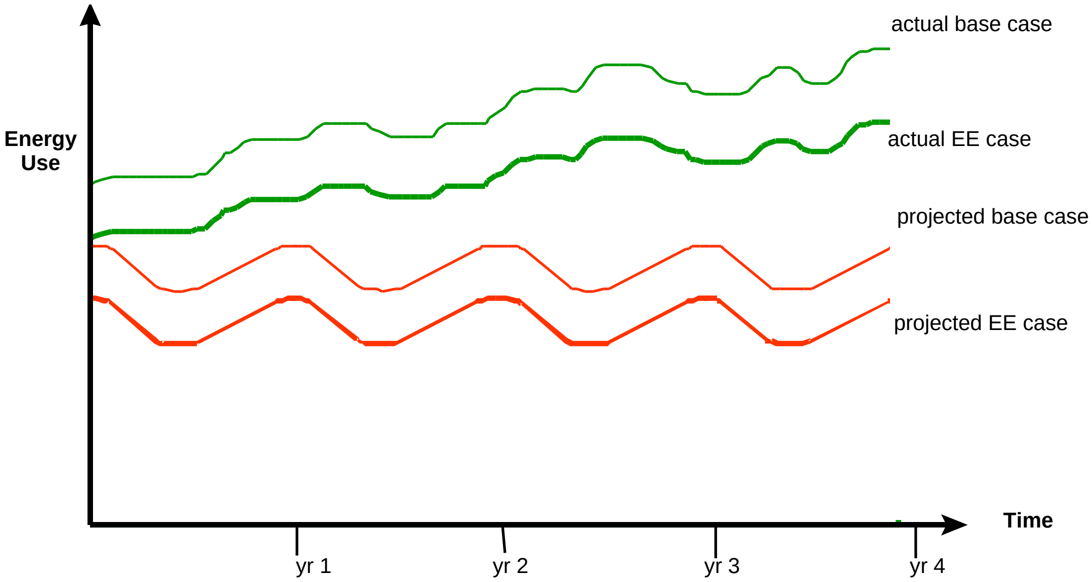

Figure 1 illustrates a hypothetical energy use profile for the first few years of an efficiency project. If all parameters affecting total energy use remained stable during the project life, one would expect a cyclical annual pattern due to seasonal weather variations. Thus the projected efficiency (EE-) case and base case might appear as shown. Occupancy, weather and other parameters introduce variation that should be corrected in the analysis process.

9. FINANCING ENERGY EFFICIENCY: THE ROLE OF PERFORMANCE CONTRACTING AND CARBON CONTRACTS

The need to quantify the baseline and to perform M&V to certify carbon offsets are similar to the needs that energy service companies (ESCos) face with regard to energy savings. Thus, the methods that have been developed to determine ESCo project baselines and the corresponding M&V protocols (such as the IPMVP) should be applicable to for crediting carbon offsets.

At the same time, capturing the recognised potential for emission reductions through EE investments will require new and innovative mechanisms for financing EE projects. Traditional project finance is appropriate, but the small size of energy-efficiency projects limits the potential due to high transaction costs and the risk perceptions of traditional financing sources.

Performance contracting via ESCos appears to be a promising option, if this process can be successfully adapted to the local conditions. Fortunately, several of the important aspects of performance contracting, including the financial structure, baseline evaluation, monitoring and verification needs, are similar to the needs of carbon offset projects. Thus, it appears feasible to use many of the concepts of performance contracting to design a process to implement energy-efficiency carbon offsets through *carbon contracts* (Swisher 2000).

Under a carbon contract, whether a performance contract or other type, a project sponsor enters into a long-term carbon offset delivery obligation with a carbon buyer. Once the contract is in place, the investors would be able to treat the carbon revenues as they would any other revenue stream. Ultimately, the impact of additional revenue from carbon offset sales on project financing could help clean energy projects achieve commercial viability, as an alternative to subsidies, special tariffs, grants, or other non-commercial mechanisms. From the perspective of investors, the additional revenue would provide more secure cash flow to cover debt servicing and/or justify improved credit terms (*i.e.* longer maturities, lower interest rates, etc.) with lenders.

On a more conventional project finance basis, a commercial bank may in the future be able to lend to a project directly on the basis of the anticipated cash flows from the carbon offset sales. These cash flows need not represent all of the debt required for the project, but rather a portion of the debt that nevertheless helps make the overall project commercially viable. Lenders traditionally seek high ratios of debt service coverage for small energy projects that are perceived to be high-risk investments, so any cash flow that makes repayment more secure is helpful.

The growing international interest in trading carbon offsets thus provides a new source of project revenues that can help secure the repayment of the project financing. Today, this revenue is not by itself sufficient to accelerate investment in EE projects. Rather, it can be part of a structured financial package to support EE projects, in which the traditional components remain essential.

