SEFI

Scoping Study on Financial Risk Management Instruments for Renewable Energy Projects

United Nations Environment Programme

Reference Document

MARSH

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Part 1: Executive Summary

This study was commissioned by UNEP Division of Technology, Industry and Economics (DTIE) under its Sustainable Energy Finance Initiative (SEFI) with the aim of providing an overview of the barriers / risks affecting investment in Renewable Energy (RE) projects, “financial risk management” instruments currently supporting RE projects and those that could be developed to reduce uncertainty and facilitate more efficient and effective financing of such projects. Key messages of the report include:

The benefits of renewable energy are clear and well documented: climate change mitigation, cleaner environment, unlimited resource supply and improved energy security. However, current approaches to financing renewable energy deals are inadequate. **“Market failure” is common because the information required for lenders and underwriters to assess a project’s viability is often unavailable or in the wrong format.** This usually results in the risks of a proposed RET deal being overrated and the required hurdle rate becoming untenable.

Traditional project finance for renewable energy deals is restricted by the credit requirements associated with off-balance sheet transactions. RE projects are usually small and their developers relatively unknown, under-capitalised and generally unable to absorb sufficient risk to provide comfort to commercial lenders.

The risks and barriers that prevent a more rapid uptake of desirable renewable energy technologies are diverse but interrelated. **From an investment perspective, the RE-specific risks and barriers of most concern relate to the small scale of projects,**

technology efficacy, operational risk and regulatory uncertainty. Only long-term policies can change the familiar patterns of commercial investment.

Other barriers: whilst this study is not intended to address in any detail the social, legal, and economic challenges in developing countries that may affect RE project financing, carbon finance can improve certain RE project revenues but is of limited interest to commercial financiers / insurers at present because of regulatory uncertainty.

When small-scale RE projects utilise private financing in addition to developer's equity, it is often as a result of an eclectic support group that may comprise; specialist / boutique consulting and financial advisory firms, high-net worth individuals seeking tax shelters, community and local finance schemes, equipment leasing arrangements and, occasionally, corporate sponsorship by a utility.

Traditional insurance products are gradually becoming more widely available to the RE sector. However, "institutional inertia" is preventing any significant progress with regard to product development. The tendency in the insurance industry is to readapt existing products rather than create new ones. Substantially more engineering tests must be carried out on RE technologies for the purposes of actuarial studies: there is an important role for the public sector in the sponsorship of this work.

Capital allocation within insurance companies is dependent on senior management being convinced that the business case for underwriting a certain class of risk meets their minimum criteria. Most small projects have a high opportunity cost and rarely exceed the internal hurdle rates required by management. There is currently an impasse in RE market development in part due to restrictive thinking. Fresh approaches and financial innovation are required. **Based on the responses to this study, the hypothetical provider of such innovation in the insurance markets is likely to be a small to medium-sized specialist risk transfer / finance operation with dedicated capital and low overheads.** Such an enterprise could facilitate and attract additional capital by providing industry leadership. However, few such operations currently exist.

This study proposes that there is a distance between the developers, their advisors and institutional investors. On one side are the boutiques and consulting firms that really interact with the majority of RE project developers. On the other side are the major financial institutions who interact at a high level with policymakers but, despite good intentions, are usually too large / inflexible to operate usefully in the RE space at this time. There is a useful role for the public sector to act as a "mezzanine player" or bridge between the expertise, creativity and nimbleness of boutiques and the distribution networks, balance sheet and market influence of major financial institutions.

New financial risk management instruments are evolving and can be adapted to meet the needs of the RE (renewable energy) sector. These include alternative risk transfer (ART) products, specialist underwriting vehicles, credit derivatives, and political risk insurance. Insurance Collateralized Debt Obligations (CDOs) may be one method of directing capacity at particular insurers and lines of business. There is an ongoing role for risk mitigation and especially credit enhancement products provided by Multilateral Financial Institutions (MFIs), Official Bilateral Insurers (OBIs) and Export Credit Agencies (ECAs).

A key objective of this study is to accelerate plans to develop product blueprints for actual application in the market. **A learning-by-doing approach to developing new and commercially acceptable RE financing and risk management products could be usefully adopted through focused interactions between the public sector, specialist financial boutiques / insurers and several global financial intermediaries.** This can be accomplished through joint ventures that combine the perceived support and credit rating of public sector entities with the creative vision of specialist private boutiques and the distribution networks of large financial services companies.

A number of programs are suggested. **The main suggestion is to develop Special Purpose Underwriting Vehicles (SPUVs) with dedicated capacity for the RE sector.** An example of an environmentally friendly risk management start-up operation from the forestry sector indicates the potential of Lloyd's syndicates as a means of providing cover to commercially viable RE projects. There are a variety of SPUV structures, which could be developed. The nature of the cover to be provided determines the level of public support required. An insurance company providing standard fire and windstorm protection for forestry requires nominal public support unless it takes on broader environmental agendas. However, the technology and operational risks inherent in RE projects mean that providing standard insurance cover is actually quite complex because of the data requirements. **Public sector support is required for engineering as well as project risk rating studies for most RETs that have limited operational experience.**

Part 2: RET assessment – Overview of technologies and current state of development of these technologies

This study covers inanimate energy sources that do not deplete mineral reserves or require major land-use engineering: offshore wind, onshore wind, wave / tidal power, wind power, geothermal, biomass (plant based materials and plant and animal wastes) , biogas, solar (photovoltaic or direct heating) and "natural" small scale hydro.

Energy efficiency and nuclear power technologies are outside the scope of this project.

Market Overview

Although only 13.8% of primary energy supply, renewable energy technologies are experiencing double digit growth, with a combined renewables capital expenditure ('capex') of USD 22 billion per annum.

In rural parts of developing countries most of the primary energy supply (~10%) is from the use of dung and foraged firewood and large hydroelectric schemes (3%). The former is a source of ill health for rural people and environmental degradation (see below); the latter has limited scope for further expansion, is land intensive and can also create environmental difficulties. Globally installed renewable energy capacity is expected to more than double over the next ten years from approx. 130 GW in 2003 to 300 GW in 2013[1]. In Europe alone the renewable-energy market has an annual turnover of 10 billion EUR.

Many of the technologies are technologically viable and some are well proven, such as onshore wind, but with exceptions their costs are high relative to fossil fuels. However, cost trends are encouraging and for example the costs of wind have fallen 400% since the mid 1980s. Most technologies are in their infancy and there is appreciable potential for further reductions through innovation and batch production.

Even based on conservative projections the resource for renewables is more than ample to meet world energy demands several times over (ICCEPT 2002). However current usage is low compared to both the scale of their potential and the size of the global energy market. Figure 1[2] provides some indicative estimates of what renewable energy sources are thought to be capable of supplying allowing for costs, physical accessibility and other factors. Taken together they account for just 1% of world primary energy consumption.

[1] World Energy Outlook 2002, International Energy Agency
[2] World Energy Assessment Report by the UNDP and World Energy

Figure1 : Renewable energy potential

Resource	Technical potential (TWh/year)	Energy conversion options
Direct solar	In relation to energy demands, virtually unlimited	Photovoltaics Solar thermal power generation Solar water heaters
Wind	Very large in relation to world's electricity demands, especially off shore resources	Large scale power generation Small scale power generation; pumps
Wave	Not fully assessed but large	Numerous designs
Tidal	Not fully assessed but large	Barrage Tidal stream
Geothermal	Several orders larger than the amount currently used. As with other technologies, use depends on costs not the quantity of resource technically available, which is huge.	Hot dry rock, hydrothermal, geopressed, magma (only hydrothermal currently viable)
Biomass	Potential varies greatly between countries, but can complement agriculture and protect watersheds and biodiversity.	Combustion, gasification, pyrolysis, digestion, for bio-fuels, heat and electricity

Source: Imperial College Centre for Energy Policy and Technology (2002)

To sum up, renewable energy is abundant and there are many promising options for converting it into useful energy. The relative merits vary greatly between countries, primarily because of variations in natural resource endowments. But it is generally true that the renewable energy resource is abundant in all regions of the world, available in perpetuity, and that the conversion efficiencies for harnessing it have improved appreciably and continue to do so.

However, there are various risks and barriers affecting the successful application and deployment of RET projects in place of fossil fuel based energy systems.

Solar

Solar energy is vastly abundant with about 30% of its spectrum theoretically available for electricity generation., The rest can provide heat.

There are basically three technologies for turning solar energy to commercial energy;

- Photovoltaics[3] (PV)
- Solar-thermal systems
- So-called 'passive solar' technologies where building design maximises solar lighting and heating. This is considered an energy efficiency measure and is not covered in this review.

World production of PV increased by 43.8% during 2002, with most sales going into the grid connected sectors in Japan, Germany and the US State of California [4]. PV systems currently cost around USD5,000 per kW, plus installation costs, still several times the costs of other renewable energy technologies such as wind, but often the lowest cost means to provide small amounts of electricity in remote off-grid applications, where there is potential for large markets.

The industry is now reaching a level of commercialisation where manufacturers such as Sharp, Sanyo and Kyocera are scaling up, with plans for 200MW activities. Plants of this scale are almost entirely automated, reducing operating costs and significant cost reduction in the product. However, this does require heavy investment upfront with a long-term view of return on investment, which makes government support essential.

Most commonly available in the form of panels or modules they can be used for four main types of application:

- Small scale provision of electricity for electricity supply in remote regions that do not have a well-developed electricity grid including remote telecommunication stations, water pumping, battery charging and solar home systems
- Very small scale applications such as calculators
- Building integrated systems (BIPV) that may also be connected to the grid, specialized products are emerging, such as solar roof tiles
- Central station supplies, where large arrays of solar modules provide electricity for the grid

Grid connected applications (mostly BIPV) now account for over 50% of the world market, stimulated largely by supportive policies in Japan, Germany, the US and other industrial countries.

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[3] PV's consist of a semi-conducting material, most commonly silicon, which converts photons of light into electrical current by means of the photoelectric effect.
[4] Renewable Energy World Review Issue 2003-2004, July –August 2003 Volume 6 Number 4

Solar Hot Water Heater technology is generally considered 'mature'; market growth will yield economies of scale and ongoing efficiency improvements, but major technical breakthroughs are not expected. In regions where the use of the technology is well established, solar water heaters are fully economic.

High temperature solar devices can be used for desalination, detoxification of waste materials and for electricity generation. But the main use so far is for electricity generation, solar concentrators can achieve conversion efficiencies of up to 40%. Most operational experience to date has been obtained from the parabolic trough schemes in California [5], whose aggregate capacity is 400 MW; they were installed in the 1980s, and have an exceptionally good operational track record over a 15-year period.

Wind: onshore and offshore

Wind power is the world's fastest growing energy source. Installed capacity has continued to grow at an annual rate in excess of 30%. During 2002 alone, more than 7,000 MW of new capacity was added to the electricity grid. This investment was worth more than € 7 billion.

By the beginning of 2003, global wind power installations had reached a level of 32,000 MW. This provides enough power to satisfy the needs of around 16 million average European households or 40 million European citizens. Although Europe accounts for 74% of this capacity, other regions are beginning to emerge as substantial markets.

Important "success stories "for wind power can be seen in the experiences of Germany, Spain and Denmark in Europe, the United States in the Americas and India among the countries of the developing world. A new market sector is about to emerge offshore, with more than 20,000 MW of wind farms proposed in the seas around Northern Europe.

Technology characteristics, maturity and costs

Wind technologies fall into two distinct types: large turbines, designed to supply electricity to the grid, which are typically in the range 1-3.5 MW rated capacity and with blade diameter of around 100 metres; small turbines rated from around 3kW up to around 100kW, which are widely used in the leisure [6] and off-grid markets. This review will focus on the large and grid-connected machines.

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[5] The sun's energy is focussed onto a central heat receiving element using parabolic mirrors. The heat is used to raise steam to fairly high temperatures of around 400o C, though much higher temperatures are available in principle from systems which focus the energy onto central receivers.

[6] Battery charging on yachts for example

Wind markets have seen substantial growth and technologies have increased in size and declined in cost. As the technology has matured large wind machines have become increasingly standardised – all are now broadly similar three bladed designs. The production cost of a kilowatt-hour of wind power has fallen by 20% over the past five years alone, onshore wind is now able to deliver energy at average costs of around 4 cents/kWh [7]. Wind is already competitive with new coal-fired plants and in some locations can challenge gas. Individual wind turbines have also increased in capacity, with the largest commercial machines now reaching 3.5MW and 5MW prototypes now being developed.

The first large-scale offshore wind farm was completed in September 2002. Horns Rev, 12 km off the Danish coast consists of 80 turbines, is rated at 160MW, with water depths of up to 20 metres. Several countries have plans for developments of a similar scale, a large resource has been identified, and offshore wind is expected to reach around 2 GW installed capacity by 2005 and grow at around 800 MW/yr thereafter.

Offshore wind currently delivers electricity at a cost of 6 to 9 cents/kWh – around twice the cost of onshore wind in good sites. The complexity of installing wind turbines offshore incurs additional costs compared to onshore wind, which is of key concern to financiers and insurers. However, engineering studies suggest that there is considerable potential for other factors to offset these costs.

Wind regimes are generally higher and more stable offshore and the absence of noise constraints mean that turbines can spin faster – which increases output for a given size of machine, and reduces blade size and loadings on bearings and structures relative to onshore machines. Larger turbines (with rotor sizes exceeding 100 meters and capacities over 3.5MW are currently in operation), variable speed DC drives, and improved cabling and forecasting techniques are also predicted to reduce costs and there is the possibility of hybrid—wind/wave and wind/tidal stream—devices.

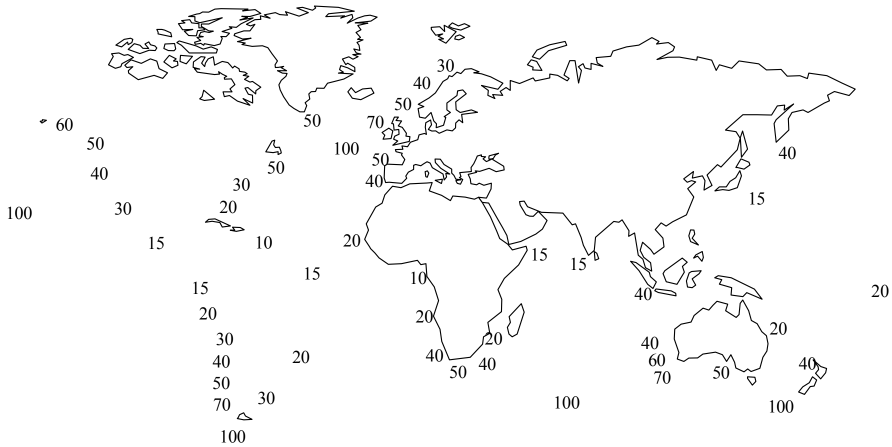
As a result, costs are widely predicted to fall; the UK Energy Review suggested that costs could fall to around 3 – 4 cents/kWh as development proceeds. Despite limited experience offshore costs have already fallen: Horns Rev is expected to deliver energy at around 50% of the cost of early developments.

[7] Wind costs are very site specific, and highly sensitive to wind regimes. Costs quoted are typical for a moderate wind speed

Wave and Tidal

Resource

The potential amount of energy to be extracted from tides and waves is very high. For the UK alone it has been estimated that nearly 100 TWh per year (30 per cent of the country's electricity requirements) could be met from a selection of the most promising sites, [8] though other estimates are seven times this figure. However, there is still limited data on the global potential.



Wave power levels are approximate and given as kW/ m of wave front

Figure 2: Global average wave power levels (Thorpe 1999)

While it is clear that wave power devices can be made to work, it has not yet been demonstrated that they can be made to work cost-effectively, with economically attractive prices for the energy generated.

Wave and tidal devices fall into three categories:

- The most developed ocean technologies are tidal barrages, where a large dam-type structure is used to control the flow of the tides through estuaries so that they can drive a largely conventional hydroelectric plant. Working examples include the 240 MW facility at La Rance in France, a 25 MW plant in Canada and a 100MW plant in China.
- Wave power, for which there are numerous designs, harness the rise and fall of the waves to generate electricity.
- Tidal stream devices harness the movement of the tides to generate electricity without construction of a large dam-type structure; leading designs resemble under water wind turbines.

[8] House of Commons: Science and Technology Committee, Session 2000-2001, Seventh Report: Wave and Tidal Energy. London: The Stationery Office. HC 291

Tidal barrages have been largely ruled out on cost grounds – the Severn Barrage proposed for the UK would cost around £14billion ($20billion) to construct and energy costs would be in excess of 15 US cents/kWh – even allowing for very long-term amortisation of costs.

Wave and tidal stream devices do not require the enormous civil engineering costs associated with tidal barrages. However they are currently at the R&D and prototype stage, with only around 1 MW of wave energy devices installed worldwide, all of which are demonstration projects. There is currently no large-scale tidal stream capacity operating, though prototypes are being tested and several promising designs exist particularly in the UK. [9]

Although tidal energy is location dependent, it does have the advantage that tides are predictable and follow a regular cycle as do power outputs. The greater resource certainty associated with wave and even more so with tidal power provides greater confidence in future revenue streams, which could help to secure financing for larger scale commercial farms in the future.

A number of other projects are also under way in various parts of the world:

- Wavegen is proceeding with an R&D project to demonstrate its floating offshore concept at the 2MW scale.
- In Australia, a shoreline device is being deployed by Energetech, and a power purchase agreement with the local utility in Australia is already in place.
- In Ireland, a 400kW floating device (the McCabe Wave Pump) has been tested as a pilot scheme, and a commercially sized device is nearing completion.
- In the Netherlands, another floating wave device (the Archimedes Wave Swing) has been developed.
- In Romania, the construction of a 2MW device is nearing completion: this will be deployed near Portugal.
- A floating wave energy device, developed by Ocean Power Technology in the USA, has been tested at a large scale in the Eastern Atlantic: the first commercial schemes are being built in Australia and the Pacific.

In general, shoreline wave energy conversion is technically developed but not fully commercially proven. It is still some way from being fully competitive commercially. Furthermore, there is, at present, insufficient operating experience, and schemes need to demonstrate long-term performance and reliability.

[9] Renewable Energy World Review Issue 2003-2004, July –August 2003 Volume 6 Number 4

Geothermal

Geothermal energy (literally, “heat from the earth”) flows from the Earth’s hot interior due to the movements of crustal plates. It is commonly tapped where zones of high heat flow are close to the surface. It is a proven resource, and has been used for electricity generation and the production of heat for industry, space heating, aquaculture and other purposes for over 70 years.
Over 12000 MW of heat capacity and 8000 MW of electric power production are currently available in over 30 countries from geothermal sources with USD15 billion capex.

Geothermal plants offer several advantages:

- they are simple, safe, and modular (1-50MWe),
- short construction periods (approximately one year for a 50-MWe plant),
- capable of providing base load, following or peaking capacity

Source: A World Bank report[10]

Many high temperature resources are found in the 'Ring of Fire' which includes most countries of the Pacific Rim. Others are located close to other crustal plate margins or at rifting locations such as the Rift Valley in Africa. These high temperature resources offer the best potential for geothermal development.” However, it is in principle available to all regions of the world.

The potential of geothermal energy is immensely greater than the quantities used so far. The useful accessible resource base is 600,000 exajoules (over 1500 times world energy consumption, and a million times the amount used so far) (UNDP/WEC 2000). Its use has depended greatly on costs, which are site specific. Figure 3 below provides estimates of Geothermal cost based on experience with past projects.

Figure 3: Estimates of Geothermal Unit Cost of Power (USc/kWh)

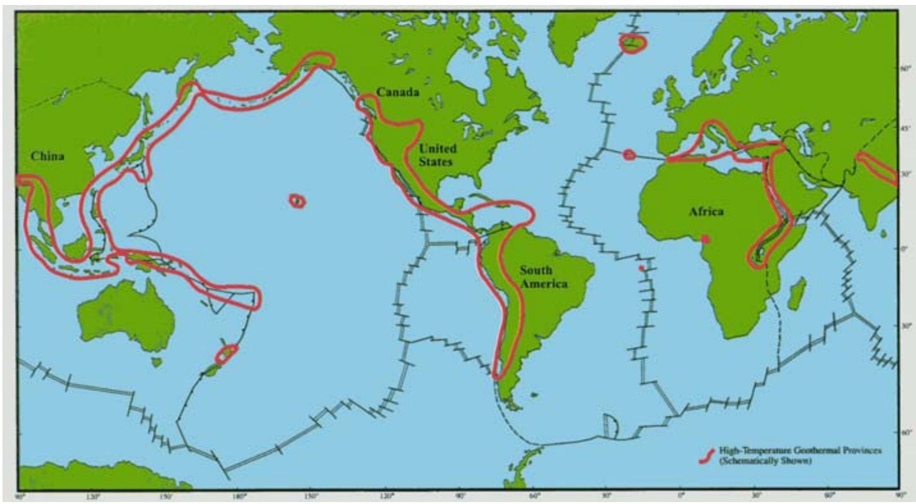
	Unit Cost (US c/kWh) High Quality Resource	Unit Cost (US c/kWh) Medium Quality Resource	Unit Cost (US c/kWh) Low Quality Resource
Small plants (<5 MW)	5.0-7.0	5.5-8.5	6.0-10.5
Medium Plants (5-30 MW)	4.0-6.0	4.5-7	Normally not suitable
Large Plants (>30 MW)	2.5-5.0	4.0-6.0	Normally not suitable

Source: World Bank Group. Web site on Rural and Renewable Energy. A 10% discount rate is assumed and 90% availability.

[10] “Geothermal Energy”, taken from the Bank’s web page on Rural and Renewable Energy

Hydrothermal resources are easiest to exploit, typically located at depths of 1-4 km containing steam or liquid water under pressure. [11] Molten rocks (magma systems) can also be accessed at greater depths (up to 7km) as can hot dry rocks (HDR) [12] at 4-8 km, depending on the temperature gradient. HDR geothermal energy is 200 times more abundant, with projects in progress in Australia, France and Switzerland although in principle they are available everywhere just by drilling sufficiently deep to produce rock temperature useful for heat extraction. Figure 4 shows the location of the global high temperature resources.

Figure 4 - Accessible high temperature hydrothermal resources



The main technical challenges to reducing costs, increasing financing and opening up this resource fall under three headings:

(1) Drilling, which typically accounts for half of the capital costs.
(2) Exploration
(3) Reservoir technology.

Under (2) and (3) the problems are how to remotely detect producing zones deep in the subsurface, and second to find better well-stimulation measures or 'heat mining' to extract the heat more extensively and efficiently.

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[11] The following borrows liberally from the review by JE Mock, JW Tester and PM Wright (1997), "Geothermal Energy from the Earth: Its Potential Impact as an Environmentally Sustainable Resource", *Annual Review of Energy and the Environment*, 1997, 22:305-56.

[12] Hot Dry Rocks (HDR) Ggeothermal energy is extracted by devloping an underground heat exchanger in buried, hot granites (250-300Oc) through opening up existing joints by hydraulic pressure.

Biomass

Biomass energy is a generic term to describe energy in the form of heat, electricity and liquid and gaseous fuels extracted from agricultural and forest residues, other organic wastes, and specifically grown crops. It currently accounts for around one tenth of world energy supplies.

Biomass has to be distinguished between organic biomass and waste biomass. The conversion technology can be either combustion/incineration or digestion (methanisation).

Biomass is used in several ways using several sources:

- For direct combustion in small and large boilers for electricity, district heating and combined heat and power (CHP);
- For gasification as to produce a fuel for heat and electricity generation as a feedstock for hydrogen or liquid fuels production. Gasification is also becoming an increasingly popular means of treating municipal solid waste.
- For biogas extraction: Another application is anaerobic digestion of industrial, agricultural and domestic wastes.
- For the production of liquid and gaseous fuels for transport [13].

Biomass already has significantly more market experience than any other emerging renewable option, (IEA, 2000b) and its use has expanded considerably in several countries in the last decade, largely as a result of supportive policy frameworks.

The 1.6 billion people who lack access to modern energy forms consume most of this biomass energy; for whom wood, dung and crop residues are the only means of cooking and heating. The following, however, concentrates on the use of biomass for the production of modern energy forms—electricity, combined heat and power, gaseous and liquid fuels—where it has a significant contribution potential.

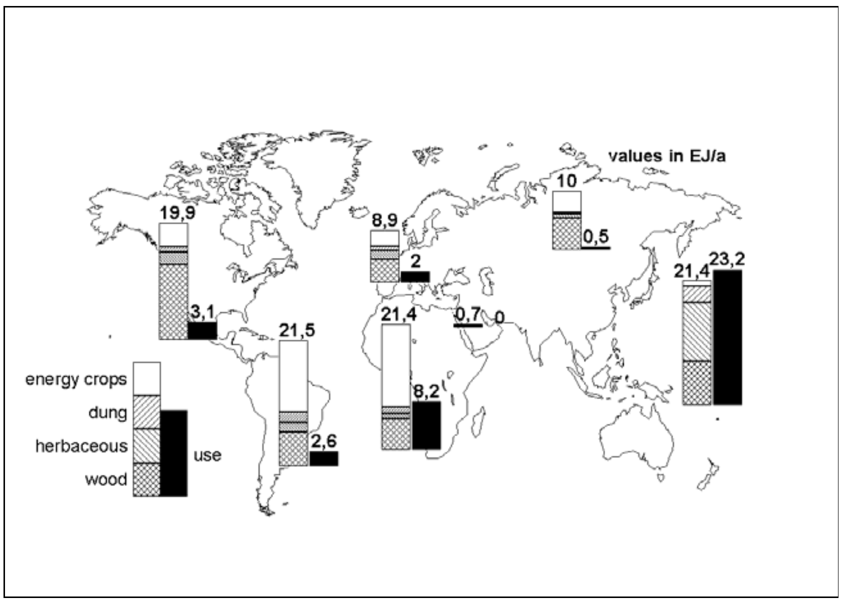
Modern biomass for heat and electricity production contributes around 4% of primary energy in the US, 11% in Austria, 20% in Finland and, 17% in Sweden. Most biomass energy is derived from other industries, such as forestry residues and wastes from the wood processing industry in the US and Scandinavian countries. Agricultural residues and paper pulp are also widely used in some countries such as Denmark and the Netherlands.

[13] Ethanol can be produced from the fermentation and hydrolysis of sugar or woody and herbaceous residues and crops, biodiesel can be produced from the pressing and esterification of oil crops, and fuels such as DME, methanol and hydrogen can be produced via biomass gasification.

Biomass for district heating and CHP is also well established and expanding in Austria, Denmark and Germany (UNDP/WEC, 2000, Bauen, 2001). Much lower costs could be achieved in co-firing applications, where suitable quantities of biomass can be supplied to existing coal plants for example. However, there are security of supply issues associated with these biomass options.

The largest potential for cost reduction lies with gasification technologies, in part because of the efficiency gains over combustion plants at capacities typical of biomass electricity plants. Future biomass electricity cost from dedicated plants fuelled with energy crops could be around $0.05-0.06/kWh. Production of biomass liquid fuels for blending with conventional vehicle fuels is well established in Brazil and the US, and a number of other industrialised and developing countries have biofuels programmes (UNDP/WEC, 2000). Figure 5 provides an overview of current biomass use against sustainable potential.

Figure 5: Biomass resources and use



Source: Bauen and Kaltshmitt 2001

In Europe the utilisation of larger volumes of biogas has been successful in wastewater treatment plants, industrial processing applications, landfilling and the agricultural sector.

The agricultural sector currently accounts for around 10% of biogas capacity but has huge potential, considering the volume of manure generated in Europe. Landfilling currently accounts for 60% of total biogas capacity with the US, UK and Germany leading with installed capacity. Whilst landfill gas energy facilities will peak in the next decade or two in Europe, before alternative waste management methods are found, developing countries hold significant prospects.

Industrial sector exploitation of biogas is very small scale across Europe with around 100 generating sites. However, opportunities for new installations are significant particularly in regions with large food and beverage production and as the EU Animal By-Products Regulation takes effect [14].

Most energy scenarios indicate biomass energy as a key component of the global future energy mix with significant benefits in terms of environment and development. There are significant opportunities associated to the development and commercialisation of biomass conversion technologies, the development of energy crops and their management, and the implementation of biomass energy projects.

Small-scale Hydro

Small-scale hydro schemes are typically defined as having an installed capacity of less than 10MW. They generate electricity by converting the energy available in flowing water (rivers, canals or streams).

Although hydro is often regarded as a 'proven' technology that is fully commercialised, developments continue on all design aspects, such as new materials, improved construction techniques, and more appropriate ancillary systems. The most modern plants have energy conversion efficiencies of up to 90%.

With 38GW of installed capacity, small-scale hydro deployment worldwide is increasing at about 900MW annually and is expected to reach 220TWh per year (55,000MW) by 2010. Rapid expansion is expected in Asia, Latin America, Central and Eastern Europe and the former Soviet Union.

The requirement, in many countries, for an environmental impact assessment to be carried out for small-scale hydro proposals; these assessments cover a range of issues, e.g. fishery protection, river ecology, water quality and turbine noise.

It should be noted that the cheapest schemes to develop tend to be in mountainous areas, although the best sites have already been exploited and environmental sensitivity is an important factor in those remaining. Low head schemes, by comparison, are often close to population centres, where the grid is strong and the rivers ponded or polluted, with consequently less environmental objections. Small scale hydro projects also have much longer lead time processes than other RET, the average planning time can be as long as seven years, and for half of the European Member States it takes more than 3 years. The nature of the engineering

[14] The EU Animal by-products Regulation effectively bans the landfill of organic wastes without prior sterilisation treatment.

work required means construction periods even for small scale hydro can be more significant than for other renewables.

RET in Least Developed Countries

It is important to recognise the differences in markets for RET in LDC's compared with markets in the developed world. With roughly 400 million households, or 40% of the population of LDC, without access to electricity the demands on RET and their applications can be very different to that of the developed world.

The focus on 'end-user' or 'energy service' highlights the importance of RET applications that can provide social benefits such as clean drinking water and quality of life as well as economic benefits such as improved agricultural productivity.

In rural areas social benefits and quality of life rather than income and economic benefits have driven markets for RET in rural areas.

Solar hot water for residential and commercial uses is cost effective in many regions; about two thirds of the 15 million domestic solar hot water collectors in 2000 were in developing countries[15]. An estimated 1.1 million solar home systems (typically 15-75W) exist in rural areas of developing countries, although an estimated 10-20% are no longer operational. Figure 6 below illustrates that the largest existing markets for solar home systems are located in the following countries (several of which are poised to expand, including India and China, who have proposed 10 million additional systems within ten years):

Figure 6: Existing markets for solar home systems

India	450 000
China	150 000
Kenya	120 000
Morocco	80 000
Mexico	80 000
South Africa	50 000

China, India and Nepal all have large manufacturing industries and programmes for biogas. Biogas digesters, covert animal and plant wastes into fuel usable for lighting, heating, cooking, and electricity generation on ether household or community scales.

[15] Renewable Energy World Review Issue 2003-2004, July –August 2003 Volume 6 Number 4

Wind driven and solar powered water pumps are examples of productive uses of renewable energy that increase incomes or provide other social services beyond home lighting, entertainment and increased conveniences.

Grid-based renewable power generation features more prominently in developing countries with many like India[16] and China [17] adopting new targets for increased capacity. Small-scale hydro, biomass, geothermal, and wind farms are all competitive and viable technologies for grid-based power generation. The LDC market can be summarised as follows: Small-scale hydro has been a mainstay of rural energy development for many years. China alone accounts for 80% of small hydro capacity in developing countries driven by long standing rural electrification programmes from the government.

Biomass power is well established in Brazil and the Philippines, where most feedstocks come from agricultural (bagasse) and forestry residues.

Wind power has been slow to emerge in developing countries with only 10% of the global total. India, with 1300MW of installed capacity, leads the developing world, its boom in the 1990's driven by special tax policies and other regulatory mechanisms.

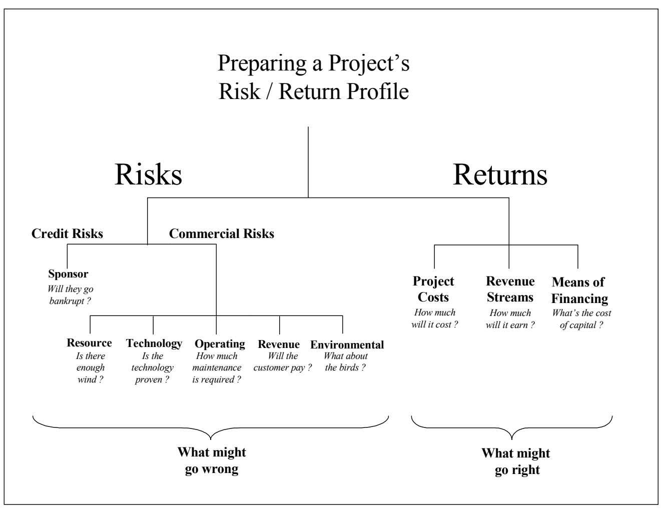
Geothermal is well established in Indonesia, the Philippines, Mexico and Kenya. Africa has an estimated total of 7000MW of geothermal potential and Kenya already has 45MW installed and operating for over 22 years at 97% availability.

