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POTENTIAL USES OF STRUCTURED FINANCE TECHNIQUES FOR RENEWABLE ENERGY PROJECTS IN DEVELOPING COUNTRIES

Study prepared by the UNCTAD secretariat

Executive summary

Renewable energy is a sector in full expansion – even though it is still far from replacing hydrocarbons as the major source of energy. Renewable energy offers great opportunities for developing countries, in particular for areas that are not immediately adjacent to existing electricity grids. However, private sector financiers are often wary of funding renewable energy projects – a sector with which they are often not very familiar and which carries certain risks. Governments and aid donors support the expansion of the sector, but often have difficulty finding sustainable models.

Structured finance techniques, which are widely used by financiers in the commodity sector to mitigate a series of risks, can help to reduce the “funding gap” for renewable energy projects, and can help Governments and aid agencies to improve the leverage that they achieve with their financial support. This report discusses the main relevant structured finance techniques and how they can be used for boosting renewable energy investments. Several case studies illustrate how this can lead to successful projects.

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This study was prepared by Lamon Rutten and Nayana Mahajan of the UNCTAD secretariat.

Introduction

1. UNCTAD has done considerable work on the use of structured finance techniques in developing countries, particularly for the commodity sector. Use of such techniques reduces the risks taken by the financier, including by shifting risk from the borrower to other parties who are more creditworthy, leaving the financier with performance risks rather than credit risks on the borrower. The general principles of structured finance and its potential uses for developing countries are discussed in several UNCTAD reports, as are some particular applications (e.g. warehouse receipt finance). This brief paper is meant as one of a series which discusses the potential uses of structured finance for a particular industry – in this case, the renewable energy sector.

2. In a wider perspective, this report reflects the mandate given to the secretariat at UNCTAD XI in June 2004: "UNCTAD should continue to assist developing countries, in particular those most dependent on commodities, in formulating strategies and policies to respond to the challenges of commodity markets. It should analyse and promote exchange of information on commodity markets and experiences with factors, policy issues and responses influencing the competitiveness of the commodity sector so as to contribute to diversification, adding value, and more effective participation in the supply chain. It should further help to build effective partnerships among relevant stakeholders aiming at viable solutions and sustainable approaches to commodity problems, including by fostering public-private cooperation in commodity chains with a view to ensuring, *inter alia* through market-based principles, a more equitable distribution of revenues and benefits along the supply chain and supporting diversification."[1]

3. As is the case for other sectors, structured finance can make otherwise unbankable projects possible. In the case of the renewable energy sector, the potential socio-economic value can be very significant. For example, "by accelerating the development of its geothermal potential of close to 2,000MW, Kenya could become completely independent of imported energy and the vagaries of weather".[2] Kenya's Government is actually looking for funds for further development of its geothermal potential. Part of this value is unlocked by the Kyoto Protocol, and the positive contribution of the Protocol is clearly recognized by the market.[3]

4. Chapter 1 provides a brief statistical overview of the energy mix, the share of renewables and the regional contributions to the mix. Renewables contributed 13.4 per cent of the World Total Primary Energy Supply (TPES) in 2002 (International Energy Agency –IEA– 2004) in which the share of combustibles and wastes remains dominant at 77.5 per cent. As emphasized in the 2003 IEA ´*Renewables Information*' report, the development of renewable energy does not necessarily require substantial financial support because there are practical low-cost and often competitive measures that stimulate investment in renewable energy technologies (RETs). Projects in this area can have considerable economic returns. However, in developing countries, financing tends to be a constraint: costs of credit are high, and consumers often need credit packages in order to be able to adapt renewable energy technologies.

Chapter 2 discusses structured financing mechanisms available for funding renewable energy projects. This report is in line with the sentiment of two authors who entitled their paper

[1] *Report of the United Nations Conference on Trade And Development on its Eleventh Session*, São Paulo, Brazil, 13-18 June 2004, TD/412, August 2004.
[2] Dita Bronicki, CEO and President, ORMAT Technologies press release, 22 September 2000, http://www.ormat.com/news_019.htm.
[3] For example, in the first quarter of 2005, the share prices of quoted clean energy companies on the GEIX in signatory countries of the Kyoto Protocol outperformed those of companies quoted in Australia and the US, both countries which did not ratify the Protocol. The New Energy Finance (NEF) Global Energy Innovation Index (GEIX) tracks the fortunes of 50 publicly-quoted companies in the renewable energy and energy technology sectors.

"Bridging the valley of death: Transitioning from public to private sector financing." [4] The subsidy schemes prevalent in the renewable sector (often called "financing schemes" by Governments and aid donors) are not discussed. In general, it should be noted that poorly designed subsidy schemes can prevent the development of sustainable renewable energy business models, while well-designed schemes can benefit from the extra leverage that structured finance techniques can provide. Four brief case studies, on small- to large-sized projects, are described in chapter 3. These case studies demonstrate how structured finance can leverage project financings, and how the market mechanism of the Kyoto Protocol can yield sufficient additional income to make an otherwise impossible project feasible. A brief conclusion draws out implications for project financiers.

5. It is hoped that this report will inspire financiers, including bankers in developing countries, to expand their activities in the renewable energy sector. There are indeed risks in this sector, but most of these can be mitigated with structured finance techniques. In particular, bankers may well be able to tap new financing opportunities by looking at renewable energy as part of supply chains, and as a tool for unlocking productive capacity. Also, Government officials and aid donors may find it useful to consider the extra leverage that structured financing can give to their activities in support of renewable energy: more effective public-private partnerships may become possible if Governments and aid donors focus their support on the initial development of renewable energy markets, and on mitigating those risks that cannot be effectively dealt with by structured finance techniques. The resulting greater diversification of energy production (and agricultural production, if developing countries can expand their production of biofuel crops) and reduction of dependence on (often imported) hydrocarbons as a source of energy will surely assist in making their economies more shock-resistant and more competitive.

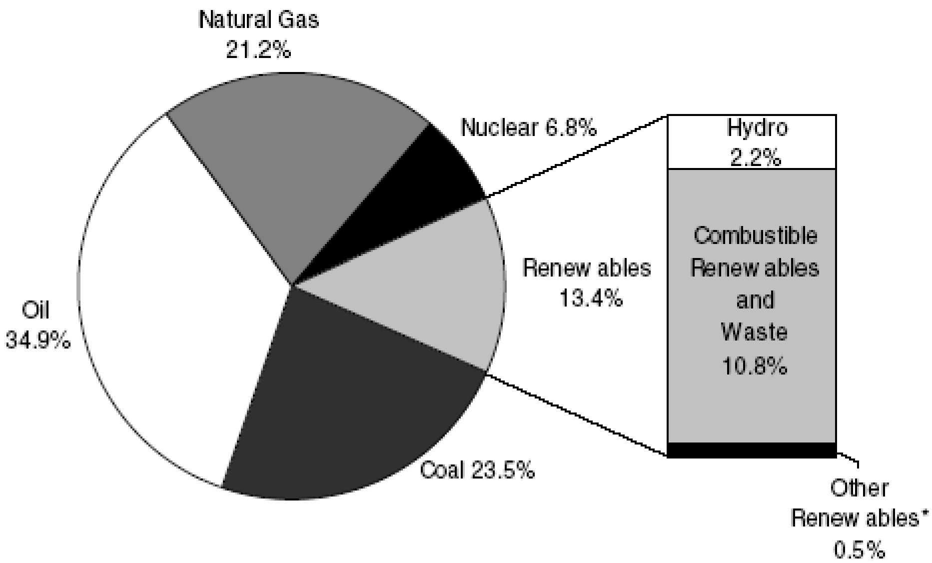
[4] L.M. Murphy and P.M. Edwards, "Bridging the valley of death: Transitioning from public to private sector financing", National Renewable Energy Laboratory, May 2003.

Chapter I

RENEWABLE ENERGY IN DEVELOPING COUNTRIES: AN OVERVIEW

6. The share of renewable energy sources in world total primary energy supply (TPES) in 2002 was 13.4 per cent, virtually unchanged from earlier years (see chart 1). In contrast, the share of renewables in electricity generation fell from 20.5 per cent in 1993 to 17.9 per cent in 2003.

Chart 1. Fuel shares in world total primary energy supply (2002)



Source: International Energy Agency/OECD, *Renewables Information 2004.*
* "Other renewables" refers primarily to solar energy, geothermal energy, wind power and marine (tidal) energy.

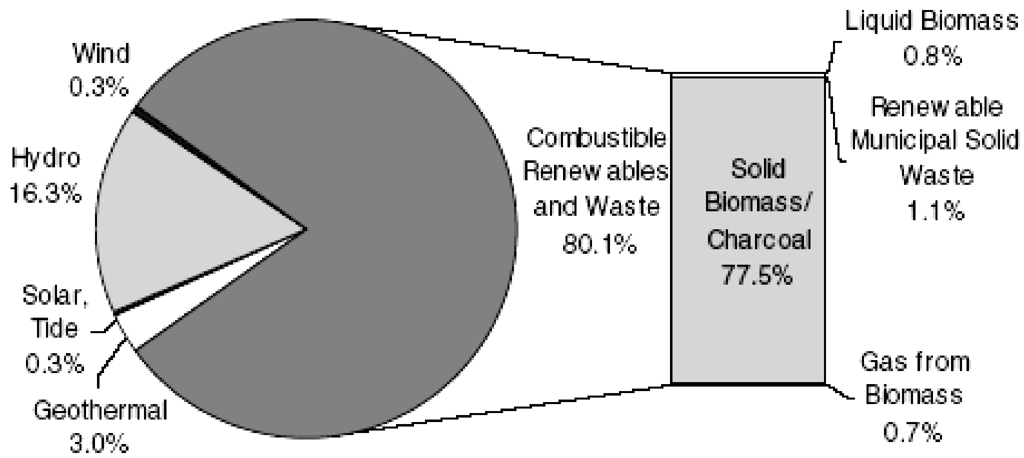
7. Solid biomass[5] was the largest renewable energy source, contributing 10.8 per cent of the TPES and 77.5 per cent of global renewables supply (see chart 2). Hydropower (mostly generated by large dams) accounts for 16 per cent, and geothermal energy[6] for 3 per cent of renewable energy supply. The shares of wind and solar power, which most laymen regard as the face of renewable energy, are still very small.