Despite the rather limited financial value of carbon offsets today, the financial structure of this type of project is very applicable to ESCos being established in Central and Eastern Europe. Performance contracting offers a way for private businesses or public agencies to use future energy savings from installed energy-efficiency measures to finance an efficiency project. In addition to being an appropriate method for financing small projects, performance contracting often requires the definition of a project baseline, and the use of monitoring and verification protocols to satisfy the contracting and payment requirements. Thus, the structure of the performance contract provides a transparent way to build the essential components of carbon offsets (baseline analysis, carbon accounting, monitoring and verification) into the project design and the financial contracting.

A carbon offset buyer is not necessarily an investor in an emission reduction project such as an EE project. Rather, the carbon buyer may expect to pay on delivery for certified carbon offset credits, which may occur only after the project has been operating for some time. The buyer tends to expect the project sponsor to share the risk of non-delivery of the carbon offsets. This can be achieved by executing a contract that includes an initial payment for the buyer to secure rights to the project's carbon offset credits and subsequent payment for these over time and on delivery.

Other key elements of a carbon contract include contractual arrangements under which the ESCo contracts to provide the investor with carbon from the project under terms and conditions such as the following (Swisher 2000).

- Expected volume of carbon reductions, and minimum threshold
- Term of the contract with measurement and payment intervals
- Pricing of the carbon offsets and timing of payments
- Penalty for failure to deliver the minimum volume of carbon
- Option to buy carbon offsets in excess of expected volume
- Premium for delivery of excess carbon offsets

Additional clauses in this kind of a contract may entail purchase rights or options that protect the buyer from shifts in market prices (*i.e.* if the price falls, the buyer is not obligated to hold at that price). The fundamental goal of the contract is to encourage and reward performance that meets or exceeds contractual obligations, leading to greater overall confidence in the contribution to the revenue stream necessary for project finance.

10. LOCAL ACCEPTANCE AND HOST-COUNTRY APPROVAL

To facilitate EE investments and advance the use of the flexibility mechanisms, potential host countries need to build capacity to channel energy-efficiency investments and to operate a workable process of registering, reviewing and certifying proposed carbon offset projects. Although private firms, NGOs and other entities can perform many aspects of project design and implementation, some activities require a national perspective. At the national level, a host country JI/CDM program can harness the JI/CDM mechanism to carry out its sustainable development objectives. This requires that such objectives have been identified and agreed upon at the national level.

Host-country government approval can be a problem for carbon offset project sponsors, especially in large countries where national authorities may be several bureaucratic steps removed from the local level. This is one reason why the early rounds of the U.S. JI certification process has endorsed more projects in Costa Rica than in India, China and Brazil combined. The objective of a national approval process should not be to add difficult conditions that would impede project development, but simply to assure that some domestic benefits are achieved.

To ensure that proposed carbon offsets projects offer domestic benefits in addition to carbon emission savings, a registry and approval process can be used to elaborate the domestic requirements for JI/CDM projects. These requirements might include reductions of local pollution, increased security of energy supplies, sustainable land-use practices, improved local employment opportunities and local participation in project planning and execution. Not all projects would satisfy such criteria, but it is important to at least demonstrate that no domestic laws or regulations would be violated and that a project is consistent with the host country's development agenda.

A national JI/CDM program requires serious policy measures and resource commitments. However, such a program can simplify development of offset projects in the host country. The most ambitious and advanced national program to date is in Costa Rica, which is another reason why so many Costa Rican projects have been recognised internationally. Although one cannot extrapolate directly from the experience of Costa Rica to other larger countries, the Costa Rican experience and capability is still worth examining. Based on the evolving national JI/CDM program in Costa Rica, the necessary functions of the program include (Figueres *et al.*, 1999):

- Establishing project application guidelines, in order to ensure that proposed projects conform to national program objectives and international (UN FCCC) standards, while minimising proposal volume and complexity;
- Developing project evaluation criteria and procedures, including specific national priorities (or exclusions), additionality criteria, M&V criteria and requirements for host-country government approval and allocation of certified emission reductions;
- Establishing a project review and approval process, including the requirements, procedures, and deadlines for receipt, evaluation and approval of project proposals;
- Building local awareness of the program, in order to disseminate information about project guidelines and evaluation procedures and generate interest and new activities;
- Marketing the program internationally, via both diplomatic and commercial channels, in order to increase recognition of project opportunities and attract potential investors;
- Monitoring, verifying and reporting project results, including tracking developments in international M&V standards and reporting to the Subsidiary Body for Scientific and Technical Advice under the UN FCCC;
- Participating in international policy debates and UN FCCC negotiations, in order to communicate the country's interests and support its priorities and concerns.

The Costa Rican program has begun to offer Certifiable Tradable Offsets (CTOs), based mostly on the country's sustainable forestry program. CTOs represent pre-certified offset credits that have host-country approval and third-party verification. This internal pre-certification increases the confidence that an offset buyer will receive international certification for the offsets. In addition, Costa Rica has recently entered the World Bank's Prototype Carbon Fund (PCF) with a portfolio of renewable energy projects under development. This program is expected to be the first PCF investment in the energy sector.