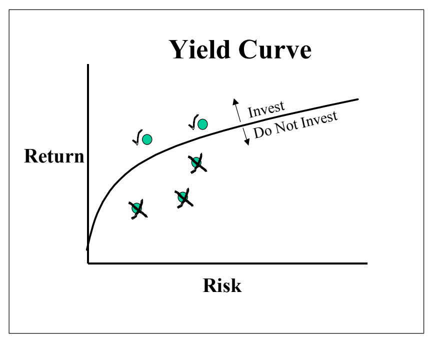
[16] India has proposed 10% of new capacity additions from renewable neergy by 2012 (perhaps adding 10 000MW)
[17] China has proposed 5% of new capacity additions from renewable energy by 2010 (perhaps adding 20 000MW)

Part 3: The role of financial risk management instruments

Financiers make lending and investment decisions based on their estimation of both the risks and returns of a project. In considering a project, a financier will usually prepare a risk/return profile, as is shown below. The analysis involves assessing each individual risk and the means to mitigate its potential impact on the project. Assessing the returns involves verifying the cost and revenue projections and then comparing the financials of the project with the cost of financing to be used.

A lender will specifically focus on the ability of the borrower (or, in the case of project finance, the project) to make loan repayments. An equity investor, who shares in the upside of the project, will base his decision on an estimation of the risk-adjusted return of the project, which graphically (see smaller figure) means deciding whether the project falls above or below the investors risk/return yield curve. For on-grid RE the returns are usually easy to assess; it is the risks that can be difficult to assess or manage. When it comes to off-grid business models, a financier has difficulty understanding both the risks and the returns.





The Need for Risk Management Instruments

Continued support for RET projects and their future success is dependent upon the involvement of the financing community. As investors and lenders are averse to risks that can give rise to unexpected reductions in a firm's or project's cash flows, value, or earnings, the application of appropriate risk management instruments is essential.

Furthermore when considering the generally poor reputation renewables have with the financing community and the fact that they are often viewed as higher risk investments, this results in stiffer requirements (seen in the terms, conditions, structure and documentation required for such transactions) for investors and developers alike.

Briefly, the risk management process can be described as the process by which an enterprise tries to ensure that the risks to which it is exposed are those risks to which the enterprise wants/needs to be and thinks it is exposed [18].

Notwithstanding the range of risks RET projects face, there are in reality only four possible responses that the parties involved in a RET project may adopt to deal with these risks. Risks may be:

- Avoided
- Mitigated
- Retained or
- Transferred

Within the risk management continuum the first two responses (avoidance and mitigation) may be categorised as risk control and the latter two (retention and transfer) as risk financing.

A company's or project's retention decision is the part of the risk management process that determines what risks (and how much) the enterprise should bear as a part of its normal business and what risks the enterprise should transfer to one or more market participants.

In general terms, the normal approach to risk management is to control all those risks that management feels it can control within the physical resources of the enterprise and finance the remainder.

Effectively, risk financing funds those losses that remain after the application of risk control techniques, including both those risks accepted as not being able to be controlled and those where controls proved inadequate to contain the risk.

There may be various risk management instruments that are available to support RET projects. Some of the most important ones are discussed in section 6 and 7.

[18] Culp, C.

Risk Allocation and Due Diligence

The financial community's understanding and perspective is driven by the answer to one central question: will the investors and lenders earn the return or receive the interest payments that they expect?

Senior and subordinated lenders, equity investors and investment bankers look at renewable energy projects in distinct ways.

Investment bankers expect to earn a fee, lenders to receive long-term and fixed payments and equity investors to earn a shorter-term payback and return. Each of the players in these deals must do its own due diligence -- or examination of the project before committing money to the project.

This may include a review and scrutiny of:

- The business plan (including fatal flaw analysis)
- Financial models showing how the project will incur expenses and generate revenue over its life including;
  - Historicals
  - Assessment of sales projections, market/ offtakers, input costs, competitors, substitutes
  - Projected cash flows, margins, IRR, NPV for Project (and Sponsor)
  - Sensitivity to changes in key assumptions
- Fuel source and security of supply – e.g. wind resource assessments
- Permits and environmental approval – required for project to begin construction and operation
- Technology involved – reliability and operating history
- Power Purchase Agreements
  - Price per kilowatt hour of electricity/tenor of agreement
  - Experience and reliability / creditworthiness of all parties involved
- Schedule of project milestones for completion of various tasks
- Security payments that the contract requires
- Insurance provisions for any losses than can impact on revenue generation
- Regulatory environment – possibility of changes to policy environment which can affect the economic of the project
- Project sponsor financial interest in project
- Other risk elements that can impact on the project's ability to service its debt

This process of risk allocation and due diligence is important and expensive, requiring the financial community to have an excellent understanding of the technologies and markets with which it is dealing. Ultimately the investors and lenders attempt to strike a deal that allocates risks to the party best able to handle them, that provides ways to measure the project's performance and that gives some monetary safeguards to project investors and lenders.

The probability and severity of risks for infrastructure projects is assessed on a project-by-project basis. Perspectives will differ depending on who assesses the risk involved. Some risks can never be properly assessed or quantified. Once assessed, a risk never actually disappears – it is simply transferred (allocated) to somebody else's balance sheet. Project sponsors and creditors usually focus on business and non-commercial risks.

Fund investors, creditors, guarantors and governments are often more concerned about operational and financial risks being taken by the project sponsor relative to its financial and management capability and operational track record. Sponsors and governments may be concerned about the financial risk aversion of creditors and their ongoing commitment should the project run into difficulties during construction.

For the same project, the risk borne by each of the parties is different, especially in project finance. The first step to mitigating project risks in developing countries is to identify which party involved in a project is 'best placed' to take on a particular type of risk. Risks may also be allocated to parties whose actions influence the probability of a particular risk materialising. What represents unacceptable risk to one investor (say, the future value of carbon credits) may not be seen as a significant risk by another.

Project sponsors are normally expected to take on all the commercial risks. For large infrastructure projects in developing countries, governments (often backed by bilateral / multilateral agencies) need to partially or fully assume the risks that result from their own actions (or lack thereof) including policy, regulatory and country risks.

Risks concerning events that neither governments nor project sponsors can control need to be covered by insurance or other contracts/solutions from private sources depending on the insurance premium demanded relative to the risk. Where such insurance is unavailable or premiums are too expensive, then public assistance is required to mitigate risk. Along with subsidized insurance cover and credit enhancement vehicles, public funds can be usefully employed to securitize revenue streams using contingent capital. When a structure for risk sharing can be identified and agreed upon, each of the key risks involved can be allocated and priced under contractually binding arrangements.

Financing RET Projects

To secure loans, developers and their equity sponsors will generally need to provide between 10% and 50% of the capital for a project in the form of shareholders equity. As the risk (real or perceived) associated with a project increases, lenders will require that equity play a larger role in the financing structure.

As lenders require a higher debt service cover ratio for risky projects, equity investors will take a greater share of the burden for capital investment, which can strain a developer's capital resources. This is often problematic also for project financials, since the cost of equity capital is always higher than the cost of debt capital, making the hurdle rate for the entire project higher.

There is therefore the need for innovative structures that can fill the widening gap between the equity and debt available to a project. Developers would benefit from any public interventions that helped strengthen their equity base through the attraction of third-party investors or private-equity funds [19] (e.g. training, tax incentives, fund capitalisation).

Moving down the finance continuum, another option to fill this equity/debt gap is **quasi-equity or mezzanine finance**, which constitutes a variety of structures positioned in the financing package somewhere between the high risk / high upside equity position and the lower risk / fixed returns debt position. It most commonly takes the form of junior debt (paid only after senior debt claims have been satisfied) coupled with the option to purchase shares in the company at a predetermined level.

Public participation in mezzanine funds, if structured appropriately, can 'buy down' the risks or leverage up the returns for commercial investors. The FIDEME fund managed by CDC-IXIS and capitalised in part by the French national energy agency, ADEME, is a good example of a public/private RE mezzanine fund. A number of RE mezzanine funds are now being developed that target specific developing country markets. [20]

The bulk of the financing provided to a project is usually in the form of senior debt (the first to be paid out), which can be structured as on-balance sheet corporate finance or off-balance sheet project finance. Only financially strong sponsors with a significant base of assets, debt capacity, and internal cash flow can use on-balance sheet corporate finance. Corporate financing requires a decision by the corporate sponsor to accept the risk and potential reward of a project in its entirety.

In this financing approach project funding is arranged through the corporate treasury. For small projects, internal corporate cash flow will often be a sufficient source of capital. For larger projects, the sponsor may need to augment investment from free cash flow by some combination of new corporate debt, equity or bond issuance, or asset disposal. Any debt issuance is underwritten by the overall creditworthiness of the corporation, not the specific project revenues.

[19] The Johannesburg Renewable Energy Coalition, through the EU Commission, is investigating the creation of a private equity fund for developing country RE projects and enterprises.
[20] The Central American Clean Energy Fund and the Central European Renewable Energy Fund.

Corporate finance is the preferred financing approach for small projects (e.g. less than $15 million), since the financing can be executed more quickly and project revenues may be inadequate to support the transaction costs associated with other financing methods. Costs of legal and arrangement fees can be kept low. With a single sponsor accepting the majority of the project risk, technical and financial due diligence will typically be accomplished more quickly. Tax incentives (e.g., accelerated depreciation) and leasing structures can help improve the financials of RE projects for corporate sponsors.

The developers, bankers, and other lenders and investors who finance energy projects often deal in the "private placement" market. That is, they negotiate privately with each other instead of issuing public debt. The private placement market differs from the public debt market because it involves investors, lenders and borrowers with special requirements. Typically, the borrowers who use the market are small and are raising money for projects about which not much information is available.

Private placement debt usually carries a higher interest rate than debt issued for the public markets. This higher interest rate can be justified for large debt issues, but is harder to justify for smaller issues. Public debt, by contrast, is expensive to issue, carriers a lower interest rate, and can be used to finance projects about which there is a great deal of information available.

Private placements also tend to be smaller than public bond issues. Borrowers can gain access to the private placement market through the "project finance" process.

Renewable energy project financing can be an expensive undertaking. Project risk, inflexible tariff structures, higher obsolescence cycles and regulatory uncertainty all conspire to keep borrowing costs for renewable energy projects relatively high. When these projects are planned in developing countries higher levels of political risk and economic uncertainty, as well as higher transaction costs, only add to the cost of capital. Moreover, debt for renewable energy projects is typically non-recourse to the equity sponsors of the project, thus making it commensurately more risky and expensive.

These factors make the minimum size of deal important particularly when such high administrative costs are involved. Typically in a project financing deal a thorough appraisal and due diligence of the project will be undertaken.

Deals will vary from bank to bank, for instance [21], Investec London will look at European renewable energy deals as small as € 5-7 million if they are part of a 'roll-out' of technology and will be replicated. The Co-Operative Bank and Triodos Bank also operate in this space. Generally, very few banks want to do

[21] Thanks to Charles Liebenberg of Investec and John Lay of Cooperative Bank for their comments.

one-off deals of less than € 10 million and with major banks the figure is much higher.

In developing countries, higher risks also mean larger project sizes are necessary for international investors to justify costs. However, working with local investors and development institutions, it is possible to create project financing type structures on a small scale. This is what IFC does in many of their energy efficiency deals in Eastern Europe.

The Role of Project Finance in Supporting RET projects

Increasingly a number of RET projects are project financed. This type of off-balance sheet financing for the benefit of the equity shareholder transfers the risk to the lender. It does not rely explicitly on the credit of the project's sponsors or developers but, instead, on the return and risk of the project itself. A project financing structure is secured on its revenue stream and all other risks that flow into and impact (positively as well as negatively) on that revenue stream. There may be 10 – 20 categories of such risks depending on how they are organized, but the crucial factor is cash flow.

The fundamental purpose of project finance structures is to enable project sponsors to transfer risks to banks and capital debt markets. As a result, the size of the deal has to make sense to the financiers. The administrative costs of project finance are steep because it is extremely credit-intensive so the due diligence required is quite detailed.

As a rule most project financiers are risk averse and it will be important to assess how risk can impact upon the cash flow profile of the project. In these situations lenders will look to ensure that a project financing structure entails a satisfactory and economic allocation of project risk among the various interested parties.

The most significant risk allocation tools are the contracts (including fuel supply & power off-take) governing each project participant's responsibilities.

For contracts associated with tradable instruments such as Renewable Energy Certificates, which can create significant additional value to project cash flows, lenders are still cautious and projects unable to monetise future revenue streams to finance construction.

Project finance deals depend entirely on the project’s cash flow projections.

This will include;
1) a base case to set the main principal repayment regime,
2) a downside case including completion delays to set the level of reserves (or discard the project – downside must test the transition through the project finance option conversion)

3) breakeven cases – focusing on key cash flows such as price of power / water / carbon credits etc. to determine the viability of contracts, and;
4) the upside case – where risks are managed and upside assumptions kick in – this is also typically known as the project sponsor's case.

Various cash reserves are established to carry through the project financing as a self-sustaining repayment system. These reserves are generally held in escrow accounts thus preventing distribution to equity until the reserves are at a comfortable level and the project's cash flow performance is as expected. The most common is a debt service reserve (DSR) – generally six months in tenor. Maintenance reserves are for future capex and maintenance payments which can be significant in power and water projects.

Once a workable structure has been mapped out for construction/completion, cash flow generation and loan payments, then it is time to calculate credit ratios. There are a number of these but the headline ratio is the debt service cover ratio. Some methods of evaluating this ratio can (but should not) include sub debt. Project finance debt has clear priority and most bankers want to see a ratio of 1: 4 or better. The debt equity ratio in project finance deals is generally around 75:25 although deals with low market risk (power purchase agreements in OECD) can achieve 90:10 while deals for mobile phones or commodities are more likely to be around 60:40.

Sources and Key Players in Financing RET Projects

While it may be difficult to attract cost effective financing for RET projects, there are a growing number of organizations who are looking to get involved, particularly where market based and/or fiscal incentives are being or have been introduced by governments to support the development of renewable energy.

Figure 7: Sources of finance

Private Finance from personal savings or bank loans secured by private assets. This type of finance is concerned mainly with smaller companies and projects.

Risk Capital, equity investment that comes from venture capitalists, private equity funds or strategic investors (e.g. equipment manufacturers). Besides the developer's own equity and private finance, risk capital is generally the only financing option for new businesses.

Mezzanine Finance, groups together a variety of structures positioned in the financing package somewhere between the high risk / high upside equity position and the lower risk / fixed returns debt position.

Corporate Finance, debt provided by banks to companies that have a proven track record, using 'on-balance sheet' assets as collateral. Most mature companies have access to corporate finance, but have limited total debt loads and therefore must rationalise each additional loan with other capital needs.

Project Finance, debt provided by banks to distinct, single-purpose companies, whose energy sales are typically guaranteed by power purchase agreements (PPAs). Often known as off-balance sheet or non-recourse finance since the financiers rely mostly on the certainly of project cash flows to pay back the loan, not the credit-worthiness of the projects owners.

Participation Finance, similar to project finance but the 'lender' is a grouping of investors, for example a co-operative wind fund, that often benefit from tax and fiscal incentives.

Export Credits, Insurance and other Risk Management Instruments are used to transfer specific risks away from the project sponsors and lenders to insurers and other parties better able to underwrite or manage the risk exposure.

Third-Party Finance, where an independent party finances many individual energy systems. This can include hire purchase, fee-for-service and leasing schemes, as well as various types of consumer finance.

Consumer Finance, often required for rural clients as a means of making modern energy services affordable. Various types of micro-credit schemes are now being deployed in the solar home system market, for example, which often involve risk sharing at the local and institutional levels. Once client creditworthiness is proven, the portfolio can be considered an asset and used as collateral for financing.

The following is a representative list of some of the major players involved in Renewable Energy finance:

- ✓ ABN Amro
- ✓ ADEME (French national energy agency) – EUR45 million public-private investment partnership, providing mezzanine finance to French energy companies
- ✓ Asian Development Bank
- ✓ Royal Bank of Scotland
- ✓ Kreditanstalt für Wiederaufbau (KfW) (Project Financing, Public Grants, Carbon Fund)
- ✓ European Bank for Reconstruction and Development

- ✓ European Investment Bank (USD70m each year for RET projects plus additional 40billion by 2010)
- ✓ Fortis Bank
- ✓ The World Bank Group
    - Asia Alternative Energy Programme
    - Energy Sector Management Assistance Programme
    - International Finance Corporation / GEF
        - ❑ Solar Development Group (USD 50M global equity / BDS for OV)
        - ❑ Photovoltaic Market Transformation Initiative (USD 30M to accelerate solar power in India, Kenya and Morocco)
        - ❑ Renewable Energy and Energy Efficiency Fund (USD 65M worldwide fund)
        - ❑ Small and Medium Enterprise Program (USD 21M for SME's from Costa Rica to Egypt)
        - ❑ IFC –Netherlands Carbon Facility (USD 40M to purchase GHG emission reductions for the Dutch Government)
        - ❑ Prototype Carbon Fund (USD 220M capitalisation)

The Role of Insurance for Financing (Conventional) Energy Projects

Insurance can play an essential part in helping to ensure that a successful project financing structure is achieved by transferring unacceptable but insurable risk away from the lender/investor to insurance markets. Generally, revenue exposure as a result of delays and maintenance issues is the prime concern for financiers. Further the time profile of many RET projects, that is the significant up front costs (up to 90%) and the resulting delay in revenue compared to conventional power plants provides a significant opportunity and role for insurance.

Insurance can provide financial protection from delays or damage during fabrication, transport, installation, construction and operational stages of the project. For certain overseas projects and investments political risks may be of more concern than commercial risks. Obtaining insurance coverage against possible losses resulting from political action or inaction by the host government can have a major impact on the willingness of investors to participate in major investments in politically risky countries. Political Risk insurance can help a financial institution increase its available lending capacity for high-risk countries through the minimization of risk presented by existing loan exposures.

By guaranteeing a future minimum value, risk finance instruments may be able to help convert political commitment (e.g. Renewable Obligation Certificates (ROCs)) into bankable instruments through which it will be possible to support the finance of RET construction.

For project finance transactions, including PFI / PPP, providers of finance require insurance due diligence services to be undertaken to review the risks and adequacy of insurance arrangements which can be key to developing contracts and clauses in credit and other agreements. Where non-insured or uninsurable risk exists there may be a requirement for a different risk transfer approach.

The framework for the project finance requirements from an insurance perspective is not distinctly different for RET projects than for other kinds of project. Amongst other things, financiers typically impose a number of insurance related conditions before financial close, including:

- Security over policy documents – assignment of policy rights to lenders
- Insurances to be in full force and effective at financial close
- Lenders are Co-Insureds
- All policy / insurer changes to be agreed with financiers
- Insurance market minimum levels of security
- Claims proceeds to be paid to a nominated loss proceeds account under financiers control
- Robust risk assessment to have been undertaken
- Waiver of subrogation rights against the parties insured
- Non Vitiation (coverage for non disclosure, breach of policy terms and conditions by another insured party)
- Severability of interest of each insured party

The insurance market is generally familiar with these requirements and although they are often the subject of detailed negotiation with lenders and lawyers, mechanisms exist for these provisions to be accommodated in a mutually agreeable fashion.

Insurance clearly has an important role in the financing of RET projects. The industry is highly adept at assessing and managing risk to meet project and financing requirements. In the case of RET projects insurance seeks to:

- Achieve a successful financial close with insurance responding to financier requirements
- Identify, quantify, allocate and treat the insurable and non-insurable risks to which the project is exposed
- Provide comprehensive insurance protection options to satisfy the needs of the project company, parent companies, financiers, contractors and others associated with the project

Part 4: Overview of risks and barriers associated with investment in RET projects

If renewable energy technologies have to compete with thermal based power without additional support, new investments may not take place and the change in the system will be difficult. Apart from the long-term contracts that have supported virtually all existing renewable energy projects, but which will be very rare in competitive markets, the market reality is that investors have relatively short investment horizons. In markets characterised by short-term energy sales and price volatility, investors will prefer technologies with short lead times, low transaction costs and risks. Funds for risky, capital-intensive renewable energy projects are currently relatively expensive and difficult to obtain, even if they are expected to produce more cost-effective power than fossil plants over their lifetimes.

Much research has been carried out to identify barriers and risks associated with investment in RET projects. In order to more fully understand these issues it is necessary to define what we mean by barriers or risks and to provide some measure of significance.

From the perspective of an investor "Risk" can be defined as the potential for unexpected events to occur or for unexpected events not to occur, either of which can affect project returns and / or fluctuations in revenue. Where returns or profitability of an investment are lowered, investors require a risk premium[22], or compensation for undertaking the risk of the realised revenue becoming smaller than expected.

Other factors which are not unexpected but can negatively impact on project returns in this context are known as barriers.

The objective of analysing risks and barriers is to define major risks or barriers associated with projects involving various renewable energy technologies (RETs). Because risks are widespread and the assessment of risks is normally project specific, taking a general risk approach can only be an indication of which main risks and barriers have to be assessed for the RETs being specifically considered.

As so many risk factors are connected with the specific location and circumstances of an installation e.g. climate conditions, infrastructure, resources, etc. risk can only really be assessed correctly for a specific project.

Thus, each investment in a particular RET project demands necessarily a risk assessment and this includes the concrete facts and data of the project, e.g. legal, administrative, political, economic and technical preconditions. Above all the influence of the location is central to any risk assessment as several RETs are

[22] Risk Premium is the difference between the expected rate of return on an investment and the risk free return (e.g. on government stock) over the same period.

directly connected with natural resources such as wind, solar radiation or geothermal energy where resource availability can be more or less dependable.

Project Risks

What are Project Risks?

Project risks can be described as likely future occurrences that will adversely affect the project's objectives or goals. Risks have three distinguishing features:

- A likely future occurrence. Risks are events or actions that may occur. Things that have happened are facts, not risks.
- The occurrence will adversely affect the project in terms of cost, schedule, quality, or the scope of the project.
- Not certain to occur: Risks are future uncertainties. An impact on the project, which will definitely occur, should be included in the project plan as a task and therefore is not a risk.

A problem is something that has already occurred and action has to be taken to deal with the problem.

Project Risks are adverse factors that have the potential to influence:

- process or operation
- technology (failures, defects, etc)
- schedule of a project
- costs (investment, maintenance, operating, etc)

Project risk management for a specific project consists of using the techniques of analysis and measurement to ensure that risks are properly identified, classified, monitored, managed and communicated to all relevant project stakeholders.

There are two stages in the process of project risk management:
- Risk Assessment
- Risk Control

The Risk Assessment

Project Risk Assessment includes three main steps:

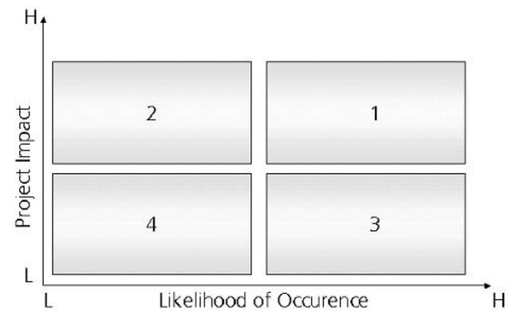
1. Identification of risks
2. Analysis of risks
3. Prioritisation of risks.

Risk Identification

Risk Identification consists of determining which risks are likely to affect the project and then defining the characteristics relating to each risk. Identifying the project's risks is the first step in making it possible for a project to proactively reduce its overall risk and increase its chances of success.

Risk Analysis

Risk Analysis is performed by categorizing all the identified risks according to the likelihood of their occurrence and the impact that they will have on the project. This can be completed and displayed by using the following matrix:



Each risk is to be listed and a decision has to be made on the likelihood of the occurrence and the potential impact on the project if it occurs.

The first quadrant where the likelihood and the impact on the project are high contains critical risks that will have a severe impact and are likely to occur. In the second one are significant risks included that are not likely to occur but will have a material impact to the project if they do. The third quadrant manages significant risks that may be able to be avoided with careful planning and monitoring. Those that do occur however will have a low project impact, which is likely to be manageable. The fourth quadrant contains risks that should still be monitored to ensure that they do not change category, the amount of time devoted to these should be proportionate with their likelihood and impact.

Risk Prioritisation

Risk prioritisation means that it may be necessary to prioritise a risk higher than the categorization activity suggests. In this way there may be an overlap of priority versus category. Prioritisation of risks enables the Project Manager and project team to focus on the areas that are most likely to have the greatest impact to the project. Depending on the assessed priority and the impact of each risk, it is useful to estimate the financial impact to the project should a risk occur. An estimation of cost should be provided to recover the project after this risk occurs.

Risk Control

Risk Control is the second stage in project risk management. There are four steps to be performed in the completion of Risk Control. The first step, called risk mitigation, identifies the necessary actions that can be carried out in advance to reduce or eliminate the impact of the risk. In the second step the Risk Planning has to be done, by developing an emergency plan for dealing with significant risk. In the next step a Risk Register is established which enables monitoring and tracking all the identified risks in order to manage them and minimise negative adverse outcomes.

Finally, clear risk communication protocols are required for use throughout the project life, which provides a project risk communication platform to communicate project risks to the project team and project decision makers.

In the context of this study we focus on **"the key risks and barriers that can threaten investment in RET projects and thus prevent a more rapid uptake of RET projects."**

The assessment of project risks demands a disciplined procedure following accepted diagnostic steps. The next chapter explains as a short introduction the general approach to the assessment of project risks.

Before considering some of the key risks and barriers impacting on RET projects and the general approach to assessing project risks, it is useful to identify from a macro-economic level various barriers that are preventing the uptake of RET projects. These can be captured under the following broad categories:

- **Cognitive barriers** – which relate to the low level of awareness, understanding and attention, afforded to the complex array of policy, regulatory, technical financing and organisational factors affecting RET projects and their wider economic and environmental benefits. In the context of the financial community limited action has been taken to start valuing / accounting for GHG mitigation or pricing the impacts of climate change into underwriting methodologies.

- **Political barriers** – associated with regulatory and policy issues and governmental leadership, which creates market uncertainty and cautious investment approaches.

- **Analytical barriers –** relating to the quality and availability of information necessary for prudent underwriting and development of quantitative analytical methodologies for risk management instruments; appropriate pricing models for valuing the impacts of Renewable Energy regulations and markets for tradable permits.

- **Market barriers** – affecting the efficient functioning of RET markets due to inequitable market and policy structures. Fossil fuel power generation is still massively subsidised and does not internalise full social and environmental costs.

- **Administrative barriers** – associated with operating under / complying with new policy frameworks which support RET and emissions trading markets. Even when a project manages to attract insurance and financing, it is complicated and expensive to qualify as an eligible project and process Emissions Reduction Purchase Agreements (ERPAs) for carbon credits.

- **Legal & Tax barriers** – generally relate to lack of clarity in property rights, legal and tax systems.

In order to validate some of these high level issues, identify further risks and barriers and breakdown key issues we have used the results from a risk assessment workshop undertaken by Marsh on behalf of the UK DTI. [23]

The report, which includes input from a wide range of stakeholders including project developers, financiers, government agencies and market facilitators, identifies several headline risk issues, which are affecting the interest of financiers and preventing projects from being undertaken. The GHG mitigation potential of RET projects makes them ideally suited as climate change projects and therefore many of the risks and barriers can apply to RET projects.

The approach takes a holistic view of the potential project, the people involved, the risks and their impacts on each other. Using a risk radar classification model shown below it is possible to identify a wide-range of diverse risks and barriers that can threaten investment in RET projects.

Many of these risks may be part of, or external to, the physical project itself and can be related to a number of factors, notably:

(a) the risk inherent in the underlying project
(b) political / institutional risks and barriers,
(c) the nature of stakeholder relationships,
(d) the structure of associated transactions,
(e) the market risks.

[23] Climate Change Projects are projects which reduce GHG emissions and which are eligible for tradeable emission reduction credits under Joint Implementation (i.e. ERUs) or Clean Development Mechanism (i.e. CERs).

Together with data from financial risk mitigation techniques used by the Prototype Carbon Fund (PCF) for financing emission reduction projects it is possible to further identify specific risks and barriers.

The nature of the wide range of risks may be characterized as follows:

Project Risk

- Lead time risks: risks associated with estimating the time and costs involved in the planning stage
- Construction risk: relates to the risks associated with the construction phase and in particular the risks that may impact on the project not being completed and operating on schedule.
- Performance risk: relates to the risk that the project does not perform or operate as expected. Elements of this can include:
  - Operational risk (e.g. machinery breakdown, property damage, business interruption, supply chain issues)
  - Fuel supply / resource risk (e.g. lack of wind, rain, wave, sun, heat etc)
  - Technology risk (e.g. prototypical, innovation uncertainty)
  - Natural hazard risk (e.g. fire, lightning, flood, storm, earthquake)
  - Permit Delivery Risks (e.g. shortfall or non delivery of tradeable permits)

Political / Institutional Risk - includes a wide range of risks relating to the political / regulatory / institutional environment in which the project is operating. These may include:

- Country risk – e.g. political stability, expropriation / confiscation of assets
- Regulatory risk – e.g. policy changes which affect market dynamics
- Kyoto Project Risk –risks associated with participating in Kyoto markets
- Administrative risk –risks associated with overly bureaucratic administrative burdens of complying with policy measures
- Legal risks – with.g. legal frameworks, ownership issues, etc.

Business Risk

- Financial risk- the risk relating to the capital structure of the project and its ability to generate cash flows sufficient to fund planned investment, operations and maintenance expenditures, service debt, and provide reasonable returns to the sponsor
- Economic risk – e.g. interest rates, exchange rates, commodity prices risk
- Counterparty credit risk: the risk that signatories to contracts are unable to abide by the contract terms and obligations

As part of the project we have identified a few of the critical project issues and undertaken more detailed analysis. This analysis includes :

Resource, Technology and Operational Risks; Regulatory Risks; Political Risks; Counterparty Credit Risks; Scale and Returns; Relative Costs; Lead Times; Transmission and Distribution; Valuing Social and Environmental Cost & Benefits; Sustainable Responsible Investment; Carbon Finance

Resource, Technology and Operational Risks

Conventional fossil fuel energy projects generally employ mature technologies that have been proven through years of successful commercial application. Conversely, RET projects often employ recent technologies that risk-averse insurers and financiers penalize with prohibitive premiums and terms. "Institutional memory" amongst insurers lingers on from the 1980s when new wind turbine technologies led to frequent losses.

Resource, Technology and Operational Risk Assessment
To determine, the relative riskiness of a RET, the hazards, their effects and the likelihood of occurrence has to be assessed.

Risk Assessment Approach

As the knowledge about RETs is widespread and includes specialists in various institutes, universities, manufacturers, project companies, consultants, etc. the project team developed a questionnaire-based approach supplemented by direct information from associations, universities and institutes. The specific experience of the members of the project team was also included. The questionnaire also allowed for any other risk or barrier that the involved participant wanted to communicate. A strict statistical evaluation therefore was not possible, as certain participants preferred to correspond their opinion completely "outside" of the enquiry form, by mail or telephone. However, these opinions or comments were integrated in the analysis and evaluation of the main risks for each RET.

The questionnaire covered three main risk groups:

1. Resource Risks
2. Technical risks
3. Operational risks

Resource Risks

All RETs use, directly or indirectly, natural resources that have very different characteristics. Depending on their origin there can be considerable fluctuations in supply, cost of supply, properties, etc. On one hand resources such as sun or wind can be influenced strongly by climatic conditions, on the other hand the properties of, for example, deep geothermal water can only be evaluated during the first pump trials after the first drilling, which requires a considerable investment.

Technical Risks

Technical risks comprise all technology risks of the implemented RET. The questions in the enquiry were developed by considering the main components, maintenance and repair, failure of power generation components or other technology components. As RETs are generally young technologies questions concerning the reliability of the technology over the long term (e.g. geothermal power plants with operation time of more than 50 years) and the availability of spare parts were also included.

Operational Risks

The operational risks describe risks or barriers that can have an effect on the complete plant operation, e.g. security of operation, availability, expenditures for maintenance and repair, availability, etc. Operational risks are those risks which occur post installation, testing and commissioning and include breakeven analysis or the development of costs over the long term.

Scope of Analysis

The following RETs were included:

1. Geothermal	5. Wind
2. Large Scale Photovoltaic	6. Biomass
3. Solar Thermal	7. Biogas
4. Small Scale Hydropower	8. Tidal / Wave

Evaluation Factors

Two factors were introduced to enable the evaluation of risks.

Grade of Risk

The “Grade of Risk” factor evaluates the probability that a risk affects the planned project in a negative way. A specific measure for “risk” was used that allowed the comparison with the likelihood of an occurrence.

Grade of Impact

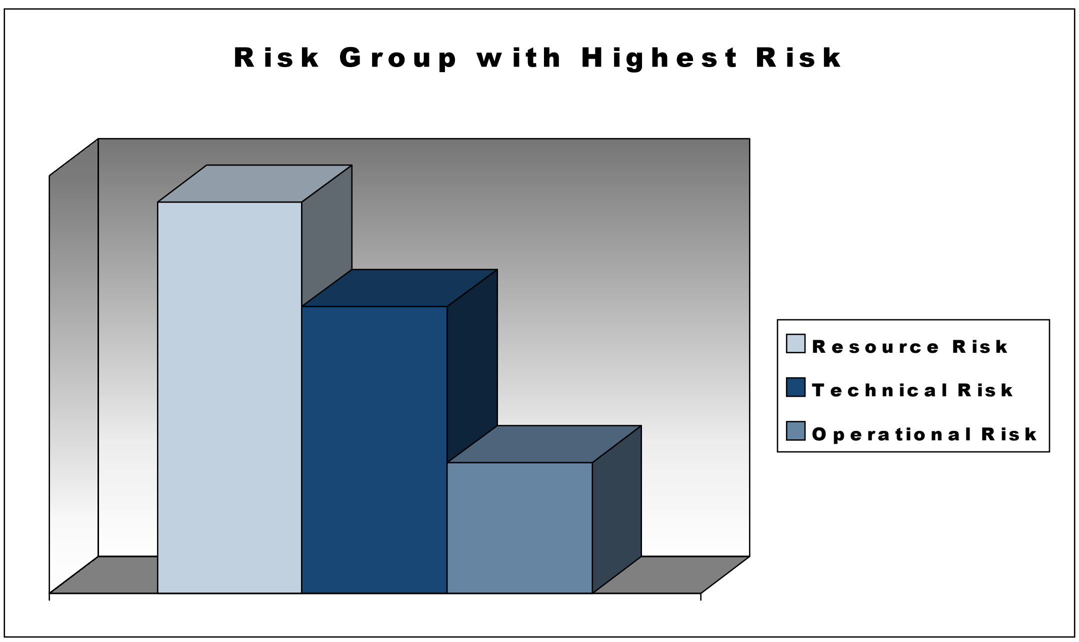
The factor “Grade of Impact” values the impact of a risk on the project as high or low. Therefore the worst case related to one specific risk or barrier was always considered.