8. In developing countries, biomass is mostly used directly by consumers for energy generation. Its share in electricity generation is quite low, 6.7 per cent in 2003. The major renewable source of electricity is hydropower (89.5 per cent); wind power accounts for 2.1 per cent, geothermal energy for 1.6 per cent and solar power for 0.1 per cent. The use of biomass for electricity generation experienced a growth of about 5.3 per cent a year from 1993 to 2003, better than hydropower (with large dams falling out of favour, this sector grew at only 1 per

[5] Mostly fuelwood (including charcoal), but crop residues (e.g. straw) and animal and human waste are also included in this category.
[6] Geothermal energy uses the natural heat produced by the earth. The US is the largest producer (accounting for more than a quarter of global installed capacity), followed by the Philippines (where it provides almost a fifth of total electricity) and Mexico. Indonesia, Costa Rica and El Salvador are other significant developing country producers. Environmental groups often protest against geothermal energy plants, complaining that they are noisy, polluting (the steam that is generated contains minerals that can contaminate groundwater and poison fish) and produce the unpleasant smell of rotten eggs.

cent a year) and geothermal energy. Solar power and wind power showed double digit growth (respectively 16 per cent and 28 per cent), albeit from a very low base.[7]

Chart 2: Products' share in world renewable energy supply (2002)



Source: International Energy Agency/OECD, *Renewables Information 2004.*

9. Because of their heavy non-commercial biomass use, non-OECD regions have emerged as the main renewables users, accounting for 77.5 per cent of world total renewables supply with Africa alone contributing 49.8 per cent of this.[8] Also, renewables account for a large share of electricity generation in many developing countries (table 2 shows the data, as far as they are available, for developing countries where the share of renewables is more than 25 per cent).

Table 1. Statistical indicators by region

			Share in total renewables(per cent)		
	TPRS (Mtoe)	**Renewables (%)**	**Hydro**	**Geothermal, solar, wind, tide**	**Combustible renewables and waste**
Africa	539.8	49.8	2.7	0.1	97.2
Latin America	454.8	28.4	35.9	1.6	62.5
Asia	1183.9	33.0	3.6	3.7	92.7
China	1254.0	19.5	10.2	0	89.8
Non-OECD Europe	99.7	9.2	44.2	0.7	55.0
Former USSR	930.5	3.0	70.3	0.6	29.1
Middle East	431.3	0.8	49.2	20.8	30.0
OECD	5343.7	5.7	34.8	10.6	54.6
World	10230.7	13.4	16.3	3.6	80.1

Source: International Energy Agency/OECD, *Renewables Information 2004.*

[7] Observatoire des Energies Renouvelables/Electricité de France, *Worldwide Electricity Production from Renewable Energy Sources, 6th Inventory – 2004.*
[8] See IEA, *Renewables Information 2004.*

Table 2. The shares of renewables in electricity generation in developing countries (2003)

	Total share of renewables (%)	Hydro (%)	Geothermal (%)	Biomass (%)	Wind and solar (%)
Argentina	37.1	36.1		0.9	0.1
Brazil	87.5	84.2		2.9	
Cameroon	96.4	96.4			
Chile	50.4	46.8		3.7	
Colombia	75.8	74.6		1.2	
Côte d'Ivoire	34.0	34.0			
El Salvador	55.9	33.4	22.1	0.5	
Ethiopia	99.2	98.9	0.2		
Gabon	62.0	61.5		0.5	
Guatemala	47.8	32.1	3.2	12.5	
Kenya	79.7	69.4	10.0		0.3
Madagascar	74.0	74.0			
Nigeria	35.6	35.6			
Pakistan	36.9	36.9			
Peru	81.2	80.5		0.8	
Philippines	35.0	16.0	19.0		
Sudan	44.4	44.4			
Uruguay	99.9	99.5		0.4	
Venezuela	65.3	65.3			

Source: Observatoire des Energies Renouvelables/Electricité de France, Worldwide Electricity Production from Renewable Energy Sources, 6th Inventory – 2004. Note that only countries where renewables account for more than 25 per cent of electricity production are included. Some countries for which there are insufficient data have not been included; in some of these (e.g. Lao People's Democratic Republic, Mali) renewables account for the major part of electricity production.

Chapter II

STRUCTURED FINANCING MECHANISMS FOR RENEWABLE ENERGY PROJECTS

10. If current trends continue, US$ 16 trillion will need to be invested in the energy sector over the next 30 years to maintain, replace and expand infrastructure – US$ 10 trillion of this in electricity projects.[9] With the current relative cost levels, most of these investments will be in non-renewable energy – coal, oil and gas. "The biggest challenge is to make the renewable products cost competitive with existing energy products."[10] Despite this, globally installed renewable energy capacity is expected to more than double over the next 10 years from approximately 130 GW in 2003 to 300 GW in 2013.[11]

11. "Affordable financing is one of the critical factors inhibiting the usage of renewable energy."[12] This is closely related to the cashflow characteristics of renewable energy projects. On the one hand, there are large and medium-sized projects that require a high initial investment; following this investment, operating costs are relatively low as one does not have to pay (or pays little) for the "fuel" supply (wind, sunlight, biomass, etc.). Non-renewable energy projects tend to have a lower initial investment cost relative to the amount of energy generated, but then face higher variable costs as the fuel supply (oil, gas) has to be paid for. It is evident that the cost of the funds necessary for the initial investment is crucial in determining whether a specific renewable energy project is competitive with a non-renewable energy project.

12. On the other hand, there are small-scale projects, where often poor consumers are asked to invest in technology, in the form of a windmill, a solar pump, etc. Over time, they can expect to earn back their investment because they will pay much less for their energy consumption than before, or because with their new access to energy, they can undertake new income-earning activities.[13] Nevertheless, it is typically very difficult for poor groups to make such investments, however profitable they may be, and without a suitable credit scheme the technology may not be adopted (and many field studies have shown that indeed, the availability of credit is crucial for the uptake of renewable energy technologies by poor consumers[14]). In all kinds of projects – small, medium-sized and large – structured finance techniques can be used to enhance credit availability and reduce costs.

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[9] International Energy Agency, *World Energy Investment Outlook – 2003.*

[10] John Mogford, BP's group vice president for gas, power and renewables, quoted in *World Renewable Energy Network News*, vol. 1, 2005.

[11] International Energy Agency, *World Energy Outlook 2002*.

[12] V. Bakthavatsalam, *Financing renewable energy projects: Raising local capital,* Indian Renewable Energy Development Agency Ltd., New Delhi,

[13] See for an interesting set of case studies on the income-generating impact of access to modern energy IT Power India, *Promoting Entrepreneurship in Renewable Energy: Sharing the Lessons Learnt*, 2004.

[14] As is noted by the Global Environment Facility (in *Financing forrenewable energy,* http://www.thegef.org/Whats_New/GEF_RE_6_Financing_for_Renwable_Energy.pdf), "there is a tremendous need for financing to create renewable energy projects", and "in many developing countries, consumers need access to credit to buy the hardware for their energy supplies". See also Jayantha Nagendran, *Sri Lanka Energy Services Delivery Project Credit Programme: A Case Study*, DFCC Bank and ESD Project Credit Programme, May 2001; Integrated Renewable Energy Development and Environment Conservation (IREDEC), Tanzania, http://www.hedon.info/goto.php/view/873/forum.htm; Stephen Karekezi and Waeni Kithyoma, *Renewable energy development,* African Energy Policy Research Network (AFREPREN), Workshop for African Energy Experts on Operationalizing the NEPAD Energy Initiative, Dakar, Senegal, 2-4 June, 2003; and Energy Sector Management Assistance Program (ESMAP), *Initiating the Bank's Peri-Urban/Rural and Renewable Energy Activities in Nigeria*, World Bank, June 2005.

13. As shown in chart 3, finance for renewable energy can come from different sources, with the structure of the finance dependent on the size of the investment. Typical small-scale projects are solar home systems, individual windmills, solar- or wind-driven water pumps, and family-sized bio-digesters (which produce methane gas out of waste, primarily for cooking). Medium-sized projects include co-generation plants (to burn agricultural waste in order to generate electricity and heat), small dams, village-level electricity grids using any form of renewable energy, landfill gas projects, and projects to produce biofuels. Large projects include large dams, wind farms and solar farms, generally for the generation of electricity for a national electricity grid. Small-scale projects are off-grid (indeed, some applications, such as solar energy, are only competitive off-grid), as are most medium-scale projects (even though co-generation plants and landfill gas projects are likely to sell electricity to the grid). From a financial structuring perspective, for large-scale projects the core issue is to raise affordable project finance with a sufficiently long life; in contrast, for small-scale projects donor agencies can often assist in raising the initial funds, but it is crucial that the project be structured in such a way that sufficient revenue is captured to cover operation and maintenance costs.[15]

14. This chapter starts with a discussion of the challenges in financing renewable energy projects, which is followed by a discussion of the principal structured finance applications, including those related to carbon credits.

Chart 3. Overview of financial sources

Small-scale projects (<1 MW)	Medium-scale projects (1-15 MW)	Large-scale projects (>15 MW)
Vendor credit	Vendor credit	Bonds
Venture capital	Project finance	Venture capital
Micro-finance		Non/limited recourse project finance
Self-financing	Leasing	Multilateral lending

A. Challenges in financing renewable energy projects

15. Structuring the finance of renewable energy projects can be difficult, owing to the "funding gap" between the capital that the bank is willing to lend under the perceived risks, and the limited amount of equity that the sponsor or developer can provide.[16] This gap can be filled by Governments or aid donors, or by reducing the perceived risks – it is the latter that structured finance sets out to do. "The opportunity for financial engineering to define pathways for bridging these gaps by integrating the capabilities and resources of various financial groups appears to be rich, as the financial industry has been rapidly expanding its supermarket of financial products and solutions. Moreover, there is the possibility of developing joint public/private sector partnerships, where the private sector leader provides the overall direction and stewardship of the investment."[17]

[15] See P. Lindlein and W. Mostert, *Financing Instruments for Renewable Energy*, KFW, 2005.
[16] *CEO Briefing*, June 2004, UNEP-SEFI Climate Change Working Group.
[17] Murphy and Edwards, op.cit.