Although the development and the design of the Costa Rican program is specific to that country's needs and conditions, the general process taken there seems to be a worthwhile model that other countries might choose to emulate to some degree. An essential element and motivating factor in the Costa Rican program has been the clear definition of the country's sustainable development objectives, which led to the design of the JI/CDM program as a vehicle to finance the pursuit of these objectives.

11. A POTENTIAL OPPORTUNITY

One attempt to overcome the barriers to EE project development for carbon offsets is a project Clearinghouse that involves all the countries around the Baltic Sea. This Baltic Clearinghouse and Information Network (Baltic Chain) is being developed with assistance from the EC INTERREG 2C Programme (Hammar 1999).

The essential functions of the Baltic Chain clearinghouse will be to streamline the process of project finance, bundle similar projects and customers, reduce transaction costs, and mitigate investor risk. Potential financing sources include local commercial banks and international financial institutions. All of these functions can help overcome the existing barriers to financing small energy projects, if they can be delivered through innovative approaches to project finance, including performance contracting and leveraging with concessional finance.

The basic components of the Baltic Chain, which will be implemented via five country desks in the host countries, include document preparation for project sponsors, project brokerage and tendering, a project preparation fund to support feasibility studies, and possibly a financial guarantee agency. (Meereis 2001). To date, about 20 projects are under development (Hammar 2001).

The role of JI in the Baltic Chain will involve a two-phase strategy. The initial phase would focus on clearly-profitable projects and commercial technologies, concentrating on small EE and CHP projects, using innovative project finance without JI crediting, but possibly with GEF support. The later phase would seek ERU credits under the JI provisions of Article 6 of the Kyoto Protocol. In the mean time, however, procedures for baseline definition, carbon accounting, and M&V can be developed and tested in the natural course of project development and implementation.

12. CONCLUSION

Each of the requirements discussed above with regard to JI/CDM certification can potentially present a barrier to the development of carbon offset projects. The existence of these technical, institutional and financial issues is sometimes treated as barriers to establishing the JI/CDM process, or as arguments against the feasibility of JI/CDM generally. However, the processes and procedures described in this paper demonstrate that these problems are soluble at reasonable cost using available methods. Table 3 summarises these requirements and some of the proposed approaches to overcoming the barriers that they might present to certifying carbon offsets.

Table 3. Requirements and strategies for securing carbon offset credit

Requirement for Carbon Offset Certification	Available Resources to Fulfil the Requirement
Clear additionality compared to a credible baseline	Standardised baselines based on benchmarks and technical criterias; validation of project design and baseline analysis
Reliable emission reduction potential	Uniform, transparent procedures for carbon accounting in different project types; validation
Practicality of monitoring, verification and certification	Standard protocols such as IPMVP; guidelines on acceptable measurement intervals, accuracy, error correction and normalisation procedures
Equity and local-currency debt financing at reasonable interest rates	Carbon contracting to combine ESCo practice with structured finance and secure carbon revenues
Institutional capacity for host-country approval and other support	National JI registry and approval programs in host countries; funding from Annex-I countries

13. REFERENCES

Figueres C *et al.* 1999. “Do AIJ projects Support Sustainable Development Goals of the Host Country?” in R. K. Dixon (ed.), *The UN Framework Convention on Climate Change Activities Implemented Jointly Pilot: Experiences and Lessons Learned,* Kluwer Academic Publishers, Dordrecht.

Hammar, T., 1999. “Baltic Clearinghouse and Information Network– First Results,” IEA/CTI Seminar, Ostritz, Germany, December.

Hammar, T., 2001. Presentation to the 15th Project Preparation Committee for Implementation of the Environmental Action Programme for Central and Eastern Europe, Copenhagen, April.

Meereis, J., *et al.* 2001. “Baltic Chain: Building Structures to Enhance the Financing of Small and Medium Sized Energy Projects,” Investitionsbank Schleswig-Holstein, Kiel, January.

Swisher, J., R. Renner and M. Shepard, 1999. “Companies Act on Climate Change,” E-Source report ER-99-11, Boulder CO: E-Source.

Swisher, J. and K. Wang, 1997. *Office Complexes Guidebook,* EPRI/TR-109450, Palo Alto CA: Electric Power Research Institute.

Swisher, J, 2000. "The Role of Carbon Performance Contracting in Climate Change Mitigation," *Proceedings, ACEEE Summer Study on Energy Efficiency in Buildings*, Monterey CA.

Swisher, J., 1999. “The Need for Technical Standards to Simplify CDM Project Baselines,” *Proceedings of the World Energy Engineering Congress*, Atlanta, October.

Swisher, J., 1997. "Joint Implementation under the U.N. Framework Convention on Climate Change: Technical and Institutional Challenges," *Mitigation and Adaptation Strategies for Global Change,* vol. 2, pp. 57-80.

U.S. Department of Energy (DoE), 1997. “International Performance Measurement and Verification Protocol,” DoE Efficiency and Renewable Energy Network, Washington, DC.

World Bank, 1999. “Validation, Verification and Certification for PCF Projects,” The World Bank, Washington, October.