Results

Geothermal

A Short Introduction Geothermal energy is saved in the form of heat below the surface of the earth. In comparison to almost all other renewable energies, geothermal, apart from shallow geothermal, cannot be attributed to solar energy. Geothermal plants utilize the warmth of the earth to heat or produce electric energy. Other applications are the extraction of water for spas, the production of coldness (air conditioning) and the extraction of drinking water. Geothermal can be divided into shallow geothermal (up to a depth of 400m) and deep geothermal (deeper than 400m) on the one side and into hydrothermal geothermal (in combination with aquifers) and the Hot - Dry - Rock - Concept (HDR) on the other. In general, the heat is brought to the surface by a primary circuit. Once at the surface, the heat is transferred to the consumer by a heat-exchanging device. Finally the thermal water is pumped back to the geothermal resource.

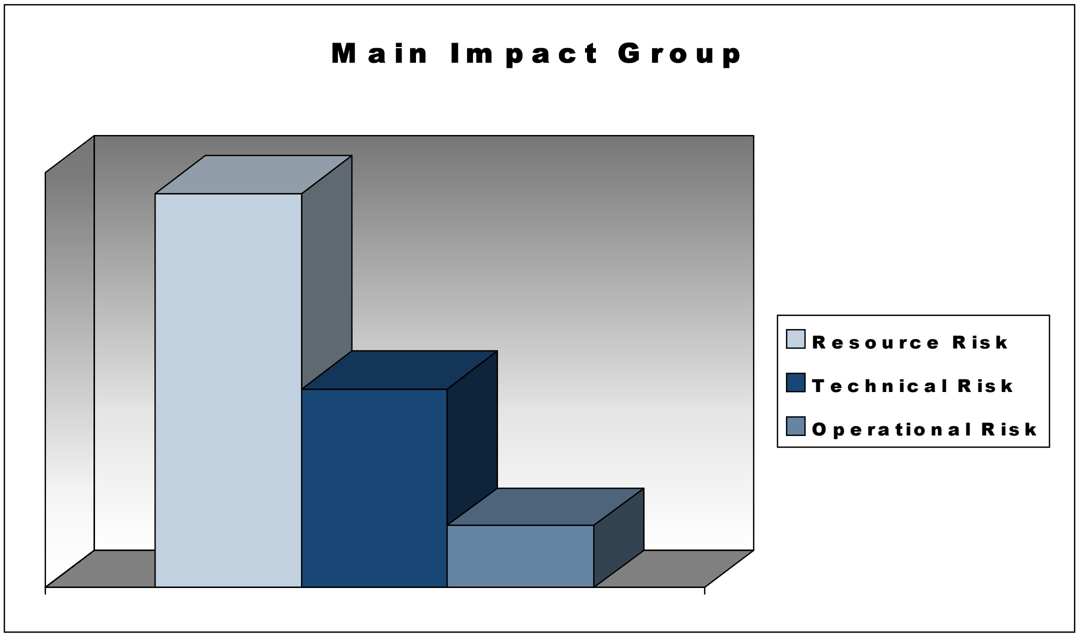
Risk Group with Highest Risk
The following diagram shows the results after the evaluation of the questionnaires. It shows that the highest risks for the implementation of Geothermal Energy projects are resource availability risks.



Risks with Strongest Impact on Successful Development of Project.

The following diagram shows the highest impact group.

Inability to locate a geothermal resource or the planned and foreseen quality or quantity of the resource is lower than expected.



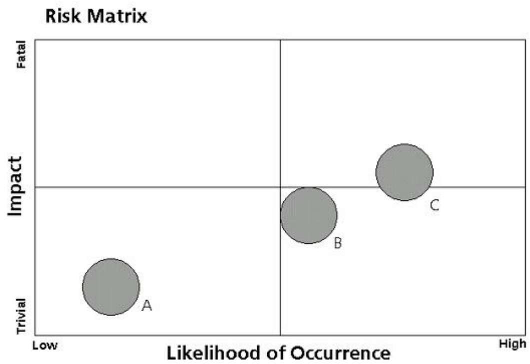
In the case that a geothermal drilling is not successful, the complete project would have to be cancelled. If the quality (i.e. temperature) or quantity is not enough, the economic consequences can lead to a situation where the completed project has become uneconomical .

The three main risks for a geothermal project are:

(A) Problems with pumps. As they can be considered the main component (if there is no power generating installation planned), the efficient functioning of the pumps is fundamental for a successful project.
(B) Lack of long-term (>20 years) experience of the technology for (low enthalpy) power generation using Kalina or ORC process. Manufacturers and contractors are gaining experience in projects worldwide. Accordingly, the availability, reliability, spares supply and maintenance capabilities will improve.
(C) Uncertainty about the quantity and temperature of geothermal resource is not known 100% before finishing the first drilling. Risk C can be minimized, but not eliminated, if sufficient time is spent with specialists during the pre-planning of the project. The quality of the expertise is of critical importance and experienced partners have to be involved to evaluate the adequacy of the project location.

Overall Risk Review

This Risk Matrix below shows the three main risks in relation to the impact and likelihood of occurrence:



Large Scale Photovoltaic

A Short Introduction

Photovoltaic solar cells use a semiconductor material that is exposed to sunlight. The energy of the incident light displaces electrons from their normal atomic orbits and an electrode grid structure on the surface of the semiconductor collects these electrons and makes them available for use in an external circuit.

Results of Enquiry & Overall Risk Review

Photovoltaic installations are special within the group of RETs. The main application of PV-installations is “island” or stand-alone systems. Larger installations can reach 150 kWp, but typical installations are between 1-5 kWp.

The result of the questionnaire demonstrates practically no barrier or risk. As meteorological data is usually analyzed before the location is chosen and an investment is realized, there is remote resource risk.

Default risk excepted, the technical and operational risks are limited for the operating company (or owner), as the panel manufacturer typically provides a guarantee of up to 25 years. Other technical parts (like a.c. converters) are not critical and can be substituted easily.

The oldest panels (more than 20 years) do show a decline in efficiency, but results of the Technical University of Berlin demonstrate that the decline of efficiency of modern modules is acceptable [24].

[24] acc. to Quaschning, V.; Grochowski, A.; Hanitsch, R.: Alterungserscheinungen bei Photovoltaikmodulen - Langzeiterfahrungen einer PV-Testanlage an der TU Berlin. 14. Symposium Photovoltaische Solarenergie. Staffelstein, 10.-12. März 1999, S. 445-449

Solar Thermal

A Short Introduction

In contrast to photovoltaic, concentrating solar power technologies do not produce electricity directly through solar radiation, but use concentrated solar energy to generate heat. This process heat is then subsequently used to generate steam and operate a turbine in a conventional power cycle.

Results of Enquiry & Overall Risk Review

The risks connected with CSP technology are relatively low. The pilot project "SEGS" by KJC in California, which began in 1984, demonstrates the potential and reliability of CSP systems over the long term.

For stable climatic regions (regarding resource risk) the implementation of CSP systems is only concerned with the question of economic efficiency and therefore depends on the economic circumstances of the country, where an installation is planned. The technological risks are low, as the electricity generating components are standard and therefore can be substituted without difficulty. The availability reaches the factors of conventional power generation (98%) and therefore the operational risks can be disregarded.

Small Scale Hydropower

A Short Introduction Hydropower installations can be classified as follows:

- Large: more than 10,000 kW
- Small: less than10,000 kW
- Mini: between 100 and 500 kW.
- Micro: less than 100 kW

Small-scale hydropower can be used in a decentralized way and locally implemented and managed. Power generated with small hydro stations can be used for agro-processing, local lighting, water pumps or small businesses. If the location permits, small-scale hydropower is a technology with a low ecological impact perfect for application in rural areas without grid connection (e.g. 3rd world countries).

Results of Enquiry & Overall Risk Review

The results of the enquiry demonstrate and confirm that the application of small-scale hydropower carries low technological and operational risks and barriers. Nevertheless, the resource is dependent on the climatic circumstances of the installation location and therefore has to be examined carefully before an investment is realized. In Chile, for example, in December 1998, the electricity supply was strongly influenced by a drought and consequently low levels of water.

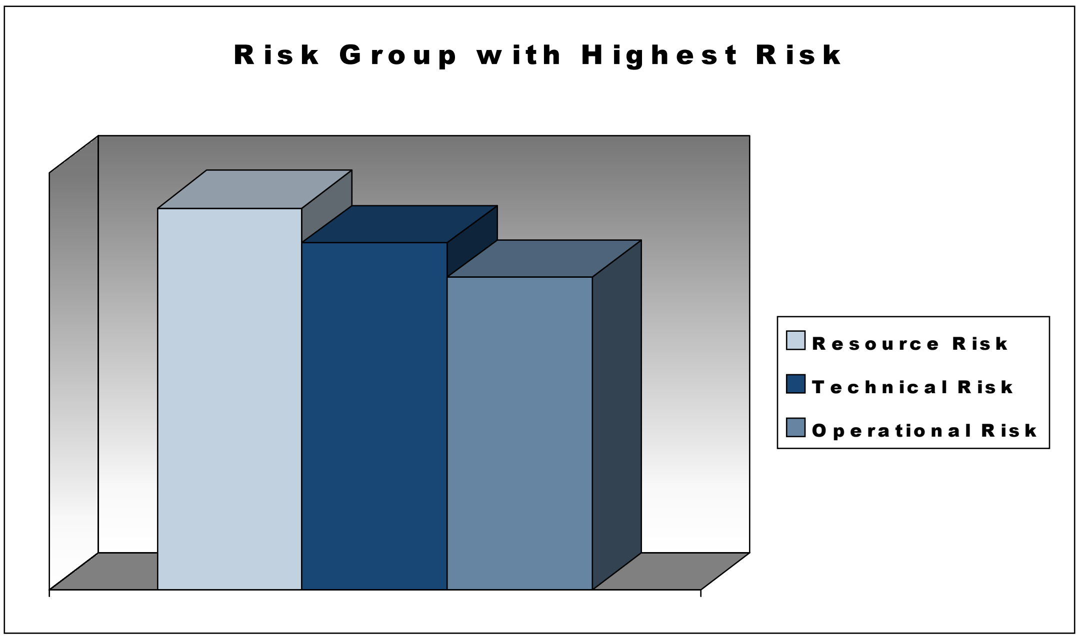
Due to well developed, long-term proven technology and low maintenance expense the operational risks or barriers can be considered as very low.

Wind

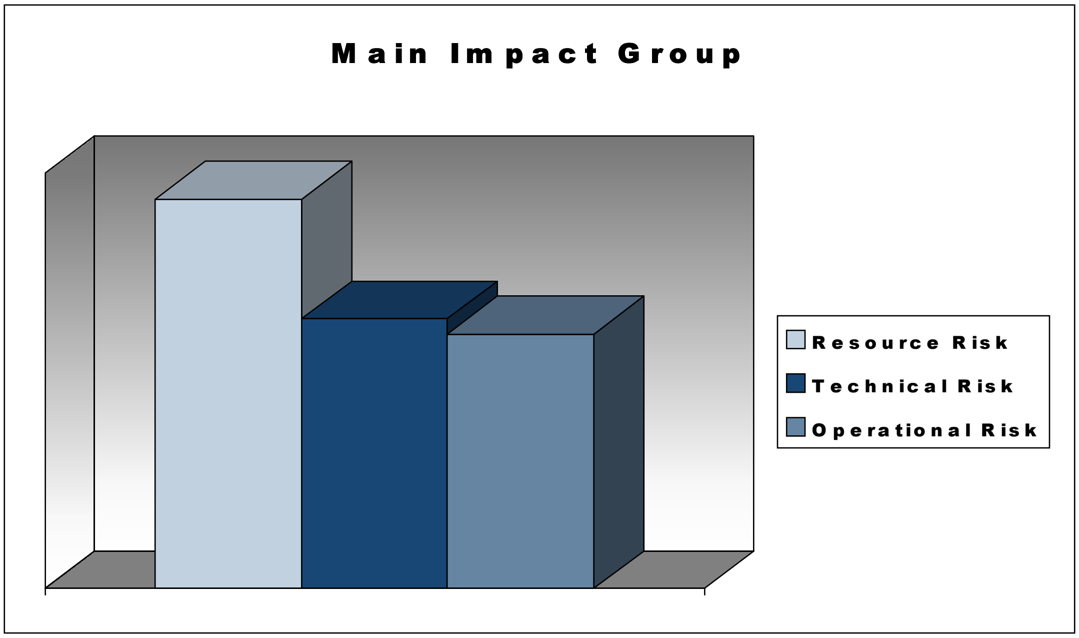
A Short Introduction

A wind turbine obtains its power input by converting the force of the wind into a torque (turning force) acting on the rotor blades. The amount of energy, which the wind transfers to the rotor, depends on the density of the air, the rotor area, and the wind speed. A typical 600 kW wind turbine has a rotor diameter of 43-44 meters, i.e. a rotor area of some 1,500 square meters. The newest models can reach 4,5 MW, with a rotor diameter of 114m and a hub height of 124m.

Risk Group with Highest Risk

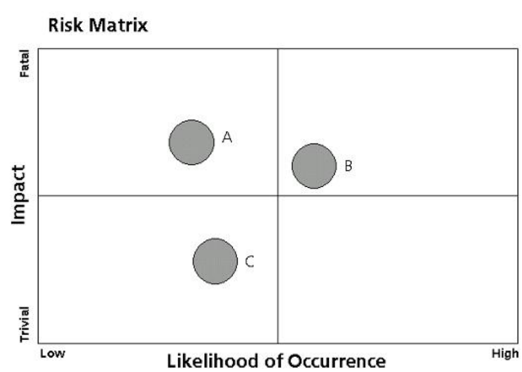


Risks with Strongest Impact on Successful Development of the Project



Resource risks present the highest potential impact. Thus, the analysis of wind frequencies for single location is of critical importance for successful project implementation. Technical and operational risks or barriers for positive project implementation are lower.

Overall Risk Review



A project company commented that the planning phase can be extensive for the implementation of a wind farm. As such, administrative costs for small or medium-sized project companies can cause significant economic barriers during the planning phase of the project.

Resource risks can be minimized if the wind measuring systems are installed early enough or historic data is available over a long-term analysis period. Results developed to date demonstrate that data gained during a one-year period is not sufficient to guarantee reliable wind frequency data to assess power generation over the medium to long term.

Somewhat surprisingly the questionnaire showed that there is still component risk (risk B) related to the main components of the windmill. A detailed analysis conducted by the University of Kassel [25] shows that 16% of breakdowns were caused by the control unit, 19% by electrical parts and 10% by the pitch control. Concerning the operational risk, the results show that the availability (Risk C) of a wind power plant, and thus the economic efficiency, is still a risk to be considered.

Biomass

A Short Introduction

Biomass power plants is an umbrella term for all kind of power plants that use renewable material as fuel.

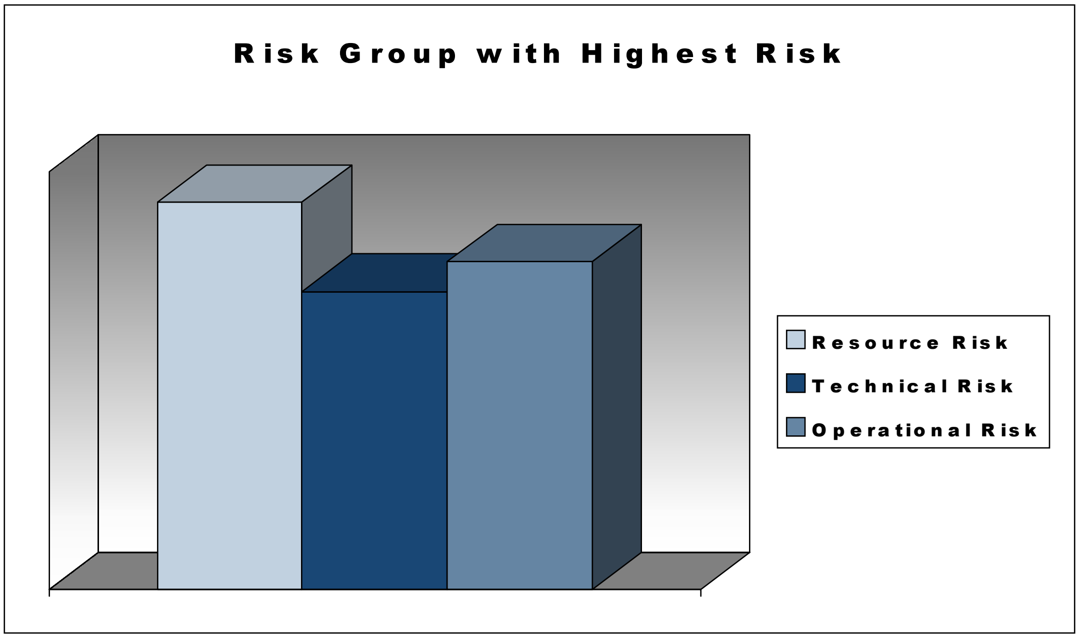
Plants can be co-fired for a certain percentage with other contaminated material (e.g. treated wood). Combination with a steam turbine for power generation and / or connection with a distributed heating net are also possible.

The size of the plant is mainly dependent on the quantity of biomassthat is available as a fuel.

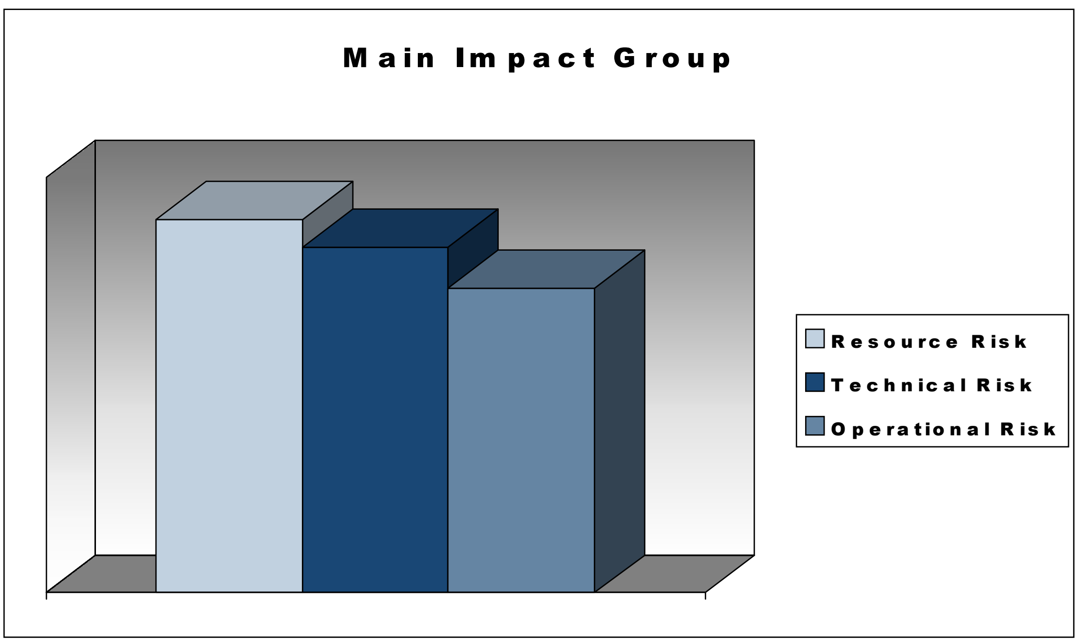
Recently, the combination with the ORC cycle for power generation has been tested and indicates a positive opportunity for such implementation in small size biomass plants.

[25] Please see for further information: http://www.iset.uni-kassel.de/

Risk Group with Highest Risk

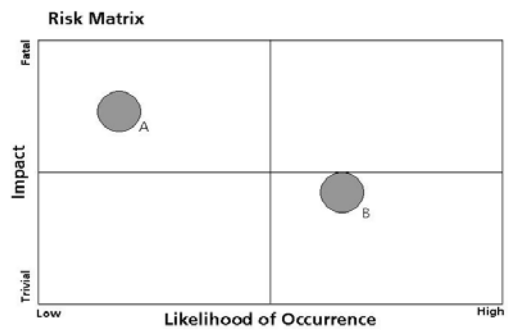


Risks with Strongest Impact on Successful Development of the Project



Overall Risk Review

Two risks were defined by the questionnaire:
Risk A is directly connected with the supply of biomass material in a stable and sufficient way.
Risk B considers the possibility of substantial fuel price fluctuations.



Many projects have had to be cancelled as a result of risk A. The risk of an unstable and / or interruptible biomass supply chain is also linked to the costs for transporting the biomass resource.

As a result it is not recommended that one large supplier should provide supply; rather that medium-sized, regionally located companies should be selected to minimize the risk and impact of a supply shortfall.

However, the experts involved in the questionnaire pointed out that during the planning phase the risk associated with the supply of material can be solved by entering into sustainable contractual solutions with creditworthy counterparties. If long-term contracts with fixed prices (Risk B) can be concluded with biomass suppliers and the supply risks transferred partially or completely, a successful project implementation is more likely. If reliable contracts can be arranged then biomass generation solutions will provide availability similar to conventional power plants.

Biogas

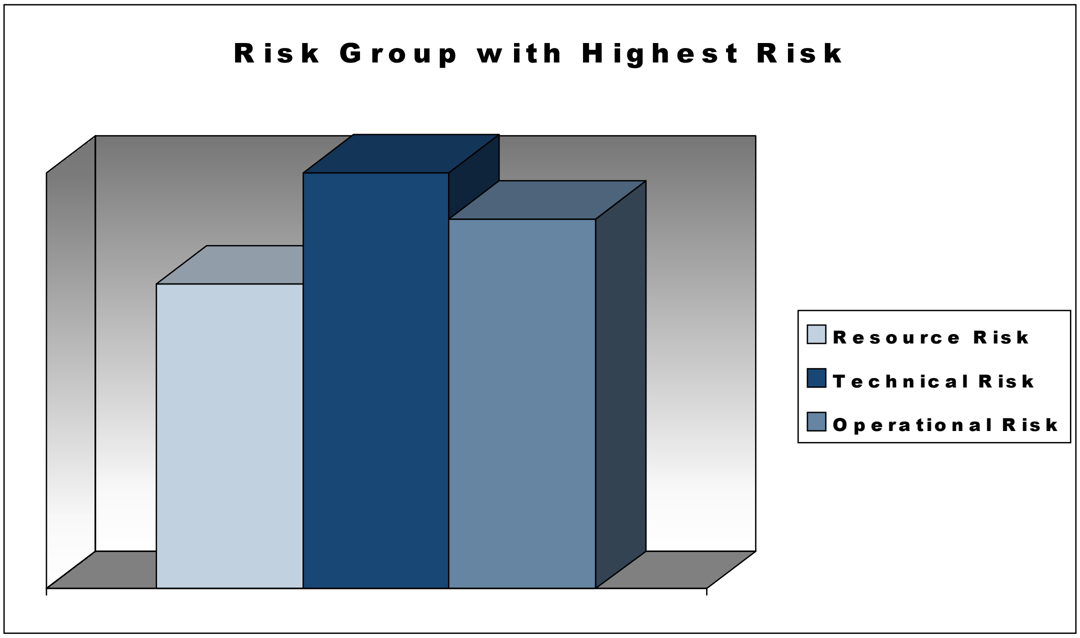
A Short Introduction

Biogas technology is a waste manure management tool that promotes the recovery and use of biogas as energy by adapting manure management practices to collect biogas.

The biogas can be used as a fuel source to generate electricity for on-farm use or for sale to the electrical grid, or for heating or cooling needs. The biologically stabilized by-products of anaerobic digestion can be used in a number of ways, depending on local needs and resources. Successful by-product applications include use as a crop fertilizer, animal feed, bedding, and as aquaculture supplements.

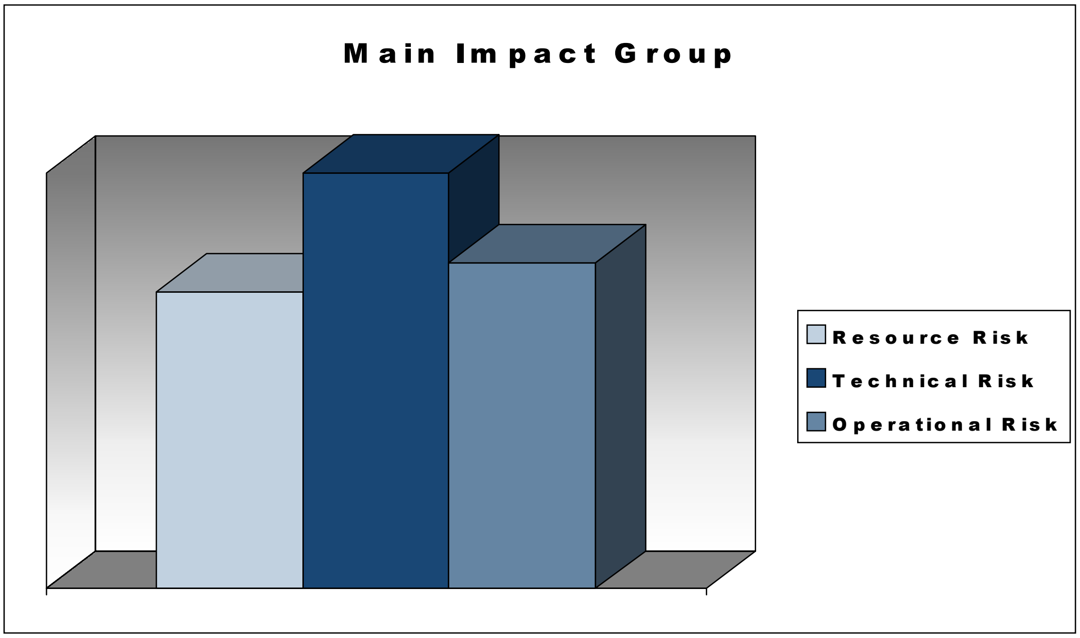
Risk Group with Highest Risk

The following diagram shows the distribution of risks in the enquiry.



The resource risk in this RET is a relatively lower risk compared with Biomass. However, technical and operational risk exists due to the complexity of the fermentation process.

Risks with Strongest Impact on Successful Development of the Project

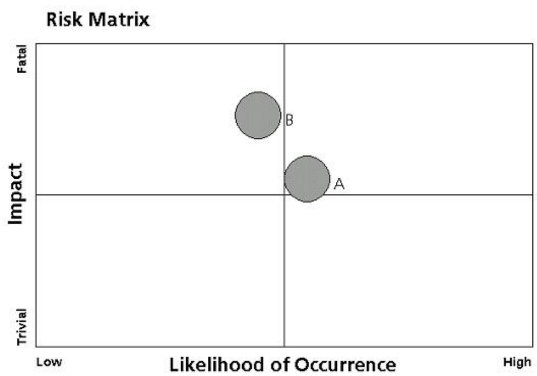


The largest impact on the project, and on the availability of a power output is linked to technical problems relating to the fermentation process.

Overall Risk Review

It was stated in the questionnaire that barriers associated with successful implementation are mainly caused by administrative circumstances (risk A). The handling of fermentable material e.g. manure or biomass from kitchen waste collection causes considerable smell nuisance. This can provoke resistance to the development of biogas plants projects in regions with a high population density.

The greatest concern with technical risks (B) concern the stability of the fermentation process. As the fermentation process has to be started and controlled chemically it is important for a positive project implementation to analyze the material to be fermented and to choose the correct technology. Experience shows that if the correct technology is chosen and the fermentation process is controlled with care, a biogas plant can reach high availability. However, the fermentation process is sensitive to the introduction of contaminants or changes in the composition of the material to be fermented.



Tidal / Wave

A Short Introduction

There are two technologies for using tidal power that have been sufficiently developed for application. Tides can be held back by a dam in a location with high differences of high and low tides, similar to large hydropower plants installed in rivers. There are currently two commercial scale barrages in operation around the world: a 240 MW bulb turbine at La Rance, France (installation 1969) and a 16 MW plant at Annapolis Royal, Nova Scotia, Canada.

The second possibility is tidal turbines. Tidal turbines utilize tidal currents, which are moving with velocities of between 2 and 3 m/s (4 to 6 knots) to generate between 4 and 13 kW/m2. A promising pilot project adapting the technology of modern wind turbines (pitch control, etc.) to seawater capturing the energy of the stream was developed in Hammerfest, Norway, in 2002.

Results of the Enquiry & Overall RiskReview.

As the second type of technology has not yet passed the pilot phase the evaluation of risks or barriers could not be undertaken.

Due to severe ecological consequences caused by the first type of technology no further projects are currently planned. Therefore a further assessment of risk and barriers was excluded from this assessment.

Conclusions

The results presented in this short analysis can only provide a high-level overview of RETs. A scientifically and statistically based analysis would be outside the scope of this study and a more detailed analysis would be necessary to support the rigourous evaluation of risks and barriers concerning RETs.

The strong dependence of RETs on the specific location of a project complicates the general view on risk and barriers considerably. A risk assessment is important for every planned project implementation and therefore this analysis provides certain hints for a more detailed approach.

Regulatory Risk

As highlighted in recent surveys and questionnaires, one of the greatest concerns and certainly a major barrier to investment in RET arises from regulatory risk of government policy changes in the energy sector [26]. This relates particularly to RET markets supported by specific government policies aimed at encouraging the deployment of renewable energy such as the Renewables Obligation (RO) in the United Kingdom.

The fundamental concern relates to the fact that any investment made under a policy regime is exposed to the numerous reviews and potential changes which may take place between the time the investment is made and the time at which invested capital is fully repaid from project cash flows. The regulatory uncertainty makes financing difficult and in some cases impossible.

Uncertainty over the length of time the government will support a policy regime prevents longer-term contracts (off take agreements) from being secured or deeply discounted. For example, the nature of the RO after 2015 is of major concern for project developers and financiers because there is no cast-iron guarantee that, notwithstanding the current UK Government's long-term policy commitment, suppliers will be obliged to purchase renewable energy beyond 2015 targets. With certainty over long term targets, for example up to 2020, suppliers would be more willing to contract (issue PPAs or invest themselves) over the kind of horizons required to make projects bankable. Similarly, certainty around future targets will help underpin the future value of ROCs, which will make financiers more comfortable about future cash flows and more willing to back projects.

Whilst 10 years of regulatory certainty is probably sufficient for RETs such as onshore wind, for RETs that are more marginal in economic terms and have longer planning and financing horizons, such as offshore wind, there is a need for 15 years or more of price certainty for financing purposes.

Political Risk

Financial institutions engaged in cross-border lending are often hindered in pursuing similar transactions by limit restrictions to country exposure mandated by regulatory agencies or internal bank guidelines. In addition, international events affecting the repayment of underlying loans can occur without warning,

[26] During August and July 2003 the BWEA conducted 64 interviews with key institutions in the wind sector. On behlaf of the DTI interviews with 41 senior representatives were conducted in June 2003.

leading to potential losses in the portfolio and negatively impacting the profitability of a lender's portfolio of assets.

While most host governments seek to attract foreign capital and promote foreign investments in their countries, the world of politics is a constantly changing environment. We have yet to hear any analyst accurately predict government policy in non-OECD countries over the medium to long-term, which makes the underlying financing of most overseas projects and transactions exposed to unforeseeable political risks.

Counterparty Credit Risk

Even when a project is large enough and theoretically profitable enough to attract the interest of banks and insurers, the actual or perceived credit risk posed by the project's host country or developer can often kill a deal. Furthermore, due to the fact that suppliers and consumer groups are also often "small", this can increase the perceived credit risk, and also deprives the financier of ECA support. This has become institutionalised: even the UK ECA, ECGD, which had £50M earmarked for RE export by Tony Blair at WSSD, has had no approaches from suppliers.

Amongst the private lenders and insurers interviewed for this paper, credit enhancement is widely believed to be one of the most effective uses of public funds made available to support private financing of clean and renewable energy infrastructure projects.

Small Size and Returns

Generally speaking, compared with conventional fossil fuel power generation plants, RET projects are of significantly smaller scale in terms of physical size as well as financial returns.

RET projects are usually unattractive prospects for commercial lenders and insurers because the administrative costs associated with risk assessments, loan processing and insurance for such projects are high and the returns are low. Attracting the financial interest of international lenders and insurers generally requires a minimum project size of €10 million, particularly when the project location is a developing country. Time and again, the small scale of a potential project has prevented an otherwise viable deal from attracting sufficient private financial interest to become a reality and this is particularly the case when shareholder-driven financial institutions are involved.