16. The key challenges facing renewable energy projects are briefly highlighted below.[18]

Transaction costs. Many renewable energy projects are small. This makes fixed transaction costs such as the conduct of feasibility analyses, due diligence and legal and technical consultancies disproportionately high, compared with conventional energy projects. Also, the differences between market segments add to a lack of standardization which in turn leads to higher costs – financial tools that work for one form of renewable energy may be of no use for others.[19]

Emerging technology risk. The technology risk attached to renewable energy remains a key issue from the financier's perspective. Many renewable energy technologies have not been adequately commercially proven and have limited track records. Furthermore, the manufacturers of the equipment may be relatively young and vulnerable companies, and there is the risk that if they stop existing, spare parts may become unavailable.

Relatively high performance risk. Renewable energy (except geothermal) is very dependent on weather conditions, and so performance risk is high. For example, drought has affected micro-hydro project and biomass investment returns, and cyclones can affect wind power projects.

Uncertainty about the potential of recovering capital costs from customers. This applies both to projects that sell electricity to the national grid, and to smaller, off-grid projects. Large projects often benefit from having "power purchase agreements" (PPAs) with national electricity utilities; these PPAs normally specify minimum prices for the electricity, but in times of crisis, they are vulnerable to political risk. On the other hand, many off-grid renewable energy projects target relatively poor consumers who would not normally enter into long-term offtake contracts. Financiers may feel uncomfortable with such "offtakers" – not only about their willingness and ability to pay the energy tariffs necessary to recuperate project costs, but also about the risks of politically-inspired intervention in these energy tariffs.

Front-loaded cost structure. Given the high initial capital costs but low operating expenses, renewable energy projects are highly sensitive to the availability and cost of finance.

Policy distortions. In certain countries, Governments heavily subsidize grid-based electricity supply to rural consumers, making it difficult for renewable energy projects to compete (unless if they receive similarly high subsidies). Moreover, politicians often make empty, but vote-winning promises in rural areas to extend the electricity grid; this discourages villagers from investing in off-grid applications.

Regulatory barriers. In many countries, the sale of "excess" electricity to the national electricity company is made difficult by various regulatory barriers. This acts as an obstacle to many mid-size renewable energy projects, and in particular to co-generation projects.

Project appraisal techniques. Use of "conventional" market pricing models, which do not accurately reflect the costs of emitting carbon and other environmental externalities, often makes renewable energy investments commercially non-viable.[20] Similarly, environmental and

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[18] See also Gene Owens, *Best Practices Guide: Economic & Financial Evaluation of Renewable Energy. Projects*, Office of Energy, Environment and Technology, United States Agency for International Development, June 2002; and Lindlein and Mostert, op.cit.
[19] See Marc D. Stuart and Michael A. Cook, "Opportunities for renewable energy project finance", *Power Economics*, November 2001
[20] Virginia Sonntag-O'Brien and Eric Usher, *Mobilising Finance For Renewable Energies*, UN Environment Programme / Basel Agency for Sustainable Energy, Thematic Background Paper, January 2004.

wider sustainable development benefits associated with renewable energy projects are not accurately reflected in the pricing of renewable energy sold to consumers.

Currency risk. International funds are often cheaper than local ones, but given the fact that the energy generated is sold locally, and paid in local currency, using foreign loans creates exposure to the risk of currency depreciation.

17. Risks are different for each project – they are often country-specific, and differ depending on the kind of project one wishes to undertake. Table 3 gives an overview of some of the key risk issues specific to the major types of renewable energy technologies.

Table 3. Typical risks of the different renewable energy technologies

Renewable energy type	Risk issues
Geothermal	• Drilling expense and associated risk (e.g. blow-out) • Exploration risk (e.g. unexpected temperature and flow rate) • Reserve risk (production capacity declines faster than anticipated) • Critical components failures such as pump breakdowns • Long lead times (e.g. planning consents)
Large photo-voltaic	• Weather damage • Component breakdowns • Theft/vandalism
Solar thermal	• Prototypical/technology risks as project sizes increase and combine with other renewable energy technologies, e.g. solar towers
Small hydro-power	• Flooding • Seasonal/annual resource variability • Prolonged breakdowns due to offsite monitoring (long response time)
Large hydro-power	• Prolonged drought • Environmental and social impact, including downstream • Political risks
Windpower	• High upfront costs • Critical component failures • Wind resource variability • Offshore cable laying
Biomass power	• Fuel supply availability/variability (including weather risk) • Resource price variability • Environmental liabilities associated with fuel handling and storage
Biogas power	• Resource risk • Planning opposition associated with odour problems
Tidal/wave power	• Survivability in harsh marine environments • Prototypical/technology risks; various designs and concepts but with no clear winner at present • Small scale and long lead times

Source: Mostly taken from UNEP, *Financial Risk Management Instruments for Renewable Energy Projects, Summary Document*, 2004.

18. Structured finance can help overcome some of these barriers and manage many of the risks, though not all (policy- and regulation-related issues need to be dealt with by Governments; limited local managerial capacity or poor understanding of renewable energy projects in local banks can be tackled by donor-funded capacity-building programmes, etc.). Some risks can be mitigated through the incorporation of certain elements into the financing structure (e.g. escrow accounts), while others can be shifted to third parties. The possibilities for shifting risk are improving. Traditionally, it was possible to externalize many of the technology-related risks (suppliers provided guarantees) and many of the market risks (through long-term power purchase agreements). Host Governments could be relied on to make certain commitments (e.g. not to change the prevalent regulatory framework), and the risks of a Government changing its position could be covered on the political risk insurance market. Occasionally, export credit agencies enabled equipment suppliers to sell on credit by covering most of the buyers' credit risk. But in recent years, several new risk mitigation instruments have become available. For example, the possibilities to shift risk to the capital market, through securitization, have much improved; and the alternative risk transfer market has started to make it possible to mitigate weather-related and other risks.

19. While there are specific risks to renewable energy projects, in terms of cost many of such projects are already competitive with non-renewable energy sources.[21] This is particularly the case if one makes "true" technology cost comparisons on the basis of total "life cycle" costs, not simply initial capital costs. Life cycle costs account for initial capital costs, future fuel costs, future operation and maintenance costs, decommissioning costs and equipment lifetime. Some recent economic work has shown that if future fuel-price risk assessment is properly factored into fossil fuel prices using accepted financial valuation tools, something that any bottom-line oriented power generator should rationally do, then cost comparisons between renewable energy and fossil-based power can shift in favour of renewable energy.[22] Higher costs for hydrocarbons and continuous improvements in renewable energy technologies are making renewable energy more and more competitive.

20. Even if one just evaluates current costs, renewable projects constructed away from the main electricity grid are likely to be competitive. For example, for 10 kW capacity in remote areas, production costs have been estimated as follows for the different technologies:[23]

- Micro-hydro: US$ 0.21/kWh
- Wind: US$ 0.48/kWh
- Diesel: US$ 0.80/kWh
- Grid extension: US$ 1.02/kWh

21. Another study notes that "a general recommendation for 'the optimal village power system' cannot be given", but notes that, with efficient management, "Minigrids may be more cost-effective than either fully decentralised solar home systems or fully centralised grid extensions".[24]

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[21] Costs can be further reduced by strengthening local manufacturing capacity. Some developing countries have become successful in this respect (e.g. India now exports wind and solar power systems), but most still rely on western technology providers.
[22] Shimon Awerbach, "The true cost of fossil-fired electricity", *Power Economics*, May 2003.
[23] Estimates from the US Office of Technology Assessment, quoted in World Energy Council, *Survey of Energy Resources*, 2001.
[24] Kilian Reiche, Alvaro Covarrubias and Eric Martinot, *Expanding Electricity Access to Remote Areas: Off-Grid Rural Electrification in Developing Countries*, WorldPower 2000.

B. Project finance[25]

22. Project finance is fairly standard in infrastructural projects, and not just in developing countries. Large renewable energy projects are no exception: many large dams, wind farms and solar farms are structured as project financings. But project finance structures can also be used for medium-sized projects.

23. The mechanism involves creating a Special Purpose Vehicle (SPV) to take out the loan to finance the project. Effectively, the loan is on the books of the project (SPV), and not the project-promoting power company. It is off-balance sheet finance, not corporate finance, which has benefits for both the project developer and the financiers.[26] Once the project has been constructed and is deemed operational (which is normally after a number of months of test operations), the financiers have no recourse to the project sponsors, but depend entirely on the project itself as a source of repayment. The source of debt service (interest and principal) is primarily the cash flow from the project, and financiers will try to gain as much control as possible over this flow. Thus, security of the fuel supply agreement and reliability of the cash flow projections assume critical importance. Financiers also build in the usual additional safeguards of project financings: the financed assets are pledged as security to the bank, all contracts are assigned to the bank (the power purchase agreement –PPA–, the construction contract, etc.), and covenants are added relating to shareholding structure and issuance of dividends. The commitment of shareholders (sponsors) to provide extra loans in the event of cost overruns, accounts pledged to the lenders, construction guarantees, sovereign risk guarantees and other guarantees, and insurances provide further security.

24. One mechanism typical of project financings is the Engineering, Procurement and Construction (EPC) contract (a turnkey contract, under which one contractor – who may subcontract to others – ensures that the project facilities are delivered ready to operate). Rather confusingly, in the renewable energy sector a specific form of this is used at times, also called EPC; but this time EPC stands for “Energy Performance Contracting”. Energy Performance Contracting is a turnkey engineering and general contracting service (just like a standard EPC contract), but with the special characteristic that the engineering contractors are paid on a performance basis rather than on the basis of a flat fee or a cost-plus basis. The performance is reflected in the savings made throughout the life of the project as compared to a “baseline” scenario. In a way, the engineering contractor guarantees that these savings are indeed made: if they are not, he is paid much less than originally anticipated.

25. Chart 4 gives a simplified overview of a typical project finance model, with the energy plant structured as a SPV. A PPA, a long-term contract with a reputable buyer, is generally central to the project financing. The PPA would have to cover a period longer than the duration of the financing, and normally the buyer would commit itself to pay for a fixed minimum amount of electricity each month. The offtaker should be a reputable electricity utility or an industrial firm; central Governments can be asked to provide guarantees on the

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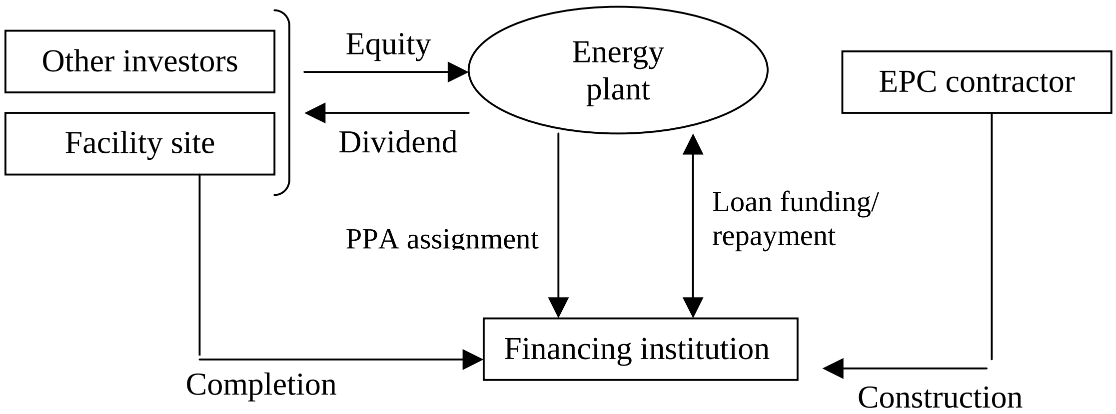
[25] Partly based on a presentation by Romel M. Carlos, COGEN 3 financial adviser, 2004 Cogeneration Week, Cambodia, and on Owens, op.cit.

[26] Enron’s abuse of off-balance sheet finance has unfairly tarnished the concept. In corporate finance, financiers lend money to a company. This leads to a higher debt burden for the company, which in turn may lead to credit rating downgrades (so a higher cost of all credit) and higher return requirements of equity investors. This can make the effective costs of undertaking a new project very high, and a company would not start projects that do not achieve correspondingly high rates of return. In contrast, in off-balance sheet finance, money is lent to the project; the company’s existing debt/equity ratio or its credit raring is not affected, and the effective financing costs are purely the result of the intrinsic risks of the project. In the case of projects in developing countries, there is the added advantage that the Special Purpose Vehicle structure can bring together project sponsors of various strengths, including developing country companies that would not be able to raise sufficient funds on their own name alone.

Chart 4. Project finance model (financing directly to project)



performance of the utility.[27] The PPA would have clauses specifying what will happen if certain problems arise – for example, what happens with the PPA if there is an unexpected construction delay. From the financier's perspective, the PPA would preferably be at a fixed electricity price (generally a fixed starting price, often expressed in United States dollars, which then increases automatically over time following a pre-agreed escalation schedule). Of course, as the experience of several failed project financings over the past decade has shown, fixed price commitments can be very difficult to maintain in times of economic crisis.

26. Apart from scrutinizing the conditions of the PPA, the financier will carry out considerable due diligence with respect to the "fuel" (e.g. if biomass, will the anticipated volume indeed remain available over the duration of the financing; if wind, what do data on past wind speeds say about the likelihood that the plant will be able to perform as planned?). The financier would also estimate the possible volatility in the plant's cash flow, and in the light of this, set minimum conditions with respect to a debt service account (which typically will have to hold 6-12 months of debt payments) and an operations and maintenance reserve account (typically, this will hold another six months of debt payments). Given the non-proven technology, the financier may additionally insist on a non-routine maintenance reserve account. Furthermore, financiers may insist on certain guarantees from the host country, want insurances assigned to them, link reimbursement conditions to the evolving credit rating of the offtaker, and so forth.[28] Structures quickly become very complex; but the resulting reduction in risk easily pays for all the costs of this work, as long as the project is not "too small" (which is of course a relative term).

27. One example of a project financing structure for a fairly large renewable energy project is that arranged for an Israeli firm called Ormat Technologies, specialized in geothermal energy, which started in 2004 with the construction of a geothermal power plant in Amatitlan, Guatemala. Earlier exploration work, financed by the Japanese aid agency (JICA), had demonstrated that sufficient steam reserves were available for commercial exploitation. The plant, which is to become operational in mid-2006, has a capacity of approximately 20 MW

[27] Many developing country Governments are being asked to liberalize electricity markets. While this can help to make utilities and electricity distribution companies more efficient, it considerably weakens the value of long-term PPAs from a project financier's point of view: this PPA, after all, depends on the creditworthiness of the offtaker. One way that Governments can overcome this problem is by giving renewable energy plants priority access to the power pool, at a fixed rate, for a certain number of years.
[28] See for an overview Thelen Reid & Priest LLP, "Project finance for commercial wind farms: An overview of contractual issues involved in successful developments", *North American Windpower,* July 2004.

(which can be scaled up to 50 MW). In order to finance the project, Ormat set up a special-purpose project company, Otitlan Limitada, under Guatemalan laws to build, own and operate the plant. Ortitlan signed a 20-year Power Purchase Agreement (to start when the plant becomes operational) with the national electricity utility, the Instituto Nacional de Electrificación (INDE); the electricity tariff is fixed, with an escalation clause (automatic annual increases). INDE's contract obligations are backed by a Government trust fund. This, together with the usual risk mitigants used in project finance, enabled Ortitlan to obtain a limited-recourse 12-year loan of US$ 41.4 million, equal to 75 per cent of the project cost, at an interest rate of 7 per cent.[29] Most of these funds came from the Inter-American Development Bank (IADB); in addition to its direct loan of US$ 22.1 million under its "A-loan" programme, IADB mobilized US$ 19.3 million from commercial banks under its "B-loan" programme.

28. The full package of risk mitigants used in a typical project finance can carry a high cost, too high for smaller projects. But some of the concepts of project finance can be used even in rather small projects in order to reduce risks. For example, the "limited recourse" aspect of project finance has been used in a lease-purchase scheme for small hydropower plants in Cambodia. Local entrepreneurs prepare the project, showing that the proposed plant is economically and financially viable. On the basis of this feasibility study, they can then negotiate a power purchase agreement with the national utility, Electricité de Cambodge (EdC), and they would also sign a lease-purchase agreement for the hydropower plant; both will come into operation only once the plant has actually been constructed. On the basis of these two agreements, the entrepreneur can then obtain short-term construction loans from local banks and equipment suppliers – in other words, until the plant is constructed, the entrepreneur takes all the risks. However, once the plant is operational, the lease-purchase agreement becomes operational: EdC buys the plant from the entrepreneur for the total of his construction loans, which can then be reimbursed. EdC leases back the plant to the entrepreneur, and deducts the payments due for the lease from the electricity payments it makes under the PPA. After a fixed lease period, the entrepreneur can buy the plant from EdC for a symbolic US$ 1. This scheme considerably reduces financing risks and, therefore, costs, and makes this form of renewable energy competitive with conventional energy sources: no price subsidies are necessary.[30]

C. Receivables-based finance

29. The crux of the receivables-based financing structure lies in leveraging contractual obligations within the value chain. Receivables from the power purchaser or receivables from other partners in the chain can be used either as security or for directly meeting the financial obligations related to the renewable energy project.

30. Chart 5 gives an example, based on the financing of small hydropower plants, structures that have actually been used in Zambia and Zimbabwe.[31] The dams were used for irrigation and for generating hydropower. Banks were unwilling to provide the required longer-term funding. But local pension funds were interested, because it was possible to structure a scheme under which they received offshore, hard-currency receivables.

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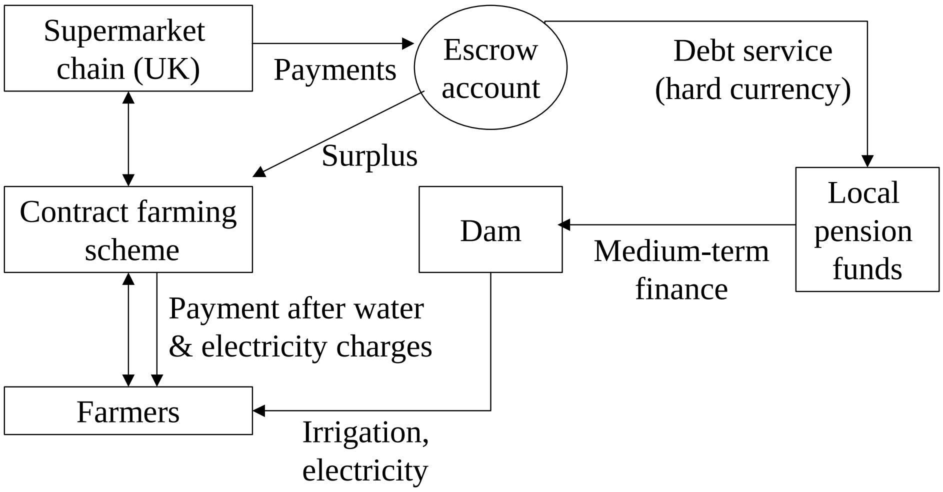
[29] IADB project abstract, http://www.iadb.org/EXR/doc98/pro/agul1001.pdf. See also UNEP/SEFI Executive Briefing, *Making it Happen: Renewable Energy Finance and the Role of Export Credit Agencies*, and Laura Vimmerstedt, *Opportunities for Small Geothermal Projects: Rural Power for Latin America, the Caribbean, and the Philippines*, National Renewable Energy Laboratory, November 1998.
[30] Linlein and Mostert, op.cit.
[31] See Edwin Moyo, "Banks' equity investments in agricultural intermediaries as a tool to provide campaign and investment finance to producers", presentation to the UNCTAD Expert Meeting on Financing Commodity-Based Trade and Development: Innovative Financing Instruments, November 2004.