The tight commercial lending and insurance markets of the last few years have exacerbated the situation. Even in the UK, viable but small-scale biomass (mature technology) projects with power off-take agreements and solid fuel supply contracts in place struggle to attract the attention of insurers and financiers. Theoretically, it is possible to "bundle" small projects together to create a package that is large enough to achieve critical mass. In practice, however, there is little evidence of this happening.

Costs of RET

The aim of this section on transaction costs is to give an overview of potential cost drivers and to create awareness of their importance. Investors may want to use the given framework to structure several sources of transaction costs and include them in their economic analysis of an investment project.

In general, transaction costs are the costs that arise from initiating and completing transactions, such as finding partners, negotiating, consulting with lawyers and other experts, monitoring agreements, etc., or opportunity costs, like lost time and resources.

The most obvious impact of transaction costs is that they raise the costs for the participants of the transaction, i.e. the investors, and thereby lower the expected profits or even discourage some transactions from occurring.

In addition to their relative small size, RET projects suffer high relative transaction costs because they often involve newer technologies and less experienced sponsors. As a result, these projects are more time-intensive and difficult to execute than conventional energy projects.

Another key barrier is the time-profile of risk, which is quite different to conventional fossil fuel. The costs are 90% up-front, since the energy source is generally free, but there is a strong element of pre-installation expense and then the power plant is the main item. Therefore revenues materialise much later than in a fossil fuel powered plant. This is unsettling for many financiers.

Table 8 summarizes the cost data collated in Part II. Included in this table for comparison are the costs of fossil fuels and nuclear power. For photovoltaics we have also compared the costs with (a) the average retail costs of electricity, since one of the advantages from this technology is that it provides distributed generation, thus avoiding capital expenditures and losses in transmission and distribution, and (b) with those of rural electrification from the grid in developing countries, since 'off-grid' solar supplies are expanding rapidly. It is important to note that these cost calculations ignore environmental externalities and, in the case of PVs their architectural value. This needs to appropriately value environmental externalities are commented on in the following section.

Table 8 RET costs now and 2020

Technology	**Current cost (US Cents/kWh)**	**Projected Future costs beyond 2020 as the technology matures (US Cents/kWh)**
Biomass Energy: ▪ Electricity ▪ Heat ▪ Ethanol for vehicle fuels ▪ (c.f. petrol and diesel)	5-15 1-5 3-9 (1.5-2.2) [d/]	4-10 1-5 2-4 (1.5-2.2) [d/]
Wind Electricity ▪ onshore ▪ offshore	3 - 5 6 - 10	2 - 3 2 - 5
Solar Thermal Electricity (insolation of 2500kWh/m^2 per year)	12-18	4-10
Hydro-electricity ▪ Large scale ▪ Small scale	2-8 4-10	2-8 3-10
Geothermal Energy[a/]: ▪ Electricity ▪ Heat	2-10 0.5-5.0	1-8 0.5-5.0
Marine Energy: ▪ Tidal Barrage (e.g. the proposed Severn Barrage) ▪ Tidal Stream ▪ Wave ▪ Tidal streams	12 8-15 8-20 8-15	12 8-15 5-7 5 - 8
Grid connected photovoltaics, according to incident solar energy (‘insolation’): ▪ 1000 kWh/m^2 per year (e.g. UK) ▪ 1500kWh/m^2 per year (e.g. southern Europe) ▪ 2500 kWh/m^2 per year (most developing countries) Stand alone systems (including batteries), 2500 kWh/m^2 per year	50-80 30-50 20-40 40-60	≈8 ≈5 ≈4 ≈10
Electricity Grid supplies from fossil fuels (incl. transmission and distribution ▪ Off-peak ▪ Peak [c/] ▪ Average Rural electrification	2 15-25 3 25-80	Capital costs likely to come down with technical progress, but may be offset by rising fuel costs
Costs of Central Grid Supplies, excl. transmission and distribution: Natural Gas Coal	3 4	Ditto

Source: Source: World Energy Assessment: Energy and the Challenge of Sustainability. UNDP and World Energy Council, 2000, updated and extended based on data gathered for the PIU Report and recent simulation studies undertaken for the UK Department of trade and industry. The above estimates are based on a discount rate of 10%. The costs of rural electrification are from the World Bank's 1996 report: Rural Energy and Development: Meeting the Needs of 2 Billion People.

The costs are expected to decline with R&D, investment and operating experience. To arrive at the lower cost estimates shown in the last column, it is evident that a major effort will be required by industry and the research community over the next 25 years. The technologies are modular, are fertile ground for discovery and invention, scale economies in batch production have barely been exploited, and there is every reason to believe that costs will decline as projected with supporting public policies.

Nevertheless, and notwithstanding the uncertainties in the above estimates, the costs of the non-carbon options to fossil fuels will, with exceptions, be higher than those of fossil fuels for some time. It is difficult to see how they can be developed therefore without policies, which reflect their economic and environmental potential, and provide industry with the necessary financial incentives to take them forward. All the technologies reported have depended on this so far.

Lead Times

An investment project can be divided into several phases:

1. the planning phase,
2. the construction and commissioning phase,
3. the production phase.
4. the decommissioning phase

Revenue is generated only in the production phase. The first two phases don't generate revenue; on the contrary they bring about many costs and uncertainties. These costs and uncertainties have to be taken into account in the evaluation of the investment by the investor. More or less time can pass between the investor's first moves about a project and the start of the production phase. The investors have many different steps to undertake between the moment they become interested in a site and the moment their production unit is finally generating and bringing in the first flow of money.

In order to evaluate their investment correctly, they need to be able to estimate the time and costs the first two phases take. This can be done quite easily regarding the construction and commissioning phase - and we will elaborate on this issue below. The time required for construction depends on factors that do not vary a lot: the availability of material, and of technical staff. There is little uncertainty.

On the contrary, evaluating the costs and length of the planning phase is much more difficult.

An aspect that is often overlooked, but was brought into focus with the Brent Spar incident is decommissioning. For most RE this should not be a major problem, but their remote locations and the possibility of contaminated substance leakage need to be factored in to the equation.

Transmissions and Distribution Issues

Intermittency can lead to difficulties for the management of electricity grids as the share of renewable energy on the grid systems rises (on which see the remarks on storage below); the other is the high cost of most options and applications relative to fossil fuels.

Inability to secure Carbon Finance

The PCF's experience has shown that carbon finance can materially improve the return on climate-friendly investments, particularly for those projects involving greenhouse gases with high global warming potential. At prices currently paid by the PCF, carbon revenues from a typical landfill gas to energy project, for example, can contribute about US$15 per megawatt hour, potentially increasing project internal rates of return by 5 percentage points or more.

Carbon finance can also provide a strong revenue stream to biomass projects that use generated power from organic wastes that would otherwise be land-filled (e.g. wood residues from pulp production or empty fruit bunches from palm oil production).

In general, the contribution of carbon finance to renewable energy, forestry and other projects that mitigate or sequester greenhouse gases tends to be more modest.

However, in all carbon transactions, particularly those involving forward transactions [27] there can be a great deal of uncertainty regarding the expected volumes of future emission reduction flows. If payment for the future delivery of

[27] Forward contracts establish a contractual obligation at the trade date for a pre-determined settlement date in the future (delivery of the commodity). While there may be potential planning and price advantages associated with forward transactions for REC's that have not yet been created, there is significant uncertainty and risk associated with the delivery of those REC's. If payment for the future delivery of REC's is to be received up-front (i.e. before the contracted permits have been delivered) then buyers / financiers are forced to bear significant risk of REC shortfall or non-delivery. Typically the presence of risk and its allocation underpins the value and structure of any related transactions of REC's and is reflected in the price paid by the buyer: the riskier the transaction, the lower the unit price and value of REC's.

REC's is to be received up-front (i.e. before the contracted permits have been delivered) then buyers / financiers are forced to bear significant risk of REC shortfall or non-delivery.

Results from Marsh Risk Assessment workshops show that numerous points were raised regarding the inability of projects to secure carbon finance. This was thought to be a influenced by a range of factors relating to the risks associated with undertaking projects and transactions, the uncertainty surrounding credit delivery, permit prices and market liquidity. It was agreed that there is currently unfair risk sharing / allocation between buyers and sellers and that this was negatively affecting project carbon financing and viability.

Risk transfer through insurance was seen a potential risk management solution but the insurance markets were thought to be unable to provide the right risk transfer products at present.

Risks Associated with Least Developed Countries

Historically affordability of rural energy has been addressed through government subsidies, donor programmes and private cash sales or small systems. However, donations without any cost recovery destroy markets. Donors are still undermining markets with capital cost subsidies and donated equipment. Furthermore donations can inhibit commercial markets, as consumers come to expect donor aid and will wait rather than pay market prices.

Scale is even more of a problem in least developed countries, because the economies are so small, and wealth levels are low. A particular concern is the ability of local society to absorb the relatively high level of technology inherent in RE. For examples the advances in Western wind power mean that monopiles are too large for the local infrastructure to manage and thus western-scale windpower cannot be easily deployed in many LDC's.

This means that a considerable amount of "capacity-building" is needed in terms of education and training, to build acceptance, and then to ensure that the inevitable downtime etc is coped with. This type of barrier is not generally recognised by ECA's.

RET projects are often intended for implementation in developing economies where there are a range of governance issues that deter foreign direct investment (FDI) and limit the availability of many currently available commercial risk management products. While low-cost, low-wage countries such as India and China are growth markets for FDI and associated risk mitigation products; there is little commercial incentive to develop such markets in Least Developed Countries

[28] (LDCs). Public involvement in risk mitigation by multilateral or bilateral agencies is necessary for FDI in LDCs because the commercial insurance cover offered for non-commercial risks is either inadequate [29] or prohibitively expensive. Ultimately, the only way to reduce the cost of such cover is to remove the need for it by transforming the underlying (or absent) political, administrative, legislative and judicial frameworks to the extent that the perception or actuality of political risk is reduced. In the meantime, public assistance will be necessary to work within existing market mechanisms in LDCs.

The economic risks in developing economies are generally related to currency, interest rates and associated inflation. Project sponsors do not have control over exchange rates, convertibility or repatriation of currency.

Currency risk is frequently treated as political risk but most LDC governments are not in a position to bear such risks. Public assistance for liquidity providing intermediaries[30] is useful partial risk coverage – especially if applied in a systematic framework designed to support clean infrastructure projects. It would be onerous for donors to provide foreign investors with this cover on a project-by-project basis. In Africa, one broad solution could be to widen the Euro-supported CFA zone [31] to neighbouring countries. Improved monetary stability tends to reduce capital flight and larger amounts of local currency would be available for project finance.

Interest rate risk is generally managed by derivatives unavailable in LDCs, although some large oil or mining firms are able to arrange interest rate swaps with the central bank. However, most LDC host governments are not creditworthy counterparties unless backstopped by a creditworthy institution. An increased program of financial and technical assistance to enable LDC central banks to price and manage interest rate and currency swaps for foreign and domestic investors in infrastructure projects would be a useful long-term risk mitigation measure for World Bank to pursue.

When asked what could help mobilize debt finance for clean infrastructure projects in LDCs and emerging markets generally, most private lenders focused on credit issues. Several suggested that wider application of credit enhancement for local debt issues would be quite useful and the IFC is doing this in market economies. However, even in LDCs, some local financial institutions such as pension funds and life insurance companies can provide substantial local currency

[28] World Bank list

[29] Most policies cover defaults and risks concerning actions taken by sovereign governments, however many energy and water infrastructure projects are exposed to risk at the sub-sovereign level when dealing with local government and municipalities.

[30] Host government is responsible for ultimate risk but is able to pay off obligation over extended time.

[31] See http://www.izf.net/izf/Index.htm the official investment site of the CFA zone. Also http://www.wami-imao.org/ the West African Monetary Institute.

funding for asset-backed (infrastructure) debt investments insured through a multilateral / bilateral agency credit enhancement. In all cases, it is in the interest of both the project sponsor and provider of FDI to secure the interest of a local financial institution because the presence of such an investor can help to mitigate non-commercial risk. One new credit enhancement facility that has attracted interest from the World Bank is the Guarantee Facility for Sub-Saharan Africa or GaurantCo[32]. This facility is intended for larger infrastructure projects but, if successful, could be adapted for smaller project finance deals as well.

Commercial vs Non-Commercial Risks in Developing Countries

In developing countries, the distinction between "non-commercial" and "commercial" risk is often blurred. This is a critical issue. If financial systems are weak (generally considered non-commercial risk) then they can certainly affect commercial risk. Payments that are not cleared or get lost in antiquated internal systems can affect a project's cash flow badly enough to disrupt its operation. When the government are the off-take buyers or regulators (e.g. utilities), their commercial behaviour (as distinct from their behaviour as political entities) can result in situations that make it difficult to distinguish whether a non-commercial or a commercial risk has materialised. This is problematic for both investors and insurers and is an area where public assistance and new thinking are needed if more/better FDI is to be attracted into "clean infrastructure" in developing countries; especially those, which do not offer any other competitive benefits for FDI in manufacturing or services such as China or India.

The costs of managing everyday commercial risks in LDCs for foreign private sector investors are higher than in their own markets. This is due to the inadequacies of administrative systems, market supporting institutions, human and social capital constraints and lack of infrastructure. Foreign firms in LDCs might be expected to cover risks (and sub-risks) classified as financial and operational. But these 'commercial' risks cannot be expected to extend to the business environment itself. Except for certain risks such as renewable energy policy, regulatory and environmental, these risks do not arise in other locations.

This point is important because of the distinction that private insurance companies and multilateral / bilateral insurers make between commercial and non-commercial risks when providing cover. A project sponsor who buys comprehensive non-commercial risk insurance (NCRI) is by no means comprehensively insured for any number of quasi-commercial reversals of fortune and business interruption caused by poor communications or hidden agendas in a developing country. NCRI from MIGA or a private insurer addresses obvious risks as well as "creeping expropriation" but typically the risk is more one of

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[32] See http://siteresources.worldbank.org/DEVCOMMINT/Resources/Fall-2003/DC2003-0015(E)-Infrastructure.pdf Implementing the World Bank Group Infrastructure Action Plan, September 12, 2003.

commercial or contract frustration. Unless a project has a mandate from the top, disinterested (and even well-intentioned) bureaucrats can tie up expensive human resources with (mis)administration – is this a commercial or non-commercial risk?

Compounding matters, there is as yet no universal framework of risks that is generally accepted with the same terms being used with the same meaning. Risks are mapped under sub-headings. Different analysts will routinely describe the same risks using different terminology, resulting in confusion. The major sub-sets of risks shown in the figure below are generally recognised. However, the interactions between them in developing countries are complex and it is rarely easy to assign any one cause should a claim arise. This is important since insurance contracts are usually quite specific. MIGA has designed breach of contract coverage, where the political event is defined as the non-payment of an arbitration award by the (sub-) sovereign. Hence, the breach of a contract by a (sub-) sovereign could be either for commercial or non-commercial reasons.

The risks listed below are not exhaustive - the relative weighting of each risk with regard to other risks will be specific to the situation, country, project and investor. There are just too many risks to be borne by any one party but many can be avoided. Some can be fully or partially covered through normal business insurance (although developing countries often lack a sophisticated local insurance industry) or through special cover provided either by private insurers or by official (multilateral and bilateral) risk insurance and export credit agencies.

Figure 9: Map of Possible Risks faced by Foreign Investors in LDCs[33]

[33] Mistry, Percy & Olesen, Neils

Commercial Risks						***Non-Commercial Risks***	
Financial Risks		**Operational Risks**		**Business Risks**		**Country & Event Risks**	
Risk	Sub-Risk	Risk	Sub-Risk	Risk	Sub-Risk	Risk	Sub-Risk
Balance Sheet	D/E Structure Asset Liability Provisions Write-downs Derivatives	**Business Strategy & Market**	Marketing Mkt.Demand Product Price Resources Technology Support	**Legal**	Laws Documen-tation Judiciary Enforcement Litigation Liability	**Political**	Confiscation Expropriation Nationalisation Deprivation Breach of Contract Sub-Sovereign
Income Statement	Structure Profitability R-o-Assets Debt Service Revenue Risk Capital Cost Ops. Cost Derivatives	**Mgt. Systems & Operations**	Production Human Financial IT Training Control Int. Audit Security	**Policy Change**	Taxation Inflation Exch. Rate Ind. /Sector Labour Social Regulatory Tariff	**Credit-worthiness**	Sovereign Provincial Local Municipal
Capital Adequacy	Equity Quasi-equity Debt Burden Off-B/Sheet	**Technology**	New Proven Equipment Sequence Training	**Financial System**	Payments Services Credit Soundness Access	**War & Conflict**	Civil Border Regional Terrorism
Credit	Borrower Sub-borrower Guarantor Supplier Customer Agent	**Fraud & Corruption**	Shareholder Employee Supplier Customer 3rd Party Government	**Business Support**	Accounting Auditing IT Support Recruitment Consulting	**Natural Event**	Earthquake Coastal Calamity Mudslides Drought Flood Famine
Liquidity	Cash Cash-flow Curr. Assets Curr.Liability Intrst Cover	**Business Disruption**	Int. Factors Ext. Factors Acts of God Infrstructure Accidents	**Infra-structure Service Failure**	Transport Power Water Drainage Telecoms	**Policy Failure Event**	Banking crisis Financial crisis Cap. Mkt. crisis Fiscal crisis Labour crisis
Interest Rate	Domestic Foreign Long-Term Short-Term			**Environ-mental Factors**	Air Pollution Water Pollutn. Soil Erosion Land Rehab. Acid Rain Oil spills Gas leaks Radiation Mine leakage	**Global Event Impact**	War elsewhere September 11th Oil Price Shock Global Cap. Mkt. Dollar Crisis
Currency	Volatility Convertibility Remittance 3rd Currency			**Compe-tition**	Foreign Domestic New entrant Dropout	**Civil Society Pressures**	Boycotts Sanctions Threats to Property Threats to People

An area of importance is the deficiency of appropriate ownership forms and properly adapted financing instruments in certain countries. Moreover, different regulations and institutional barriers in the European countries hinder the free flow of capital for RES within the European common market. On the other hand, solutions for establishing RES have been developed very successfully in individual countries. Differences in cultures and institutions have promoted growth of several approaches to RES investment. These differences can be understood as a European source of experience that constitutes a rich basis for transnational emulation.

Valuing Environmental and Social Benefits

A serious barrier to progress is the fact that fossil fuel (and nuclear), are largely subsidised by governments and under-priced with no allowance for environmental externalities. Renewables must often compete against 'hidden' subsidies for conventional fuels – everything from subsidised kerosene and coal to government investments in power grid extensions not recovered through electricity rates.

This places renewable energy at a commercial disadvantage but this can be resolved by regulating and internalizing the associated cost of Greenhouse Gas Emissions, noise and air pollution. Emissions Trading will assist in creating a value and cost associated with such factors.

Another barrier is the non-recognition of environmental benefits, which may flow from RE e.g. amenity value, poverty alleviation.

Socially Responsible Investment

As recognition grows of the contribution that renewable energy can make towards rural development, lowering health costs, energy independence and climate change mitigation, renewable energy is shifting from the fringe to the mainstream of sustainable development. This is increasingly being recognised as an issue that can affect the way companies involved are valued by shareholders and investors.

At the same time commercial markets for renewable energy are expanding, shifting investment patterns away from traditional governments and donor sources to greater reliance on private firms. Such changing investment patterns make it more important to think about markets for renewable energy, rather than simply about the technologies themselves and the economic characteristics. The older technology-orientated paradigm focused on technology assessment, economic viability and technology demonstrations.

The new paradigm focuses on market assessment, policy and institutional issues and demonstrations of sustainable business and social models. It must not be forgotten that many renewable energy efforts are directed at improving energy for the poor as a key objective.

Part 5: Overview of existing insurance underwriting practices and availability of insurance products for RET projects

Principles of Insurance

Insurance is a legal contract whereby an approved party, the insurer, in return for a payment, undertakes to pay another party, the insured, a sum of money (or an equivalent in kind) upon the occurrence of a specified event(s) which causes a financial loss to the insured. Insurance contracts provide financial indemnification for losses arising from a defined set of causes, mainly from acts of nature, from human error and malfeasance and from other accidental causes.

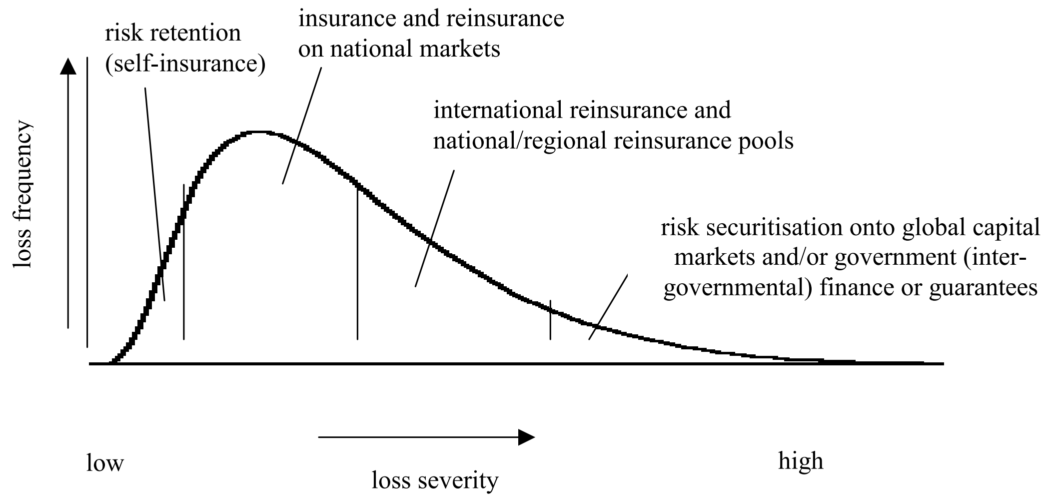
Fundamentally insurance can lower a corporation or project's cost of capital and increase liquidity by reducing the financial impact of risk events. Insurance mechanisms aim at reducing uncertainty for a group as a whole through the pooling of risks that exhibit certain probabilistic features.

There are clear constraints on the types of risks that can be insured and on the magnitude of these risks that can be transferred to insurance markets. Attempts have been made to categorise these, however, and insurance practitioners would emphasise that decisions to insure a particular risk are not taken on theoretical grounds, but in the light of practical experience and commercial considerations. In summary the willingness and capacity of insurers to provide insurance is constrained by:

a) regulatory and legal limitations
b) pricing issues
c) demand for insurance in the marketplace
d) the capacity to provide sufficient risk transfer.

Most people and organisations would tend to self-insure low frequency/low severity events when they have the financial capacity to absorb losses. Higher frequency, low-medium severity risks tend to be covered by national insurance and reinsurance markets. Global insurance markets and national or regional reinsurance pools will cover higher severity risks. The highest severity risks must be securitised on to global capital markets or may be covered by government finance or guarantees.

Figure 10: Spectrum of Financing of Catastrophic Risk Exposures



Insurance companies must be able to price their products in an economically sustainable way. Underwriters define the actuarially fair price of insurance or the expected loss. This can be both methodologically complex and data intensive, and can vary significantly across insurance companies. From a theoretical base Adam Smith argued the fair price paid for an insurance contract is:

P = E + A + R

- P is the price paid for the contract, also called the premium
- E is the expected claim payments that the provider of the insurance contract must potentially make under the contract to the insured party
- A is the "load" or the premium mark-up intended to recover the administrative and other costs of providing the policy protection
- R is the "risk premium" added by the insurance provider to cover its assumption of risk from the insured

In order to bear risk in return for a premium an insurer must have sufficient information to be able to estimate with a sufficient degree of accuracy the likelihood and severity of losses from the insured events. Insurance contracts carry a principle of utmost good faith which places a duty on the insured to disclose all facts material to the risk being proposed, whether requested or not. Any fact is material that would influence the judgement of a prudent underwriter in deciding whether or not to accept a risk and at what terms (Section 18.2 Marine Insurance Act (1906))

Typically a prudent underwriter will undertake the following activities:

- Risk assessment through engineering reports, surveys, warranties using
  - Estimated maximum loss calculations
  - Loss records
  - Pre / post loss controls / preventative measures
- Decision whether to take on risk or not and how to limit the coverage or modify other terms of the contract.
- Rating methodology taking into consideration
  - Schedule of property values / total sums insured
  - Indemnity periods
  - Loss controls and preventative measures
- Premium Calculation including loading to reflect administrative costs and expenses
  - Cost of hedging or reinsurance,
  - Cost of providing related services (e.g. loss adjustment, underwriting, investment, etc.)
- Review of all / any other material information including project details, financial highlights, etc.
- Claims payment

Where high-quality historical data is available either on loss experience at the policyholder level or aggregate loss experience that the insurer is quite comfortable can be applied to the policyholder in question (i.e. is representative of future loss experience) then an individual rating methodology can be used.

Clearly in the case of many RET projects there is limited loss history on an individual policyholder level or an aggregate level. Wind projects are currently the only RET where pricing structures are now standardised through rating programmes. Most other RET projects do not have the required statistical data for measuring probability distributions and correlations between random loss events. Under such circumstances where no client specific data is available, underwriters can use actuarial approaches to pricing including:

- Behavioural modelling – making specific assumptions about the nature of the risk and then modelling it using actuarial data as the basis for the model parameters.
- Empirical extrapolation – try to identify data from other firms that is equally robust and useful at the firm (or more likely, for the class of firms) in question.

For many RET projects there may be limited understanding of the risk and limited actuarial data. In these instances the judgement of the insurance rating division is usually the primary determinant of the rate. Like individual ratings, judgement ratings are assessed on a per policy basis. Judgement ratings are sometimes called “expert systems” and can involve varying degrees of formality. Sometimes the career experience of the rating personnel is deemed adequate.

In other cases the insurance company may develop elaborate models that attempt to predict or approximate the loss experience of a given policy.

Overview of Insurance Markets

The industry has the expertise and is familiar with assessing a wide range of risks involved in investment projects. Most notably the industry is familiar with risk associated with large energy and infrastructure projects including: operational risks including delays in start up, business interruptions; political risks, financial risks including exchange rate movements, credit failure, etc.

The price of commercial insurance cover is subject to wide fluctuations, a pattern that has become increasingly erratic over the past two decades. Before September 11th, underwriting results were affected by deductibles being too low and terms and conditions too wide. The insurance market was also suffering from overcapacity, so underwriters reduced their rates in order to gain a larger market share. This, however, failed to generate income - for that they had to rely on investments. Yet poor stock market performance and low interest rates have largely halted the flow of income from investments, and as a consequence, premiums are doubling or even tripling throughout the insurance industry, and the scope of cover offered is being reduced.

In many cases, most notably for new / unproven / prototypical technology, this has resulted in prohibitively expensive insurance premiums and limited coverage. Many RET projects have remained on the drawing board, unable to secure finance due to perceived risk and as a result of increased underlying costs.

The process of consolidation that the entire insurance market has been undergoing for the past decade has compounded the situation. It has halved the number of active insurers. As an example, at Lloyds of London, the number of individual syndicates has fallen from 400 in 1990 to a mere 86 currently – a number that may fall even further. Several insurance companies have withdrawn completely from underwriting commercial risk.

There are now however indications that insurance markets are softening, particularly in the property business lines. However, some commentators suggest that the insurance market cycle will be determined by the speed of financial recovery for re / insurers from September 11th. For some lines of insurance business rate increases are slowing and becoming more competitive.

Insurance Markets for RET Projects

The application of commercial insurance products to energy projects is mostly limited to the area of property and casualty insurance, business interruption insurance, third party liability insurance and workmen's compensation insurance.

Typically insurance for RET projects is supplied by two distinct commercial markets, the Marine market and the Non Marine Property and Casualty Market. As the oldest documented form of insurance, the marine insurance market covers several different types of maritime exposures including:

- Hull (damage to ship)
- Cargo (loss of physical goods)
- Freight (loss of income from loss of cargo)
- Liability (legal liability of ship owner)

For those RET projects that operate in Marine environments such as offshore wind, wave and tidal power these insurance markets provide the expertise to underwrite the risks associated with marine environments. Furthermore, even for onshore RET projects that rely on offshore transportation methods there is clearly an offshore exposure which again requires participation by marine markets.

The Non-Marine Property and Casualty markets generally provide cover for everything else that is considered onshore. The product lines most relevant to RET projects may include:

- Property
- Liability
- Boiler and machinery
- Inland marine (i.e., transportation)
- Crime and fidelity
- Errors & omissions
- Directors & officers

Distinguishing between onshore and offshore RET projects is important because of the fundamentally different risk profile of marine risks and the rigid and inflexible markets that cater for these risks.

The onshore energy construction market on its own will not necessarily be able to provide adequate cover for the RET project partners and lenders, even though they have more experience with certain RETs such as wind power technology and are well versed in project finance. There are a number of pure offshore energy risks that are automatically excluded by onshore underwriters that are fundamental to an effective insurance cover for offshore projects.

Careful consideration needs to be given to identifying those markets, which can provide appropriate cover and expertise for offshore energy construction risks (including cable-laying), and are equally familiar with renewable energy technology and financiers' requirements.

Due to the fact that onshore and offshore risks are placed with different markets it is important that the insurance programme is placed on a "seamless" basis to eliminate gaps and duplications in cover ensuring a smooth transition between construction and operation. This will also enable the Project Company to budget for agreed premiums during the operational phase. Insurance placed on a "seamless" basis is preferred by financiers who can see that project risks have been comprehensively protected during this high risk period.

For certain risks such as political risks, governmental agencies and multilateral institutions are responsible for providing insurance and lending to governments or to projects with government guarantees. The principal official multilateral providers of Non-Commercial Risk Insurance (NCRI) are:

- The World Bank Group (WB) comprising the two main components of the Bank that lend to governments or projects with government guarantees
- The International Bank for Reconstruction & Development (IBRD) and its soft-window, the International Development Association (IDA)
- International Finance Corporation and the Multilateral Investment Guarantee Agency, two organisations that provide financial services directly to the private sector

The involvement of an intergovernmental agency is perceived to be an essential ingredient in deterring, moderating or correcting host country behavior that might have an adverse impact on foreign investment.

Barriers to Developing Risk Transfer Instruments for RET Projects

There are general constraints on the types of risks that can be insured as well as the magnitude of risks that are transferred to insurance markets. Underwriters consider the expected severity and frequency of losses along with other economic and political factors. There is a grey area between insurable and uninsurable risks, based on frequency and severity of losses.

The major criteria for the insurability of risk can be classified as follows[34]:

- the probability of events occurring
- the maximum total loss associated with an event
- the average total loss associated with an event
- the average time span between two events
- the level of insurance premium required
- the degree to which insured parties can manipulate the risk (moral hazard)

[34] Dirk Kohler, Global Sustainable Development Project www.gsdp.fr

- the degree to which parties subject to greater degrees of risk are more likely to seek insurance (adverse selection)
- legal limitations
- insurance cover limitations (liability limits, deductibles, etc.)

Insurance industry practitioners emphasise that decisions to insure a particular risk are not taken on theoretical grounds, but in the light of practical experience and commercial considerations.

Only some project risks are insurable – generally those that permit insurers to classify and price the risk. Insurers want risks which have: quantifiable losses; reliable estimates of claim frequency and severity; little potential for catastrophic loss; feasible premium levels; and a large pool of potential insured projects to distribute risk. One-off projects, innovative technologies and unfamiliar operating environments are anathema to an actuary.

Insurance Products and Underwriting Practices for RET Projects

Research suggests that for most RET projects, with the exception of some products for wind (property and liability), most standard products have underwriting restrictions. Typically the insurance is arranged on a case-by-case basis and normally entails comparatively higher prices and restrictive terms and conditions.

Projects of less than USD15 million (excluding small wind projects) have difficulty finding insurance cover, and as a result, financing. Only niche insurance operations with low overheads are able to service small-scale developers and even then there is a steep learning curve and indeterminate risk reward ratio for many projects.

Beyond conventional property and liability insurance there are no standard products that specifically address the unique risks associated with RET projects. Some new products have started to emerge and develop, but very few (with the exception of some one-off risk finance structures) have been transacted. The challenges with regard to underwriting RET projects may be briefly summarized as follows:

- Prototypical nature of new technologies
- Limited underwriting expertise and practices to deal with new technologies
- Lack of actuarial information on likelihood and severity of risks
- Rigid and inflexible markets for different risks
- Lack of suitable risk transfer mechanisms / structures
- Low transaction sizes
- Poor loss histories associated with certain RET
- Location of many RET projects in catastrophic weather zones

For many RET facilities and applications insurance will play a discreet but vital role in managing risks that can have detrimental impacts on company balance sheets.

Technology and Innovation - Insurers cite cultural as well as technical difficulties when assessing the risks associated with technology and innovation. They tend to regard new technologies and methodologies as uninsurable entrepreneurial risks. This is because the insurance sector is characterised by ex post evaluations of risk, which by definition cannot be applied to innovation. Even when 'innovation' consists of a new combination of established techniques (say, for cogeneration of waste), the exact outcomes and potential effects are nonetheless without precedent. Lack of hard data is the reason for avoiding a proactive stance toward innovation – particularly for smaller projects. This is the reason that activity dependent upon uncertain policy such as Kyoto is largely uninsurable. However, underwriting is possible even without actuarial data, such as in large, novel engineering projects and sometimes occurs where a government has mandated insurance for certain activities or areas.

Onshore and Offshore Wind Energy

A number of insurers had bad experiences with wind power in the 1980s and early 90s and although the industry has undergone enormous growth since and the technology has matured considerably, many insurers are still cautious in their approach and the level of capital they are willing to expose.