Chart 5. Receivables based financing: An example



31. In each case, the production of the dam's customers (the farmers) was assigned to the dam's financiers (the pension funds). The farmers produced horticultural crops thanks to the dam, and these crops were sold under a long-term contract with overseas customers (supermarket stores in the United Kingdom). The supermarkets were informed of the assignment, and asked to pay into an escrow account controlled by the financiers. Thus, the sales proceeds of the farmers' exports were directly used for securing the financial obligations of the lender; the proceeds after payment of debt obligations went to the farmers. This structure made it possible for the farmers to benefit from new rural infrastructure for irrigation and energy generation, and for financiers to fund a project that otherwise would have been impossible to finance.

32. Receivables-based financing can also be used to stimulate the production of biofuels. For example, in India there are several projects to replace diesel by bio-diesel, produced from a vegetable oilseed called jatropha. One company, Southern Online Technologies, active in the state of Andra Pradesh, funded a jatropha-processing plant and the campaign finance for several smallholder jatropha plantations on the back of receivables. It was able to sign forward contracts with railway and trucking companies for the sale of the jatropha oil to be produced, and with farmers for the delivery of jatropha seeds. On the basis of this, the company was able to finance a US$ 4 million processing plant. Biofuels projects of this nature can also generate "carbon credits" (see next section) as a second revenue stream.[32]

33. Another illustration of a situation where receivables finance can be used for a renewable energy project is provided by the cooperative El Tinte in the Departamento of Cajamarca, Peru.[33] The cooperative produced fresh milk (about 500 litres a day) for a distribution company called INCALAC. They used to milk their cows by hand and carried the product to cool in the river. The inconsistent quality of milk produced by this method resulted in a low purchase price of US$ 0.06/litre, rather than the full price of US$ 0.11/litre. The Inter-American Development Bank (IADB), however, was willing to finance a small hydropower scheme, through a rotating fund which it had set up in Peru to finance micro hydro plants. This made it possible for the cooperative to use a refrigerator to control the temperature of the milk, the result of which was higher quality, better hygiene and a consistent sales price of US$

[32] In a jatropha project proposed in the Philippines, revenue from the sale of Carbon Emission Reduction certificates is estimated to total almost one sixth of the total project costs, for the first seven years of the project alone (http://www.iges.or.jp/en/cdm/pdf/philippines/02/20.pdf).
[33] Taken from UNDP, *Sustainable Energy Strategies: Materials for Decision-Makers*, 2000.

0.11/litre; the additional income was enough to cover the cost of the hydropower scheme – US$ 35,000 – within five years. In addition, not only could the cooperative install electric milking machines, but also it was able to invest in a grain mill. While IADB apparently did not find this necessary, payments from INCALAC could have been routed through a local escrow account; such a structure should have made commercial banks comfortable with the credit. Renewable energy schemes like this can easily be incorporated into many of the contract farming arrangements that have been becoming increasingly prevalent in recent years.

D. Carbon credits

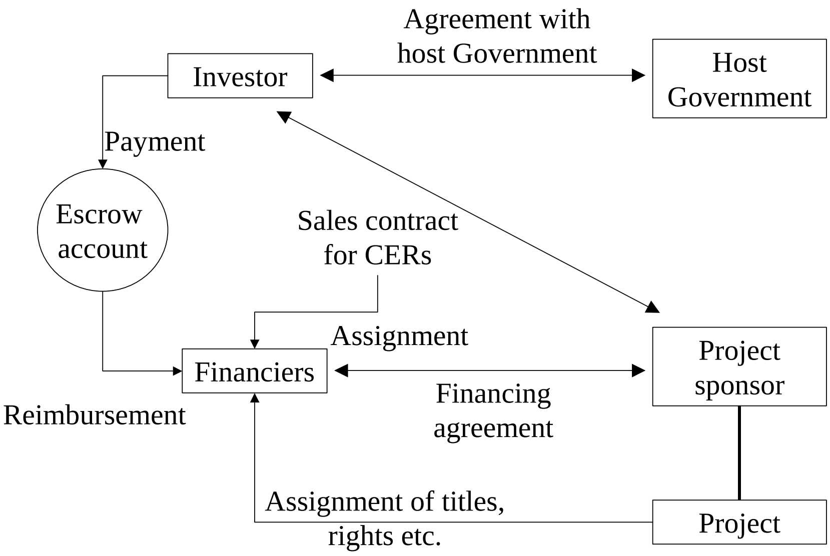
34. The Kyoto Protocol offers three "flexibility mechanisms" that participating countries can use to meet their greenhouse gas (GHG) reduction targets. One of these, the Clean Development Mechanism (CDM), is emerging as an important source of foreign investment for developing countries. CDM is a policy whereby industrialized countries receive credits against their emissions reduction commitments for investment in GHG reduction projects in developing countries.[34] If the project is successful in reducing emissions, the project owner receives Carbon Emission Reduction certificates (CERs[35]). These credits can be used against GHG reduction commitments or they can be banked (saved for the future), pledged or sold – they can even be sold forward.

35. CERs can be used to enhance equity returns or for supporting debt with carbon cash flows.[36] CERs are normally sold under 7- or 10-year contracts, so that the financier can take security on 7 to 10 years of future receivables flows. The sums involved can be considerable. For example, a 12 MW wind/hydro plant in South Africa generated credits of 20,000 tonnes/year, while a landfill gas capture project in Latin America generated credits of 280,000 tonnes/year.[37] At a very conservative estimate of US$ 5/tonne (and since the ratification of the Kyoto Protocol by the Russian Federation prices have been increasing, and are now approaching four times this level) this equals annual cash flows of US$ 100,000 and US$ 1,400,000 respectively. Funding can be received as prepayments where the financier prepays the CERs to be delivered, and sells them on to an investor. Or alternatively (see chart 6), funding can be in the form of a traditional pre-export finance, where the CER sales contract is assigned, and the buyer makes payments through an escrow account. Case 4 in the next chapter gives an example of how a CER forward sale under the Joint Implementation system of the Kyoto Protocol (which applies to Eastern European and Commonwealth of Independent States countries, but in terms of CER sales is similar to the CDM) can make a project viable.

36. CERs are paid in hard currency, which could allow an investor hard currency revenue for a project that otherwise would generate only local currency. They could also be used to pay suppliers, for example an equipment supplier, who can use the CERs to meet his own CO_2 reduction obligations. Revenue from CERs coming before the “main” project revenue could provide necessary bridge finance. CERs have already been used in many renewable energy projects, from landfill gas projects (where they tend to have the largest impact on project rate

[34] See for extensive information the website of the UNCTAD/Earth Council Institute Carbon Market Programme, http://www.unctad.org/ghg/.
[35] A range of greenhouse gases are covered under the Kyoto Protocol, and their greenhouse effect is expressed in carbon dioxide equivalents. This is what makes landfill gas projects, with capture methane, so attractive: one tonne of methane emission reductions is worth 21 tonnes of CO_2 reduction.
[36] A CER contract generally has a 7- or 10-year duration. The contract sets out the price to be paid, and the quantity to be bought. Normally, payment is only on delivery.
[37] Swiss Re Financial Services sources.

Chart 6. Standard CER pre-financing mechanism



of return) to a project in Brazil where a pig iron producer avoided a switch to coal as a source of energy and was able to continue using its sustainably-managed tree plantations.[38]

37. As an example of the potential significance of CER financing, consider the Sahabat Complex in Sabah, Malaysia, managed by the Federal Land Development Authority (Felda). It consists of 10 oil palm mills, a refinery and a palm kernel crushing plant. To power all of this, 570,000 litres of diesel are processed each month, costing Felda more than US$ 2 million a year. The plan is to replace the 8.7 megawatt diesel generator with electricity generated from burning empty fruit bunches in boilers, at a cost of close to US$ 10 million. This will reduce CO_2 emissions from burning the diesel, and CH_4 emissions that result from the empty fruit bunches rotting in the fields or ponds. Felda will have to demonstrate by how much these emissions will be reduced and can then start the procedures to certify the reductions, which then become tradable. Potential CER revenues are significant – for each mill, eliminating CH_4/CO_2 emissions now caused by rotting fruit bunches could already lead to an annual reduction of emissions of 36,000 tonnes, CO_2 equivalent; the CO_2 reduction that results from not using diesel is to be added.[39]

E. Micro-finance

38. Poor households often pay disproportionately high prices for their energy supply because they have no access to modern energy sources. For example, in Indonesia, rural households that are connected to the electricity grid spend US$ 1 per month on energy, while 26 per cent of the households that are not connected to the grid spend U$ 6.7-$ 15 per month on kerosene and batteries/battery charging, and 40 per cent spend between US$ 3.3 and US$ 6.7 per month.[40] Such households are typically willing and able to pay for alternative, more efficient energy, including wind and solar power, but have difficulties meeting the necessary upfront

[38] See *Clean Development Mechanism Project Design Document - V&M do Brasil Avoided Fuel Switch Project*, September 2003, http://www.mct.gov.br/clima/ingles/quioto/pdf/4Round/V&M/PDD.pdf.
[39] Yoshihito Shirai and Mohd. Ali Hassan, "UPM and KIT plans", 2003.
[40] Nexant, *Subsidies and Financial Mechanisms for Rural Energy Services*, USAID-SARI/Energy Program, November 2003.

costs for off-grid applications. For example, “for many low- and middle-income rural households, the purchase price of a solar home system represents almost one year’s income”.[41]

39. There are three mechanisms to overcome this barrier: supplier credits; consumer credits from a Government entity; and micro-finance. Credit risk, and the ability to manage such risk, determine which mechanism is the most viable. Credit modalities generally fall into one of the two following categories:

- Fee-for-service: An operating company acts as an energy service provider by installing and servicing the renewable energy system. Users pay a fee, usually on a monthly basis. Operating companies can be traditional energy utilities, but also producers of renewable energy systems, agricultural cooperatives or regular leasing companies.[42]

- Hire-purchase: Consumers buy a renewable energy system from a local retailer who has access to a loan scheme from a third party – which can be a bank, his supplier (particularly in the case of a franchising network) or an NGO, which in turn may be refinanced or subsidized by the Government or a donor agency, and may benefit from loan guarantees. The bank or NGO has an agreement with the retailer for installation and servicing, which puts pressure on the consumer to continue reimbursing his debts.