For many commercial wind energy projects, owned and developed by larger parent companies in the power sector, insurance has been provided under the main property insurance package covering the parent companies power assets worldwide. While these packages provide much needed early capacity for wind projects, there is a growing trend to pull away from parent company packages to self procure appropriate cover tailored to the wind projects unique risk profile. Parent company packages have been largely unsuitable because rates, terms and conditions have not matched the 'horizontal' risk profile of wind projects. Wind farm assets are typically lower value and the probability and severity of loss much less compared with a power station, which can be completely destroyed by explosion and fire.

Insurers have far more experience with onshore wind power technology and project finance compared with offshore projects. The market for construction insurance of wind farms has expanded somewhat over the past two years, as the technology has matured and the size and number of projects has increased.

In general terms, the loss experience in the construction phase for wind farms has been relatively good, and this has meant that even though the technology has increased in size and complexity over the past few years, the general rating level has remained fairly constant. Underwriters are wary of further increases in turbine size and this could have an effect on rating structures. Deductibles have increased to a degree, but they are still generally lower than for other types of construction projects, again reflecting the fact that these projects have had good experience.

If the demand for insurance continues to grow and a good loss history is maintained then increased capacity can be created and more competitive terms provided. The table below gives a guide as to some of the current major participants:

Market/Location	UK Projects	International Projects ex USA/Canada)	US/Canadia Projects
Munich Re/London	Y	Y	Y
Royal & Sun Alliance/London	Y	N	N
Allianz/London	Y	Y	Y
ACE Global Markets/London	Y	Y	Y
ACE Europe/London	Y	Y	N
AIG/London	Y	Y	Y
Aegis/London	Y	Y	Y
Millennium/London	Y	Y	Y
Swiss National/Zurich	Y*	Y	Y (self procured)
Partner Re/Zurich*	Y	Y	Y
Converium/Zurich*	Y	Y	Y
MARP/Munich*	Y	Y	Y
AXA Paris / Hamburg	Y	Y	N
Liberty International/London	Y	Y	Y

This is not an exhaustive list; there are regional markets that might participate in ‘home’ business, and others whom we might consider in the international context, but the table represents the current lead and support markets for this type of project in the open market.

Market facilities such as WindPro have also been developed specifically to cater for onshore wind business anywhere in the world.

Offshore Wind farms are a relatively new area of risk for insurers to consider.As a result there is currently a limited spread of risk and expertise in the insurance market for this type of risk. Furthermore, offshore oil and gas construction projects have produced significant losses to the insurance market, which has further resulted in a cautious approach by underwriters. However, the marine (offshore) insurance market, with its experience of oil and gas production in the

North Sea is showing an increasing appetite for providing insurance for offshore wind farms.

In terms of quantum of claims, all offshore stages are higher risk than onshore stages as, by the time property is offshore, towage and offshore installation costs, or a proportion of them, will have been expended. This element of risk increases as a part or component is built into the offshore structure. The level of risk offshore is reflected by deductibles that are much higher than those applying to onshore stages.

Establishing an operating history and retaining certain operating risks through a self insurance vehicle is one way that some large wind farm developers gain entry into wholesale reinsurance markets. However these captives and captive-like structures are only available in certain jurisdictions. Insurance legislation varies from one country to another and specifies what an insurance company can supply under its license. The legal definition of 'insurance' in a particular country may mean that certain products are restricted. Whatever the underlying judicial framework, insurance contracts must be legally enforceable.

Construction Phases

During the construction stage of wind energy projects there are a variety of policies available that provide comprehensive and wide coverage. The policy forms available for wind energy range from "off the shelf" products to more bespoke products that acknowledge the specific needs of the project.

The primary features of the typical offshore construction policy are that it is:

1. Normally joint insurance, effected by the operator, rarely by the principal contractor, on behalf of all parties, including co-venturers, contractors, sub-contractors and suppliers
2. A "Package" insurance – covering the project for all risks of physical loss or damage (Construction All Risks – CAR) for a wide range of activities associated with the project from supply stage through to commencement of operations, including third party liabilities and loss of revenue due to Delay in Start-Up (if required)[35]

The main aspects of risk an underwriter will take into account in consideration of an onshore / offshore construction risk are:

[35] CAR package policies typically cover all risks of physical loss or property damage for a wide range of activities associated with the project including: procurement, construction, fabrication, load out, loading/unloading, transportation by land, sea or air (including call(s) at port(s) or place(s) as may be required), transhipment, storage, towage, mating, pile driving, installation, burying, hook-up, connection and/or tie-in operations, testing and commissioning, existence, initial operations and maintenance, project studies, engineering, design, project management, testing, trials, cable-laying, trenching, and commissioning.

i) project period (and particularly the testing/commissioning period)
ii) the experience and records of the various contractors involved
iii) risk management philosophy and process
iv) the length and methods of offshore transits as well as the time of the year and any relevant weather considerations
v) *water depth and sea-bed conditions at offshore installation site
vi) turbine technology used, geotechnical considerations (including foundation design)
vii) any other unusual underwriting features e.g. experimental design, or design which has been known to cause particular problems
viii)*the amount of subsea work including cable-laying
ix) *wind force and wave loads disruption – there needs to be a recognition of the impact of sea conditions on all offshore work. The combined forces of the wind and waves could have significant impacts on construction activity, damage foundations and delay any repair work
x) *ground and undersea soil conditions – insurance underwriters will expect that the necessary seabed and geological surveys have been undertaken with regard to piling and cable laying

*Applies to offshore CAR risks only

Clearly, underwriters regard different stages of wind energy projects as presenting different hazards, which demand a stage-by-stage rating approach. In the case of the construction of an offshore wind farm, for rating purposes, it is normal for underwriters to split the project into general stages. These may include:

- onshore fabrication of steel monopile tower/piles
- turbine / blades / gear boxes
- towage / loadout of monopile tower, emplacement, and piling-in
- loadout and installation of turbine / blades
- cable laying activities
- hook-up and commissioning
- existence during hook-up and commissioning
- maintenance.

Fabrication stages present a relatively high probability of small losses (e.g. fires in fabrication yards), and a relatively low probability of high-level losses. The volume of faulty design clause claims has contributed towards the generally poor claims experience underwriters have suffered on offshore construction risks.

Towage risks are deemed to be more and attract high premiums. Moreover, underwriters impose, as a standard provision, a surveyor warranty in respect of load-out, towage and installation phases of the works.

Installation presents a relatively high probability of significant risk of total loss of a significant component part. Negligence or human error in the performance of the work is a major hazard, particularly at a stage in the work when large offshore work units may be manoeuvring tightly around each other and around the partially completed structure by crane. Adherence to working and maintenance guidelines in the use of cranes is of critical importance.

The stages after the installation of major components offer underwriters a reduced risk of loss, although work will continue during hook-up which offers a continuous possibility of loss, particularly to the sub sea cable due to anchor drag / jack-up leg damage. Naturally, the process of testing prior to operational start-up may also present risk of loss and underwriters currently will only provide consequential loss cover following a design fault, excluding the faulty part itself.

Operational Phase

Once each turbine has reached an operational state, a new operational “all risks” policy takes affect. In addition to providing protection against all risks of physical loss or damage (including natural catastrophes) operational insurance policies can also provide cover for:

- Damage to balance of plant, including all electrical infrastructure
- Mechanical and electrical breakdown of turbines
- Business interruption arising from a physical loss or damage of any part of the wind farm, balance of plant, or substation
- Owned, or non-owned substations’ failure affecting liability to generate power
- Revenue protection including gross revenue, profit, and / or debt service as well as other forms of financial incentive including tax credits.
- Overhead transmission and distribution lines - cover is limited to approximately 1,000 metres

Whilst still an issue during construction the following risk issues become far more significant in terms of probability and rating during the operational phase of wind farms:

- Design features to minimise damage associated with weather related events including:
  - High wind and freak wave conditions
  - Lightning - insurers will wish to know the lightning protection in place and any other mitigating factors and studies.
- Collision risk - insurers will wish to know the risk management procedures and protection methods that are in place to avoid vessels colliding with the wind farm.

Delay In Start Up / Business Interruption

A significant number of onshore wind farm projects have historically been project-financed, with banks (financiers) requiring delay in start up cover for fixed costs, debt interest and principal repayments.

Underwriters are therefore concerned about:

- access to premises
- any losses at suppliers' premises
- damage to equipment whilst in transit
- damage to equipment whilst being installed

This has led underwriters to develop good experience of what the main Delay in Start-Up (DSU) issues are, and potential mitigation measures to reduce or prevent major losses.

Access to the construction site becomes an even more important issue when moving offshore. Most offshore developments are between 5 and 12 kms from the coast, in depths ranging from 2m to 15m. These shallow depths will require special construction vessels and jack-up rigs. The barges and vessels will only be able to operate within certain weather parameters and wave heights. Weather conditions may therefore mean that the period for erecting the wind farm offshore may be limited to the summer months.

A delay to the project could mean that the weather windows are missed and could see the project being delayed for a substantial period of time until suitable weather conditions become available. Insurers are concerned about the interruption period being extended due to adverse weather conditions, so increasing the delay in start up loss.

There have been almost no DSU losses on wind farm projects, and underwriters generally provide lower premium rates and deductibles for this exposure than for other types of project. For this exposure, underwriters look very carefully at the critical path items, replacement times, and the plan for getting equipment to site.

Technology Risk – Defective Part Cover

As prototype offshore turbines of 5MW are entering the market, indications from the insurance market suggest that such large-scale technology risk will be a difficult cover to place. This is primarily due to the unknown nature of how the offshore wind farm technology will behave against the elements, thus the insurance market will need time to gain the confidence that is usually seen with tried and tested technology.

As turbines increase in size it is unlikely that insurers will give cover for "defective part" until details of the operating history can be provided. However, insurers are likely to provide cover for damage arising from faulty part / workmanship. Manufacturing warranties are an essential risk management instrument that most insurers and turbine manufacturers insist upon as they transfer the technology risk to the component part manufacturer. These can last up to 5 years in tenure for both onshore and offshore wind.

Wind Insurance

Since wind farm revenue is based on the power generated by wind turbines, which in turn are dependent on the wind resource, any deviation from expected wind speed is a major concern for equity investors and / or lenders.

Since power generated by wind turbines is directly correlated to wind speed, wind-based derivatives and insurance provide protection to financiers.

Wind insurance provides protection for financial loss suffered from deviations in wind speed. Wind data and underwriting techniques are sufficiently robust to enable quite flexible wind insurance cover.

However, due to the lack of deal flow (typically clients seek USD1million to USD2 million of coverage), lack of educated buyers and small transaction sizes, few underwriters participate in this market. Further, each wind project has unique risk characteristics that must be individually underwritten. So, the investment in underwriting a single transaction is much higher than with other perils. When considering these barriers in the context of least developed country wind projects, the costs are significantly higher due to the lack of quality of long-term data sets, the low hit ratio and higher than normal underwriting costs present real challenges to developing wind insurance products.

Geothermal Energy

Geothermal projects are expensive to drill and build and often employ some degree of public assistance. Depending on the depth of drilling costs can vary between EUR3 and 5 million.

Due to the significant capital outlay and potentially long periods before revenue generation, financiers are particularly concerned with any risks that may further delay or prevent the project from meeting its debt obligations. The most significant obstacle preventing investment in geothermal projects relates to the geological resource risks. No amount of geological and technical evaluation can provide certainty concerning how much thermal water can be derived until drilling is complete.

For these reasons any additional expenses resulting from losses associated with drilling exploration wells need to be covered by insurance, where available. Most importantly products need to be developed that cover geothermal resource risk for cost-effective premiums. Historically this has not been the case, the most notable exploration risk cover was provide by Munich Re at a premium of 25% of the sum insured. The overall value of the project was EUR20 million and the premium for resource risk cover was EUR4 million.

Operators Extra Expense / Control of Well

Broad cover is generally available for geothermal drilling risks as the technology used is based on existing oil and gas exploration drilling. Energy underwriters understand and are experienced in assessing the risks associated with drilling oil and gas wells, most notably the risk of a blowout[36]. Blowouts are one of the most feared and costly operational hazards associated with the oil and gas industry. The costs are largely associated with controlling a blowout and if a well is damaged or lost then the costs of redrilling can add to the financial burden.

There may be some similarities to insuring the extra expenses associated with fossil fuel drilling operations but the risk / reward is quite different, meaning that often geothermal energy drilling projects get only one try. This is in part the result of, and is compounded by, the fact that small geothermal projects are generally not backed by large corporations but by developers who are viewed as a credit risk thereby inflating already expensive premiums and terms of finance.

Cover for geothermal wells is becoming more widely available and reasonable as underwriters see growing interest in these types of projects. The cover has been notoriously expensive, as underwriters were unsure of the real financial impacts associated with drilling risks. However, it is now generally recognised that the drilling of geothermal wells poses less risk than the drilling of oil and gas wells and thus more cost-effective cover can be purchased.

The main elements of an operator's extra expense cover include:

- Control of well – costs of materials and supplies required, the services of individuals or firms specialising in controlling wells, directional drilling and similar operations necessary to bring the well(s) under control
- Redrilling/extra expense - actual costs and/or expenses reasonably incurred to restore or redrill an insured well
- Seepage and pollution, clean-up and containment - the cost of any attempt at removing, nullifying or cleaning up, seeping, polluting or contaminating substances emanating from wells

[36] Blowout description

Biomass / Biogas

Small scale biomass / biogas technologies associated with agricultural, industrial landfilling and waste water treatment sectors are generally mature but new and larger scale processes are emerging all the time. Finding cover and financing is often an "economies of scale" issue for smaller projects in diverse geographical locations.

Several insurers are examining the possibility of bundling together proximate biomass projects in the UK but have not had any luck so far. One issue that comes up repeatedly when seeking financing for biomass / biogas and cogeneration projects is security of fuel supply – effectively business interruption cover for supply chain and crop yield insurance issues.

Marsh Ltd are involved in the development stages of several large biomass / waste fuelled power generation facilities. All have a waste supply exposure, which is preventing the project from reaching financial close. This fundamental barrier to the project being 'bankable' is driven by lenders, who require long-term contracts for waste to be secured and protected by insurance. Currently there is no product available for these purposes.

Machinery Breakdown and Business Interruption

With efficacy now proven in small-scale installations, business interruption insurance after machinery breakdown has fairly standard cover available at reasonable terms and conditions.

Business interruption insurance after machinery breakdown covers the discontinuity loss (financial loss) caused by a machinery breakdown and therefore is the natural extension to machinery breakdown insurance. The loss caused by discontinuity very often exceeds the cost of the replacement of damaged machines many fold.

The insurance covers:

- Fixed costs which can be financially defined or which are legally necessary. These fixed costs can include wages, salaries, leasehold, rent, tax, and capital service,
- Profit, which the firm would have earned, if the loss had not occurred
- Costs for minimizing loss e.g. amounts of money paid by the owner in order to shorten the period of business interruption or to prevent a business interruption. This may include the cost of shifting production to other sites, buying additional goods or external power, money spent on enhancing repairs, like surcharges for dispatch, overtime or acceleration premium (incentive bonus).
- Costs caused by the spoilage of direct material.

Most engines and mechanical accessories can be insured (under machinery breakdown insurance).

Technology risk for small-scale projects is not considered an issue by many insurers as most of the technology involved in biogas projects is now mature, although manufacturing warranties are still a pre-requisite. Where technology increases in size the technology risk is more of an issue but this can be alleviated in instances where components (based on mature technology) are configured in a new way or machinery with a larger cylinder capacity is used. In terms of securing cover it is important to ensure that any "new technology" involved is not perceived to be prototypical by the underwriter.

Wave / Tidal

The current wave / tidal sector is rapidly developing with many devices showing potential to become commercial.

Whilst it will be a long time before underwriters are comfortable enough with the technology involved to start writing technology based risks, some marine insurers are willing to provide cover for the construction, delay in start up and liability risks associated with small demonstration projects.

Hydro Power

Large-scale hydro is well understood and can be insured. Run of the river hydro facilities of sufficient size are also well catered for as the machinery is well understood and the risk acceptable. Small-scale and micro-hydro is less attractive to underwriters and cover can be more difficult to come by because of scale and premium volume issues.

Resource risk again can be an issue for hydro plants, but less so for small-scale run of river plants which are not impacted by low rainfall periods.

Availability of adequate flow data has been historically available from the insurance. Market and/or weather insurance or derivatives may be used to hedge against either too much or too little water.

Access to the operating plant can be an issue in respect of Business Interruption.

Solar

Often tends to be a small-scale or consumer product and so does not usually attract the attention of commercial insurers.

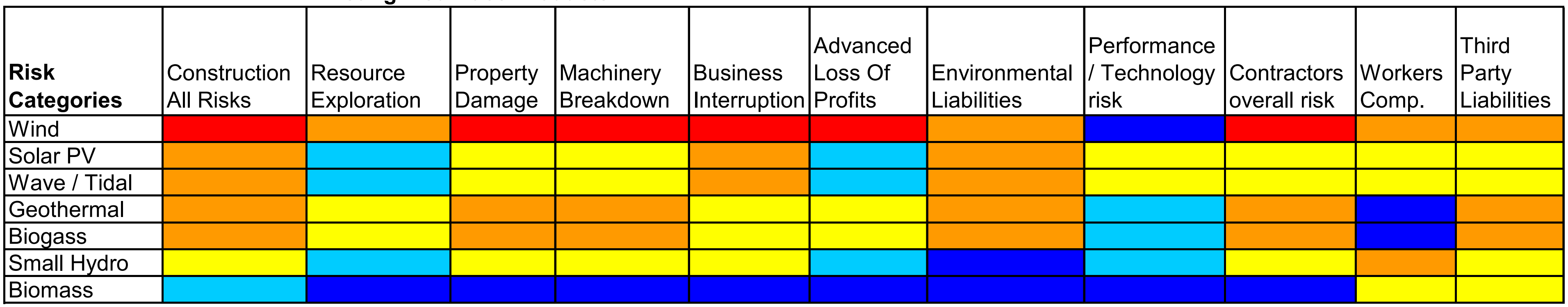
However, in Australia the government has thrown its support behind a proposed $800 million, 1km-high tower that stands atop a transparent solar collector measuring 7km in diameter. The process works by heating air at the base - which is about 30C hotter than air at top of the tower. The resulting convection force creates a powerful updraft, which generates 650 GW of clean power a year. Marsh Ltd will be placing insurance for both the construction (Property Damage / Delay) and operational (Business Interruption) phases of the development.

In California, the state government is investigating the use of large scale solar to pump water, and a major reinsurer has looked into providing cover should the project go ahead.

In order to broadly summarise graphically the availability of existing insurance products for different RET, a ‘Heat Map’ has been utilised. The Risk Transfer Heat Map will provide an indication, based on current projects and market conditions, of the extent of insurance cover provided by each product for each type of RET.

Example RET Risk Transfer Heat Map

Existing Insurnace Products



Availability of cover

Increasingly comprehensive and competative cover - rates going down, cover being extended
Broad cover - leading markets available, standard rating available, possible high premiums / deductibles
Partial Cover - Growing market interest, some gaps in cover, limited capacity, high premiums / deductibles,
Limited cover - Few markets, restrictive terms and conditions, many exclusions
No cover available from insurance markets

Performance Bonds / Letters of Credit / Guarantees

Commercial third party guarantors provide guarantees for a fee and include banks, insurance companies and investment companies. Bank guarantees usually take the form of **letters of credit**[37] that are used to guarantee the loans of an under-capitalised company. In turn, a sponsor will reimburse the bank against a draw on its letter of credit (LC). [There are other types of guarantees provided by banks where they do not have recourse to the sponsor. LCs described here are not for risk transfer as they just enhance sponsor corporate guarantees for the project.] There are basically two types of LC: commercial LCs and standby LCs. Commercial LCs relate to the transport of goods while standby LCs may be likened to a letter of comfort. Standby LCs are not actually guarantees but serve the same purpose as they are not actually meant to be drawn upon. Increasingly, firms are looking to contingent capital facilities provided by reinsurers if they feel there is a real possibility they will require a capital infusion at pre-negotiated terms. Banks tend to consider standby LCs as contingent obligations. Insurance companies can issue performance bonds and construction completion bonds and some types of insurance policies such as political risk and business interruption insurance are structured as financial guarantees. There is a grey area between many types of insurance and guarantees.

Typical **coverage of guarantees** includes:

- **Commercial Risk** – the repayment and performance of loan agreements is the most common assumption of commercial risk in project financing. Most types of commercial risk need to be covered by guarantees from the sponsoring party or from some responsible third party. These generally include;

a) **completion** – sometimes assumed by the contractor
b) **cost over-run** – many bad experiences means contractors are reluctant to cover this, completion bonds are sometimes used for large projects
c) **delay** – particular problem in LDC privatisations
d) **costs of raw materials & energy** – deliver-or-pay contracts
e) **market for product** – off-take agreement

- **Political Risk**

Political Risk Insurance for Capital Markets Transactions

Financial guarantees from multilateral financial institutions (and others) are established risk mitigation instruments for debt issues. In the last five years, issuers have also started using political risk insurance (PRI) from the private sector to upgrade the credit ratings of their bonds.

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[37] Quick guide to letters of credit

PRI enables a bond to achieve an investment grade rating, even when foreign currency rating of the issuer's nation is sub-investment grade (or marginal)[38].

Although PRI can cover a number of risks, the ratings agencies usually only require currency inconvertibility and transfer cover. This coverage protects investors against the inability of the borrower to convert interest and principal payments from local currency to hard currency (often US dollars). PRI also protects against the inability of the borrower to transfer foreign exchange out of the host country, as well against expropriation of funds intended for debt service. As the ratings agencies generally only require a portion[39] of the interest and principal to be covered by PRI, the issuer's cost for obtaining this type of cover is often lower than for other credit enhancement alternatives such as credit "wraps". The net savings to issuers buying PRI cover can range from 50 to as much as 250 basis points[40].

It is important to note that PRI does not increase the credit quality of the issuer and that enhanced foreign currency ratings on an issue will not exceed the issuer's local currency rating. This is one way in which this instrument differs from a financial guarantee. PRI simply protects against the possibility that a country-related problem may interfere with the debt service. This coverage is sufficient to enhance the rating of the bond, even though it does not affect the issuer's credit rating. Since PRI is not a financial guarantee, the credit rating of the insurer offering the PRI does not necessarily have much of an impact on the market's perception of the deal.

In a typical PRI capital markets structure, a trustee separates the lenders from the borrowers and the borrower is obliged to make timely payments to an account administered by the trustee, who remits the funds to the investors. Security is provided by an escrow or reserve account, which is sufficiently funded to cover several interest payments. The PRI policy is issued to the trustee as the insured and usually incorporates a waiting period of 150 days to resolve temporary currency problems. As a result, the borrower must make warranties and representations to work with the insurer in the event of a claim. Usually covenants rest on the insured; however, since the insured is a trustee with limited fiduciary duties, the issuer must assume the majority of these obligations.

Deals and Payouts

[38] The rating for a private sector debt issue is usually capped by the foreign currency rating of the host country.
[39] Typically this ranges from 18-36 months of interest payments to be insured.
[40] Courtesy Sovereign Risk Insurance Ltd.

Investors respond well to bonds that are credit-enhanced with PRI cover. In November 2003, Sovereign Risk Insurance Ltd.[41] announced the issuance of a PRI policy covering a dollar-denominated bond issue by Banco Bradesco S.A., Brazil's largest private bank. The policy was issued in support of US$500 million 10-year subordinated notes. The proceeds of the bonds will be used to finance Bradesco's lending in Brazil. The issue, which originally was sized at US$300 million, was heavily over-subscribed, and was increased to US$500 million. The 10-year political risk insurance policy covers up to 18 months of interest payments on the bonds against the risks of currency inconvertibility and non-transfer. Merrill Lynch placed the bonds. Moody's assigned a "Baa1" rating to the subordinated notes based on the fundamental credit quality of Bradesco, and to the existence of Sovereign's currency inconvertibility and non-transfer policy. This rating is seven notches above the long-term foreign currency debt rating of the Federative Republic of Brazil (rated "B2" by Moody's). Sovereign has the ability to issue political risk insurance policies for amounts up to $125 million and for periods up to 15 years.

In addition to debt, private sector PRI also covers equity investments. In 1999, a RET project in Indonesia triggered one of the largest political risk insurance claims in history, totaling $292.5 million. The claim was in respect of MidAmerican Energy Holdings Company's loss of its equity investment in two geothermal power plants in Indonesia as a result of the Asian financial crisis. Of this $292.5 million, OPIC provided $217 million in PRI, and a syndicate of private insurers provided an additional $72.5 million in coverage.

The **Partial Credit Guarantee** (PCG) covers all occurrences and causes of non-payment (not just sovereign risk) for a designated part of a creditor's loan to a project – usually the later maturities, normally to cover commercial financing of public borrowers. They are only available to IBRD eligible countries (not IDA countries – the LDCs) and are generally used to facilitate the extension of tenor in loans and bond issues in the capital markets. Commercial bank lenders with PCGs will usually extend maturities, which are otherwise not achievable by the borrower on its own credit. PCGs are flexible instruments that can accommodate different structures to suit different needs such as: covering principal for bullet maturity bonds; rolling coupon and principal guarantees for different types of bonds; and later maturity principal repayments of amortising syndicated loans.

The Leyte-Luzon Power[42] project: this geothermal power deal is a well-known but good example of a partial credit guarantee facilitating the construction of a large RET project. In 1994 IBRD made a direct loan to the project and also

[41] Sovereign is a joint venture between ACE Bermuda Insurance, Ltd., and XL Insurance (Bermuda) Ltd. See www.sovereignbermuda.com

[42] See World Bank Projects Finance & Guarantees Group site http://www.worldbank.org/guarantees/ for a complete breakdown of IBRD and IDA Guarantee projects by geographical region.

provided a guarantee for a $100 million bond issue floated by the Philippine National Power Corporation (PNPC) in the US market. The guarantee was in the form of a put option enabling investors to 'put' the bonds to the IBRD at par on their maturity date in year 15. Without the put feature there was no way that PNPC could have floated a 15-year bond issue to US institutional investors. The put option, which is one form of a partial credit guarantee, enabled the bonds to be sold into the US 144a institutional market - generally investors that only buy investment grade paper. So, by deploying the PCG for this geothermal plant, the IBRD actually introduced the Philippines to a new fixed income investor base. The Philippine government provided indemnity to the World Bank for providing the put option guarantee. PCGs are generally applied in cases where creditworthy sovereign borrowers have limited access to medium and long-term capital markets or to fill a financing gap for large public or private infrastructure investments. This type of guarantee has been used for sovereign borrowing, but can be structured for private projects, provided that the counter-guarantee is available. By providing a partial credit guarantee with sovereign counter-guarantee, the WB is taking the risk of the sovereign government on its balance sheet.

Types of guarantees[43]:

- **Limited Guarantees**– may be limited in time or amount or both. Guarantees are not required to cover 100% of the lender's credit exposure. They may take the form of deficiency guarantees or first-loss guarantees up to a certain amount. WB partial credit guarantees are an example of coverage for a designated part of debt service payments. Limited guarantees for cost over-runs and operating expenses are fairly common as are pre-committed pools of funds (limited amount). Guarantees limited in time can take the form of a bridging guarantee that expires after the project performs to specifications for a certain period of time.
- **Indirect Guarantees** – generally take the form of a third party guarantee for rights and obligations of parties in project contracts – take-or-pay (off-take), put-or-pay (supply) or transportation agreements – which would set the contractual framework for limited recourse loans of the project or equity investments. Government subsidies are indirect guarantees.
- **Contingent Guarantees** – for remote / contingent risks.
- **Implied Guarantees** - essentially "comfort letters", these are subjective although often given between parent companies and subsidiaries.
- **Completion Guarantees** – the greatest period of risk in a project financing is during the construction and start-up phases of a project. Completion guarantees are normally provided by a project's sponsors where their credit standing is superior who in turn may purchase bonds and insurance.

[43] See http://www.worldbank.org/html/fpd/water/wstoolkits/Kit3/kit3-22.html for general information.

- **Construction Contract Guarantees/Bonds**[44] – include; a) bid bonds – to make sure each bidder is serious, b) performance bonds – to provide funds in the event the contractor fails to perform, c) advance payment guarantee – to assist the contractor to purchase materials and equipment and hire personnel, d) retention money bonds – holding back some payment to cover unforeseen expenses and e) maintenance bonds – to correct construction defects. Typically the performance bond and retention bond are converted to a maintenance bond upon completion of the contract.
- **Deficiency Guarantees** – limited in amount to the deficiency suffered by a creditor in the event of default[all the financial guarantees operate to cover the deficiency only.]
- **Political Risk Guarantees** – multilateral / bilaterals provide explicit political risk guarantees / insurance. In addition, multinational / MFI sponsorship provides comfort for private financiers and may serve as some de facto political risk cover.
- **Export Credit Agencies** – provide a variety of political & commercial insurance, as well as comprehensive cover.
- **Direct and Indirect Political Risk Guarantees** - multinational sponsorship (including multilaterals/bilaterals) provides some de facto political risk cover.

[44] For a discussion of using construction bonds to improve **energy efficiency** see http://www.commondreams.org/views/032600-103.htm. See H. Stockenstrom's page for bond descriptions http://www.cwilson.com/pubs/construction/hgs1/

Part 6: Evolving financial risk management instruments that can support RE projects

Background

Prices for traditional commercial insurance have climbed steadily since the late 1990s, when the supply of risk capital *(capacity)* began eroding. This usually cyclical trend has accelerated since September 11th 2001 and, while capacity has returned to certain lines such as property, some types of cover are simply no longer available at any price. As a result, corporate risk managers searching for new risk solutions are looking closely at the various financing arrangements known collectively as Alternative Risk Transfer (ART). These products, which blend elements of corporate finance and insurance, are designed to protect balance sheets from the financial repercussions of natural and man-made disasters. ART products are known informally as the derivatives of the insurance industry[45] and a fair amount of attention has been given to the so-called "convergence" of the insurance and capital markets over the last few years.

However, according to industry sources, there is a lot more looking than buying. Chris Tagg, of the Structured Risk Practice at Marsh, estimates that only about 1% of ART-related enquiries actually result in transactions. According to Swiss Re[46] , the global ART market was worth U$88 billion in 2001 and will grow by an average of 10% a year for the next several years. However, these figures are mostly premiums related to self-insurance vehicles (discussed below) which are not considered "pure" ART by specialist practitioners. Pure ART includes only products that combine finance and insurance tools, and / or involve recourse to new capital markets. The best known example of pure ART is securitizing catastrophe risks and selling shares in the risks to bond buyers to bring in capital from new sources, while providing an element of insurance to the bond issuer ("cat" bonds).

For the purposes of this text the term "ART" will include self-insurance / captives, which have been around since the 1970s. This should underscore the additional point that ART products are not necessarily new financial contracts but are often variants of traditional risk management methodologies. "New" risk mitigation instruments (say, for RET) will continue to evolve from products and practices currently deployed elsewhere.

[45] See http://www.artemis.bm/ - an excellent general information site for ART products and services.

[46] See http://www.swissre.com/INTERNET/pwsfilpr.nsf/vwFilebyIDKEYLu/SHOR-5J3KEN/$FILE/sigma1_2003_e.pdf

Risk Transfer vs. Risk Finance

Commercial or non-commercial, *core* or *non-core*, the process of risk management is about distinguishing risk so that a retention decision can be made about a project or line of business. In the case of most RET projects; the financing options will determine the amount of retained risk that a project can carry. The more equity there is available for a project, the more risk that can be retained. A company's retention decision is both a risk management and capital structure decision. There is a basic cost / benefit trade-off to determine whether the benefit of transferring risk is above the cost at the margin (if it is possible to transfer at all). Considering the already marginal nature of many RET projects, lenders (especially in developing countries) can require an onerous degree of risk transfer before committing funds and the expense of buying this cover can easily kill an otherwise economically viable project. When discussing products and solutions that fall under the ART umbrella it is important to clearly delineate between risk *transfer* and risk *finance*. Some specialists refer to the former as synthetic equity and the latter as synthetic debt but the distinctions should always be clear – different firms offer different combinations of products and it can become confusing.

The fundamental question for any risk management scenario is: what risks can be retained and what risks can /need to be transferred? Risk that is retained and self-insured is a **risk financing,** and not a risk transfer, solution. Discussions about ART solutions often include combinations of both risk finance mechanisms (including captives and a variety of 'finite risk' products – usually involving sharing of risks and returns) and risk transfer (Integrated Risk Management products, layered risk transfer structures etc.) ART products arrive as "contracts, structures and solutions" (Culp 2002). For example, many weather-related ART products are essentially derivatives transactions, while some are clearly insurance contracts. Recently, relationship-intensive deals combining re/insurers, banks and customers working together have become more popular. These can combine a complex collection of contracts/structures with advisory services to create synthetic contingent capital facilities and balance sheet optimization. As discussed above, ART is really a term of convenience for all efforts to expand the scope of what insurance companies and investment banks can do to help their clients manage risk.

Risk equates to both danger and opportunity and businesses retain their *core risks* – the risk of doing business in their chosen field. Of course, the definition of what a core risk is will vary from one company to the next. Some airlines will hedge out the forward costs of jet-fuel in the derivatives markets because they do not consider it a core risk, while others may make a conscious decision not to hedge. The same sort of example holds true for fuel-supply agreements to power infrastructure projects. Core risks are transferred when the risk in question exposes a firm to a catastrophic loss potential (example: weather – both threat and resource for RET). Most risk transfers involve non-core and contingent risks. All else being equal, a company will prefer to transfer high severity/low frequency events (natural disaster etc.) and retain low severity/high frequency events (small property damage etc.). In developing countries, lenders often want to transfer quasi-commercial risks (failed wire transfers etc.) that would normally be retained as a matter of course in OECD countries. An *unfunded retention* is the retained risk of a project for which any losses are not financed until they have occurred, while *funded retention* means that specific funds are allocated to carry particular losses. A funded retention or *preloss financing* can either be *paid-in* or *contingent* capital.