40. The major benefit of Government-run credit schemes to finance investments in renewable energy by poor households (either individually or as a group) is that subsidies can easily be built into the financing. But this financing mode tends to run into the usual problems of Government-provided rural credit, including high cost and unnecessarily low recovery rates; in the long run, such loss-making credit schemes often work counter to the objective of creating sustainable credit schemes for poor households.

41. Supplier credits can work – around the world and including in poor areas, consumer items such as televisions and refrigerators are successfully sold on credit by dealers. So why not renewable energy systems? In the Dominican Republic, for example, Soluz Dominicana, a solar panel vendor, has set up a successful fee-for-service leasing scheme.[43] In India’s state of Karnataka, the Solar Electric Lighting Company (SELCO) was successful with a “lease to own” scheme, in which consumers made a down payment of 25 per cent followed by small monthly payments for a period of three to five years.[44] In both cases, donor funding was essential in starting up the business – in effect, SELCO, with operations in several countries, was set up as a for-profit company by a US-based NGO. But in several countries, suppliers have tried to set up credit schemes, but then gave up either because of high defaults, or because of the high cost of collecting frequent payments in remote rural areas. In any case, even if finance is provided by others, “the financier has to rely on the long-term presence of the dealer or service-provider. They are the financier’s operating agents for servicing the systems and, if required, for the repossession of systems from defaulting customers”.[45]

[41] Anil Cabraal, Mac Cosgrove-Davies and Loretta Schaeffer, *Accelerating Sustainable Photovoltaic Market Development,* World Bank, 1997.
[42] Depending on tax regimes, providing lease finance can be an interesting option for highly profitable companies. The lessee – the user of the leased asset – can deduct its full lease payment as a business expense, while the lessor can often accelerate the asset’s depreciation, giving him an immediate tax reduction.
[43] See http://www.energyhouse.com/p_dominican_republic.htm, and International Energy Agency, *Summary of Models for the Implementation of Photovoltaic Solar Home Systems in Developing Countries. Part 2: Practical Experience,* March 2003 (this latter report also provides several other case studies).
[44] See http://www.selco-india.com.
[45] Paul van Aalst, **“**Rural electrification with solar energy: Structured financing requires partnerships”, *New Strategies for a Changing Commodity Economy*, UNCTAD Partners for Development Summit, Lyon, November 1998.

42. Micro-finance is the option of choice in many schemes to bring renewable energy to poor households. Models of micro-finance institutions (MFIs) differ according to their scale, ownership and management structures. Some examples are:

- Specialized registered professional micro-finance providers or development banks;
- Village banks;
- Registered cooperatives and credit unions;
- Development NGOs and micro-finance intermediary facilitators.

43. Most MFIs currently finance only activities considered directly income-generating (agricultural inputs, working capital for the purchase of goods to be traded, etc.). Often, energy systems and services are not recognized as directly leading to increased profitability.

44. However, partly driven by the availability of cheap financing and subsidies from international donors, a number of MFIs have recently introduced renewable energy technology (RET) loan products, and MFIs are starting to recognize the socio-economic benefits of including these products in their service packages.[46]

45. RET loans are different from the traditional loans provided by MFIs. They are for the procurement of a relatively expensive system, which costs several times more than what MFIs normally are willing to lend to clients without a long, positive track record. Also, the loan will be reimbursed over a fairly long period: the minimum is two years compared with the maximum period of six to eigth months for traditional MFI loans (in practice, most MFIs are unwilling to provide loans for periods of more than three years, even though the RET packages have an economic life of on average 20 years). Furthermore, to a significant extent, the loan is collateralized by the RET system (in the case of default, the MFI can seize the system and resell it), contrary to traditional MFI finance, which mostly relies on peer pressure and group lending schemes.

46. Some MFIs have developed innovative schemes to finance renewable energy systems. One example is that of the pioneering Grameen Shakti[47], which has experimented successfully with several schemes, including fee-for-service schemes. One of its innovations was the introduction of a Micro Utility model, focusing on the income generation potential of solar energy. This model has a low down payment, no service charge and an extended repayment period for a solar home system owner, who then rents solar-powered lamps to neighbouring shops. Its most successful product, however, is the packaging of a solar system with a mobile phone, with buyers providing telephone services, at a fee, to the surrounding villages.

47. Such a “value chain” approach – typical of structured finance – can unlock new opportunities for MFIs that are interested in developing renewable energy. For example, sustainable rural renewable energy projects could be structured around simple diesel motors that can operate on bio-diesel; villagers grow, for example, jatropha, and extract its oil which is used to generate energy, which can then power productive activities. The resulting extra revenue can be used to reimburse the MFI’s loans. Many similar schemes can be imagined, providing great scope for MFIs not just to diversify their lending activities into renewable energy (and the growing of its inputs, e.g. jatropha oilseeds), but also to contribute to sustainable economic development in their target areas.

[46] Winrock’s Clean Energy Group, *Financing Renewable Energy Technologies: A Guidebook for Micro Finance Institutions in Nepal*, Winrock International, July 2004.
[47] See for a discussion Nancy Wimmer, “Successful solar business: A model for policy in developing countries”, Presentation at the World Renewable Energy Policy & Strategy Forum, Berlin, June 2002. Grameen Shakti is a not-for-profit renewable energy company, part of the Grameen group in Bangladesh.

Chapter III

CASE STUDIES IN FINANCING RENEWABLE ENERGY PROJECTS

Case 1. The Theun-Hinboun hydropower project, Lao People's Democratic Republic[48]

> **Case summary**
>
> **Project:** construction of a large dam and 210 MW hydropower plant in the Lao People's Democratic Republic.
>
> **Financing strength:** virtually all electricity was sold to the Thai State electricity company under a long-term power purchase agreement. This made it possible to convert financing risks from a risk on the willingness and ability of the Government of the Lao People's Democratic Republic to reimburse, to a risk on the good performance of the power project.
>
> **Key project partners:** Government of the Lao People's Democratic Republic and its electricity utility, Scandinavian hydropower companies, Asian Development Bank, export credit agencies and Thai banks.

48. **Project.** In the early 1990s, the Norwegian Agency for International Development (NORAD) financed a feasibility study on a large hydropower dam in the Nam Theun river (a tributary of the Mekong) in the Lao People's Democratic Republic – it was to be the largest in the country. The feasibility study was positive, but there were great concerns about the project's financing (at an estimated cost of US$ 270 million). The Government of the Lao People's Democratic Republic did not have the funds, it was not considered creditworthy by international lenders, and the necessary legal and regulatory framework was missing.

49. **Financing.** In order to overcome these risks, a project finance structure was used. A Special Purpose Vehicle called Theun-Hinboun Power Company (THPC) was created in 1993, with as shareholders Nordic Hydropower,[49] GMS Power,[50] both with 20 per cent, and the state-owned Electricité du Laos (EdL), with 60 per cent. For EdL to pay its equity share, the Government took a 40-year loan with the Asian Development Bank (ADB) and on-lent most of it to EdL.

50. THPC obtained a 30-year build-own-operate-transfer (BOOT) licence from the Government; after 30 years, the project infrastructure will be transferred to the Government. Importantly, environmental risks were put squarely on the shoulders of the Government (the environmental liability of THPC was limited to US$ 1 million[51]); later, when it was found that the environmental impact of the dam was underestimated, it was possible for the project sponsors to claim that this was the Government's responsibility. THPC signed a long-term fixed-price contract (25 years, from the start of commercial operations) with the Electricity Generating Authority of Thailand (EGAT), under which the latter committed itself to pay a fairly high price for a volume equivalent to 95 per cent of the project's 210 MW capacity – and to pay even if it did not actually take delivery of the electricity.[52] The price was relatively

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[48] Based primarily on various Asian Development Bank sources, in particular, *Project Performance Audit Report on the Theun-Hinboun Hydropower Project (loan 1329-lao[sf]) in the Lao People's Democratic Republic*, November 2002.

[49] A company set up for operations in the Mekong region by the two largest hydro-companies in Norway and Sweden; the latter has since sold its shares, leaving only the Norwegian company, Statkraft SF.

[50] A subsidiary of a private Thai firm, involved in dam projects in several countries in the region.