1. Why ART?

ART underwriters can add value by being willing to deal with risk problems for which there are no readily available insurance or capital market solutions. These risk problems may have one or more of the following characteristics:

- **Uniqueness** - since many risk markets are designed to handle certain predefined kinds of risk, any risk not fitting into one of these categories will be difficult to transfer or trade.
- **Complexity** - the risk problem may be based on a set of facts and circumstances that require a deep understanding of the client's industry or other aspects of the client's situation, often coupled with other complex subject areas like accounting, tax, legal, etc.
- **Cyclicality** - certain problems relate to the fact that revenues or expenses may fluctuate from accounting period to accounting period and ART solutions can provide a 'revenue smoothing' effect that does not alarm shareholders.
- **Illiquidity** – any one or more of the above attributes can create the problem of an "illiquid risk," for which there is no active insurance or capital market that is readily willing to take on that risk for a price. Illiquid risks are expensive to insure.

There are some generalizations that one can make about ART products:.[47]

- The customer and re/insurer both participate in the risk/reward of an ART deal
- Art products bundle together multiple contracts/structures then are packaged and priced as a single product to the customer
- ART deals cover multiple risks and tend to blur the distinctions between reinsurance and insurance
- The customer often gets paid much more quickly than traditional insurance – there is often a banking relationship built in for this purpose
- Claims are often automatic/triggered and so do not have to be submitted
- And ART products always impact the economic risk capital structure of a firm.

[47] Culp, Christopher, see http://gsbwww.uchicago.edu/fac/christopher.culp/research/index.htm

2. ART Products

Integrated Multi-trigger & Multi-line Products

Steep rises in insurance premiums have increased the attractiveness of products such as multi-trigger business-interruption policies that pay out for a disaster only if one or more "trigger" events occur – an insurance event followed by a non-insurance event. Such "integrated risk management" (IRM) products are designed to provide enterprise-wide risk transfer solutions.

Traditional reinsurance and many derivatives transactions allow companies to manage their risks through an approach known as layering. Typically, a non-financial company 'X' such as a utility or commodity producer faces three types of natural risk:

1. **Production-related Risk** (supply chain, demand shock)

2. **Financial Risk**
   A) Market Risk:
      a) Interest Rate Risk (on debt and liabilities)
      b) Currency Exchange Rate Risk
      c) Fuel/Commodity/Raw Material Supply Risk
   B) Credit Risk on all Assets

3. **Operational & Business Risk**

- Liability
- Property
- Casualty

The relation between the risk transfer suppliers and the order in which those suppliers absorb losses incurred by company X for the above risks is layering. Traditional (re)insurance is a vertical risk management product (excess-of-loss, for example) – for the customer, this translates to a different risk mitigation product for each risk. Each risk is managed independently of the others. When a single company underwrites losses arising from more than one source of risk, the resulting ART product is called an *integrated* risk management solution.

Munich Re described a **double-trigger** deal recently done with the power company **Aquila** for **Business Interruption** risk for gas-fired turbines in the USA as follows: IF a gas-fired turbine faced an unscheduled inoperative period THEN the reinsurer would finance the purchase of power to feed the grid in Aquila's name. The two triggers for activation of the product are;

1) An unplanned outage at the facility **AND**

2) A spike in spot electricity prices – the contingent event for which the product would provide financial coverage.

The caveat in this policy – 24 hours notice to the reinsurer of the unplanned outage. However, this could be designed with an immediate trigger if there is an electricity price spike.

Trigger structures may be fixed or variable – generally the first trigger is fixed as in the Aquila example: unscheduled down time of a gas-fired turbine. The second trigger is then like a currency knock-in or other barrier option whose exercise is contingent upon a second event. In the case of Aquila, the second event is a spike in volatile spot electricity prices that would make it very expensive for the firm to buy power from the market to meet its power delivery obligation to the grid. The fixed trigger exists solely to limit the conditions under which the policy can be exercised but does not usually affect the value of the policy conditional on an exercise occurring.

Multi-line policies often have *switching* single triggers – or triggers that will vary according to some weighting scheme defined in the trigger definition across the multiple risks of the policy. These triggers depend upon the specific weights of the assets and liabilities of the firm in question. Say an insurance firm has investment losses on its portfolio – if the loss is not bad then it may not require any cover unless underwriting losses are also large. Under a switching trigger, the policy is activated only when underwriting losses exceed a certain threshold level X for an investment loss level of Y.

Multi-line IRM solutions can be complex. Several years ago, the Canadian company, **United Grain Growers** (UGG) worked with the broker Willis and identified 47 risks affecting UGG's cash flows, earnings, and/or value[48]. The most important risk was determined to be the weather. The weather can cause a decline in grain volume that impacts revenues by up to 20%. However, after two years of efforts, UGG decided that neither weather derivatives nor vertical (stand-alone) solutions made sense. Ultimately, UGG went to Swiss Re for a multi-line structure – in this case, a three year program that combined credit, counterparty, weather, environmental, inventory and grain price coverage with property/casualty cover. This is essentially an "**earnings-per-share**" (EPS) **risk management solution** triggered by differences between the long-term grain volume averages and actual volume as measured by the Canadian wheat board. Swiss Re mitigated the moral hazard posed by an EPS-policy (If financial performance is guaranteed why invest in the business?) by using a grain index whose value was not unduly influenced by UGG.

[48] Culp, Christopher

Blended covers[49] combine multi-trigger structures and multi-line IRM products with finite risk products – a mixture of risk transfer and risk financing. On their own, the risk transfer features of multi-trigger and multi-line excess-of-loss (XOL) policies can be equated to synthetic equity. Combining this synthetic equity with a finite risk product designed to help firms prefund their losses and manage timing risks results in a hybrid security that functions a bit like synthetic mezzanine debt.

Finite Risk Products are also called 'financial reinsurance' because the principal risk they are intended to address is *timing* risk that losses will occur faster than expected and adversely impact quarterly results released to the financial markets. The primary difference between traditional reinsurance and alternative finite risk products is that the latter helps cedants to diversify their risks across *time*, rather than across other risk types. While finite risk products rearrange the *loss development experience*, they do not necessarily change who bears the ultimate risk – these are generally risk finance, rather than risk transfer, vehicles. Finite risk contracts are multi-year, limited liability contracts where the premium is based on expected investment income.

Most finite risk products exist to help firms manage an existing (say, an environmental issue like an oil spill) liability and, as such, there are a number of *retrospective* finite risk products. Some prospective products do exist as well such as spread loss treaties (SLTs), another form of risk financing. In an SLT, the cedant pays an annual premium into an ***experience account*** (fund) over the multi-year term of the contract. Investment income on reserves is credited to the experience account and actual losses plus the reinsurer's arrangement fee are deducted. If the fund goes into deficit then the cedant pays increased premiums, but if the fund is surplus then the fund's investment income is distributed to the cedant. The reinsurer's obligation is to make payments for losses as soon as they occur even if the experience account goes into deficit. Any such losses are cumulated and then redistributed over the remaining term of the agreement, which can be quite long. The reinsurer bears some underwriting risk but usually subject to an annual or aggregate limit.

Finite risk products are "convergence" products and so may be offered directly by derivatives dealers. For instance, an SLT is essentially an asset swap. The amount of the loss is known but there is "basis risk" with regard to cash-flow timing and reserves reinvestment. (Similarly, excess-of-loss treaties are roughly equivalent to a call option spread etc. – there are many such comparisons).

Contingent Capital Structures (Synthetic Debt & Equity) are a type of risk finance that can take the form of an insurance policy, a swap, an option, or hybrid security such as a specially structured notes or fixed-term preference shares. The

[49] Sometimes this term is also used for a combination of traditional reinsurance with finite risk products.

(re)insurer functions as a source of stand-by capital (risk finance) that can be called upon to replenish equity capital that gets depleted due to the occurrence of some contingent event. Since the customer may not want or be able to carry the cost of extra debt/equity capital to finance such contingencies, paying for **"contingent capital" can be viewed (and valued) as an option**. This option gives the holder the right to raise capital from an option provider at pre-defined terms upon the occurrence of a pre-agreed event for a pre-specified amount of time. The paid-in capital injected can take the form of (subordinated) debt or sometimes preference shares. Contingent capital is usually contingent debt or a contingent hybrid. This ART instrument is the closest substitute for direct issuance of new debt or equity and it usually does not relate to any specific risk exposures on the part of the buyer. The cost of purchasing the contingent capital commitment is less than the cost of carrying additional equity capital of the same amount.

Like multi-trigger structures, most contingent capital products include a second trigger to mitigate moral hazard. However, the first trigger event is usually not defined explicitly in the contingent capital agreement. This is not a problem for the reinsurer because, as long as a company can get equivalent amounts of capital at a better rate somewhere else, then the contingent capital option is *out-of-the-money* (has no intrinsic value) and will expire worthless, thereby allowing them to pocket the premium. The debt or hybrid capital provided upon exercise of a contingent capital facility comes with a fixed maturity date – it is risk finance, not risk transfer. Several early IRM / contingent capital options resulted in the reinsurer becoming a major shareholder of the company to which it provided capital. Now, if the facility calls for an injection of hybrid equity capital it will probably include provisions for the reinsurer to redeem its claim by way of conversion into traded securities.

The price of a contingent capital (CC) facility can be structured like an option premium and paid up front or like a commitment fee for a letter of credit . The needs of the buyer will influence the load that the reinsurer prices into the option valuation[50]. If the facility has an early termination option then the unused part of the premium can be returned. The price of a CC facility will also factor in the financing rate of the underlying security if the option is exercised. The rate can be fixed or floating and will depend on the credit quality of the client company. The customer can usually choose between a higher option premium and a lower financing rate or a lower premium but higher rate depending upon the probability that the capital will be drawn upon. CC facilities are designed to be more readily available and less restrictive than LCs but contain covenants to protect the reinsurer such as early termination if the company changes hands or targets for financial ratios. The buyer/borrower can request funds within a certain time frame

[50] Risky credits command a higher premium. The buyer will compare alternative sources if the CC facility is stand-alone. Often, a CC facility comes as part of a broader IRM package.

after the option has been exercised and, for the right price, delivery of funds can be guaranteed in 24 hours.

Alternative Securitization Structures

Securitized products are of interest to ART practitioners and others because of their appeal to investors. The line between a traditional securitization (mortgage-backed securities etc.) and an 'alternative' is not distinct. From the perspective of increasing investment flows to the RET sector, there are several potentially useful structures.

Collateralized Debt Obligations (CDOs) are well understood and offer a model for other types of securitizations[51]. These structures bundle (credit or other) risk together and then securities are issued based on different levels of credit / risk exposure, thus creating a risk transfer and financing conduit based on credit differentials. The assets that back a CDO can include just about any type of debt obligation. As with most securitizations, a special purpose vehicle (SPV) acquires the assets, reengineers the cash flows (sometimes with credit derivatives) and issues securities or notes that typically are classed by credit rating and sold to investors in a series of "tranches". The senior notes or 'Class A' securities in a CDO are usually wrapped in an insurance guarantee from MBIA or another credit insurer and achieve an AAA (sometimes AA) rating. As principal is repaid on the assets held by the SPV, it is repaid first to Class A security holders, then to Class B (probably single A) securities holders and so on until the last class of note holder is paid. The owner of the SPV retains a residual value or unrated equity tranche on which dividends are paid after the note holders are paid off in succession. This is known as a credit 'waterfall' and the structure has proven appeal to both institutional and retail investors who can choose their own level of credit exposure, yield and tenor from within the tranche structure.

Insurance CDOs are emerging as a new source of capital for smaller insurers. There have been five separate offerings in the USA over the last year that raised $1.5 billion in new capital. Insurance CDOs are generally backed by insurance company senior debt, surplus notes and trust preferred securities. The ratings agency Fitch expects that development of insurance CDOs will significantly affect the US insurance market in the coming year[52]. Several different small companies can pool debt together in one CDO to reduce underwriting costs and legal fees while increasing the issue's critical mass. Individually, small and mid-size insurance companies do not have easy access to the capital markets and obtaining bank loans or raising equity capital is costlier as well as difficult to transact. Lack of risk capital during the current cycle has meant that smaller insurers have been unable to deviate from core lines of business. Access to the capital markets via

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[51] See http://www.moodyskmv.com/products/CDOAnalyzer.html for an example of a commercial analytic program.

[52] *International Securitization & Structured Finance Report*, November 15, 2003.

insurance trust preferred CDOs would lower smaller insurers' cost of capital. How does this new US capacity translate to improved general cover for the RET sector? Well, increased capacity among smaller insurers means the current hard market for many types of cover will start to erode and competition for insurance business will increase. As this happens, freshly capitalised smaller insurers in particular are likely to start providing cover to the increasing number of community financed renewable energy schemes. The development of the insurance CDO market is a positive trend for capacity in general and the smaller players in particular, and as such it is good for small-scale insurable (i.e. wind, biomass) RET projects.

Insurance Linked (Risk Linked) Securities / Securitization (ILS - synthetic reinsurance) have a payoff profile that depends in some part on the outcome of the reinsurance offered by the SPV that issues the notes. There are a growing number of examples of risks that can be insured using a securitization platform. The best-known example is the **Catastrophe Bond** or 'Cat' Bond. These ILS usually follow a structure that is similar to a CDO and payments are linked to a portfolio of premiums and losses arising from natural disasters such as earthquakes, ice storms, tropical cyclones, Midwestern tornadoes and other varied risks. Typically, the reinsurer pays catastrophic reinsurance premiums to a single purpose SPV, which then passes on the premiums and the proceeds of the sale of securities to a collateral trustee. This portfolio is usually swapped to smooth interest payments to the investor. As with most securitizations, collateral held in trust can be used to pay principal only after the SPV's contingent liabilities have been paid. In this instance, the contingent liabilities are the claims on the catastrophe reinsurance treaty negotiated between the ceding insurer and SPV. The claims paid to an insurer seeking reinsurance cover from a cat bond issue are generally loss-based. A loss-based insurance contract to which bond holders' payments are tied may either be indemnity based or index based. An indemnity based contract means that the SPV's bondholders pay out on actual business losses. Index based loss claims are based on the loss development in one or more specific regional catastrophic loss indices. Index products reduce concern about moral hazard and adverse selection but introduce *basis risk* for the insured. There may be a poor correlation between the index and actual losses experienced. However, the transparency of indices increases cat bonds' liquidity and attractiveness to institutional investors and hedge funds looking for portfolio diversification. Cat bonds can be designed with a variety of trigger mechanisms that define payouts to the insured.

ILS can be created into contingent capital structures. Several years ago, Allianz was concerned that a major catastrophic loss would lead to a hardening of the reinsurance market and sought to cap its future reinsurance costs by using an option on an ILS issue as a type of preloss funding. The option has a three-year expiry and was sold to institutional investors via an SPV named Gemini Re. If exercised, the option writers (investors) agreed to buy an ILS issue from Allianz. The ILS would be a $150 million three-year note whose principal and interest payments were linked to losses on European wind and hailstorms. The options are called ‘subscription agreements’ and knock-in when wind and hail losses reach a specified triggering amount. The premium payment received by the option writers is called a ‘commitment fee’.

Other risks such as credit default insurance, product liability insurance and bulk retrocession capacity (for trade credit insurance) have been successfully repackaged and sold as securities. As long as there is a large enough pool of risks, virtually any line of insurance could be securitized. For example, Gerling’s issue of Synthetic European Credit Tracking Securities (SECTRS) was designed to provide €450 million in retrocession cover to Namur Re (the SPV) based on a portfolio of 92,000 businesses selected at random in the trade insurance market. Since 1996, about $8 billion in risk lined securities have been issued – mostly cat bonds. Until recently, the upfront costs of structuring and managing the SPV have dissuaded some lines of insurance such as life cover from securitizing but this is changing as the structures find legal templates – and as counterparty credit risk becomes more of an issue amongst insurers. In the wake of the break-up of Gerling and a number of insurance industry downgrades, there is a “flight to *quantity*” as opposed to *quality* where risk is spread to a number of different counterparties. In this environment, the credit-enhanced structure of insurance linked securities makes sense – particularly when several re/insurers can work together to bundle their risks. There is no reason why securitization structures cannot evolve to include a variety of RET project related risks. Perhaps exposure to RET insurance cover could be included as one of a portfolio of diversified energy, weather related or emerging market risks. A multilateral or bilateral could provide a credit enhancement to the senior tranche. The possibilities are numerous and as long as credit and capacity are problems in the insurance industry, the growth potential for securitized structures looks auspicious.

Captives & Captive-like Structures

A captive insurance or reinsurance company is a type of organized **self-insurance** program in which a firm sets up its own insurance company (usually in conjunction with a re/insurer[53]) to fund and manage its retained risks. Depending on the existing property/casualty insurance markets, a large project developer (wind power in particular) may be able to provide insurance for some of their operating risks at wholesale cost - a substantial saving over commercially available insurance. Most multi-national corporations maintain their own captive re/insurer.

The captive arrangement can be quite useful for asset protection – funds legitimately paid to the captive as premium are removed from the underlying business, and, if the captive has been placed into an asset protected structure, is thus out of the reach of creditors. Tax savings often play a significant role in the

[53] The (re)insurer provides certification of coverage; reinsurance; loss control and mitigation advice; claims reserving, adjustment; risk management; underwriting, regulatory work etc. in return for an annual fee.

captive arrangement. For instance, the wind power developer may believe there will be future uninsured losses or liabilities, but it is usually not possible to take a tax deduction for reserving against those future contingencies. However, the captive is legally able to accrue reserves against those contingencies. The underlying business may take tax deductions for premiums paid, but the captive itself defers taxation - *to the extent that it is able to accrue reserves*. The international tax advantages of captive arrangements have been well established in a number of court cases[54].

Often, captive insurance and reinsurance companies are subsidiaries of single sponsoring firms but *multi-parent* captives facilitate some sort of risk diversification across different firms. Group captives are often set up by industry trade associations. One example is Energy Insurance and Mutual Limited[55], the group captive representing nearly 160 different electricity and gas utilities in the USA. When each member is too small to justify having its own captive then this structure can make sense but the self-insured risks need to be fairly similar to work. *Rent-a-Captive* structures offer an ART solution for smaller firms seeking pre-loss financing of retained risks. The participants relying on the rent-a-captive for insurance do not actually own it – a re/insurance broker or company like Marsh or Aon will set up the structure for companies that lack the equity to start their own single-parent or group captive. *Protected Cell Companies* (PCCs) have been available since 1997 and are set up like rent-a-captives except that customers have "ring-fenced" segregated accounts.

SPUV for RET (The Way Forward)

RET project sponsors often find there is simply a lack of available indemnity cover. If some public assistance was made available, a number of different "special purpose underwriting vehicles" (SPUV) could be created for the purpose of providing cover to RET projects. For example, a captive can be financed by a holding company that is itself partially financed by a contingent capital facility provided by a multilateral financial institution (MFI). To hold down costs, a *mutualisation* structure could be employed for the *primary* level of risk in a layered facility held within a specialist captive or in a cell of a PCC. Mutualisation of risks between RET projects effectively means that they will pool their premiums and indemnify each other up to a certain primary level. The next level or layer of cover would be provided through the contingent facility (pre-loss financing) provided by the hypothetical MFI. This creates a standard excess of loss (XOL) deal that will attract commercial reinsurance cover for the third and final layer of cover. Other examples of self-insurance structures include "multi-assured facilities" where one product is provided and several insureds share the cover on an aggregate basis. Once the line of cover (say, $10 million) is

[54] See http://www.captiveinsurancecompanies.com/captive_cases.htm
[55] See http://frontpage.dchisholm.aa.psiweb.com/CompanyStats/2001-EnergyInsMutual90102196.pdf

completely paid out the product is finished. This sort of structure is cost effective for developers doing a rollout of one type of technology.

SPUVs can take on a vast number of different forms. Another potential model is to acquire capacity from an existing Lloyds syndicate in the London market or to form a new specialist syndicate. A new reinsurance company, Forest Re, that will provide specialized cover to small and medium sized ($4 million and up, although community schemes can be aggregated) sustainable forestry operations. The sponsors have identified a gap in the forestry reinsurance market – typically, small-scale operations cannot find cover. The geographic spread and aggregate potential portfolio of available small-scale forestry risks creates a strong business case for financing a SPUV. After first planning to set up a captive, the manager has decided to get the business started with a syndicate that can benefit from Lloyd's A- credit rating and 65 worldwide operating licenses. In addition to the usual fire and wind risks, Forest Re also intends to insure the carbon content of forests[56] and provide crop yield insurance for fuel crops in developing countries. The management of Forest Re intends to lobby the public sector to provide some funding for capacity building operations and potentially other types of support such as contingent risk finance. If Forest Re is successful in creating a SPUV with this type of focus then there is a reasonable chance that the model can be extended to insure a number of smaller RET project risks that are uneconomic for the large insurers to cover.

Weather Risk, Weather Derivatives and Market Development

Introduction

Weather risk is the uncertainty in cash flow and earnings caused by weather volatility. Energy companies and renewable energy projects have a natural weather position and this is their largest source of financial uncertainty. For instance, lower than normal upstream precipitation reduces revenues for downstream hydropower facilities, while inconsistent wind speeds at a wind farm installation can lead to unwelcome earnings volatility. Cold temperatures are often associated with lower winds at a time when power consumption generally increases and prices rise.

Weather risk has special attributes that set it apart from commodity price risk and other sources of risk. Weather affects the "volume" or unit quantity of energy transacted – this is known as *volumetric* risk. In contrast, commodity prices affect the margin at which a single energy unit is transacted. Both contribute to total risk as independent variables and as components of covariant risk. Also, weather risk is particularly *localized*. There are few, if any, benchmark indices in weather that have commercial meaning to the broader market. Standardized commodity futures

[56] Depending upon whether CO_2e generated by carbon sinks has future value in extant international treaties.

prices and weather indices rarely correlate for a given local area so weather risk cannot usually be managed with a generic energy price hedge. Weather **derivatives** are:

- Financial protection from weather conditions that adversely affect earnings.
- Protection from volumetric risk.
- Designed to absorb a specific amount of weather exposure, leaving a residual risk that is commensurate with risk tolerance.

The origins of the weather derivative market dates to 1996/1997. In the early days of power market deregulation in the USA, when weather risks were first being quantified, the energy markets looked to the insurance industry for new risk solutions. However, insurers were not initially receptive to requests for non-catastrophic cover. As a result, Enron, Koch Industries and Aquila created the first derivative products to manage weather related risks and power companies became the dominant market-makers in the nascent over-the-counter (OTC) market for weather derivatives. In some respects, the market developed backwards as the secondary market developed first and the primary market lagged behind. This became evident after Enron failed and credit concerns subsequently forced Aquila, PG&E, Reliant, Dynegy, El Paso and others out of the market. One result of this credit crunch and market maker exodus has been a pick-up in the traded volumes of standardized heating degree and cooling degree day (HDD & CDD) contracts on the Chicago Mercantile Exchange (CME, http://www.cme.com/prd/wec/) .

After foundering during 2002 and early 2003, demand from end-users has increased but the supply of risk capital is still diminished. Reinsurers and banks have reinforced their presence in the market (often employing former energy traders) and are now the primary market makers in weather derivatives. These players tend to hold more risk in their portfolios than the power companies did and trade less in the secondary market with some knock on effects on liquidity. As a hybrid product, weather derivatives are part of the convergence of capital / insurance markets and generally fall within the mandate of Alternative Risk Transfer (ART) units at the re/insurers. Additionally, a number of Bermuda-based (for regulatory reasons) specialist companies called “transformers” have been created to convert derivatives into insurance (and vice versa) and these are active in the weather markets. The structured finance units at banks and insurers frequently incorporate weather derivatives as part of tailored hedges that may also include foreign exchange, interest rate and commodity price risk management elements. A customized hedge offered by a re/insurer or bank will eliminate more of a client’s *basis* risk but will increase the cost of the risk *premium* relative to products traded in the secondary market.

Secondary Market Participants (market-makers) include:

- XL Weather & Energy (A1)

- Entergy-Koch Trading (A3) – new joint-venture with AXA Re
- Goldman Sachs (Aa3)
- Hess Energy & Trading Company (Baa2)
- Renaissance Re (A1)
- Partner Re (Aa3)
- Deutsche Bank (Aa3)
- Swiss Re (Aa1)
- ABN AMRO (Aa3)
- Societe Generale (Aa3) - Management buyout in August – now "Coriolis Capital Management", currently in negotiations for Aa3 credit guarantee with other bank.

Products

a) Temperature

Temperature is the most commonly traded weather product on the secondary market. A common measure of temperature that has arisen from the market is a degree-day. A degree-day is the deviation of a day's average temperature from the reference temperature. Specifically, a heating degree-day (HDD) is equal to the greater of the reference temperature minus the average of the daily high and daily low temperatures and zero. A cooling degree-day (CDD) is equal to the greater of the reference temperature minus the average of the daily high and daily low temperatures and zero. Temperature derivatives are transparent and pricing is based upon a mean-reverting model of stochastic volatility. The CME trades a range of standardized futures and options contracts for a number of US locations and in October 2003 launched contracts for 5 European cities as well[57]. Credit concerns have helped the development of the formerly moribund listed futures and options – the front delivery months (short-term contracts) are now fairly liquid.

At the same time, the use of non-standard temperature contracts is also increasing because simple HDD and CDD indices are too blunt to meet the needs of many existing and potential participants in the weather market. Often a market participant's exposures can be linked to a small number of 'critical' days, when relatively extreme temperatures occur. So there is increasing use of, and interest in, options to protect users against specific temperatures occurring for a set number of days over the course of a contract. These "t-max" and "t-min" contracts are also known as critical day contracts. Typical HDD or CDD contracts cover between 200 and 400 degree days, and for every day the temperature is above (for a call contract) or below (for a put) the strike, an HDD contract pays generally around $10,000 a degree day. Contract maturities usually start from three months. T-max and t-min contracts generally cover between 20 and 50-degree days and pay out between $200,000 and $500,000 for every day the temperature is above (for a t-max contract) or below (for a t-min contract) the strike level. They typically cover 10 to 20 days of extreme weather.

[57] London, Paris, Amsterdam, Berlin & Stockholm (see http://www.cme.com/prd/wec/euweather4953.html)

b) Wind & Wind Power Indices

Variability in wind speed has a substantial impact on the volume of electricity generated by a wind installation and thus similarly impacts revenues. Wind speed is not constant and from year to year, generation can vary significantly. Studies in Denmark show that generation in the worst year is 30% below that in an average year[58]. Products based on wind power indices (WPIs) are available to wind farm developers in areas where there is sufficient data (and a large enough risk) to create an index. Weather patterns are stochastic. The long-term average of wind speed is variable over decades. Climate change and macro weather patterns must be taken into account. WPIs compare the wind power generation for specific locations to variability in wind speed observed on a monthly basis. The indices are generally a "unit-less" measure of monthly generation and are directly compared with normalized actual generation from the wind farm. The average value of the index over any 12-month period is 100 in a normal year. For example, an annual value of 95 indicates the index is 5% below normal for the region of interest. Entergy-Koch Trading[59] (EKT) and Deutsche Bank[60] produce WPIs that are asserted to have a high correlation with generation. If so, wind project sponsors will have better access to financing because hedging volumetric risk reduces the uncertainty of future cash flows. This enables a wind farm developer to

- Reduce Debt Service Coverage Ratio
- Increase Debt to Equity Ratio without increasing level of risk
- Reduce the number of years to positive cash flow.

The methodology is straightforward as long as there is enough data to create the index at a reference site (or sites) that is highly correlated to the wind flow into the turbine. The wind developer then usually buys a **put option** at a particular strike level on the annual wind power index. The "tick value" of the put is usually a function of the energy production sensitivity to wind and the forward price of electricity. Dealers recommend that for maximum reduction of earnings volatility this deal be transacted on multi-year basis. In some respects this is similar to financial insurance – a finite risk product. The developer pays away a premium to ensure a minimum amount of wind (revenue) is guaranteed each year and earnings volatility over time should be reduced by up to 30%.

Of course, there is no reason to stop with a put option and once one derivatives trade has been made (particularly an illiquid one), another often beckons. The income of wind farm = price of electricity x volume of wind. After the wind risk has been hedged, the next potential hedge is the **power price**. Typically, power can be sold forward in long-term contracts. However, it is also possible to sell power on the spot market and benefit from higher prices (price spikes are common) while also buying a put on power prices to protect against lower long-

[58] Source EKT
[59] AXA RE and EKT have just announced a "worldwide strategic alliance" for weather trading.
[60] http://www.db.com/

term prices. At this stage, the developer is protected against low wind speed and low power prices but he has paid away considerable premium. What to do next? Well, he *could* sell calls on wind back to the dealer (or another market-maker if one can be found) to finance the power puts. And so forth. There are many possibilities for structuring risk management solutions but more complex does not necessarily mean better for the hedger (developer). If the core risk is hedged with an illiquid OTC product like a WPI then the developer may be best advised to stick to products traded on the secondary market to fine tune the wind farm's adjusted risk profile.

c) Precipitation / Snowfall

Dealers are now developing a variety of regional precipitation contracts based on established and observable indices. As an example, EKT and the Swedish Meteorological and Hydrological Institute (SMHI) have launched the SMHI Nordic Precipitation Index alongside the existing Nordic Temperature Index. These indices represent average temperatures in urban areas and also average precipitation in the major hydro-electricity producing areas of Norway and Sweden. The Nordpool traded electricity market is the most liquid in the world and this is what drives weather derivatives product development for the region. Standardized contract terms[61] assist in market development. Nordic energy companies can combine weather derivatives with their existing Nordpool forward power contracts to closely match the risk of their businesses.

As long as there is enough *data* (and a large enough risk or pool of risks), precipitation indices can be designed for any location. XL Weather & Energy (formerly Element Re) "insured" a German utility against the loss of power sales revenues that might result from an unusually rainy summer. Most of the utility's customers are farmers who must buy electricity to run irrigation pumps when there is a shortfall in rain. Based on precipitation measurements by the German Meteorological Agency, the deal pays the utility in cash when a plenitude of rain means the farmers can irrigate their land without pumps. One of the Agency's weather stations is very close to the farmers' fields, and that was a critical factor in structuring this deal.

Characteristic of Weather Derivatives in Established Markets

The variety of structures available from market makers in OTC weather derivatives parallels other commodity markets although the stochastic processes used in weather market models are rather different. These include:

- Contracts - Swaps, Calls, Puts, Collars, Exotics, Baskets, etc.
- Term – Monthly, Seasonal, Multi-Year, etc.
- Limits – Most transactions capped to create finite exposures
- Hybrids – Weather-linked financings, securitizations, quanto hedges

[61] See Example contract form NPI for a sample EKT SMHI precipitation index contract.

ISDA is currently working to incorporate weather into standard ISDA forms. Increasingly Credit Support Annexes are utilized.

The Weather Risk Management Association (WRMA, www.wrma.org) has:

- Developed standardized confirmations
- Specified settlement language / data
- Identified locations as "back-up" stations for primary locations
- tested aspects of the contracts through the bankruptcy of two industry participants.

Developments in Europe

Participants in the weather risk market rely on **data** to develop new products, and the quality and availability of data varies widely from one jurisdiction to the next. Generally, prospective hedgers and traders must rely on the raw weather data produced by the national meteorological services (NMS). In the USA, weather data is consistent and freely available leading to a liquid market for many weather products. In Europe there is no standardization, and different NMS offer different amounts of data at different times[62] and at varying prices. This has lead to an uneven development of the European weather derivatives market. Cross-border trades are difficult to execute.

However, in November 2003, the EU adopted a **Directive** on the re-use of public sector information[63] that deals with the way public sector bodies influence the market by allowing the re-use or sale of their information resources. The directive aims at facilitating the establishment of European data-products based on public sector information, enhancing an effective cross-border use of public sector information and limiting distortions to competition on the European market. The WMRA and other stakeholders have fought successfully for a number of amendments that relate to the transparency, cost and availability of EU weather data. The Directive will take effect over the next 18 months and results are likely to be mixed from one state to the next. Weather risk data providers are optimistic about any potential progress because sourcing weather data in Europe is a large "frictional" cost for all commercial market participants. Better access to data will also benefit SMEs that are currently priced out of the weather market. The cost of data for a large hedge in an established location is nominal. But a smaller player wishing to hedge exposures in a more remote location generally finds the cost of data is untenable.

Emerging Markets: Weather Derivatives and World Bank

The World Bank and IFC have a long-standing interest in weather risk management. The Bank has provided technical assistance through a series of

[62] For example, turnaround times can vary from 5 days in the Netherlands to 60 in Germany.
[63] See official site http://europa.eu.int/information_society/topics/multi/psi/directive/index_en.htm

studies (funded by a competitive innovation grant) exploring weather index insurance solutions for agricultural risk in Nicaragua, Morocco, Tunisia and Ethiopia[64]. These studies led to an IFC project (approved 2002) with an agricultural insurance company in Morocco[65]. The Bank facilitated a Mexican weather risk management transaction in December 2001 by providing training and technical assistance. This year, World Bank and the donor-financed Commodity Risk Management Group (CRM http://www.itf-commrisk.org/) are helping the Indian insurance company ICIC Lombard to model and insure three rainfall index pilot programs and have developed contracts that provide cover to 5400 farmers as insurance products since August 2003. A number of initiatives are underway in other countries, which is promising. World Bank (in conjunction with the IMF) has considerable experience helping governments to design and implement financial market regulations. Current positive experiences brokering weather risk management deals can be translated into a broader context through developing a fairly simple regulatory framework that can be applied in developing countries to facilitate the general introduction of index based insurance products. As a first step, the Bank now actively promotes the collection and public dissemination of weather data. Specific weather index insurance promotion projects involving data management and weather stations have been proposed in Ukraine and Romania. Apparently, last year IFC approved an investment in Aquila's global weather risk facility but then the market maker folded due to credit problems. Now, according to Ulrich Hess, an economist in the CRM group, IFC is close to a similar venture with a "top five global insurer" in which IFC will provide risk capital to the insurer's weather trading desk to encourage emerging markets transactions.

Credit Risk & Credit Derivatives (for RET)

Introduction

Credit risk, in its pure form, is the risk that the other counterparty to a transaction involving a financial instrument will fail to perform according to the terms and conditions of the contract, due to problems such as bankruptcy, illiquidity, etc. The computation of credit risk is primarily based on the probability of default. The past few years have witnessed a real "hardening" of the market for credit despite historically low interest rates in the West.

The evolution of products such as credit derivatives highlights investors and lenders concern with credit risk. This is largely conditioned by participants' perception of the probability of default or downgrade. This perception is formed by the quality of counterparty relationships. *Counterparty* risk is a broader concept than credit risk and goes beyond financial failure to encompass, amongst other things, delays in execution (business interruption), the financial and regulatory framework within which a counterparty operates and its willingness to

[64] See Environmental Finance October 2003: http://www.environmental-finance.com/
[65] http://wbln0018.worldbank.org/ifcext/spiwebsite1.nsf/5f9fbc1edf0a843585256aae006b01a5/04af3ef4bb80835385256b0b005d784c?OpenDocument - IFC project summary.

perform. General counterparty risk relates to the prevailing market conditions (but not *market* risk), while specific credit risk is directly linked to the likelihood that the other party in the contract will fail to perform its obligations.

This distinction commercial financial institutions make between general and specific risk is common in connection to market exposure but is more recent with regard to credit risk. Ratings by the main agencies (S&P, Moody's etc.) emphasize specific credit risk, but may also involve general counterparty risk as was the case during the Asian crisis of 1998 when the entire Japanese financial sector was re-priced (and in many cases incorrectly priced) with the "Japan Premium". Short-dated and securitized AAA Japanese equipment and car loans traded at Libor + 110 basis points as foreign banks and fund managers kicked out paper - the *perception* of credit risk is just as important as the actual risk[66].

The perception of credit risk prevents numerous RET projects from reaching financial closure. This can be because of the project developer or the location of the project. Developing countries' sovereign debt is often penalized by the rating agencies and, generally, sub-sovereign entities and corporates cannot be rated higher than the domicile nation. The trend over the last five years has been for investors to trim their holdings of developing-country debt and shift toward the stronger end of the credit spectrum. Although conditions have improved since the Argentina crisis in late 2001, many borrowing countries are still under pressure. For some borrowers, ongoing pressure could worsen domestic economic and political problems sufficiently that the outcome is default. According to Standard & Poors[67], Latin America still shows the greatest potential for further credit deterioration due to liquidity and refinancing risk. However, issuers in Russia, Lebanon and Romania show promise in terms of potential upgrades. Mexico and Poland now have investment-grade ratings. Institutional bond investors have demonstrated a renewed appetite for yield this year but are very selective about individual credits. Utilities remain out of favour as a sector but investor comfort with infrastructure project bonds is increasing and this offers some promise to large-scale RET projects.

Credit derivatives are useful for hedging certain types of credit risk and can potentially be of use to the RET sector. Instruments such as credit-linked notes (CLNs) allow broker-dealers to repackage small and illiquid credits into tradable securities that can be distributed to a variety of investors.

Credit Derivatives (in Emerging Markets): Instruments

While a wide variety of corporate products exist in OECD countries, credit derivatives in emerging markets (with some exceptions) are generally linked to

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[66] However, the actual risk is real enough – over 55 countries have restructured their debt at the London Club in the last 20 years due to foreign exchange shortages.
[67] See S&P press release July 2003 http://www.emta.org/keyper/EmgMkt_Rating%20Actions_Q22003.pdf

sovereign debt[68]. Trading volumes in emerging market credit derivatives have grown throughout 2003, although much of the increase in activity has been in a handful of countries such as South Korea, Mexico and Brazil.

Credit Default Swaps (CDS) transfer the credit risk of an asset from one party to another. The holder/buyer of a credit instrument (often a bond) pays periodic fees to the seller of the swap. If there is a predefined “credit event” (default, bankruptcy, credit downgrade, etc) then the buyer receives an agreed payment. These are straightforward products but as ever, the devil is in the detail – the definition of “credit event” is often disputed. In emerging markets the credit event is generally defined as sovereign default. Certain natural resource businesses in developing countries are large enough to warrant their own products and it is possible to tailor specialized products - for a price. According to a leading market maker, default swaps account for about 80% of the outstanding notional principal in emerging markets. By comparison, CDS are said to represent less than 40% of the global credit derivatives markets. Available maturities range from 1 to 10 years although longer tenors may not be liquid.

Credit Linked Notes (CLNs) are estimated to account for about 10% of emerging markets credit exposure. The interest and principal payments of CLNs are linked to the credit risk performance of "reference assets" - a single company, a portfolio of companies, sub-sovereign debt or other assets. CLN investors have an exposure to, but do not own, these "reference assets". In effect, CLN investors buy credit risk (or sell credit protection) on the reference assets from a company selling credit risk (or buying credit protection) under a credit default swap embedded in the CLN transaction structure. The credit protection buyer pays a regular swap premium in return for a contingent payment if a "credit event" occurs in relation to the reference assets. If a payment is required, the face value of the CLNs will be reduced, and CLN investors will experience a loss. Credit ratings on CLNs are an opinion of the likelihood that the defined credit event will result in the face value of the notes being reduced to make a payment to the credit protection buyer under the credit default swap.

First Default Basket Products protect against the first default of a basket of names. Pricing depends on individual default risks as well as on default correlations. These products are tailor made for clients and account for a marginal but growing share of the market.

Synthetic Collateralized Debt Obligation (CDOs) first entered the emerging markets about five years ago. These CDOs combine securitization and credit derivatives to “tranche” a pool of underlying default swaps into different classes of credit risk. The issuer of CDO notes purchases protection on the reference pool

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[68] See http://pages.nyu.edu/~rgr208/imf.pdf Ranciere, Romain Credit Derivatives in Emerging Markets, IMF discussion paper, September 2001

either through a default swap or by selling credit linked notes. The different tranches usually carry ratings ranging from triple-A to single-B. A final equity tranche is unrated and represents the "first loss" in exchange for the highest return. A default swap, made with an external counterparty, represents the senior tranche and covers a certain percentage of the reference portfolio. The proceeds of the notes are invested in a pool of highly rated government securities. Principal and interest is paid to the highest rated notes first, while any losses are borne by the more junior tranches. This structure is popular with investors but expensive to put together without a template.

Total-return swaps: the generic name for any non-traditional swap where one party agrees to pay the other the "total return" of a defined underlying asset, usually in return for receiving a stream of LIBOR based cash flows. A total return swap may be applied to any underlying asset but is most commonly used with equity indices, single stocks, bonds and defined portfolios of loans and mortgages. The total return swap is a mechanism for the user to accept the economic benefits of asset ownership without utilising the balance sheet. The other leg of the swap (usually a spread to LIBOR) reflects the cost of borrowing a counter-party's balance sheet to hold a credit that the buyer may not be able to otherwise invest in. Total return swaps can be designed to use any underlying asset - no notional amounts are exchanged.

Credit-spread put options are similar to total return swaps because they do not depend upon a specific credit event occurring. A credit-spread put option is a hedge against credit spreads widening (against whatever underlying asset that the instrument is "spread" to – often an interest-rate swap or US treasury bonds). The buyer of the option pays an upfront premium to the seller (writer of the put) and then the seller is at risk should the spread in question widen beyond some preset level. These instruments are useful where available in emerging markets as credit assets often suffer (spread widening) for a variety of reasons without the occurrence of any "credit event" that would be necessary to trigger a default swap.

TRAC-X EM, launched by JP Morgan and Morgan Stanley in August 2003[69], is an index representing a tradable portfolio of five-year CDS, referencing a diversified pool of emerging market sovereign credits. The credits are a subset of the countries comprising the JP Morgan Emerging Markets Bond Index (EMBI). The TRAC-X EM portfolio currently contains 19 sovereign credits that represent 84% of the EMBI. TRAC-X EM incorporates the new 2003 ISDA credit derivative definitions, quarterly maturity dates and independent live pricing. A new five-year portfolio referencing an updated pool of credits is expected to launch every six months. Investors can 'roll' trades into the newest TRAC-X EM contract and markets will continue to be made for all previous contracts. The transparency of this vehicle is popular with traders. In October, a Jersey special

[69] See press release http://www.findarticles.com/cf_dls/m4PRN/2003_August_6/106327139/p1/article.jhtml

purpose vehicle issued US$400 million of Series 1F TRAC-X EM Credit-Linked Notes due 2008.

The Trading Environment for Credit Derivatives

As with any traded derivative product, the depth and tenor of the market for a particular credit derivative instrument is dependent upon the liquidity of the underlying credit instrument. For this reason, the vast majority of emerging market credit derivatives traded in the OTC market are linked to sovereign risk. Some Mexican and Latin American **emerging market corporates** such Cemex, Pemex, Telmex and Petrobras trade in the dealer market for default swaps. However, most trading of emerging market corporate credit risk is done through credit linked notes and other structured credit derivatives. These deals allow investors to go synthetically long a credit or basket of credits they would not otherwise look at?. CLN structures make it possible to source illiquid corporate credit risk and repackage it into listed, Euroclear-ready securities underwritten by a brand name bank. The documentation for these transactions is tailored to the specific underlying asset and (ideally) requires more in-depth fundamental credit analysis to effectively price the risk and get investors comfortable with the credits. **The broker dealers** of credit derivatives are generally the major investment banks involved in the emerging bond market.

Most investors dealing in this asset class are looking for yield pick-up over the sovereign from a corporate with a relatively solid credit story. **Hedge funds** are active participants in emerging markets as end users of default swaps. By "selling protection" via default swaps, they are able leverage exposure. However, the focus of hedge fund activity has switched from macro-directional strategies (outright default swap seller positions) to relative values strategies. Hedge funds are also active buyers of the junior tranches of CDOs. **Mutual funds and pensions funds** that manage emerging market fixed income portfolios represent a growing share of the market. They are often sellers of protection by buying credit linked notes and tranches of CDOs. The positive basis between default swaps and bonds enable them to replicate and outperform emerging market indices, especially if they are not too sensitive to liquidity concerns. Fund managers are also natural buyers of protection to hedge spread and default risk inherent in long bond positions. Recently **private banks** have started taking on more emerging market credit risk for yield hungry high net worth clients. **Commercial banks** are often buyers of credit protection to reduce country credit exposure, to free up credit lines, and to improve balance sheet efficiency. As these banks develop and validate internal risk systems capable of offsetting loan portfolio credit risk with the purchase of credit protection, and bank accounting and regulatory standards continue to evolve, major banks' use of credit derivatives is expected to increase.

Hedging a default risk is significantly different than hedging an interest rate risk. Since interest rates movements can be modelled as standard continuous differentiable Wiener stochastic processes, it is possible for market makers to design fairly accurate dynamic hedging strategies for interest rate swaps and options. As a result, there are large and liquid OTC markets for these instruments. By contrast, the evolution of default risk is more accurately modeled by a discontinuous jump process (Poisson process) that does not readily translate to the financial markets. In any event, deploying the instruments available to hedge credit derivatives often simply intensifies the overall risk since "short squeezes" are common in illiquid bond repo markets. It is debatable as to whether credit derivatives efficiently mitigate credit risk in emerging and illiquid markets but these instruments do *distribute* credit risk amongst a wider investor base. While most financial institutions are good at measuring and pricing simple risks, few have the actual expertise required to trade credit derivatives properly. This is particularly true of medium-sized banks, corporate treasuries, insurance companies, pension funds and unit trusts. Mistakes with leveraged credit derivatives can be expensive. After a blunder, the approach to credit analysis typically followed by most medium sized and smaller financial institutions is both static and defensive right across the board. This is unhelpful to SME borrowers seeking finance from these institutions[70] and to the general investment climate.

Possibilities for the RET (and Public) Sector

Information, and the liquidity of the "underlying" (or the lack of it) guides market psychology with respect to pricing and trading all types of derivatives. For this reason, structures such as the credit linked note (CLN) offer the best possibility to the RET sector. Conceptually, it is possible for a public sector institution to bundle a group of RET project bonds/loans as a first default basket in a listed and rated CLN. An institution such as the IFC could construct a portfolio of suitable RET-related bonds/loans from one or several emerging markets and work with the private sector to underwrite the structured note. The listed offering is likely to be well received by retail funds. If this pilot deal is successful, then it is likely to be replicated.

Multilateral Financial Institutions: Risk Mitigation Products

Introduction

Credit enhancement by the Multilateral Financial Institutions (MFIs) has been proven an effective tool to mitigate perceived and actual risk. Over the last decade, the major development institutions have (re)introduced a variety of guarantee products that are well received by commercial banks and insurers. While MIGA (World Bank) and ICIEC (Islamic Development Bank) are traditional NCR / PRI insurers whose products cover debt and equity investments, the other MFI products only cover lenders. The IFC's credit enhancement

[70] By contrast, the top money centre banks such as Citibank have developed software that permits the estimation of credit risk and market risk individually by counterparty (for major clients) and will integrate the exposure for risk control. Generally, smaller accounts are managed through statistical analysis or some general framework. The issues of client scale and lack of available credit information are persistent weak links with regard to pricing credit products for RET.

program is flexible and their structured finance solutions include tailored guarantee products. The best-known MFI guarantee products are the partial (political) *risk* guarantee (PRG) and partial *credit* guarantee (PCG). Additionally, MFIs are also able to offer guarantees for contractual risks although these products do not seem to be understood by the commercial market.

Guarantee products in general seem to be receiving considerable attention at this time as a number of recent papers and presentations have referenced their use in manifesting infrastructure deals. World Bank in particular has been reassessing its approach to facilitating investment flows to the water sector and leveraging its risk mitigation product line[71]. The Camdessus report, "*Financing Water for All*", delivered in March 2003 drew criticism for focusing on large infrastructure projects. Since then smaller "clean" infrastructure projects have also benefited from renewed attention. When comparing the guarantee products offered by the MFIs, the most important distinction to make is whether or not the issuing MFI requires a sovereign counter-guarantee for the loan (or bond) the client wishes to cover. Generally, renewable energy (and water) projects are regulated by local / municipal governments or sub-sovereign agencies. MFI products that require a sovereign counter-guarantee are only useful for particularly large and well-sponsored infrastructure projects.

With the exception of the IFC and MIGA, one could argue that, thus far, the MFIs have maintained a reactive approach to implementing the available guarantee instruments. For instance, guarantees only account for about 1% of World Bank Group's total loan exposure and this seems quite low given the products' utility. The deal sheets from other MFIs are sparse as well. The IFC only began offering partial credit guarantees (no counter-guarantee necessary) on a commercial basis to clients in some emerging markets in 2001 and has since overshadowed its parent and the other MFIs with a steady stream of deals that include some infrastructure projects as well. To be fair, guarantees are usually sought from World Bank when there is quite a reasonable risk of an event materializing and not all the MFIs are as experienced as the IFC in assessing credit risk. Additionally, while guarantees may provide specific protection to specific investors in specific transactions they are no substitute for substantive long-term regulatory reform, which is what an institution such as World Bank is most interested in. However, considering the current negative investment flows to LDCs, the facilitation of a more liberal supply of MFI guarantee products (at reasonable cost) to the private sector is a desirable objective.

The Partial (Political) Risk Guarantee

Partial risk guarantees may cover up to 100 percent of a loan for specific political risks. The IBRD / IDA (World Bank) PRG is particularly comprehensive and

[71] See, for instance, Implementing the World bank Infrastructure Action Plan, September 2003 http://siteresources.worldbank.org/DEVCOMMINT/Resources/Fall-2003/DC2003-0015(E)-Infrastructure.pdf

covers creditors for specified sovereign risks arising from a government's default on contractual obligations, or the occurrence of certain *force majeure* events of a 'political' nature. Such risks or events might be specified to include: (a) maintaining an agreed regulatory framework; (b) adhering to escalating tariff agreements for an infrastructure project; (c) delivery contracts, such as fuel for a power generating project; (d) compensation for delays or interruptions caused by government actions (delays in providing license approvals and consents etc.); (e) change of government resulting in the new government reneging on the commitments of its predecessor; (f) requiring hard currency for payment obligations; (g) unfavourable changes in national laws; (h) expropriation and nationalisation; (j) the host government obstructing an agreed process of arbitration; and (k) non-payment of agreed termination amounts or an arbitral award following a covered default. Figure 11 below provides indications of the type and extent of cover offered by selected MFIs and some distinctions between public and private sector products.

Figure 11: Partial Risk Guarantee's type and extent of cover offered by selected MFIs

Multilateral Financial Institution	**Cover**	**Political Risks**		
	Debt / Equity Cover	Expropriation / Nationalization	Transferability / Convertibility	War & Civil Disturbance
Sovereign Guarantee Required				
IBRD & IDA PRG	Debt	■	■	■
Asian Dev Bank PRG (Public Sector)	Debt	■	■	■
ICIEC Bank Master Insurance	Debt	■	■	■
Sovereign Guarantee Unnecessary				
MIGA Political Risk Insurance	Debt/Equity	■	■	■
IADB PRG (Private Sector)	Debt	■	■	■
Asian Dev Bank PRG (Private Sector)	Debt	■	■	■
ICIEC Foreign Investment Insurance Policy	Debt / Equity	■	■	■

Figure 12: Partial Risk Guarantee Cover of Contractual Risks

Multilateral Financial Institution	**Cover**	**Contractual Risks**						
	Debt / Equity Cover	Breach of Contract	Changes in Law	License Requirements	Approvals and Consents	Obstruction in the Process of Arbitration	Arbitration Award	Non-payment of a termination amount
Sovereign Guarantee Required								
IBRD & IDA PRG	Debt	■	■	■	■	■	■	■
Asian Dev Bank PRG (Public Sector)	Debt	■						
ICIEC Bank Master Insurance	Debt	■						
African Dev Bank (Public Sector)	Debt	■	■	■	■	■	■	■
Sovereign Guarantee Unnecessary								
MIGA Political Risk Insurance	Debt/Equity	■					■	■
IADB PRG (Private Sector)	Debt	■	Cover Possible					■
Asian Dev Bank PRG (Private Sector)	Debt	■	Cover Possible					
ICIEC Foreign Investment Insurance Policy	Debt / Equity	■	■			■	■	

While MIGA and ICIEC offer PRI / Breach of Contract products on a stand alone basis, Asian Development Bank, African Development Bank and IADB offer them in conjunction with other products (typically a loan). IBRD and Islamic Development Bank (Master Insurance) can offer cover on a standalone basis, but usually write it in as part of broader regulatory and contractual agreements. MIGA's traditional political risk instruments are used far more frequently than the other available instruments. However, this is not surprising since MIGA's primary purpose is to encourage foreign direct investment into developing countries by providing traditional PRI cover and technical assistance. There has been no apparent reason for the MFIs to duplicate MIGA's program and products so their PRI products have been tied to specific loans for larger / more complex deals. However, broad contractual risk cover is highly desirable in the current hard market for credit, and informal discussions in the City of London indicate that financiers are interested in learning more about how to obtain it. This indicates that the MFIs could use contractual risk instruments in a directed fashion to achieve their development aims.

The Partial Credit Guarantee

A partial credit guarantee covers creditors (not equity investors) irrespective of the cause of default and there are a variety of structures and currencies available to choose from. For these reasons PCGs are popular with commercial bankers and can turn short / medium-term finance into a longer-term arrangement. This can be achieved through guarantees for longer maturities; liquidity guarantees in the form of put options take-out financing or by rolling guarantees that cover a fixed number of scheduled payments etc. The common feature is that the guarantee is partial. Generally, up to 40 or 50 percent of a loan (or specified amount) can be guaranteed, with or without a government counter-guarantee depending upon the MFI and the program. An increasing number of PCG deals are done to facilitate local currency financing which is an effective means of managing currency risk as well as raising funds. The IFC is quite flexible and will tailor products to suit the requirements of the market and the client. However, these products are not available in LDCs yet because, in the deals done so far, the MFIs must be able to swap out their currency risk or match local funding. The table below denotes the major PCG programs.

Partial Credit Guarantees

MFI Partial Credit Guarantees
Sovereign Guarantee Required
IBRD Partial Credit Guarantee
Asian Dev Bank PCG (Public Sector)
African Dev Bank (Public Sector)
ICIEC Bank Master Insurance
Sovereign Guarantee Unnecessary
IFC Partial Credit Guarantee
IADB Credit Guarantee (Private Sector)
Asian Dev Bank PCG (Private Sector)
African Dev Bank Enclave Projects

Since it started issuing PCGs in 2001, the IFC has done more deals than the other institutions combined. Most of their work is in the financial sector but PCGs have been provided for several water projects as well as a small ($0.72 of a 3.0 million bond) for the GEF PVMTI **Al Amana & Noor Web** project in Morocco. This shows that credit enhancement can be used to enable small RET projects to leverage private sources of finance.

IFC's **Tlalnepantla Municipal Water Conservation** project in Mexico is a good example of a small local currency guarantee which is intended to facilitate sub-sovereign financing. In February 2003, IFC issued a partial credit guarantee (of up to $3 million) to a private Trust to help it raise funds from the local capital market. The Trust is financing water conservation projects carried out by a local water utility that is owned and operated by the municipality of Tlalnepantla. This is the first municipal bond offering in Mexico that is dependent on the full faith and credit of the local municipality without a federal guarantee. The transaction introduces a new local asset class for the Mexican capital markets and is the World Bank Group's first direct financing of a municipality. Municipal governments provide the majority of infrastructure services in developing countries, but they often lack access to capital markets.

Sub-Sovereign Lending

Sub-sovereign lending is currently a topic of discussion at World Bank. The example offered by the European Bank for Reconstruction and Development's (EBRD) sub-sovereign loan program in Eastern Europe is useful in this context. Since 1996, EBRD has been offering loans to sub-sovereign entities to finance municipal and environmental infrastructure. The loans have a maximum tenor of 15 years with a three year grace period and can cover up to 35% of project costs – usually averaging U$ 5-20 million. EBRD requires collateral for loans and functions more like a commercial bank than a MFI in this respect. Pricing can vary from LIBOR plus 100 to 500 basis points and local currency lending is available in some countries. No write-offs or rescheduling have been reported since the start of the program.

Currency Devaluation Backstop Facility

The Camdessus report on financing water projects recommended further evaluation and testing of a proposed "devaluation backstop facility" to prevent the disruption of water services due to the impact of a devaluation – theoretically by rescheduling the debt over a time period that is "politically and socially feasible". To date, only OPIC has established such a facility for the AES Tietê power project in Brazil.

The World Bank recently announced its intent to test and establish a pilot liquidity backstop facility in 2004/2005. Among the key issues to be resolved are the devaluation trigger points and the implications of an inability to repay the facility during the lifetime of the concession agreement. For the purposes of a devaluation facility, currency variations can be categorized by severity: 1) "normal" fluctuation, 2) "shock" devaluation is characterized by the belief, based on sound fundamentals, that the currency will eventually recoup most of it losses and 3) "catastrophic" devaluation, the most recent example of which is the Asian crisis of 1997/98 - six years later, exchange rates in Thailand remain at about half their pre-crisis level. The Conundrum: who pays the bill if the currency does not appear destined to recover? No doubt, there will be many potential takers for the proposed currency devaluation backstop facility. In the best-case scenario, the

Bank will be able to use such a facility to mitigate perceived risk. However, there are perplexing issues of moral hazard to resolve before any rollout of this facility can be expected.

Private Sector Awareness of MFI Risk Mitigation Products

As noted in the introduction, the MFIs have recently undertaken efforts to better inform private sector financiers and insurers of the risk mitigation instruments available and how to access them. There is some way to go in this regard, judging from informal surveys in the City of London. Generally, the MFIs suffer from an "image problem" with the private sector that, by its nature, fears onerous administrative requirements and long delays. Additionally, the majority of instruments available only cover the risks of *lenders*. Sponsors, who drive projects forward with their equity investments at risk, have no recourse and, as a result, are cautious in their appraisal of MFI risk mitigation products.

Private Sector Awareness of Risk Mitigation Instruments

Risk Mitigation Instrument	Private Sector Awareness	Need in RET Sector
Traditional Political Risk Instruments	High	Medium ("regulate don't expropriate")
Contractual/Regulatory Instruments	Low	High
Credit Risk Instruments	Medium	Very High
Devaluation Risk Instruments	Low	Unknown

However, as indicated in the table above, there is a particularly strong need for contractual and credit risk instruments in the RET sector. Ongoing education and outreach programs combined with improved accessibility to Bank staff will all be valuable to increasing private sector awareness of MFI risk mitigation products. MIGA and the IFC have been more successful than the other MFIs in implementing their guarantee programs, in part because of regular contact with the commercial markets. The EBRD, located in London, is also noted for commercial awareness. World Bank has recently proposed some incentive changes to help motivate staff to undertake "high risk / high reward" 'Corporate' projects. Such a cultural shift at World Bank could certainly have a positive influence on the number of "clean" infrastructure deals that are enabled through the use of guarantee products.

Applications for the RET Sector

Any instrument than can mitigate perceived or actual risk in the eyes of lenders is valuable to the RET sector. However, MFI guarantee products that require sovereign counter-guarantees are of little practical use to RET project developers. Small-scale and flexible Partial Credit Guarantees as offered by the IFC have proven effective. More use of these instruments to help create bankable renewable energy projects would be welcomed. The EBRD's sub-sovereign lending program is also potentially useful to the RET sector but focuses on the financing needs of municipalities rather than the private sector.

The Global Environment Facility

Introduction

The **Global Environment Facility**[72] (GEF) is the **financial mechanism** of the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC), and functions under the guidance of, and is accountable to, the Conferences of the Parties of these Conventions[73]. The GEF is currently in the "GEF-3" period (FY03-06) and the total resources available during this period are **US$ 3 billion**. At COP7 three new funds were announced. Two are related to the UNFCCC; the Special Climate Change Fund and the Least Developed Countries Fund. While the third, the Adaptation Fund, is related to the Kyoto Protocol. The GEF was requested to operate these new funds. However, to date, only the Least Developed Countries Fund is operational and it provides technical assistance to governments but does not fund projects.

"The GEF shall operate, on the basis of collaboration and partnership among the Implementing Agencies[74], as a mechanism for international cooperation for the purpose of providing new and additional grant and concessional funding to meet the agreed incremental costs of measures to achieve agreed global environmental benefits in the following focal areas[75]:

(a) Climate Change,
(b) Biological Diversity,
(c) International Waters, and
(d) Ozone Layer Depletion."

RET-related projects fall largely within the GEF's climate change mandate. Initial elements of a proposed GEF approach to support projects that address "vulnerability and adaptation to climate change" were presented at the May 2003 Council meeting in an information paper[76]. The approach described in the paper is based on three key components: (1) support provided under the GEF climate change focal area for those adaptation activities which fall within the context of *national communications*; (2) support for projects that *link* climate adaptation

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[72] Website http://www.gefweb.org/index.html
[73] GEF also operates the financial mechanism of the Stockholm Convention on Persistent Organic Pollutants on an interim basis.
[74] World Bank Group, UNEP, UNDP (and since 1999 ADB, IDB, EBRD, AfDB, IFAD, UNIDO, FAO)
[75] " Instrument for the Establishment of the Restructured Global Environment Facility" (1994, amended 2002) http://www.gefweb.org/Documents/Instrument/instrument.html
[76] GEF/C.21/Inf.10, A Proposed GEF Approach to Adaptation to Climate Change HYPERLINK http://www.gefweb.org/Documents/Council_Documents/GEF_C21/C.21.Inf.10_Adaptation_to_CC.pdf
http://www.gefweb.org/Documents/Council_Documents/GEF_C21/C.21.Inf.10_Adaptation_to_CC.pdf

strategies with other measures that achieve other GEF-supported global environmental benefits; and (3) greater consideration to climate change impacts as a long term risk to the sustainability of other GEF projects.

The third point above is interesting because GEF is proposing to thread the climate change theme (and associated funding) through all its focal areas. For example, within the biodiversity focal area, assessment of ecosystem vulnerability to climate change can be financed in the context of threat analysis. In addition to these activities, it is proposed that dedicated resources be provided under the climate change focal area so as to demonstrate through a more focused and strategic approach projects the link between climate change adaptation strategies and other measures that achieve GEF-supported global environmental benefits. Recently it was agreed that top priority should be given to funding of adaptation activities to address the adverse impacts of climate change from the resources of the Special Climate Change Fund[77]. The importance of linkages among focal areas is currently being emphasized. However, since the Special Climate Change Fund and Adaptation Fund are not yet operational, a nominal US$50 million in the FY05-07 is to be allocated within the climate change area to "advance learning on how best to respond to adaptation"[78].

- GEF Contingent Finance Mechanisms**Contingent Grant**: Unlike a conventional grant, a contingent grant is repaid to the GEF if the project is successfully financed. The project proponent views the grant as a short-term, unsecured loan that is included in total project costs. If the project is unsuccessful, the GEF funds paid out become a grant.
- **Performance Grant**: This type of grant is provided on the basis of completion or satisfaction of certain milestones. A contingent grant and a performance grant could be combined so that a project sponsor receives funds upon completion of certain milestones (performance) and funds could be forgiven if the project is not successful (contingent).
- **Contingent or Concessional Loan**: A **contingent loan** differs from a contingent grant in that a loan is treated as debt and therefore has a higher repayment priority than the converted grant. A grant is treated as project equity or an asset unless another arrangement is negotiated. A contingent loan is repaid on a similar schedule and with similar interest to other loans. Similar to the contingent grant, it could be forgiven if the project fails. A **concessional loan** refers to GEF's ability to provide loans at below-market rates. The availability of the concessional loan could be contingent upon participation of other commercial lenders to achieve co-financing and leveraging of non-GEF funds. Contingent or concessional loans would likely supplement (and probably be subordinate to) other project debt.

[77] see GEF/C.22/4

[78] see GEF/C.22/6 GEF Business Plan FY05-07
http://www.gefweb.org/Documents/Council_Documents/GEF_C22/C.22.6_Business_Plan_FINAL.pdf

- **Partial Credit Guarantees**[79] are used to encourage private-sector lenders, such as commercial banks and leasing companies, to make loans for projects that they would otherwise not lend to. These guarantees share the risk of the loan with the private lender so the still lender has an incentive to make a good lending decision but has partial downside protection in the event the loan is not fully repaid. GEF partial risk guarantees were pioneered in the IFC/GEF Hungary Energy Efficiency Co-financing program[80] and are also being used in the IFC/GEF Commercializing Energy Efficiency Finance project in 5 additional countries. As noted in the section on MFI risk mitigation instruments, PCGs have proven quite effective at leveraging investment flows.

Utility of GEF Contingent Finance Instruments

Contingent financing is conceptually attractive when there is substantial uncertainty about the existence and extent of incremental costs, characteristics not unusual in projects endorsed by development institutions. Instead of committing to a grant which may subsequently prove to have been unnecessary, contingent financing recognizes the potential need for support but draws on GEF resources only when justified later, on the basis of actual rather than projected costs. To avoid *moral hazard* (inducing project failure to "collect" a grant), contingent loans and contingent grants are carefully structured to include risk sharing arrangements. Project sponsors are expected to cover normal commercial costs while the GEF can cover the incremental costs of achieving environmental benefits.

In many cases, the barrier to private sector investment has been identified as "perceived risk rather than a clearly identifiable higher cost" and so the GEF is interested in using guarantees or other alternatives to grants. Wider application of credit enhancement has been identified time and again by the private sector as being of paramount importance to attracting investment capital to work in developing countries and uncertain projects. The presence of GEF funds in a deal provides comfort to other lenders. However, working with GEF is a slow process, as noted earlier, and this is a deterrent to the private sector.

Sample GEF Projects & Programs

In 2000, **China** received GEF assistance of $12 million for a $98 million wind power project. The remaining funds will be provided by the Asian Development Bank (ADB – a new implementing agency), and provincial power companies and banks in China[81]. To meet GEF criteria, the project had to demonstrably help remove barriers to wind power development and promote private sector

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[79] See section X on MFI Risk Mitigation products for a discussion of partial credit guarantees.
[80] See http://www2.ifc.org/enviro/EPU/EEfficiency/HEECP/heecp.htm
[81] See http://www2.ifc.org/enviro/EFG/GEF-SME-Program/gef-sme-program.htm

investment. Additionally, the venture created significant local employment opportunities. Of the $12 million contributed to the project by GEF, $ 6 million was a grant and the other $6 million will be an **interest-free contingent loan**. This loan will be repaid if the wind farms are successful, but will be converted into a grant if they are not. This approach allows GEF to help bear the perceived risks associated with wind farms while helping to build confidence in the new technology.

The 1999 GEF-sponsored 'Thai Chiller' Replacement Program[82] responded to a request by the Electricity Generating Authority of Thailand (EGAT). EGAT wanted to obtain financial assistance for a program to replace outdated air conditioners (chillers) with new, environmentally sound systems. The chiller fleet in Thailand had very low energy efficiency, and used CFC refrigerants. The Thailand Chiller Replacement Program utilized an **interest-free contingent loan** provided by both the GEF and the Multilateral Fund (MLF) to finance the replacement of current CFC chillers with high efficiency, non CFC equipment.