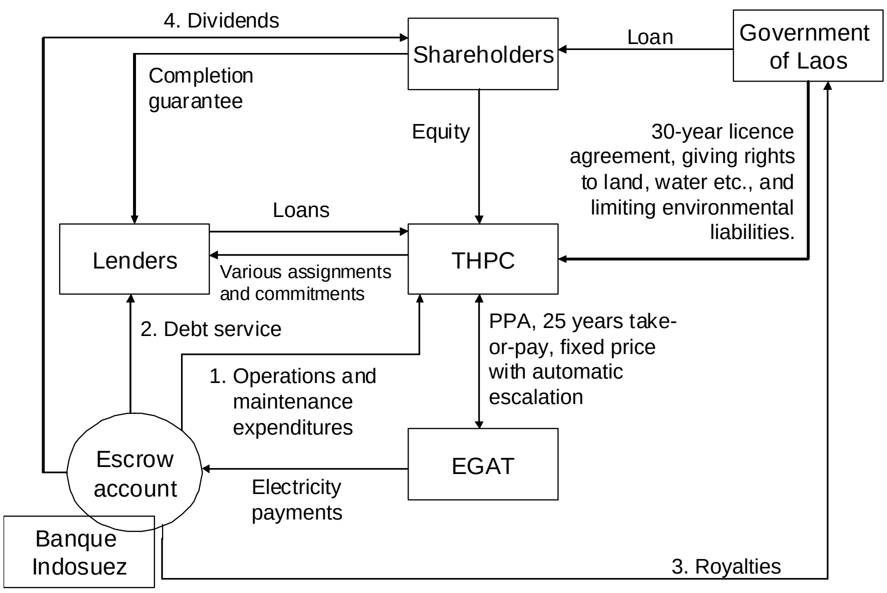
[51] This was later increased to US$ 2.6 million.

[52] If delivery is less than committed because of equipment outage or operational difficulties, EGAT charges THPC liquidated damages for each gigawatt-hour not delivered as per the power purchase agreement. There was also a PPA with EdL, for a much smaller amount but with prices indexed to the price paid by EGAT, for delivery to rural areas in the Lao People's Democratic Republic near the power plant.

high[53] because of the assured availability of supply (other hydropower projects were "run of the river", which means that they provide electricity only if water levels are high enough). On the other hand, half of the price was expressed in United States dollars, and the other half in Thai baht, with the exchange rate artificially fixed at 1 US$ to 25.35 baht. When the baht fell by almost one third to the dollar in the Asian crisis of 1998, this actually led to lower tariffs in dollars.

51. The structure benefited from several other risk mitigants (chart 7 gives an overview of the main elements). In its loan agreement with the ADB, the Government committed itself to meet its obligations under the 30-year BOOT licence. ADB provided a waiver to its usual negative pledge covenant (like other multilateral lenders, ADB normally does not allow borrowing Governments to pledge future revenue to third parties). The shareholders gave a completion guarantee to the lenders: if the project had less than one month of successful operations, the lenders would have full recourse to the shareholders. An offshore escrow account, managed by a French bank, was set up and pledged to the lenders. EGAT paid into this account, and every six months the funds in the account were distributed, going first to the operations and maintenance (O&M) costs of THPC (the lenders, however, had to approve THPC's work schedule), and then to debt service to the lenders. Then, escrow account funds were used to pay royalties to the Government (after a five-year tax holiday, THPC also started paying taxes), and only if funds were still left, dividends were paid to the shareholders. O&M costs are managed by THPC awarding an O&M contract every three years. The Lao People's Democratic Republic agreed to join the World Bank Group's Multilateral Investment Guarantee Agency (MIGA), which allowed the lenders to take out sovereign risk insurance with MIGA.

Chart 7.
The financing structure of the Theun-Hinboun project



52. The project's debt-equity ratio was set at 59:41 – a fairly high leverage, in particular given the high perceived risk of the Lao People's Democratic Republic, but possible through the risk mitigation effects of the project finance structure. The Government of the Lao People's

[53] A 1994 base rate of US$ 0.043 per kilowatt hour, to increase by 3 per cent a year during the 4-year construction period, and then 1 per cent a year during the next 10 years. Because of the baht devaluation, the tariff paid in 1999 was only US$ 0.04 per kilowatt hour.

Democratic Republic lent US$ 6.4 million to the project, but most of the funds came from export credit agencies[54] (US$ 58.6 million, which financed the equipment and civil work done by their countries' companies) and from commercial banks (US$ 64.7 million – including in Thai baht, from a Thai banking syndicate).

53. Power production started in 1998 – the project was finished in time, and under budget. The Asian crisis and the resultant devaluation of the baht had reduced the actual electricity tariffs paid by EGAT to below what had been expected, but at more than US$ 0.04 per kilowatt hour, this still was almost double the US$ 0.023 production cost.[55] The shareholders had recovered their original investments in nominal terms by 2002. Only an under-estimation of environmental costs and a slow response once the environmental and social impact of the project became better understood marred the otherwise successful record of the project. THPC's electricity sales have become the principal export of the Lao People's Democratic Republic, and provide the largest single source of revenue for its Government (much of which it has used for increasing social expenditures).

Case 2. Phu Khieu Bio-Energy Co Ltd, Thailand[56]

Case summary

Project: 65 MW bagasse-fired co-generation project in Thailand (2004).

Financing strength: creation of a SPV to raise equity and debt funding.

Key project partners: EC-ASEAN CoGen Programme – financed by the European Commission and coordinated by the Asian Institute of Technology (Bangkok) for the ASEAN region and Carl Bro International (Sweden) for Europe; Mitr Phol Sugar Group (through its United Farmers & Industries Co. sugar mill); Alstom (turnkey contractor).

54. Phu Khieu Bio-Energy is one of the subsidiaries of the Mitr Phol Sugar Group (MPSG) in Thailand, one of the largest and most advanced sugar companies in South-East Asia. As a by-product of its sugar production, Mitr Phol produces considerable volumes of bagasse (the dry pulp that remains after extraction of juice from sugar cane). Bagasse can be used to generate electricity and heat, in a co-generation plant.

55. **Project.** The Biomass Cogeneration Plant consisted in the extension of an existing co-generation plant to cover all the steam and electricity needs of one of Mitr Phol's sugar mill during the crushing, refining and off-milling periods. It was developed as an independent legal entity and was established to profit from the excess of bagasse and the possibility of selling excess power to the grid (29 MW). Although the plant is located within the sugar mill and has a broad interface with its operation, it is an independent operation and is economically self-supporting. The plant became operational in mid-2004.

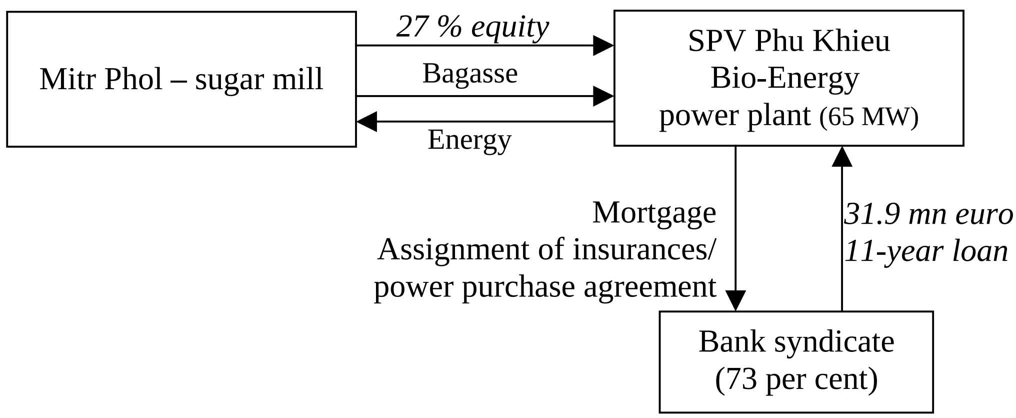
56. **Financing.** The investment cost excluding civil works, building foundations and financing costs was EUR 35.5 million. The expected payback period was about five years. A Special Purpose Vehicle (SPV) was created for raising capital, of which 27 per cent was financed by equity and 73 per cent by debt (11-year loans provided by two Thai banks). Funding this independent SPV facilitated the isolation of the project from risks such as bankruptcy which is a core consideration for financing. As is typical in this kind of financing,

[54] From Norway, Sweden and Thailand.
[55] This risk was not properly recognized at the time of project development. Since then, THPC has restructured its loans to ensure that debt currency matched revenue currency. One conclusion that the Asian Development Bank has drawn from this is that currency risk management, either in this simple form or through currency hedging, should be included from the start in project design.
[56] Based on a presentation by Alan Dale Gonzales, CoGen 3, 2004 Cogeneration Week in Viet Nam, April 2004, Ho Chi Minh City, Viet Nam

until the project is actually operational, financiers have full recourse to the project sponsors (in this case, the EPC contractor and Mitr Phol); but once the powerplant is operational, they depend entirely on revenue from its power sales.

57. The SPV, Pu Khieu Bio-Energy, was the focal point for the various structuring arrangements of the project financing. It signed a 21-year power purchase agreement with the national electricity utility, EGAT. The PPA tariff included a capacity charge (a payment for the availability of a certain volume of MW at contracted times) in Thai baht but indexed to the dollar exchange rate; and energy payments for the actual kWh delivered, indexed to the market price of natural gas. It signed a fixed-price EPC contract with a construction company. It entered into an operations and maintenance contract with the plant operator (the sugar mill). It signed agreements with Mitr Phol: on the delivery of bagasse by the sugar mill, and the delivery of heat and power by the power plant, and the various payment flows involved. Various insurances were taken out. All these agreements and insurances, as well as the project assets, were assigned to the banks, so that if the SPV defaulted on its obligations, the banks could appoint an agent to take over the project and continue its operations.

Chart 8. Phu Khieu Bio-Energy, project structure



Case 3: *Uttam Urja* initiative, India[57]

Case summary

Project: community-based project providing a package of energy products (1,000 domestic solar lighting systems) and services in rural India (1999).

Key financing feature: no recourse to Government subsidy even though the cooperative bank's usual collateral requirements were waived.

Key project partner: a newly created grassroots institution called the Energy Service Network (ESN), comprising of local NGOs, supply chain entrepreneurs and local communities.

58. The village communities of the *Bikaner* district in Thar District in India were largely dependent on kerosene for meeting lighting and related requirements. Owing to the difficult terrain and scattered settlements, it was economically unviable to extend grid lines. In this context, renewable energy sources and, in particular, solar systems were considered appropriate for meeting energy requirements related to lighting.