Generally, the IFC operates as a commercial investor. However, in certain cases there are strategic and/or developmental reasons that justify the use of below-market rate financing. The IFC operates a number of programs that uses GEF's concessional financing to fund strategic market interventions that remove barriers to energy efficiency technologies and business activities.

- Poland Efficient Lighting Project (PELP): PELP was the first GEF climate change mitigation project designed to work directly through private sector delivery channels. It was a $5 million initiative designed to reduce electricity consumption in Poland by stimulating the consumer market for efficient lighting products.
- Efficient Lighting Initiative (ELI): Based on PELP, ELI is a three-year, US$15 million program that aims to help overcome barriers to energy efficient lighting technologies in a variety of countries.
- Hungary Energy Efficiency Co-Financing Program (HEECP): HEECP utilizes US$5.7 million of GEF funds pooled with a $12 million IFC investment and a program of **partial credit guarantees** to build the energy efficiency financing capability of Hungarian financial intermediaries.

IFC also executes another program with GEF funding, the **IFC/GEF SME Program**[83], which stimulates greater involvement of private small and medium enterprise (SME) sector in addressing biodiversity and climate change. Viable institutions working with SMEs in GEF eligible countries are able to act as IFC/GEF SME Program Intermediaries. SME Program Intermediaries receive a long-term low interest rate loan of $500,000 to $1 million (for up to 10 years at an interest rate as low as 2.5% p.a.). Intermediaries use the loan proceeds for debt or

[82] See http://www.wfeo-comtech.org/UNCSD/ProductionEfficienciesES.html
[83] See http://www2.ifc.org/enviro/EFG/GEF-SME-Program/gef-sme-program.htm

equity financing of the approved project(s), which address the biodiversity or climate change objectives of the GEF. To date 22 intermediaries operating in more than 20 countries have been approved and are now financing the activities of over 130 different SMEs.

Some Public-Private Development Partnerships (for RET)

Over the last year, the World Bank Group has devoted considerable attention to improving their approach to financing water infrastructure projects[84]. The water sector and the renewable energy sector face some of the same challenges, such as high regulatory risk and potentially low returns. Along with guarantee products offered by the MFIs, several useful public private interactions have been highlighted in recent presentations. Some of these (and some others) that are potentially beneficial to the RET sector are discussed below.

- **Rapid Response**[85] is a "window" into knowledge resources and advice from **World Bank Group**[86] experts working on investment and privatization issues in more than 100 developing countries. A monthly email alert service is available and the website boasts an exhaustive database that includes reports on over 2500 infrastructure projects as well as a free help desk service to help would-be developers to navigate the wealth of information. There is also a bespoke fee-based service that covers small advisory transactions requiring up to 5 days of an expert's time, but this is only available to the public sector. Rapid Response's objective is to contribute to "higher quality design and implementation of public policy" in developing countries.
- **The Public-Private Infrastructure Advisory Facility**[87] (PPIAF) is a multi-donor technical assistance facility aimed at helping developing countries improve the quality of their infrastructure through private sector involvement. PPIAF was developed at the joint initiative of the governments of Japan and the United Kingdom, working closely with the World Bank. PPIAF pursues its mission through channeling technical assistance to governments in developing countries on strategies and measures to tap the full potential of private involvement in infrastructure. Proposals for PPIAF support can originate from any source and can support activities intended to benefit any developing and transition country included on an extensive OECD list. PPIAF has funded the creation or strengthening of 18 institutions dedicated to the sustainable growth of private participation in infrastructure[88]. Six of these institutions are regional level regulatory associations or project development organizations and the others are predominantly national level regulatory bodies. PPIAF recently sponsored a workshop on "tools for risk mitigation in

[84] See http://siteresources.worldbank.org/DEVCOMMINT/Resources/Fall-2003/DC2003-0015(E)-Infrastructure.pdf Implementing the World Bank Group Infrastructure Action Plan, September 12, 2003.
[85] See http://rru.worldbank.org/About.asp
[86] See also the useful page http://www.worldbank.org/privatesector/map.htm for the WBG "PSD Roadmap"
[87] See http://www.ppiaf.org/
[88] World Bank Group Private Sector Development Strategy Implementation Progress Report, June 2003

clean infrastructure projects" in conjunction with the Prototype Carbon Fund of the World Bank. RET projects were highlighted.

- **Private Infrastructure Development Group** (PIDG) is a group of like-minded donors seeking to increase private sector investment in the infrastructure of developing countries. PIDG was founded by the UK Department for International Development (DFID), the Swedish Government acting through the Swedish International Development Co-operation Agency (SIDA), the Netherlands Minister for Development Co-operation and the Swiss State Secretary for Economic Affairs of the Government of the Confederation of Switzerland. The group is active in organizing and funding a variety of useful public-private interactions and capacity building exercises.
- **The Emerging Africa Infrastructure Fund**[89] (EAIF, the Fund) is a public-private financing partnership initiated by the Private Infrastructure Development Group (PIDG). EAIF represents a new financing approach for commercially viable, private sector infrastructure ventures in sub-Saharan Africa. Following a competitive tender to the private sector, the Fund was launched in January 2002. The Fund's equity of US$100 million is provided by the PIDG. The Fund's debt capital has been provided in two tranches - US$120 million of senior debt (Barclays and Standard Bank providing US$60 million each), and US$85 million of subordinated debt from development finance companies. The Fund's manager is a joint venture by its shareholders, Standard Bank Group, the Netherlands FMO and Emerging Markets Partnership (EMP), a private sector manager of infrastructure funds. The Fund's core product is the provision of US dollar denominated senior-ranking term debt, usually between US$10 million to US$30 million per transaction and up to 15 years maturity. Subordinated debt may also be offered where appropriate (usually alongside senior debt), subject to the overall amount and tenor of lending being within these limits. The Fund may issue guarantees in respect of senior debt where this facilitates the provision of local currency funding. All EAIF's products are offered on commercial terms following a detailed assessment of the borrower's credit and risk profile. EAIF is not a concessional lender and is not able to offer "soft terms". However:

  - The Fund is able to lend without political risk cover.
  - The Fund has the ability to offer loans up to 15 years in tenor and can consider loan repayment profiles that suit the cash flow profile of the underlying business.
  - The commercial orientation of the Fund management process seeks to provide clients of the Fund with a responsive, flexible and efficient service.
- **DevCo Advisory** was formed in June 2003, when a MOU was signed between IFC and the United Kingdom's DFID[90]. DevCo Advisory will

[89] See http://www.emergingafricafund.com/first.htm

[90] See http://www.worldbank.org/privatesector/transaction/devco.htm

support the IFC's efforts to facilitate infrastructure investment. DFID has agreed to contribute $10 million over three years (2004-06) under the umbrella of a broader portfolio of work being developed in association with the PIDG. The PIDG donors are exploring new mechanisms for attracting greater private sector involvement and investment in low-income developing countries (primarily Africa and South Asia). The rationale behind this new PIDG initiative is that in addition to the World Bank's Private Sector Advisory Services (PSAS), there is a role for an infrastructure development company (DevCo) which would act as principal and honest broker, rather than an advisor to governments. DevCo's mandate is to structure bankable infrastructure opportunities in developing countries (water & sanitation, energy, transport etc.). DevCo Advisory will help PSAS expand its level of activities in PPI in the poorer countries through the direct provision of additional resources to be used in PSAS led mandates. These resources will be used primarily to cover the costs of specialist consultants working with PSAS teams to help prepare pro-poor infrastructure projects for private sector investment in the poorer developing countries. DevCo Advisory is set up as a multi-donor facility, and the IFC is aiming to secure the contribution of additional funds from other donors to help expand this activity further.

- **GuarantCo** (still in design stage) is the working title for another initiative by the PIDG. GuarantCo is intended to provide credit enhancement for local currency borrowing to support private sector and PPP infrastructure investment in low-income developing countries. It hopes to address market failure in the domestic capital markets of these countries and reduce the exchange rate risks associated with financing infrastructure projects that generate local currency revenues. It will have potential value in mobilizing long-term credit for large-scale commercially viable RET projects in target countries.
- The IFC's **Capacity Building Facility**[91] (CBF) was established in July 2000 to provide a flexible vehicle for IFC support to small and medium enterprises. CBF works with outside organizations through partnerships. In general, CBF funds projects designed to expand the capabilities of intermediaries that deliver sustainable products and services to SMEs. In its first two years, CBF approved $13.5 million for 65 projects. Projects are usually aligned with other work undertaken by the World Bank Group. The CBF is designed to build SME financing capacity and, as such, is of indirect benefit to small scale RET project sponsors in developing countries.

This list is a short guide with a focus on infrastructure. There are a number of other development partnerships to investigate including a bilateral infrastructure fund. The interactions listed above provide a selection of resources for potential RET project developers to contact for technical assistance (and possible project funding).

[91] See http://www2.ifc.org/sme/

Part 7: Scope for developing new financial risk management instruments for the RE sector

As discussed there are many risks and barriers impacting on the ability of RET projects to raise finance.

Facilitating and Enhancing the Monetisation of Environmental Benefits through Risk Management Instruments

As already discussed renewable energy project financing can be an expensive undertaking. Project risk, inflexible tariff structures, higher obsolescence cycles and regulatory uncertainty all conspire to keep borrowing costs for renewable energy projects relatively high. When these projects are planned in developing economies (DCs), higher levels of political risk and economic uncertainty, as well as higher transaction costs, only add to the cost of capital.

However, new markets for tradable permits exist and are emerging to provide vital policy support mechanisms for the deployment of RET projects. Notably, for example under the UK Renewables Obligation Order the value of the Renewables Obligation Certificates can make the difference enabling projects to secure sufficiently long PPA's (10 years plus) to access the debt markets. Furthermore, emerging markets for greenhouse gas (GHG) emission reductions provide additional financial incentives to RET project developers and opportunities to use additional cash flow from the sale of tradable permits to reduce the burden of servicing project debt. For RET projects being developed in countries with no RET policy support mechanisms carbon finance from JI and CDM projects may make the difference between a project being marginal and profitable.

The ability for RET projects to "monetise" i.e. claim and transact environmental products associated with Greenhouse Gas emission reductions and other environmental benefits for the betterment of their balance sheets, is a growing but under-utilised and undervalued practice.

By linking renewable energy and carbon cash flow to debt payments, the project developer can increase net margins on electricity revenue, and enhance the average DSCR for the project.

This can result in one of two things. It either allows the project to be financed because it increases the required DSCR past the predetermined threshold set by the lender, or it decreases the amount of equity investment required for the project – thereby increasing ROE. Either way, both the project developer and the project lender are significantly better off.

Once the intent to apply renewable energy and carbon permit cash flow to debt service has been established, it is necessary to focus on developing financial risk management techniques that can mitigate risks impacting on expected future cash flows.

Potential Innovative Product

The effectiveness of monetisation in lowering project debt service is fundamentally influenced by the certainty surrounding expected future cash flows associated with renewable energy generation.

Marsh has been developing an innovative product that employs new and established financial risk management techniques that can facilitate and enhance the monetisation of renewable energy assets.

To enhance monetisation the product will need to provide sufficient certainty over the future delivery of forward streams of permits to reduce permit price discounting and enable forward settlement[92].

Traders in TREC and GHG markets have noted that since most trades include a stream of permits (GHG reductions over multiple years), particularly reduction occurring during the Kyoto Commitment period (2008-2012), forward settlement is more common than immediate settlement. In this sort of transaction, a buyer acquires promised reductions of consecutive vintages. For example, a buyer might acquire rights to 10,000 tons per year during 2005-2007. Typically only a small percentage of the payment for such streams can be provided up front with the remainder provided “on delivery,” meaning once rights to the reductions have been transferred to the buyer.

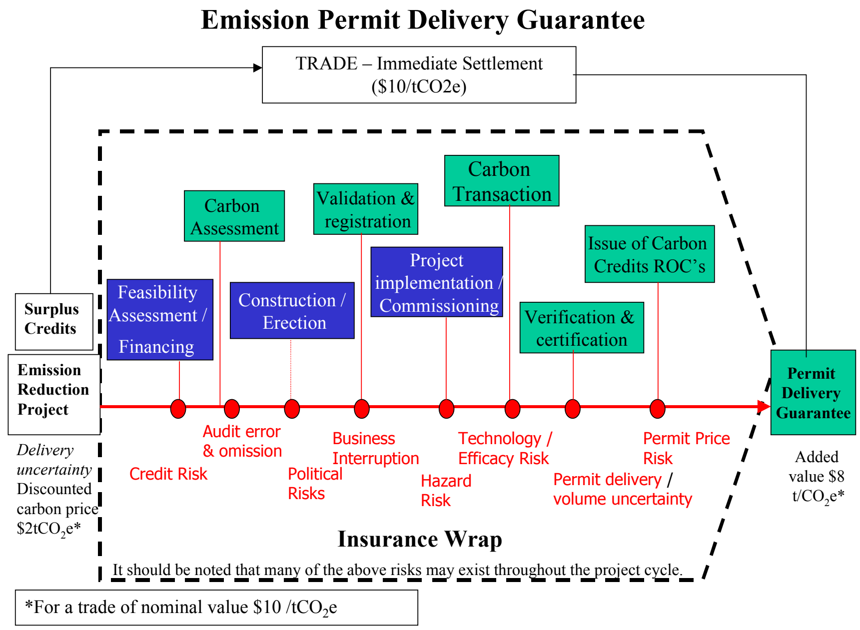
Traders and project developers have noted that while there may be potential planning and price advantages associated with forward transactions for permits that have not yet been created there is significant uncertainty and risk associated with the delivery of those permits. If payment for the future delivery of permits is to be received up-front (i.e. before the contracted permits have been delivered) then buyers are forced to bear significant risk of permit shortfall or non-delivery which can result in heavy discounting of permit prices.

A key feature of the product structure will be that it enables parties involved in forward permit transactions to transfer the risks impacting on the delivery of those permits to insurance markets. This will provide project developers and financiers with a guarantee backed by “A” or above rated insurers that the contracted forward sale of permits will be delivered.

[92] A forward contract establishes a contractual obligation at the trade date for a pre-determined settlement date in the future (delivery of the commodity).

Product Principles

Portfolio diversification



Projects will need to be selected based on certain minimum criteria that will help to mitigate risk. It may also be possible to utilise a risk-rating model to screen high-risk projects from the portfolio.

Projects and their risks will be bundled under the portfolio structure to enable a critical mass of insureds to be reached whilst offsetting less attractive risks with more palatable risks. Additionally the portfolio approach will enable a diversified portfolio of emission reduction projects to be selected reducing the overall risk to all parties.

Bundling a wide range of diverse and uncorrelated risks will increase the independencies of risk events and reduce the average portfolio loss. Empirical analysis has shown that a portfolio of projects is superior to investments in single projects or risk averse investors and this supports the hypothesis that diversification reduces risk significantly[93].

The law of large numbers implies that the average loss in an insurance pool will become more certain as more independent and identically distributed units are added to the pool. In this way portfolio diversification will enable the statistical

[93] Implementing the Kyoto Mechanisms – Contributions by Financial Institutions

qualities required for pooling arrangements and risk reduction to be achieved, and will also potentially reduce transaction costs for insurers.

As projects are pooled and risks are diversified the potential to achieve a large number of independent and identically distributed events that may cause a random loss is improved. The PDG mechanism could enable risks that are typically considered as uninsurable – e.g. technology risks – to be included under the one pooling arrangement.

Furthermore, where traditionally insurable risks (i.e. property damage and business interruption) are combined with Renewable Energy related credit, technology, political and permit price risks then there may be opportunities for insurers to take advantage of the natural hedges between uncorrelated risks to produce a combined program resulting in lowers costs and volatility.

Special Purpose Vehicle

The development of a Project Portfolio Risk Financing Vehicle will consist of a Special Purpose Vehicle (SPV) to act as the secondary layer and most significant insurance mechanism.

It is envisaged that a SPV could aggregate the total number of credits created by the participating projects in the portfolio over time. A compliance account could be established to balance any overall surplus or deficit arising from the consolidated performance of project participants. The SPV could also facilitate an efficient flow of credits from the Portfolio of projects to enable a buffering mechanism.

This should reduce the overall risk exposure to underwriters and in turn reduce the cost of risk transfer following agreement from each participating project that their surplus may be used to make up other projects' shortfalls.

'A' or above rated insurers will provide an 80-90% guarantee for the delivery of contracted credits to the buyer. This co-insurance structure will require the buyer to retain a 10% share of any loss. This approach will align the buyer's interest with that of the underwriters, with the potential for overall improved risk management and reduced attritional losses.

Importantly this structure will enable reduced transaction costs by allowing buyers to deal with a single SPV rather than each project individually.

Other key applications of this product include, but are not limited to, the following:

- Establishing a cash reserve account to be applied to debt service in the event of liquidity problems

- Funding a cash reserve account that can hedge against variability of revenue streams
- Prepaying debt based on forward Renewable Energy or Emission Reduction Purchase Agreements (RE/ER PAs)
- Depositing renewable energy and carbon cash flow directly with banks for credit against debt service, thereby lowering liability on electricity cash flow
- Using RE/ER PAs and/or forward renewable energy and carbon sales as collateral for loans

Many of these may exist in some form already in other sectors but their application to RET projects needs careful consideration. Most assuredly, the above suggestions involve all sorts of complexities. Yet this does not negate their utility as techniques to lower project debt service.

Part 8: Key considerations for the development of new insurance / underwriting methodologies and other financial risk management instruments

Capacity Building

Financing RET projects is new to financiers and insurers. Considering investing or underwriting new business in the RE sector for the first time is an investment in itself, one that turned out to be a poor investment decision for many insurers of wind farms in the late 1980's.

Renewable energies represent a major step-change innovation as compared with existing energy supply options. In terms of scale, capacity, energy resource characteristic, points of sale for output, status of technology, and a number of other factors, RE technologies are usually markedly different from conventional systems. The differences are not lost on financiers, as financing a RE plant is different from financing conventional fossil-fuelled power plants and requires new thinking, new risk management approaches, and new forms of capital.

Since financiers are typically averse to things that are new, these differences and the risk perceptions they imply can become the most significant barriers to investment, even for RE technologies that are cost-competitive with conventional energy supply options.

To become more effective at placing capital in RE markets, financiers must travel up a learning or experience curve. Market failures impede this learning process and create barriers to entry into the market.

Policy makers have an important role to influence the way markets operate and create more enabling environments for financing.

Addressing Policy Factors Affecting RET Projects

Policy and regulatory risk issues have featured highly in the analysis of risk and barriers affecting financing decision making for RET projects.

Typically, the medium to long term uncertainty about how policy / regulatory decisions will affect RET projects and their cash flows in the future has resulted in challenging conditions for projects seeking finance.

There is an important need to formulate a standardised approach that enables potential policy decisions to be evaluated and understood in terms of their affects on the risk profile of RET projects. Once the consequences of policy decisions can be more robustly measured and quantified in terms of their impact on project risk profiles it may be possible to build these elements into underwriting methodologies and other financial risk management instruments.

Given the multifaceted nature of the policy dimension, it will be prudent to explore and evaluate several policy / regulatory events and translate this into an assessment of specific impacts on RET project risk profiles.

Exploring and evaluating the impacts of policy decisions on RET projects is a complex process, and one needs to give consideration to the following issues:

- Certain policy events will have zero or negligible impact in isolation, but rather will have an impact through a combination of events and / or circumstances
- The price paid for power and tradable permits such as ROCs comprises a number of discreet elements, each of which may be impacted by several policy-related considerations
- Certain policy events or trends may impact upon more than one element of the price, or upon a number of aspects of the market
- Climate change policy decisions do not arise in a vacuum; they will be conditioned by other prominent factors, most notably the broader political and economic context, and technological change
- Circumstances will change over time; review will take place which will change the structure and operation of market responses in advance of implementation

Source: Adapted from Climate Change Capital policy analysis framework

Bearing in mind the importance of ROC price in underpinning many UK domiciled RET financing structures, it is useful to focus on this particular aspect of policy risk.

Taking a bottom up approach by considering the constituent elements of the ROC price, and then determining the policy considerations that will impact upon these elements is useful. For illustration purposes it would helpful to evaluate policy impacts such as:

- ROC regime abolished with change in government from 2006
- Changes to RO e.g. increasing target to 2020
- Changes to co-firing rules i.e. relaxed or restricted
- UK Climate Change Levy rate reduced / increased / or abolished
- Climate change projects allowed in EU ETS

Risk Rating Methodologies for Project Financing

A key consideration needs to focus on removing barriers to investment. At present, the market does not have sufficient tools to appropriately determine the performance, delivery and asset quality risks associated with RET projects.

One of the fundamental barriers to insurance and other financial risk management instruments is the inability to estimate with a sufficient degree of accuracy the likelihood and severity of potential risks that can impact on the cash flow profile of RET projects. As discussed throughout this report uncertainty over project cash flows can have detrimental affects on the project's ability to raise finance.

As already discussed there may be various reasons for this, including the following:

- The **information** that enables a correct assessment of a project's viability is **generally lacking**, and there is limited economic justification for any single market participant to produce such information[94].
- The lack of required statistical data for measuring probability distributions and correlations between random loss events

Without this information many transactions and project appraisals have been based on subjective decision making, which has led to non-uniform and overrated project risks and unattractive terms to finance.
What is needed is a robust, reproducible and transparent methodology for rating RET project risks. This type of methodology would need to be built around specific project appraisal criteria applying human style decision making to determine a final project score.

These project appraisal criteria would need to take into consideration the wide range of risk elements. These elements would need to be modelled within the system according to the role they play in providing decision support to the user. Thus "indicator", "behavioural", and "structural" sub models would need to be developed to account for:

- a number of risks which would be classified as external risk sources
- internal elements that could be considered to be at risk
- elements which form the basis on which decisions are undertaken to manage the elements that are at risk

[94] Investment officers commonly shepherd a RE proposal through the bank's loan approval process, but face challenges convincing the investment committee that the project will provide returns commensurate with the risks of the new technology. Building a strong case often requires including the expertise of independent experts; for example, technical specialists to verify that wind data for a proposed wind farm is technically sound

A "fuzzy logic" model harnesses the uncertainty and flexibility of the rules and concepts that human decision making is based on. It allows two factors to interact to produce one output and is a better representation of human decision making because it can be adjusted to match actual decision thresholds.

Rating inputs will be designed with a minimal level of subjectivity. Input variables are combined in a series of "rule blocks". The rule blocks define how each set of inputs interact, and make defining the process more simple as only one decision needs to be considered at a time. The rating methodology will need to consider the interaction of each of the following variables:

- Risk event = the event that occurs that causes a change to the external risk source
- Risk source = the risk external to the business that is likely to change and so affect the project risk profile
- Value driver = the decision made within the project to manage or mitigate changes to the external risk source; and the information on the external risk source and consequent impact on the project on which the decision is based
- Asset = the TGC / carbon credits or in the absence of a direct ability to measure the credits, the assets identified as being correlated to the delivery of the credits
- Performance indicator = KPIs indicating changes in the assets as a result of changes in the risk source

From this a flow diagram can be built up which represents the rating decision map working from the original inputs through to the final (RET Project Rating) output.

This type of tool clearly have would have many different applications and potential users including:

- Corporate entities looking to optimise their asset portfolio by allocating/reallocating capital to the appropriate businesses / RET projects
- Financial institutions in assessing the risk/return of proposed new investments & transactions, and thus to help set pricing and terms & conditions of these investments
- Investors and emitters in the investment appraisal process to distinguish between competing investments
- Multi-lateral financial institutions and government bodies to evaluate emission reductions as part of early market development initiatives (e.g. World Bank PCF)
- Underwriters who could build the rating methodology into underwriting decision making to enable a rational and stable pricing structure to emerge for RET projects

Appendix A

Acronyms and Abbreviations

AfDB	African Development Bank
ASEAN	Association of South East Asian Nations
AsDB	Asian Development Bank
CDM	Clean Development Mechanism
CERES	Coalition for Environmentally Responsible Economies
CLN	Credit Linked Note
CSR	Corporate Social Responsibility
CUP	Cooperative Underwriting Program (of MIGA)
DFID	Department for International Development (a UK Ministry)
EBITDA	Earnings before interest, tax, depreciation and amortisation
EBRD	European Bank for Reconstruction & Development
ECA	Export Credit Agency
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GNI	Gross National Income
GNP	Gross National Product
IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction & Development
IDA	International Development Agency
IFC	International Finance Corporation
IFI	International Financial Institution (i.e. IMF and World Bank)
ILS	Insurance Linked Security
IMF	International Monetary Fund
IRR	Internal Rate of Return
kWh	Kilowatt Hour

LDC	Least Developed Country
M&A	Mergers & Acquisitions
MDB	Multilateral Development Bank
MFI	Multilateral Financial Institution
MIGA	Multilateral Investment Guarantee Agency
MW	Mega-Watt
NCR	Non-Commercial Risk
NCRI	Non-Commercial Risk Insurance
NGOs	Non-Governmental Organisations
NPV	Net Present Value
OBI	Official Bilateral Insurer (for political and non-commercial risk)
OCF	Official Capital Flows (Non-Concessional Funds plus ODA)
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
O&M	Operations and Maintenance (contracts or agreements)
OPIC	Overseas Private Investment Corporation
OTC	“Over-the-Counter” (securities)
PCG	Partial Credit Guarantee
PPA	Power Purchase Agreement
PPI	Public Private Interaction
PPP	Public Private Partnership
PRG	Partial Risk Guarantee
PR	Political Risk
PRI	Political Risk Insurance
PSA	Production-sharing Agreement
RDB	Regional Development Bank
RE	Renewable Energy
RET	Renewable Energy Technology
RoA	Return on Assets
RoE	Return on Equity
SME	Small and Medium-Sized Enterprise
SEFI	Sustainable Energy Finance Initiative
SPUV	Special Purpose Underwriting Vehicle
STAP	Scientific and Technical Advisory Panel (GEF)
UK	United Kingdom (Great Britain and Northern Ireland)
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade & Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USD	United States Dollars
WB	World Bank

WBG	World Bank Group (i.e. IBRD, IDA, IFC and MIGA)
WHO	World Health Organisation
WTO	World Trade Organisation
XOL	Excess of Loss (Reinsurance contract)

Appendix B

Glossary of Terms

Accession Countries: Countries joining the European Union on 1st May 2004
Appetite for Risk: A measure of the propensity for Risk Taking or Risk Aversion
ART (Alternative Risk Transfer): Generic phrase used to denote various non-traditional forms of re/insurance and techniques where risk is transferred to the capital markets More broadly, it refers to the convergence of re/insurance, banking and capital markets
Asset-backed Securities: Debt securities, which depend on a pool of underlying receivables. In ART these refer to insurance-linked securities
Blended Cover: Typically a combination of traditional re/insurance product lines with other risk management products in a single aggregated policy. These are commonly arranged on a multi-year basis
Bond: Capital instrument issued by government or private corporation. Redemption may be linked to an event (e.g. CAT bond)
Call Option: Gives buyer the right to buy, seller is obliged to sell
Capacity: Amount of reinsurance that can be underwritten by an entity or market
Captive: The term for an insurance company that is owned by the company it insures. It is a Risk Financing strategy to lower the cost of insuring Risk and is usually established in a 'low-tax' environment
CAT: Common term for a catastrophe
CAT Bonds: Securitized insurance receivables – and example of an ART structure
Cedant: An insurance company buying reinsurance cover
Collateralized Debt Obligations (CDOs): Securitization of loans/bonds etc.
Commercial Risk: Risk from a company's commercial activities as distinct from insurable risk
Contingent Credit: Credit made available related to specific events and limits
Credit Derivatives: Securities that offer protection against credit/default risk of bonds or loans
Deductible: First part of loss borne by policyholder

Degree Day: Term created to better forecast demand for energy. Number of degree days is calculated from the difference between actual temperature and a previously set level (usually 65 degrees). Expressed in Cooling Degree Days or Heating Degree Days
Derivative: A financial contract whose value is derived from another (underlying) asset, such as an equity, bond or commodity
Excess of Loss Reinsurance: Reinsurance, which pays on the basis of the excess of claims over and above a pre-determined retention limit
Experience Account: Reserve fund set up to hold the premiums for finite reinsurance from a single insured party. Earns interest over the fixed term, and through an agreed profit commission formula returns to the insured whatever principal and interest is not paid out as losses and net of a risk premium that will be charged by the reinsurer for assuming the timing / investment risk due to a loss frequency or severity that was not anticipated
Financial Risk Management (FRM): A method of mitigating risk in various financial transactions
Financial Risk Management Instrument: Includes both insurance and non-insurance instruments
Finite Risk: Re/insurance policy with an ultimate and aggregate limit of indemnity often with direct link between premium and claim amounts
Forward Contract: Commits user to buying or selling an asset at a specific price on a specific date in the future
Global Environment Facility (GEF): The GEF is the financial mechanism of the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC)
G20 Countries: The G20 countries account for 86.7% of the world's GDP and for 65.4% of the total global population. The full membership includes Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, UK, US, and the EU presidency
Hedging: A financial markets term for undertaking risk management activities that usually involves taking a position (to purchase or sell financial instruments) that is counter to the original transaction
Hot Dry Rocks (HDR): HDR technology involves developing an underground heat exchanger in buried hot granites (250-300 degrees C) through opening up existing joints by hydraulic pressure
Index Based Contracts: Options contracts based on an index. The value of the derivative is derived from the index. Variation between actual losses and those derived from the index creates basis risk
Insurance Guarantee Funds: Funds set up to meet in full or part the cost of claims from insolvent insurance companies
Insured: One who transfers a risk to another party. The person named in the agreement of indemnity from an insurance company (or person) affording them indemnity from risks set out therein. Interchangeable with ‘Assured’
Insurer: The insurance company who has agreed to accept the risk and to pay monies by way of an indemnity to an insured in the event of loss. The amount paid can be an agreed amount or actual loss sustained

Interest Rate Swap: An exchange of financial instruments to give each party their preferred position
Investment Grade: In the context of bond ratings, the rating level above which institutional investors have been authorised to invest
Least Developed Countries (LDCs): LDCs are generally characterised by low levels of economic activity and poor quality of life. There are 48 countries on the UN list
Leverage: Also known as 'gearing', leverage generally refers to a high level of debt financing relative to equity. It can also imply trading on margin – particularly derivatives
Legal Liability: The responsibility imposed under law upon one person by another, whether by negligence (common law), statute or contract
Liability Insurance: Provides protection for the insured against loss arising out of his legal liability resulting from injuries to other persons or damage to their property
Loss or Damage: Loss is technically distinguished from damage in fire insurance when all or any portion of the property insured is consumed. "Loss" designates that portion which is entirely consumed, while "damage" designates that part of the property, which is not consumed, but remains in a damaged condition after a fire
Mutual Insurance Company: Organisation in which members or policyholders share risks, and premiums go into a pool from which claims and expenses are met
Option: A contract, which gives the buyer the right, but not the obligation to buy or sell a particular asset at a particular price
Over The Counter (OTC): A derivative that is not traded on an exchange but purchased from an investment bank
Policy: The actual insurance contract with all its details
Property Insurance: Provides financial protection against loss or damage to the insured's property caused by 'all risks' of physical loss or damage unless otherwise excluded or on a 'named perils' basis to included such risks as fire, smoke, windstorms, hail, explosions, aircraft, motor vehicles, vandalism, rioting, civil commotion, etc.
Project Finance: Often known as off-balance sheet or non-recourse finance since the financiers rely mostly on the certainty of project cash flows to pay back the loan, not the creditworthiness of the project's owners
Proportional Treaty: A reinsurance contract, which takes a defined pro rata share of all risks within treaty limits
Put Option: Gives seller the right to sell – the buyer is obliged to buy
Quota Share: Reinsurance on a percentage basis of a fixed share of all risks
Reinsurance Pool: Pooling of reinsurance risks within fixed limits of a group of reinsurers
Retention: The strategy of retaining some of the cost of risk in the insurance contract. 100% retention is known as Self-Insurance
Risk Based Capital: System of calculating insurance capital required for a specific risk or 'package' of risks with reference to different elements of risk
Risk Exposure: An exposure to loss (property, liability, etc.)
Risk Financing: Methods of funding the cost of risk (e.g. insurance, credit and financial reserves)
Risk Linked Securities: Generic name for securities such as CAT Bonds
Risk Management: Identification, evaluation and control of risk

Securitisation: Securing the cash flows associated with insurance risk. Securitised insurance risk enables entities, which may not be insurance companies, to participate in these cash flows
Self-Insurance: Funded from an organisation's own financial resources
Strike Price: Price at which future or option contract operates
Swap: Two companies exchange cash flow linked to a liability or asset
Timing Risk: Risk that claims may become payable earlier than expected
Tradable Green Certificates: TGCs are generated by the certification of RE production. Certificates are tradable and consumers are required to prove that they have reached renewable energy production quotas by purchasing certificates
Tranche: Term to describe a specific class of bonds within an offering. Usually, each tranche offers varying degrees of risk to the investor and is priced accordingly
Transfer of Risk: The transfer of the financial consequences of a risk to another by legal contract and/or insurance
Value-At-Risk: Often abbreviated as VAR, these are a class of models used by financial institutions to measure the risk in complex derivative portfolio positions
Weather Hedge: Product, which allows buyer to partially or fully offset climate-related risks
World Bank Group: Includes the following sub-groups: IBRD, IDA, IFC and MIGA

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