59. **Project.** The *Uttam Urja* ("best energy") project was initiated in 1999, and by March 2003, close to 1,000 domestic

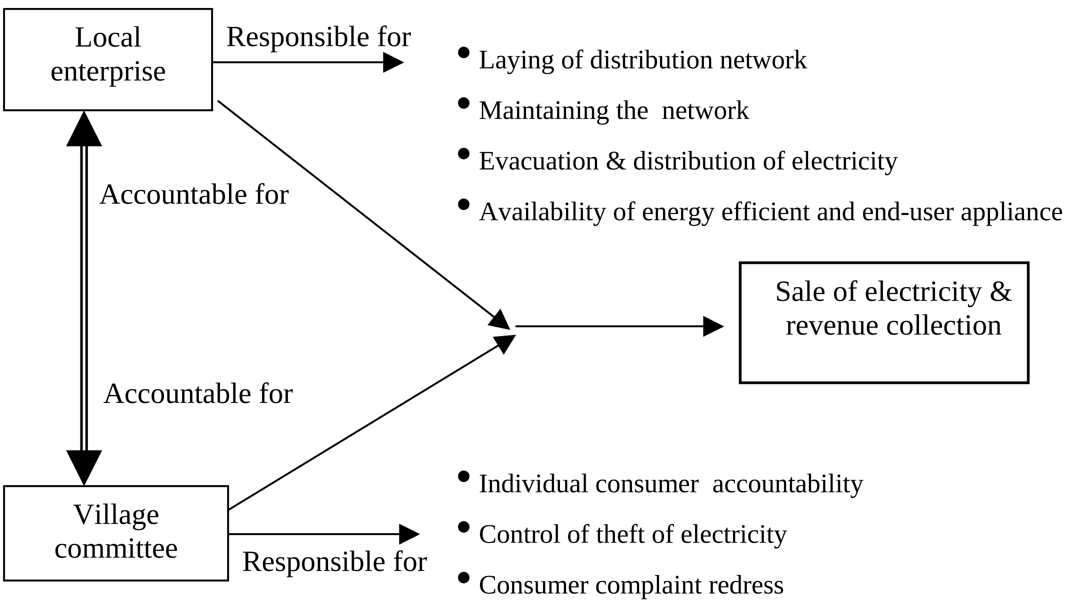
[57] This case summary is based on a case which is a part of the Good Practices Inventory of Asia-Pacific Environmental Innovation Strategies (APEIS), Research on Innovative and Strategic Policy Options (RISPO).

lighting systems (lanterns, home lighting systems and solar panels) had been sold – without recourse to the existing Government subsidy. The project focused on developing a grassroots institution called the Energy Service Network (ESN), comprising local NGOs and electronic systems dealers and retailers. Currently, the network is being facilitated and coordinated by the Tata Energy Research Institute (TERI), which is focusing on enhancing the capacity of the members of the network. TERI worked with the solar home system (SHS) manufacturers on product innovation, design, quality and ensuring its suitability for the rural communities. In order to customize the technology and bring it closer to the acceptance and affordable levels of the community, systems were assembled at the project sites. Entrepreneurs already involved in similar activities (radio or electronic repair and maintenance shops, NGOs with a service workshop, etc.) were identified for this activity.

60. This project was driven largely by the objective of overcoming the limitations of the subsidy-based dissemination system of the Government, which limits the reach of the product and the scope of customization and innovation in technology service delivery mechanisms.

61. **Financing.** The focus was on the provision of a "package" of energy products and services for rural people, rather than the provision of the product alone. The provision of easy credit was integral to this. For this several options were examined and experimented with for their appropriateness in the socio-economic context of the market, including setting up a non-banking finance company, fixed deposit schemes, soft loans from banks and leasing arrangements. The breakthrough was, however, made when the National Agricultural Bank for Rural Development (NABARD) waived the collateral security required for extending credit to rural development banks up to a predetermined limit for financing SHS customers (refinancing); and Kisan credit card[58] holders were encouraged to use their credit to buy the decentralized solar systems. Chart 9 shows the structure that was set up.

Chart 9. Operation of a mini-grid as a partnership



Source: taken from a presentation by Akanksha Chaurey, TERI, 27 August 2003.

[58] Kisan is a credit facility extended by rural cooperative banks to all marginal farmers, with credit risks up to a certain limit (equivalent to one season's working capital needs) covered by the central Government.

Case 4. Bakony Power's Ajka Plant, Hungary[59]

> **Case summary**
>
> **Project:** conversion of a 30 MW coal-fuelled power plant to a biomass fuelled plant by the forward sale of Carbon Emission Reduction units.
>
> **Financing strength:** securitization of 453,000 tonnes of carbon dioxide emissions reduction. The forward sales were used to fund biomass plantations which were cricoaé in ensuring steady fuel input prices for easy credit.
>
> **Key project partners:** purchase of credits by the Dutch Government under its Emission Reduction Unit Procurement Tender programme (Erupt), Bakony Power Company.

62. With the expiration of its power supply contract with the state electricity company and with new, stringent environmental norms, the coal-fired Ajka power plant, one of the two plants of Bakony Power in Hungary, came near to closure.

63. **Project.** A plan was developed to convert two of the five coal boilers of the Ajka plant to biomass-fired technology: this would enable Ajka to meet environmental requirements, and the resulting "green" energy could be sold at a relatively high price (60 per cent above standard electricity tariffs) to the national grid. "Security of supply for the fuel is the basis for financing of any biomass project."[60] Biomass projects are highly sensitive to fuel supply and price risk, given the regulatory risk and the paucity of long-term biomass supply contracts in place – and this plant will need 150,000 to 200,000 tons of biomass a year. To mitigate the price risk, Bakony developed a diverse portfolio of biomass fuel suppliers, and started a plantation market that would see its fuel supplies guaranteed and secure. The Hungarian Ministry of Energy had supported the first demonstration project for energy plantations with grants, but farmers were reportedly reluctant to set aside land for these plantations, fearing that onetime investments by the Ministry would not be enough to make the plantation business profitable.

64. **Financing.** Debt financing was a major problem. In the newly liberalized – and distorted – electricity market, banks were either charging a prohibitive interest rate or demanding two years' historical market development data that were not available. In addition, financiers had doubts about the security of Bakony's heat supply contract with the local alumina factory: a 10-year contract was in place, but the alumina factory could cancel this with two years' notice. Project securitization of 453,000 tonnes of carbon dioxide emissions reduction between 2008 and 2012 proved to be a solution. At an estimate of EUR 5.5/ton, EUR 2.2 million was expected from the biomass conversion programme; this brought the internal rate of return of the project from an unviable 8-14 per cent to an acceptable 11-17 per cent. The credits were purchased by the Dutch Government under its Emission Reduction Unit Procurement Tender (Erupt) programme. Half of the credits were paid upfront, and the other half are paid as various milestones of the upgrade project are reached. The steady revenue stream using the emission reduction unit forward sales was used to convince farmers of the viability of the plantation business. But more importantly, the revenues from its forward sales were used to fund the biomass plantations.

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[59] See "Energy Risk", March 2004, http://www.evomarkets.com/.
[60] Michael Wild, "Securing fuel supply: A precondition to project finance", UNEP Finance Initiative, Renewable energy finance workshop, Budapest, 27 September 2004.

Conclusion

65. Burning fossil fuels is not a long-term option for sustainable economic growth. However, in the current environment, if renewable energy technology is to become a serious alternative in developing countries to the traditional non-renewable sources of energy, at a minimum two things have to happen: the costs of renewable energy have to become competitive in a growing number of situations; and investors and consumers need access to finance to invest in renewable energy.

66. Given the high upfront cost of renewable energy technologies, access to affordable long-term finance is crucial for potential investors. However, financing renewable energy projects remains permeated with both real and perceived risks. Financiers need to seriously consider the bankable investment opportunities in renewable energies. Sufficient recognition needs to be given to the benefits that would accrue to users of RETs and the resulting financial benefits for both the financial institution and the client. Financiers can no longer claim that technologies are "new" and "not proven", and should be less reticent to take renewable energy systems as collateral for their loans. Structured finance techniques can help manage many of the risks – project finance and receivables finance are both powerful mechanisms, CERs can enhance financings, and micro-finance institutions are able to adapt these mechanisms for their own use.

67. The greatest opportunities lie with a new, decentralized approach – schemes that aggregate the renewable energy investments of a large number of people, rather than large-scale dams, wind farms or solar farms. As the *Uttam Urja* project demonstrates, even poor customers are willing to purchase renewable energy at the real cost (without Government subsidy) if the products and services are of high quality.

68. Private players are increasingly acting on this commercial logic. With the Kyoto Protocol now ratified, the private sector has even greater opportunities in the renewable energy sector because it is within this sector that emissions cuts will be made and traded.

69. Governments and aid donors can enhance public-private partnerships in this area. Among other things, public funds can be used to augment capital flows from the private sector; now, public funds often have no impact on private sector willingness to invest in renewable energy, or even crowd out private sector investors and financiers.[61] Importantly, public guarantees or aid agency or international finance organization guarantees can make projects bankable. For instance in the case of Ormesa Geothermal Complex in California, a loan guarantee from the US Department of Energy was crucial in overcoming financial uncertainty;[62] similar guarantees could be equally useful in developing countries.

70. Governments are already changing policies and regulations in the energy sector, and this process merits support. For example, policy restrictions, like monopoly structures in the power sector which prevent the emergence of independent private power producers, are slowly changing, giving space to many new medium-sized renewable energy projects.

71. The need for renewable energy finance to be self-sustaining is critical – growth of the sector cannot rely on continuous subsidies. A good policy and regulatory environment, Government and aid agency support that leverage on the available market mechanisms (such as structured finance), and a financial sector open to innovative forms of renewable energy finance can work together to reach many of the more than 2 billion people in the world who now have no access to modern energy.

[61] See for an excellent discussion on how to do better Murphy and Edwards, op.cit., and Lindlein and Mostert, op.cit.

[62] http://www.nrel.gov/documents/profiles. After this first project, financiers had become familiar with renewable energy projects, and later projects did not need similar guarantees.